SNAME

THE INTERNATIONAL COMMUNITY FOR MARITIME AND OCEAN PROFESSIONALS

STUDY GUIDE

Professional Engineer License Examination in Naval Architecture & Marine Engineering

With Sample Examination & Solutions

July 2026 Edition
Subject to Annual Update and Revision

Prepared by:

The Society of Naval Architects & Marine Engineers

PERC

Professional Engineering Review Course

WWW.SNAME.ORG

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(July 2026 Edition)

Reporting Errors: Please help us make this text the best it can be for our members. To report errata to this edition, please send your correction(s) to Education@SNAME.org. Thank you for your assistance to SNAME!

Acknowledgement:

The Education Staff at SNAME wish to thank Mr. Nicholas G. Yarka, PE, for his indispensable expertise in making this 2026 Edition a valuable resource for all our members.

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INTRODUCTION

In 1995 The National Council of Examiners for Engineering and Surveying (NCEES) approved the offering of a national examination for professional licensure of naval architects and marine engineers (NAME) with The Society of Naval Architects and Marine Engineers as the sponsoring organization. A survey of the Society's membership was conducted to determine the range of subject matter of importance to practice in this field and an examination specification was developed and published. In the October 1998 and April 1999 issues of Marine Technology and SNAME NEWS, articles were presented by the then President, Jose Femenia, discussing various aspects of the examination for Professional Engineer Licensure in Ship Design Engineering (SDE). The first Principles and Practice Examination was given on October 29, 1999. In 2001, the name was changed and thenceforth is identified as Naval Architecture-Marine Engineering (NAME). To assist the Society's membership in their exam preparation, some study materials were developed and presented on the SNAME Web Site that are concerned with some subject areas of the examination specification (the examination specification was published in the Marine Technology issue Volume 35, Number 4, of October 1998). Since 2001, an annual examination has been administered in April of each year by the various licensing jurisdictions authorized to offer a Principles and Practices examination in this field of licensure. During 2005 and 2006, a second survey of the naval architecture and marine engineering field was conducted to assess needed changes in requirements related to abilities, knowledge and practices. Based on this survey, a revised examination specification was developed and implemented in April of 2008. More recently, test questions have been developed solely through NCEES utilizing industry experts. While SNAME no longer develops questions for the exams, it remains focused on changes to the specification and exam format and provides its PR Review Course (PERC) annually for the next exam, now held in October of each year.

Obtaining a Professional Engineer license in Naval Architecture and Marine Engineering is one of the biggest steps to be taken in establishing your position in the field. The Society of Naval Architects and Marine Engineers, serving as a longstanding member in NCEES' Participating Organizations Liaison Council (POLC), is pleased to be of help as you prepare yourself for the examination. This Study Guide will provide you with important information on what, how, and when to do it and who to contact for additionally needed information.

The Society encourages its non-licensed membership to consider sitting for the PE exam in Naval Architecture- Marine Engineering next October. **Application deadlines vary by jurisdiction and in some jurisdictions are as early as six months prior to the exam.** Members must contact their licensing boards to determine whether their jurisdiction will be offering the exam, and for the examinee qualifications, application deadlines, and application fees. Contact information for the licensing boards, as well as other information pertaining to professional licensure, can be found on the website for the National Council of Examiners for Engineering and Surveying at http://www.ncees.org. It is understood that all 50 states and some territories offer the NAME examination to qualified applicants. However, if a member's jurisdiction decides not to offer the NAME examination, it is worth noting that, since the examination is national in scope, the state or other jurisdiction may offer registration by comity if the examinee passes the examination administered by another jurisdiction. This information should be available from the local licensing board.

Beginning in 2002, SNAME has offered its **Professional Engineer Review Course (PERC)** annually to assist those preparing to take the NAME examination. Those interested in registering for a PERC offering should go online at www.snamelearning.org, or use this link for more information on the NAME PE exam: https://sname.org/professional-engineer-pe-review-course-sname-member-only-feature
For further questions, contact SNAME headquarters at education@SNAME.org.

The examination specification has three main categories, Naval Architecture, 45.5%, Marine Engineering, 36.0% and Common, 18.5%. Each of these categories is further subdivided into topic areas, each of which is weighted within the above noted amounts (for more information, see **"Examination Specification"** below). The study materials that are presented in the PERC typically cover more than one subject area at a time; some presentations are of a more general nature while problems concerned with a specific subject area will also be included from time to time. Problem solutions and reference suggestions are also given, but not necessarily with the initial presentation of subject area materials. The PERC ends with a set of sample problems and solutions in the format of the NAME exam. Marine electrical engineers should note that the NAME exam has only about a 7% focus on electrical equipment, load analysis, distribution, energy conversion and emergency systems. Therefore, marine electrical engineers might find licensure in Electrical and Computer or Control Systems more appropriate for their needs. They should refer to the NCEES web site at http://www.ncees.org for further guidance. NAME examination questions have been authored by a wide variety of currently licensed individuals representing many facets of the marine industry, so that it may be challenging to confidently respond to every exam question.

ELIGIBILITY

The primary purpose of licensure is to protect the public health, safety and welfare. As noted by NCEES:

> "**Professional engineering and surveying licensure provide public protection.** The safety of buildings, bridges, roads, and other structures and technologies used in our everyday lives depends on licensed professional engineers and surveyors who have successfully demonstrated a level of competence through education, experience, and examination requirements."

(See "Why Licensure Matters", https://ncees.org/licensure/why-licensure-matters/)

55 United States jurisdictions (all 50 states as well as The District of Columbia, Puerto Rico, The U.S. Virgin Islands, Guam, and The Northern Marianas Islands) have enacted professional engineer licensing statutes that are administered by appointed licensing boards. ***Important: Eligibility to sit for an NCEES exam varies and is determined by each licensing board. It is your responsibility to review your licensing board's requirements before registering for an exam.***

The passing of license examinations provides one means of measuring the professional competence of candidates. Typically, the various licensing jurisdictions generally require a minimum of 12 years of experience to become qualified to take the Principles and Practice of Engineering (PE) exam. Eight (8) years of experience is usually credited to those applicants who have graduated from an ABET (Accreditation Board for Engineering and Technology) accredited engineering program, and additional experience is sometimes credited for completion of advanced engineering degree requirements at an accredited institution. Some states require graduation from an accredited engineering program. Also, some states consider possessing a doctoral degree in an engineering discipline as satisfying the education and experience requirement.

Most jurisdictions also require that candidates pass the Fundamentals of Engineering (FE) examination to be qualified to sit for the P.E. license. While some states do not require passing the FE examination in order to become qualified to take the Principles and Practice examination, it should be noted that, if in your career you move your practice from one jurisdiction to another, licensing by comity may not be possible if you have not passed the FE Exam. ***Licensing qualification requirements vary from state to state (jurisdiction to jurisdiction)*** and several states do not offer examinations in all engineering fields, so a candidate needs to contact the appropriate licensing board to obtain specific information on requirements and application forms.

To obtain the website, address and phone number for each jurisdiction's licensing board, please visit the NCEES home page at www.ncees.org, or go directly to the NCEES US and territorial chart found here: https://ncees.org/about/member-licensing-board-directory/

For more information, see the NCEES Exam Guide.

LICENSING REQUIREMENTS

Licensing requirements and associated fees vary from jurisdiction to jurisdiction and applicants are responsible for contacting their appropriate board. Application forms for taking the Principles and Practices examination in Naval Architecture and Marine Engineering and instructional information are available from the individual licensing boards. Information regarding licensing boards is attainable from the following link: https://ncees.org/exams/pe-exam/

The following should be noted:

- Requirements for educational background (ABET vs non-ABET degree) and length of experience, etc., vary by jurisdiction.
- Not all states use the NCEES NAME exam as their basis for licensure.
- Licenses issued as a discipline specific engineer (e.g. Naval Architect and Marine Engineer, Mechanical Engineer, Civil Engineer etc.), are restricted in practice in a specific field, which is usually the discipline of the professional examination taken for licensure.
- Licenses issued as non-discipline specific (typically noted as Professional Engineer), are allowed to practice in his/her area(s) of competency, regardless of which discipline of the professional examination was taken for licensure.
- Deadlines for application submittal vary by jurisdiction. The candidate should allow ample time to assemble the required data and complete the application process.

Accordingly, the candidate should check their licensing board.

DESCRIPTION OF EXAMINATION

Examination Schedule

The NCEES examination in Naval Architecture and Marine Engineering (NAME) is presented in a mixed format question style and typically given only in October of each year. Contact your state board or refer to the NCEES NAME page (https://ncees.org/exams/pe-exam/naval-architecture-and-marine/) to determine specific dates and locations.

Examination Content

The Principles and Practice of Engineering (PE) examination in Naval Architecture and Marine Engineering (NAME) covers a broad range of subject matter, and tests for a minimum level of competency in a particular engineering discipline. The Examination Specification table below indicates the subject areas covered in the examination along with their approximate examination weighting. It is designed for engineers with a minimum of four years of post-college work experience in their chosen engineering discipline.

The NAME examination is 9.5 hours in duration and given in a closed-book style; **no additional materials besides an approved calculator may be brought into the exam**. After completing the check-in process, the proctor will provide you with 2 reusable booklets and 3 markers for scratch work. The examination is composed of 85 multiple-choice questions as well as alternative item types (AITs). All questions, including AITs, are scored as either correct or incorrect. There is no partial credit. AITs include but are not limited to the following:

- Multiple correct—allow examinees to select multiple answers
- Point and click—require examinees to click on part of a graphic to answer
- Drag and drop—require examinees to click on and drag items to match, sort, rank, label
- Fill in the blank—provide a space for examinees to enter a response to the question

See here for more information on alternative item types (AITs). The questions are estimated to take approximately 6 minutes to answer, on average, and generally require some computation to be carried out. All questions are independent and equally weighted, so time management is important. If a problem solution is not immediately apparent, it is usually wisest to skip to the next one and return later when time might still be available.

The PE Naval Architecture and Marine Engineering exam is computer-based and administered one day per year. Like other PE exams with small examinee populations, this is a single-day testing event. Examinees may reserve their seats up to a year in advance at a Pearson test center once they are registered with NCEES and approved by their board (for a directory of NCEES member licensing boards, click here). Candidates are encouraged to reserve their seat for this single-day event as early as possible.

As noted above, the exam includes 85 questions, and the exam appointment time is 9.5 hours. It includes:

- Nondisclosure agreement (2 minutes)
- Tutorial (8 minutes)
- Exam (8.5 hours)
- Scheduled break (50 minutes)

You can learn more about the examination process at the NCEES YouTube channel.

Calculator Policy

To protect the integrity of its exams, NCEES limits the types of calculator examinees may bring to exam sites. The list of approved calculators is reviewed annually. The following calculator models ***are the only ones acceptable for use during the 2026 exam:***

- **Casio:** All fx-115 and fx-991 models (Any Casio calculator must have “fx-115” or “fx-991” in its model name.)
- **Hewlett Packard:** The HP 33s and HP 35s models, but no others
- **Texas Instruments:** All TI-30X and TI-36X models (Any Texas Instruments calculator must have “TI-30X” or “TI-36X” in its model name.)

Remember to bring extra batteries if needed. Forgot to bring your calculator? Don’t worry - a TI-30XS calculator can be accessed on-screen during the exam.

EXAMINATION SPECIFICATION

Refer to the table below for the Examination Specification and subject area weighting (the following information comes from NCEES and is **Effective October 2025):**

PRINCIPLES AND PRACTICE OF ENGINEERING EXAMINATION
NAVAL ARCHITECTURE AND MARINE ENGINEERING

CBT Exam Specifications

- The PE Naval Architecture and Marine Engineering exam is computer-based. It is closed book with an electronic reference.
- Examinees have 9.5 hours to complete the exam, which contains 85 questions. The 9.5-hour time includes a tutorial and an optional scheduled break. The Examinee should complete all questions.
- The exam uses both the International System of units (SI) and the U.S. Customary System (USCS).
- The exam is developed with questions that will require a variety of approaches and methodologies, including design, analysis, and application.
- The knowledge areas specified as examples of kinds of knowledge are not exclusive or exhaustive categories.

Topic:	Number of Questions
Naval Architecture: Hydrostatics and Stability	**10–15**
A. Tools, methods, and procedures (e.g., curves of form, integration methods, inclining, sallying)	
B. Intact stability (e.g., center of gravity, righting arm, free-surface, docking, grounding)	
C. Damage stability (e.g., floodable length, probabilistic stability, righting arm, downflooding, effect of list, free communication)	
D. Dynamic stability and transitional stability (e.g., equilibrium polygon, porpoising, chine walking, parametric roll)	
E. Weights (e.g., weight estimate, weight distribution, weight control)	
Naval Architecture: Hydrodynamics	**6–9**
A. Resistance and propulsion (e.g., different hull forms, shallow water effects, channel effects)	
B. Propulsor, foil, and appendage design (including cavitation)	
C. Maneuvering and directional stability (e.g., steering, rudders, control surfaces)	

D. Seakeeping (e.g., forces and motions, added mass, wave damping, response amplitude operators, motion stabilization)

E. Model testing (e.g., scaling laws, data expansion, CFD validation)

Naval Architecture: Ocean Engineering	**4–6**

A. Wind, waves, and currents (e.g., wave theories, wave spectra, tides, wind scale, sea state)

B. Mooring systems (e.g., floating structure to seabed, berthing, anchoring)

Naval Architecture: Structural Design	**7–11**

A. Internal loads (e.g., sloshing, tank loading, hydrostatic loads)

B. External loads (e.g., slamming, impact, berthing, collision, drydocking, grounding, mooring, launching, ice, wind, waves)

C. Primary structures (e.g., hull girder, midship section)

D. Secondary structures (e.g., frames, beams, girders, trusses, plates, columns, pillars, foundation)

E. Tertiary structures (e.g., clips, brackets, knees, gussets)

F. Structural considerations (e.g., stress concentration, fatigue, corrosion, thermal variations)

G. Finite element analysis

H. Hull responses and reactions (e.g., vibration, impulse, whipping, springing, slamming)

I. Material selection (e.g., ferrous materials, nonferrous materials, plastics, composites, wood, concrete)

Naval Architecture: General Arrangements	**5–8**

A. Arrangements and details (e.g. compartment arrangements, workflow, access and egress, maintenance and removal routes, hazardous zone plan)

B. Crew accommodations and habitability (e.g., staterooms, galleys, mess, lounges, storerooms)

C. Boundaries (e.g., watertight, fire)

Marine Engineering: Propulsion and Power Generation	**6–9**

A. Internal combustion plants (e.g., diesel)

B. Fuels and lubrication (e.g., properties, handling systems, effects on equipment, choices of fuels and lubricants)

C. Drive train (e.g., propellers, propulsors, gearing, shafting, bearings)

D. Drive train vibration (e.g., flow-induced, machinery-induced, shafting)

E. Propulsion architecture (e.g., selection, efficiencies, propulsion alternatives)

Marine Engineering: Piping System Design **5–8**

A. Component selection (e.g., pumps, valves and control devices, strainers, filters)

B. Design considerations and limitations (e.g., viscosity, limiting flow speeds, flow effects, noise, cavitation, pipe hammer, pressure relief)

C. Layout (e.g., piping arrangement, support, maintenance)

D. Calculations (e.g., pipe flow, pipe resistance, pressure drop, stress analysis)

Marine Engineering: Auxiliary Equipment Selection **5–8**

A. Heat exchangers

B. HVAC/refrigeration

C. Fire protection (e.g., personnel, fire detection, fire zone definitions, egress, firefighting equipment)

D. Hydraulic systems

Marine Engineering: Electrical Systems **5–8**

A. Component selection (e.g., generators, transformers, motors, batteries, fuel cells, switch gear, cables)

B. Design considerations (e.g., power load, overload, redundancy, power factor, emergency generator requirements, bonding, safety, automation and control systems)

C. Calculations (e.g., electrical load analysis, cable sizing, voltage drop, power conversion)

D. Electric propulsion considerations (e.g., fuel cell, hybrid, batteries, charging infrastructure, propulsion motor sizing)

Marine Engineering: Environmental Considerations **4–6**

A. Combustion emissions standards compliance and corresponding equipment (e.g., exhaust scrubbers, incinerators)

B. Environmental protection (e.g., oily water separation, sewage treatment, solid waste, ballast water treatment)

Common: Hull Outfitting **4–6**

A. Deck machinery and cargo handling (e.g., winches, anchoring and mooring equipment, gangways, lifting appliances)

B. Securing systems and fittings (e.g., bollards, bitts, chocks, rigging)

Common: Materials, Corrosion, Welds, and Connections **4–6**

A. Connectors and fasteners (e.g., bolts, adhesives) and bimetallic joints (e.g., explosion bonding)

B. Welding design and procedures (e.g., stresses, symbols, filler materials, methods, inspection, testing)

C. Elements of corrosion (e.g., galvanic series, general wastage, pitting, crevice and stress corrosion, fretting, stray currents)

D. Corrosion-control applications (e.g., impressed current systems, sacrificial anodes, bonding and grounding)

Common: Rules and Regulations **5–8**

A. Statutory requirements, international regulations, and third-party standards

(e.g., U.S. Coast Guard, IMO, OSHA, EPA)

EXAMINATION REGISTRATION AND PREPARATION

Register for the exam by logging in to your MyNCEES account and following the onscreen instructions.
Prepare for your exam by

- Reviewing the exam specifications, fees, and requirements
- **Attending the SNAME PE Review Course (PERC), held from July to October**
    - See information about the Course here.
- Reading the reference materials
- Understanding scoring and reporting

A $400 exam fee is payable directly to NCEES (as of July 2026). Some licensing boards may require you to file a separate application and pay an application fee as part of the approval process to qualify you for a seat for an NCEES exam. Your licensing board may have additional requirements. Familiarize yourself with your state licensing board's unique registration procedures before registering for a PE exam.

PE NAME Exam Pass Rates

The latest available information from NCESS (dated January 2026) reports the following:

First Time Examinees:	46
First Time Pass Rate:	63%
Repeat Examinees:	08
Repeat Pass Rate:	38%

Examination Development Examination Validity

To ensure the validity of the Principles and Practices examination, a survey of practitioners is conducted periodically in which the critically required knowledge and skills are identified. The results of the survey analysis allow the subject areas and their weightings to be determined. The survey is repeated periodically to keep the requirements current with developments in the field. Based on the examination specification, examination questions are developed by and selected for inclusion in an examination by a group of currently licensed practitioners. The questions are repeatedly reviewed to ensure appropriateness, completeness and accuracy.

Examination Content Outlines

Due to the breadth and depth of knowledge and skills required for the practice of naval architecture and marine engineering, the subject areas covered in the examination typically include multiple elements, only a few of which can be adequately covered in any examination. Thus, there are significant differences in the content of questions covering a subject area in succeeding examinations, though the questions are intended to give as broad coverage as possible.

Scoring Exams

Exam results are typically available 7–10 days after you take the exam. You will receive an email notification from NCEES with instructions to view your results in your MyNCEES account. Results will include information specific to your licensing board regarding how you should proceed based on your performance.

All results are reported as pass or fail. If you fail the exam, you will receive a diagnostic report showing your performance for each of the major topics covered on the exam. The diagnostic report is provided to help identify the knowledge areas where improvement is needed before retaking the exam. The purpose of this report is to provide general information on performance; it is not designed or intended to be used for any other purpose. NCEES does not provide examinees with their exam questions or answers for review or future exam preparation.

Your exam results are based on the total number of correct answers that you selected. The weighting of each item on the examination is the same, the raw score for the examinee is equal to the number of items whose answers are correctly selected. There are no deductions for wrong answers. The score is then converted to a scaled score, which adjusts for any minor differences in difficulty across the different exam forms. This scaled score represents an examinee's ability level and is compared to the ability level required to pass the exam, which has been determined by subject-matter experts. There is no predetermined percentage of examinees that should pass or fail. All exams are scored the same way. First-time takers and repeat takers are graded to the same standard.

Direct all questions about score notification to your licensing board. While NCEES compiles the exam results, the individual licensing boards notify examinees of their scores.

Providing for Reasonable Accommodation

Upon request, reasonable accommodations in compliance with the Americans with Disabilities Act (ADA) will be provided. Requests for exam accommodation are managed through the Pearson test service provider. To request reasonable accommodation, **you must indicate your need during the exam registration process**. Once you've registered, you'll receive an email from NCEES that contains next steps to continue your accommodations request. Please visit the Pearson website for more details.

Important: If you fail to indicate your need for reasonable accommodation during initial registration, your current exam registration will need to be canceled, and you will have to complete a new registration.

More information may be found on the NCEES Website at http://www.ncees.org . All are encouraged to visit the site and explore the information provided.

STUDY REFERENCES FOR NAVAL ARCHITECTURE AND MARINE ENGINEERING

To start with exam preparation, it is suggested that the prospective examinee collect an appropriate selection of the professional references summarized below:

- Introduction to Naval Architecture, E. Tupper, 2013, INA/SNAME
- Principles of Naval Architecture, The Geometry of Ships, 2009 SNAME
- Principles of Naval Architecture, Intact Stability, Colin S. Moore, 2010 SNAME
- Principles of Naval Architecture, Strength of Ships and Ocean Structures, Mansour and Liu, 2009 SNAME
- Principles of Naval Architecture, Vols II and III, E.V. Lewis, 1988, SNAME
- Applied Naval Architecture, Robert Zubaly
- Ship Design and Construction, T. Lamb, 2003, SNAME
- Ship Production, R.L. Storch, C.P. Hammon, H.M. Bunch & R.C. Moore, 1995, SNAME
- Fiberglass Boat Design and Construction, R.J. Scott, 1996, SNAME
- Marine Engineering, R.L. Harrington, 1992, SNAME
- Elements of Ocean Engineering, R.E. Randall, 2010, SNAME
- Rules for Building and Classing Marine Vessels, American Bureau of Shipping, (Marine Vessel Rules, MVR), American Bureau of Shipping, (ABS)
- Rules for Building and Classing High Speed Craft, 1997, (HSC) American Bureau of Shipping, (ABS)
- U.S. Code of Federal Regulations, Title 33 and Title 46 (CFR 33 and CFR 46)
- Mechanical Engineer's Handbook, Avallone and Baumeister, or
- Eshbach's Handbook of Engineering Fundamentals, Tapley

Many of the texts are available for purchase through the Books page of this website. The ABS Rules and the Code of Federal Regulations (CFR) are available online, so there is no need to obtain them in hard copy. Also, if they are used in an exam item, the problem statement will include the appropriate Rule or Code citation.

During the conduct of the course, there are a number of other references that the instructors suggest as useful. If you have already registered for the PERC, you can go online and review the various Unit Assignments and find other recommended texts. Also, you can contact SNAME Headquarters at Education@SNAME.org for any revisions to these texts.

STUDY AND PREPARATION TIPS FOR TAKING THE NAVAL ARCHITECTURE & MARINE ENGINEERING (NAME) PROFESSIONAL ENGINEER EXAM

The NCEES Naval Architecture and Marine Engineering (NAME) PE exam covers a wide swath of engineering disciplines. Preparation requires a targeted, resourceful approach, and there are some clear strategies that can help. With a systematic approach to studying, along with participating in our **PE Review Course (PERC)**, you will have the resources needed to pass. PERC offers lectures and materials developed by SNAME, and past examinees agree that it's a good, comprehensive review of the topics covered in this test.

Based on input from past PERC attendees and test takers, and the latest test specification (dated October 2025), we have collected some tips on how to prepare for the test.

Preparation and Study

Review the Exam Specification. The NCEES Exam Specification lists all the topics to be covered on the NAME PE Exam, along with the estimated number of questions apportioned to each topic. This will help you focus on which subjects to study, based on your education and experience. Whether your specialty is hydrostatics and stability or not, you'll need to focus some study on this topic as it can have as many as 15 questions on the test. On the other hand, if ocean engineering isn't your specialty, you might better use your time focusing your studies elsewhere, since it's only 4-6 questions. It's always good to study as many topics as possible; but if you're short on time, the specification will help you choose which subjects offer the most advantage for you.

Stick to a Study Regimen. Review all the information distributed during PERC and use the course cadence to keep your preparation on track. Attend all sessions, even if you think you have the topic well in hand; students have found the discussions during the live sessions to be valuable. But if you're not taking the course, use the exam specification as your study program. Break up the topics into weeks of study as you head toward the October exam, giving extra time to those topics you need to brush up on more.

Your Technical Library. You can find a suggested professional library on the PERC webpage. The reference library has a list of the latest books, including links to digital publications, where available. While you cannot take any texts or references into the exam, these may offer some good material while studying for the test. *They also form the basis for a solid technical library as you progress in your career.* If you'd like to see a copy of a book before deciding to purchase, reach out and plan to stop by SNAME headquarters to look through them. Send an email to Education@SNAME.org, and we will make sure the books are readily available for you.

Master the NCEES Reference Book. Be as familiar with the NCEES reference handbook as possible, it is the only resource you can access during the test. Use it for every practice problem you do and for day-to-day engineering tasks at work if you can (verify the accuracy of the contents if applying it to real work).

Game day (taking the exam) is not the time to figure out where information is in the book!

- Some information may be unintentionally hidden or added in sections that are not necessarily intuitive to the topics.
- Information may be published in non-searchable formats (such as photocopies or screengrabs). This is particularly applicable for formulas and charts, so a quick 'Alt-F' search will often have zero results.
- You'll need to be explicit in your searches, using appropriate hyphens and apostrophes. For example, you need to search for 'Hazen-Williams', and not 'HazenWilliams' for the pipe flow equation. Learn the exact keyword triggers and the specific layout of sections, so you can navigate to any major equation or chart within seconds.

Replicate the Exam Environment. The exam is computer based and held at test centers. The typical format is to have a split screen with the exam on one side and the NCEES Reference book on the other. Get used to this test configuration; practice solving problem sets at home with a split screen, placing practice problems on one half of the monitor and the reference book on the other, to mimic the exact testing center layout. For a good overview of the computer-based testing (CBT) used for the PE exam, review the NCEES videos found here. These videos cover topics like flagging items for review, types of questions, and calculator choices.

*Contact NCEES for ADA accommodation requests, if required.

Practice, Practice, Practice. Utilize any and all practice problems, exams, etc. you can get your hands on. While the NCEES-published practice exam is the most reflective resource of the actual exam, use the problems provided during PERC, both in the lectures and the SNAME Study Guide. The SNAME questions provide a deeper level of knowledge than you may typically find on the exam, which is a good thing!

Diversify Academic References. Supplement your weak areas using classic foundational texts, such as *Principles of Naval Architecture (PNA) or* Zubaly's *Applied Naval Architecture*, and a standard marine engineering textbook to look up root concepts.

Emphasize Marine Systems. Examinees often find the "morning" naval architecture section (buoyancy, weights, intact/damage stability) straightforward. The "afternoon" marine engineering section is notoriously tricky due to wording of questions and breadth of topics. Be sure to participate in those PERC live sessions with the instructors; they can give you tips on approaching these problems.

Use the Official NCEES Practice Exam. Save the official NCEES practice test until 1 to 2 months before your exam date. Take it under strict, timed conditions to gauge your true preparedness. This gives you some extra time to brush up on topics you might need to study more. Also, try the practice exam provided with our PERC classes. It's given as a reference for every student taking the course, and a new version is being updated in time for the next PERC.

Taking the Examination

Which Calculator Can I use? To protect the integrity of its exams, NCEES limits the types of calculator examinees may bring to exam sites. The list of approved calculators is reviewed annually. The following calculator models are the only ones acceptable for use during the 2026 exam:

- **Casio:** All fx-115 and fx-991 models (Any Casio calculator must have "fx-115" or "fx-991" in its model name.)
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- **Texas Instruments:** All TI-30X and TI-36X models (Any Texas Instruments calculator must have "TI-30X" or "TI-36X" in its model name.)

Remember to bring extra batteries if needed. Forgot to bring your calculator? Don't worry - a TI-30XS calculator can be accessed on-screen during the exam.

Stay Consistent. Realize that most problems take a very similar form (unit conversion first, then application of formula(s)). This method may provide you with a general method of working problems, especially those that are on topics outside of your engineering discipline. Using a consistent, formulaic approach (harmonize units, then pick a formula or two from the handbook) may help you with some problems.

Spot the Missing Equations. Based on historical practice, some questions may require formulas not explicitly printed in the reference handbook. This is why using the reference book during daily study periods will pay off. Use your study time to figure out what is missing; these concepts are often provided directly inside the question text or may be implied by basic engineering principles. SNAME will provide you with a digital copy of the reference book, which might help you fill in some of the gaps. You can't take this (or any other) book into the test, but it may help you study and learn techniques before the test.

Follow the 3-Minute Rule. If a problem takes more than 3 minutes to set up or solve, flag it immediately and move on. Collect as many easy, direct-lookup points first before chipping away at the tougher questions.

Prepare Yourself (physically) for the Exam Process. There is something to be said for exam fatigue – it's a long test and pacing is important. Set aside a solid block of time and go through one of the practice exams in total, to acquaint yourself with the exam process. This might help avoid fatigue during the real exam.

Always go for the guess. There is no deduction for wrong choices, so leave nothing blank.

Best of luck with your studying and the exam! Have questions or need assistance? Reach out to education@sname.org.

SAMPLE EXAMINATION

SAMPLE NAME EXAMINATION

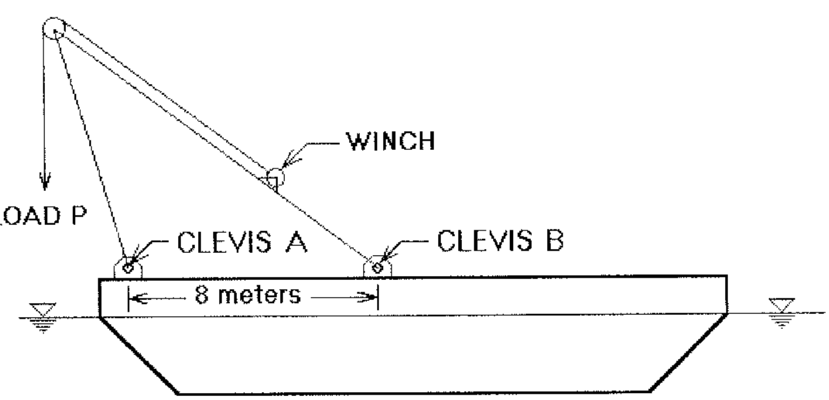
<u>Sample Examination Questions –</u> The following questions concern Subject Areas of the NAME Principles and Practice Examination specification in the approximate weighting of the examination as of 2025. The solutions to these questions have not been timed and do not necessarily reflect any specific problems that have been or will be on an NAME examination. More than 6 minutes may be required to solve them. General knowledge questions may be asked which do not have a clear answer in the PE handbook. The PE Exam typically has five ungraded questions that can have different material than what is given in the handbook. To simulate this, the last five questions are included as an extra opportunity for self-study. We believe that if you can successfully solve all these problems, you will be reasonably well prepared for taking the examination. You have our best wishes for a successful effort. Comments and suggestions regarding errors, manner of presentation or other improvements will be appreciated.

<u>Sample NAME Exam Problem No. 1</u>

Subject: Structural Design

A shear leg, composed of three pipe sections in a tilted tripod arrangement, is mounted at the bow of a square-ended barge (as indicated in the figure below), so to be suitable for hoisting and lowering mooring anchors and buoys in a mooring field. The design calls for a lift capacity of 5 tonnes. The forward two side-legs are 10 meters long and their base connections (in clevises) are set 12 meters apart. The third leg is 12.8 meters long with its base attached 8 meters aft of the axis of the other two legs' bases. The third leg is attached to its base connection with a round pin connected through a clevis. The pin is thus in double shear. The hoisting cable passes over a sheave at the apex of the tripod and is attached to a winch mounted on the third leg as shown. The design shear stress of the pin is 16 MPA. The required diameter (mm) of the third leg's clevis-pin is most nearly:

A) 10
B) 20
C) 30
D) 40



MOORING BARGE

Sample NAME Exam Problem No.2

Subject: Structural Design

A commercial vessel is to be outfitted with a radar antenna, of 250 kg mass, atop a 10-meter stayed mast that is mounted on the flying bridge. The flying bridge is located 30 meters above the ship's base line and the vessel has a design draft of 10 meters. The installation is to be designed to sustain a roll-amplitude of 35 degrees with a 6 second period of roll. The mast is to be simply supported at its base and stayed transversely and fore and aft by shrouds connected at its top that are attached to flying bridge structure five meters fore and aft and outboard Port and Starboard from the mast base. The design loading of the transverse shrouds (kilonewtons) due to vessel rolling is most nearly:

A) 5
B) 14
C) 28
D) 50

Sample NAME Exam Problem No. 3

Subject: Structural Design

A 10 short-ton plate-yard crane is to be mounted on a light-weight, simply supported beam having a 40 foot span. In order to provide adequate beam stiffness, a design criterion restricts mid-span deflection to 1/360 of the span. The lightest weight W-Shape I-Beam that meets this criterion is most nearly:

A) W 24 x 62
B) W 24 x 55
C) W 21 x 57
D) W 18 x 55

Sample NAME Exam Problem No. 4

Subject: Environmental Considerations

Refer to the excerpt from 40 CFR on the following pages. A twelve-cylinder low-speed diesel engine with an MCR of 18.4 MW, a 600mm bore and 2000 mm stroke, which was manufactured in 2012 would fall into which engine category?

A) Uncategorized
B) Category 1
C) Category 2
D) Category 3

(a) The emission standards of this part 1042 for freshly manufactured engines apply for new marine engines starting with the model years noted in the following table:

Expand Table

Table 1 to § 1042.1—Part 1042 Applicability by Model Year

Engine category	Maximum engine power [a]	Displacement (L/cyl) or application	Model year
Category 1	kW < 75	disp.< 0.9	[b] 2009
	75 ≤ kW ≤ 3700	disp.< 0.9	2012
		0.9 ≤ disp. < 1.2	2013
		1.2 ≤ disp. < 2.5	2014
		2.5 ≤ disp. < 3.5	2013
		3.5 ≤ disp. < 7.0	2012
	kW > 3700	All	2014
Category 2	kW ≤ 3700	7.0 ≤ disp. < 15.0	2013
	kW > 3700	7.0 ≤ disp. < 15.0	2014
	All	15 ≤ disp. < 30	2014
Category 3	All	disp. ≥ 30	2011

[a] See § 1042.140, which describes how to determine maximum engine power.

[b] See Table 1 of § 1042.101 for the first model year in which this part 1042 applies for engines with maximum engine power below 75 kW and displacement at or above 0.9 L/cyl.

(b) New engines with maximum engine power below 37 kW and originally manufactured and certified before the model years identified in Table 1 to this section are subject to emission standards as specified in appendix I of this part. The provisions of this part do not apply for such engines, except as follows beginning June 29, 2010:

(1) The allowances of this part apply.

(2) The definitions of "new marine engine" and "model year" apply.

(As per eCFR.gov, displaying title 40, up to date as of 7/09/2026. Title 40 was last amended 7/09/2026.)

(c) Marine engines originally meeting Tier 1 or Tier 2 standards as specified in appendix I of this part remain subject to those standards. This includes uncertified engines that meet standards under 40 CFR 1068.265. Those engines remain subject to recall provisions as specified in 40 CFR part 1068, subpart F, throughout the useful life corresponding to the original certification. Also, tampering and defeat-device prohibitions continue to apply for those engines as specified in 40 CFR 1068.101. The remanufacturing provisions in subpart I of this part may apply for remanufactured engines originally manufactured in model years before the model years identified in Table 1 to this section.

(d) [Reserved]

(e) The requirements of subpart I of this part apply to remanufactured Category 1 and Category 2 engines beginning July 7, 2008.

(f) The marine engines listed in this paragraph (f) are subject to all the requirements of this part even if they do not meet the definition of "compression-ignition" in § 1042.901. The following engines are deemed to be compression-ignition engines for purposes of this part:

(1) Marine engines powered by natural gas or other gaseous fuels with maximum engine power at or above 250 kW. Note that gaseous-fueled engines with maximum engine power below 250 kW may or may not meet the definition of "compression-ignition" in § 1042.901.

(2) Marine gas turbine engines.

(3) Other marine internal combustion engines that do not meet the definition of "spark-ignition" in § 1042.901.

(g) Some of the provisions of this part may apply for other engines as specified in 40 CFR part 1043.

(h) Starting with the model years noted in Table 1 of this section, all of the subparts of this part, except subpart I, apply as specified in 40 CFR part 60, subpart IIII, to freshly manufactured stationary compression-ignition engines subject to the standards of 40 CFR part 60, subpart IIII, that have a per-cylinder displacement at or above 10 liters and below 30 liters per cylinder. Such engines are considered Category 2 engines for purposes of this part 1042.

[75 FR 22994, Apr. 30, 2010, as amended at 76 FR 37977, June 28, 2011; 81 FR 74142, Oct. 25, 2016; 86 FR 34507, June 29, 2021]

(As per eCFR.gov, displaying title 40, up to date as of 7/09/2026. Title 40 was last amended 7/09/2026.)

Sample NAME Exam Problem No. 5

Subject: Structural Design

A longitudinally stiffened section of deck plating is composed of 20mm plate fitted with 200mm x 100mm x 13mm inverted angles, spaced on 750mm centers. The plate-stiffener Section Modulus (10^3 mm^3) is most nearly:

A) 4550
B) 3980
C) 439
D) 407

Sample NAME Exam Problem No. 6

Subject: Electrical Systems

An electric motor drives a saltwater circulating pump through a coupling connecting their shafts. The motor delivers 150 horsepower at 900 RPM. The steady state torque transmitted (foot-pounds) by the shaft coupling is most nearly:

A) 1750
B) 875
C) 91.7
D) 15.1

Sample NAME Exam Problem No. 7

Subject: Structural Design

A longitudinally stiffened ‘Tween deck is to be designed to carry a live load of 1200 pounds per square foot. The supporting arrangement of the deck consists of a set of longitudinal girders (spaced at 25 feet) and main-transverse web-frames (spaced at 30 feet). At the intersection of each longitudinal girder and main-transverse web-frame, a pillar (or stanchion) is placed to support the load. The longitudinal stiffener spacing is 30 inches. Neglecting the dead load of the structure, the axial load on a pipe-section stanchion (Long Tons) and the longitudinal stiffener design load (Pounds per foot) are most nearly:

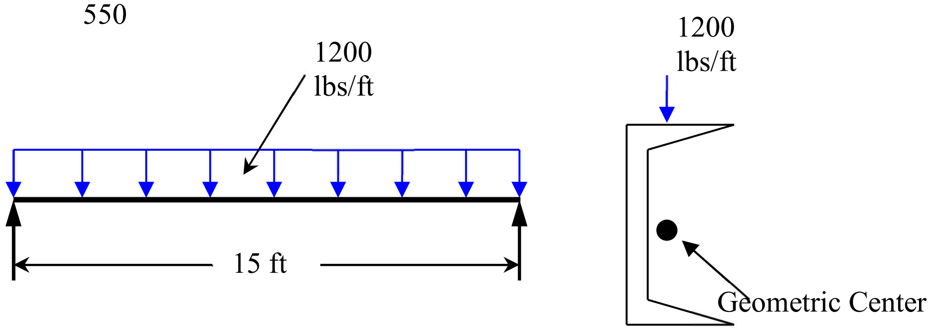
A) 450, 1.5
B) 450, 300
C) 400, 1200
D) 400, 3000

Sample NAME Exam Problem No. 8

Subject: Structural Design

A channel section (C 15x50) is loaded as shown below with the lateral loading in line with the section center of gravity, the geometric center of the section. In addition to the vertical shear and bending considerations, a twisting moment is generated (inch-pounds per foot) that is most nearly:

A) 1,700
B) 960
C) 700
D) 550



Sample NAME Exam Problem No.9

Subject: Hull Outfitting

A luffing and slewing crane, to be located on a vessel's foredeck for anchor handling and other miscellaneous work, is to have a capacity of 5 tons when extended horizontally to its maximum length of 45 feet. Crane luffing is controlled by a hydraulic cylinder ram attached 6 feet below the connection between the crane boom and the pedestal and 6 feet outboard of the connection. In the fully extended position stated, the load (Tons) on the hydraulic ram is most nearly:

A) 40
B) 50
C) 200
D) 300

Sample NAME Exam Problem No.10

Subject: Structural Design

The transverse bulkhead of a single-shell salt-water ballast deep tank, extending from the deck to the bottom, of a liquid cargo barge (20 feet deep) is horizontally stiffened. The stiffeners are at a 24-inch spacing and supported by vertical webs 12 feet apart. The tank vent extends to 36 inches above the deck. The design load on the bottom-most stiffener (pounds per foot) is most nearly:

A) 2700
B) 2300
C) 1300
D) 1100

Sample NAME Exam Problem No.11

Subject: Hydrodynamics

A container vessel proceeding in a seaway experiences pitch amplitudes of 12 degrees with a pitch period of 7 seconds. The vessel is 870 feet long and the center of flotation is located 0.08 L aft of midships. The maximum vertical acceleration (g) deck cargoes experience on the foredeck at 0.05L aft of the Forward Perpendicular due to the pitching is most nearly:

A) 1.0
B) 2.4
C) 3.0
D) 3.4

Sample NAME Exam Problem No.12

Subject: Welds/Connections/Corrosion

A 150 H.P. electric motor is to drive a main circulating pump with a maximum speed of 900 RPM. The motor and pump shafts are connected by a flanged coupling having six, ½ inch diameter steel bolts. If the shear stress in the coupling bolts is not to exceed 13.5 ksi, with a factor of safety of 4.0, the bolt circle diameter (inches) must be not less then:

A) 4
B) 5
C) 6
D) 7

Sample NAME Exam Problem No.13

Subject: Welds/Connections/Corrosion

An Upper Engine Room hoisting winch for use in main engine overhaul work is to be mounted on a removable I-beam that spans the 20-foot wide engine room casing. The hoist is to have a 5 S.Ton capacity, and the connection brackets at each end of the I-beam are to be fitted with bolts adequate to resist the shear force and bending moments generated when the hoist is located at mid-span with the maximum shearing force in the bolts not to exceed 13,500 psi. The bracket bolts are to be six in number and in a single line with 3-inch spacing. The diameter of the bolts (eighths of an inch) need to be not less than:

A) 8
B) 10
C) 12
D) 14

Sample NAME Exam Problem No.14

Subject: Environmental Considerations

A “noise pollution” case involves the airborne noise emitted from the propulsion gas turbines of a high-speed ferry. As part of an investigation, it is noted that in the open, sound intensity falls off inversely:

A) as the square of the distance from the source
B) as the cube of the distance from the source
C) as the fourth power of the distance from the source
D) Directly proportionally to the distance from the source

Sample NAME Exam Problem No.15

Subject: Ocean Engineering

A Pierson Moskowitz spectrum has a wave period of 7 seconds and a spectral ordinate of 1.18. What does this correspond to on the Beaufort scale?

A) 5
B) 6
C) 7
D) 8

Sample NAME Exam Problem No.16

Subject: Environmental Considerations

Given the below except from MARPOL Annex IV, which of the following is not an acceptable means of dealing with untreated onboard sewage without the use of a sewage treatment plant?

A) Discharging sewage onboard an in-use lifeboat
B) Holding sewage for more than 90 days in a holding tank
C) Discharging sewage 19 miles from the nearest land, moving at 3 knots.
D) Discharging sewage 8 miles from the nearest land, mixed with wastewater to dilute it

Regulation 8

Discharge of sewage

(1) Subject to the provisions of regulation 9 of this Annex, the discharge of sewage into the sea is prohibited, except when:

(a) the ship is discharging comminuted and disinfected sewage using a system approved by the Administration in accordance with regulation 3(1)(a) at a distance of more than 4 nautical miles from the nearest land, or sewage which is not comminuted or disinfected at a distance of more than 12 nautical miles from the nearest land, provided that in any case, the sewage that has been stored in holding tanks shall not be discharged instantaneously but at a moderate rate when the ship is *en route* and proceeding at not less than 4 knots; the rate of discharge shall be approved by the Administration based upon standards developed by the Organization; or

(b) the ship has in operation an approved sewage treatment plant which has been certified by the Administration to meet the operational requirements referred to in regulation 3(1)(a)(i) of this Annex, and

(i) the test results of the plant are laid down in the ship's International Sewage Pollution Prevention Certificate (1973);

(ii) additionally, the effluent shall not produce visible floating solids in, nor cause discoloration of, the surrounding water; or

(c) the ship is situated in the waters under the jurisdiction of a State and is discharging sewage in accordance with such less stringent requirements as may be imposed by such State.

(2) When the sewage is mixed with wastes or waste water having different discharge requirements, the more stringent requirements shall apply.

Regulation 9

Exceptions

Regulation 8 of this Annex shall not apply to:

(a) the discharge of sewage from a ship necessary for the purpose of securing the safety of a ship and those on board or saving life at sea; or

(b) the discharge of sewage resulting from damage to a ship or its equipment if all reasonable precautions have been taken before and after the occurrence of the damage, for the purpose of preventing or minimizing the discharge.

Regulation 10
Reception facilities

(1) The Government of each Party to the Convention undertakes to ensure the provision of facilities at ports and terminals for the reception of sewage, without causing undue delay to ships, adequate to meet the needs of the ships using them.

(2) The Government of each Party shall notify the Organization for transmission to the Contracting Governments concerned of all cases where the facilities provided under this regulation are alleged to be inadequate.

Regulation 11
Standard discharge connections

To enable pipes of reception facilities to be connected with the ship's discharge pipeline, both lines shall be fitted with a standard discharge connection in accordance with the following table:

Standard dimensions of flanges for discharge connections

Description	*Dimension*
Outside diameter	210 mm
Inner diameter	According to pipe outside diameter
Bolt circle diameter	170 mm
Slots in flange	4 holes 18 mm in diameter equidistantly placed on a bolt circle of the above diameter, slotted to the flange periphery. The slot width to be 18 mm
Flange thickness	16 mm
Bolts and nuts: quantity and diameter	4, each of 16 mm in diameter and of suitable length
The flange is designed to accept pipes up to a maximum internal diameter of 100 mm and shall be of steel or other equivalent material having a flat face. This flange, together with a suitable gasket, shall be suitable for a service pressure of 6 kg/cm^2	

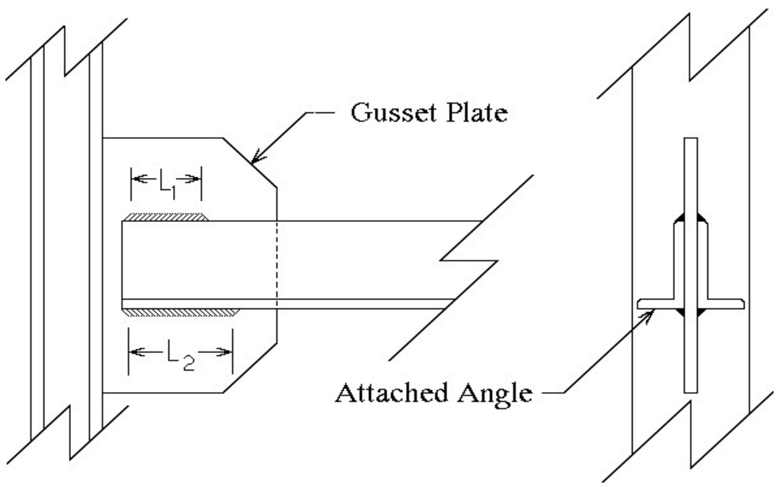
For ships having a moulded depth of 5 m and less, the inner diameter of the discharge connection may be 38 mm.

Sample NAME Exam Problem No.17

Subject: Welds/Connections/Corrosion

Two mild steel 3-in by 2.5-in by 1/2-in angles are to be welded to a 1/2 –in thick gusset plate as indicated in the sketch below with 5/16-in welds. The yield strength of the material is 33 ksi and the allowable shear stress through the weld throats is 13.6 ksi. The required length of weld L_1 (inches) will be most nearly:

A) 27.5
B) 18.3
C) 12.2
D) 9.1



Plan View of Gusset Plate with Two Angles Attached

Sample NAME Exam Problem No.18

Subject: Propulsion and Power Generation

A marine engineer is tasked to determine the vibration characteristics of a ship's propeller and propulsion shafting system. The 30 meter long, steel propeller shaft is hollow, having an outside diameter of 0.6m and an inside diameter of 0.3 m. As part of a simple mass-spring vibrating system, the effective linear spring constant, k_{eq} (N/m) of the shafting acting with the propeller mass is most nearly:

A) 5800×10^6
B) 1940×10^6
C) 1850×10^6
D) 1410×10^6

Sample NAME Exam Problem No.19

Subject: Propulsion and Power Generation

A motor generator set, weighing 1,900 pounds, is mounted at mid-span of a simply-supported deck beam having a moment of inertia of 26.0 inches^4, a section modulus of 8.7 inches^3 and a length of 12 feet. The lowest motor rotating speed (RPM) capable of exciting the fundamental mode of a simple mass-beam system is most nearly:

A) 1,500
B) 1,000
C) 500
D) 250

Sample NAME Exam Problem No.20

Subject: Propulsion and Power Generation

A 20,000 ton displacement cargo vessel having a four bladed propeller is estimated to have vertical vibration natural frequencies (Hertz), as follows: 2-noded, 1.2, 3-noded, 2.2, 4-noded, 3.0 and 5-noded, 4.0. The vertical mode of vibration most likely to be excited when the vessel is in the maneuvering mode at 60 RPM is:

A) 2-noded
B) 3-noded
C) 4-noded
D) 5-noded

Sample NAME Exam Problem No.21

Subject: Hydrostatics and Stability

A vessel having the characteristics listed below has an Initial GM of 3.2 feet when all fuel and water tanks are pressed up to 98% capacity.

Length Between Perpendiculars	580 feet
Beam	72 feet
Draft	24 feet
Double Bottom Depth	5 feet
Displacement	20,600 L.Tons
KM	31.6 feet

The vessel has four cargo deep tanks, each 35 feet long, 36 feet wide and 14 feet deep. A cargo of molasses (specific gravity 1.4) is loaded into the deep tanks until the tanks are filled to a depth of 10 feet. Assuming that KM remains the same, the apparent GM, with the deep tanks partially filled with molasses, is (feet) most nearly:

A) 4.71
B) 3.86
C) 2.44
D) 2.23

Sample NAME Exam Problem No.22

Subject: Hydrostatics and Stability

A cargo ship having a rolling period of 14 seconds sustains an accident that causes the flooding of one of its holds. After the accident, the rolling period is 21 seconds. The percent loss of transverse GM is most nearly:

A) 35
B) 45
C) 55
D) 65

Sample NAME Exam Problem No.23

Subject: Hydrostatics and Stability

A vessel having the characteristics given below has 250 tonnes of fuel transferred from the No. 2 Center Double Bottom tank, located 32 meters aft of the F.P. to the No. 6 Center Double Bottom tank, located 96 meters aft of the F.P., a distance of 64 meters.

Vessel characteristics:

LBP	165 meters
Beam	23.5 meters
Displacement	24,300 tonnes
Block Coefficient	0.72
Longitudinal Center of Flotation-6.2% of LBP (aft of midships)	
TPcm	28.50
MTcm	557 tonne-meters

If the vessel is initially on an even keel with a mean draft of 8.5 meters, the draft forward (meters) after completing the fuel transfer will be most nearly:

A) 8.213
B) 8.339
C) 8.356
D) 8.374

Sample NAME Exam Problem No.24

Subject: Hydrostatics and Stability

An oceangoing vessel has the following characteristics:

Length Between Perpendiculars	193 meters
Beam	26.066 meters
Draft	9.495 meters
Displacement	30,743 tonnes
Sea Water Density	1.025 tonnes per cubic meter

Half-Breadths of the vessel's Waterplane are as given in the tabulation below.

Station	Half-Breadth (
0	0.171
½	1.300
1	3.807
2	8.300
3	11.696
5	13.033
7	12.965
8	12.211
9	8.815
9-1/2	6.106
10	2.914

Using Simpson's First Rule, the vessel's Tonnes per Centimeter Immersion (TPcm) (tonnes) is most nearly:

A) 19.5
B) 37.1
C) 39.0
D) 58.5

Sample NAME Exam Problem No.25

Subject: Hydrostatics and Stability

A coastal cargo vessel has the following particulars:

Displacement (Tons, Salt Water)	7,500
Length Between Perpendiculars (Ft.)	350
Beam (Ft.)	50
Draft (Ft.)	20

The vessels Block Coefficient (C_B) is most nearly:

A) 0.73
B) 0.75
C) 0.77
D) 0.79

Sample NAME Exam Problem No.26

Subject: Hydrostatics and Stability

The structure and loadings of a rectangular tank barge having dimensions of 100m x 20m x 10mm requires reviewing. The barge has four (4) transverse bulkheads that subdivide it longitudinally into five tank compartments, each 20m in length. It has a double bottom structure of one (1) meter depth and a light displacement of 2,000 tonnes. The basic structure is of single side shell construction and has the following nominal plate thicknesses:

Deck	12mm
Side Shell	10mm
Innerbottom	10mm
Bottom Plate	14mm

The barge is loaded in its three middle tanks to a depth of 6m with a liquid cargo having a specific gravity of 1.5 for transport on a coastwise voyage. The displaced weight (tonnes) and draft (meters) of the barge in salt water are most nearly:

	Displacement	Draft
A)	5600	2.73
B)	9200	3.51
C)	12800	6.24
D)	18000	8.78

Sample NAME Exam Problem No.27

Subject: Hydrostatics and Stability

A yacht designer wishes to scale an existing yacht as a prototype for a new 55' LOA design. The parent vessel has the following particulars:

Length Over All	45' 11"
Waterline Length (LWL)	42' 04"
Displaced Weight (lbs)	25,500
Sail Area (Ft^2)	975
Ballast (lbs)	11,000

The new, 55' design will have particulars most nearly:

	Sail Area	Ballast
A)	1,170	13,200
B)	1,240	15,800
C)	1,400	18,900
D)	1,645	24,100

Sample NAME Exam Problem No.28

Subject: Auxiliary System Selection

In a 50 ton vapor-compression-cycle single-box refrigeration system using R-134a, the refrigerant leaves the condenser as a saturated liquid at a temperature of 80° F, and it leaves the evaporator with 10° F of superheat at a temperature of 0° F. The compression efficiency is 65%. Ignore any sub-cooling in the receiver and pressure drops in the piping, condenser, and evaporator. The system is not fitted with a liquid-suction heat exchanger. The heat absorbed in the evaporator (BTU/lb-m) is most nearly:

A) 65
B) 80
C) 95
D) 110

Sample NAME Exam Problem No.29

Subject: Hydrostatics and Stability

A small catamaran harbor ferry has a hull form consisting of tubular hulls 15 meters long and 1.0 meter in diameter. The hull centerlines are spaced 8 meters apart. When loaded with passengers until the vessel draft is 0.5 meters, the vessel's metacenter is located above the vessel keel (meters) most nearly:

A) 10.4
B) 20.4
C) 20.8
D) 41.2

Sample NAME Exam Problem No.30

Subject: Hydrodynamics

A mono-hull sailing yacht having a waterline length of 72 feet and a nominal hull speed of 11.4 knots is to be towing-tank tested using a 12-foot model. The towing tank carriage speed (feet per second) for testing the 12-foot model at the same Froude Number is most nearly:

A) 3.4
B) 3.9
C) 6.8
D) 7.9

Sample NAME Exam Problem No.31

Subject: Hydrodynamics

A fuel barge is scheduled to be towed by a harbor tug at an average speed of 6 knots, the barge requiring a tow force at 6-knots estimated to be 88 Short Tons. Four tugs are available, each having a propulsive efficiency estimated to be 65%. The tug most nearly able to meet the tow power requirements will have (horsepower) available for towing:

A) 2,500
B) 3,250
C) 5,000
D) 6,500

Sample NAME Exam Problem No.32

Subject: Hydrodynamics

Open water model tests of a ship's propeller indicate that $K_T = 0.225$ and $K_Q = 0.031$ when the advance ratio, J, is 0.6. The open water propeller efficiency, η_o is most nearly:

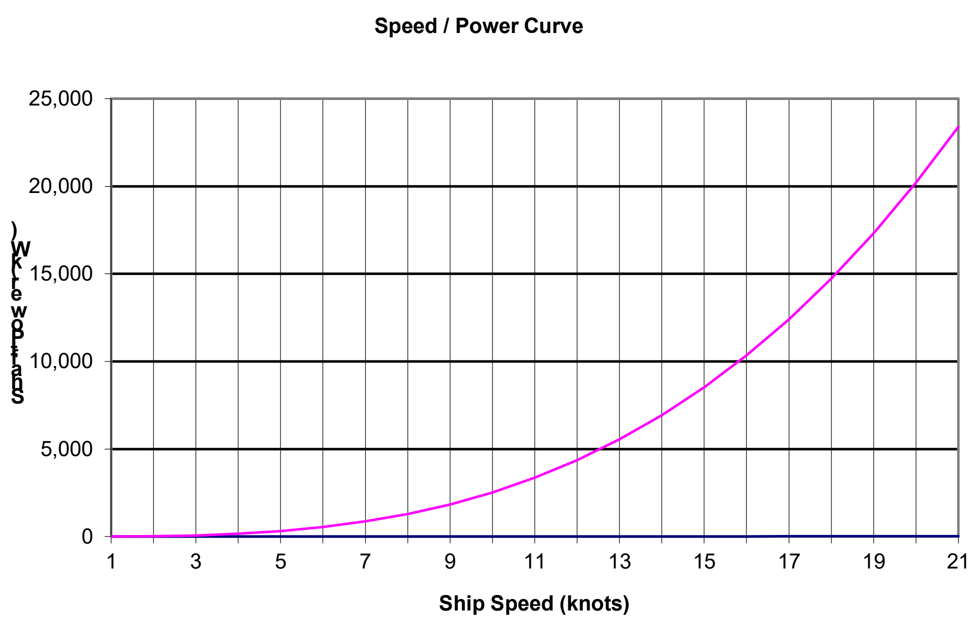
A) 0.55
B) 0.60
C) 0.65
D) 0.70

Sample NAME Exam Problem No.33

Subject: Environmental Considerations

The International Maritime Organization (IMO) has established a power-based maximum allowable NO_X emission rate of 3.4 g NO_X per kW for <130 RPM engines for ships constructed after 2016. A given diesel-powered vessel has an average fuel consumption of 180 g/kWh, and a normal cruise speed of 18 knots. A proposed regulation would require the vessel to operate at 12.5 knots to further reduce NO_X production. Using the Speed/Power Curve below, and assuming a linear relationship between engine horsepower and NO_X emissions, the estimated percent reduction in NO_X per hour of steady state operation is most nearly:

A) 33%
B) 44%
C) 50%
D) 66%



Sample NAME Exam Problem No.34

Subject: Hydrodynamics

A naval architect is tasked to select a propeller for a vessel designed to have a sea speed of 23 knots. Model tests show that the Block 0.60 hull form of interest has a Taylor Wake Fraction of 0.24. The selection of a suitable propeller would be based upon a Speed of Advance (Knots) most nearly:

A) 17.5
B) 18.9
C) 19.5
D) 20.9

Sample NAME Exam Problem No.35

Subject: Hydrodynamics

A naval architect is tasked to make an evaluation of the performance of one of his company's vessels on the company's trade route and plan for appropriate drydocking. Log book nalysis shows that the ship's propeller, which has a pitch of 31 feet, turns at 90 RPM, when steaming at full power. The vessel log also notes that the vessel had a distance made good of 650 nautical miles in 24 hours of fair weather travel. Analysis shows that the vessel's apparent slip (%) is most nearly:

A) 0.8
B) 1.7
C) 11
D) 16

Sample NAME Exam Problem No. 36

Subject: Ocean Engineering

The speed (Feet per Second) and Period (Seconds) of a harmonic deep-sea wave 800 feet long is most nearly:

A) 64, 12.5
B) 91, 12.5
C) 64, 8.8
D) 91, 8.8

Sample NAME Exam Problem No. 37

Subject: Hydrodynamics

A naval architect is tasked to evaluate fore deck structural loadings of a container vessel having a length between perpendiculars of 230 meters traveling into head seas at 24 knots, and experiencing a nominal period of encounter of 7 seconds with a pitch amplitude of 10 degrees. The forward most containers are secured in position 0.05 L aft of the forward perpendicular. If the waterplane centroid is located 0.08L aft of midships, the range of vertical acceleration (g), augmented by vessel pitching, and thereby inducing loads on the hull structure, experienced by the forwardmost container will be most nearly:

A) -1.75g to + 1.75g
B) -2.75g to + 0.75g
C) -.75g to + 2.75g
D) -2.75g to + 1.75g

Sample NAME Exam Problem No.38

Subject: Rules and Regulations

The American Bureau of Shipping (ABS) in the Mobile Offshore Drilling Units rules defines the wind force on vessels as:

$P = 0.00338\ V_k^2\ C_h\ C_s$ lbf/ft^2
$F = P\ A$ lbf

P = wind pressure
V_k = wind velocity in knots
C_h = height coefficient
C_s = shape coefficient
F = wind force
A = projected area in ft^2 of all exposed surfaces in either the upright or heeled condition

A 500-foot long vessel with a mean draft of 20 feet has a lateral area of the above water portion of 7,500 ft^2. Assuming a shape coefficient of 1.0 and an average height coefficient of 1.10. The wind force (in long tons) and heeling moment (in long ton-feet) on the vessel in a beam wind of 55 miles/hour is most nearly:

A)	8.5	285
B)	8.5	500
C)	28.5	285
D)	28.5	500

Sample NAME Exam Problem No. 39

Subject: Hydrodynamics

A tanker of 250m LWL steams ahead at 17 knots. It encounters a train of deep-water waves having a period of 7 seconds advancing towards the tanker from 50 degrees off the tanker's starboard stern. The tanker's period of encounter (Seconds) is most nearly:

A) 3.05
B) 6.28
C) 14.4
D) 16.0

Sample NAME Exam Problem No.40

Subject: Structural Design

The structure and loadings of a rectangular tank barge having nominal dimensions of 100m x 20m x 10m requires reviewing. The barge is subdivided longitudinally into five tank compartments, each 20m in length. It has a double bottom structure of one (1) meter depth and a light displacement of 1,000 tonnes. The basic structure has the following nominal thicknesses:

Deck	12mm
Side Shell	10mm
Innerbottom	10mm
Bottom Plate	14mm

The barge is loaded in the three middle tanks to a depth of 6m with a liquid cargo having a specific gravity of 1.5. The barge is to be used to transport the cargo on a coastwise voyage. The midship section moment of inertia (meters^4) is most nearly:

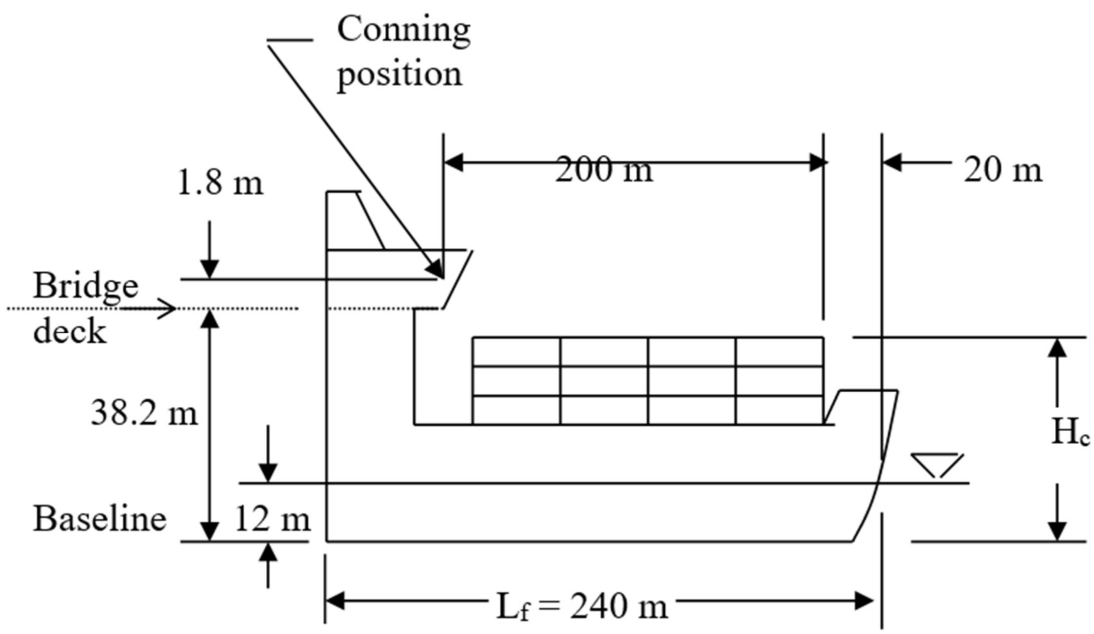
A) 14
B) 17
C) 29
D) 31

Sample NAME Exam Problem No.41

Subject: Rules and Regulations

Check the navigation bridge visibility of a new oceangoing ship design using ABS Rules. The ship particulars are as follows:

Height of Bridge Deck above baseline	38.2 m
Height of conning position above Bridge Deck	1.8 m
Distance from conning position to forward end of containers	200 m
Distance from forward end of containers to bow	20 m
Vessel freeboard length, L_f	240 m
Draft	12 m
Trim	0 m



Using the ABS regulations provided below, the maximum allowable height above baseline, H_c (meters) of the forward most container stack is most nearly:

A) 20
B) 23
C) 29
D) 32

Excerpts from: ABS Rules for Building and Classing Marine Vessels ®, 2026

PART 3 Hull Construction and Equipment
CHAPTER 6 Navigation
SECTION 1 Visibility

2 Navigation Bridge Visibility *(2024)*

Vessels of not less than 55 m (180 ft) in length overall are to meet the following requirements for visibility from navigation bridge, unless they are navigating solely the Great Lakes of North America and their connecting and tributary waters as far east as the lower exit of the St. Lambert Lock at Montreal in the Province of Quebec, Canada. Special consideration may be given to vessels that operate only on domestic or on short, limited, international voyages.

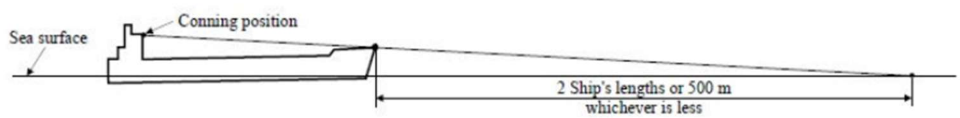
2.1 Field Of Vision

2.1.1 Conning Position

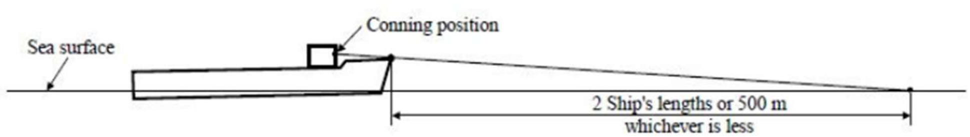
2.1.1(a)

The view of the sea surface from the conning position is not to be obscured by more than 2 L_{OA} (Length Overall) or 500 m (1640 ft), whichever is the less, forward of the bow to 10° on either side for all conditions of draft, trim and deck cargo under which the particular vessel is expected to operate. See [FIGURE 1] as applicable.

FIGURE 1



(a)



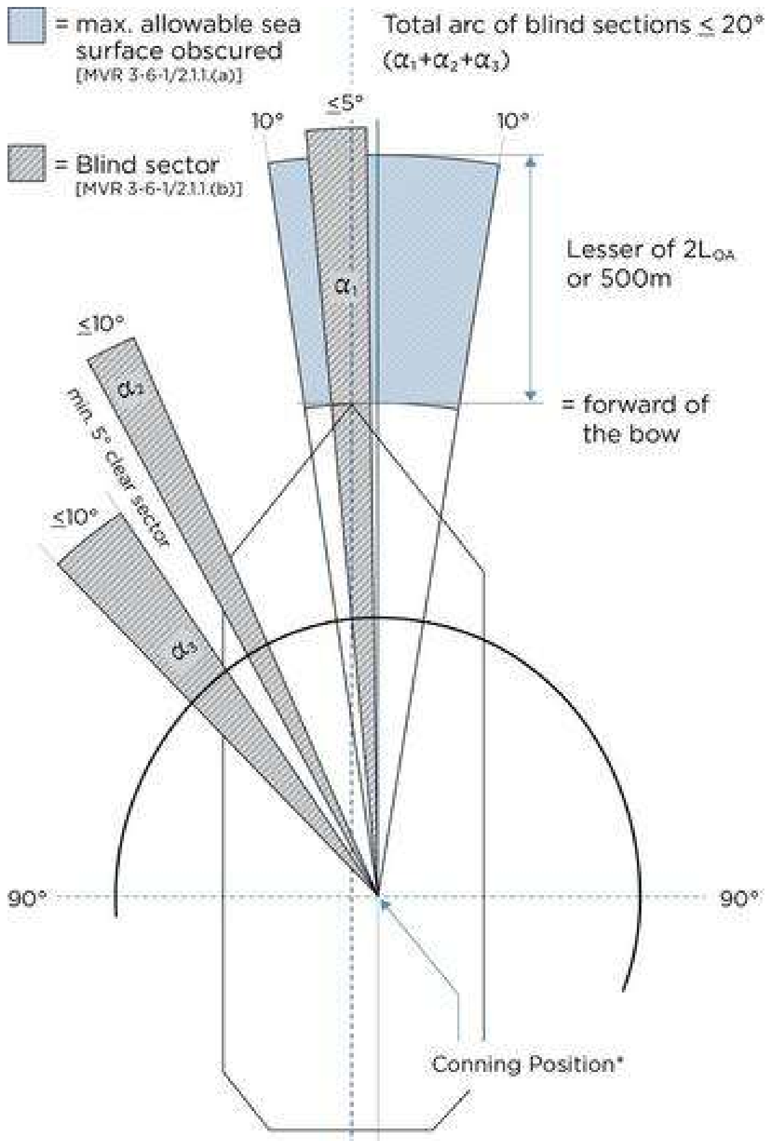
(b)

Notes:

1. A conning position is a place on the bridge with a commanding view and which is used by navigators when commanding, maneuvering and controlling a vessel.
2. Attention is drawn to flag Administrations requiring lengths of less than 2 L_{OA} .

2.1.1(b) ***(2024)***

No blind sector caused by cargo, cargo gear, specialist equipment, support for helicopter deck or other obstructions outside of the wheelhouse forward of the beam which obstructs the view of the sea surface as seen from the conning position is to exceed 10°. The total arc of blind sectors is not to exceed 20°. The clear sectors between blind sectors are to be at least 5°. However, in the view described in [1.1.1(a)], each individual blind sector is not to exceed 5°. See 3-6-1/Figure 1A.



Commentary:

The obstruction by the forward bulwark is to be checked for compliance with the above requirements. If the bulwark does not create a blind sector more than 5°, then it is acceptable to exclude this portion of the bulwark in determining the line of sight from the conning position to the sea surface reference point.

End of Commentary

2.1.1(c)

The horizontal field of vision from the conning position is to extend over an arc of not less than 225°, that is, from right ahead to not less than 22.5° abaft the beam on either side of the vessel. See [FIGURE 3], as applicable.

Sample NAME Exam Problem No.42

Subject: Hydrostatics and Stability

A ship having a beam of 32.2 meters and a design draft of 12.2 meters has a bilge radius of 4.5 meters and a Dead Rise of 0.5 meters. The ship's midship section coefficient (C_m) is most nearly:

A) 0.987
B) 0.978
C) 0.956
D) 0.912

Sample NAME Exam Problem No.43

Subject: Hydrostatics and Stability

A small vessel for ocean service is to be inclined to determine its GM. The vessel dimensions are as follows:

LBP = 75 meters
Beam = 12.5 meters
Draft = 4.5 meters

The vessel's Block Coefficient, $C_B = 0.72$
A 7.5 metric tonne weight is moved transversely a distance of 5.2 meters, causing the vessel to heel 2.6 degrees.

The vessel's GM (meters) is most nearly:

A) 0.15
B) 0.30
C) 0.45
D) 0.66

Sample NAME Exam Problem No.44

Subject: Hydrostatics and Stability

A vessel about to be drydocked in a graving dock has characteristics as listed below:

LBP	150 meters
Beam	20 meters
Draft	4.52 meters Forward
	5.36 meters Aft
TPcm	22.14
MTcm	125
LCF	0.08L aft of midships
Landing Point	0.45L aft of midships

The keel loading at the landing point just prior to being fully landed of the docking blocks is most nearly:

A) 130
B) 140
C) 155
D) 190

Sample NAME Exam Problem No.45

Subject: Propulsion and Power Generation

A 250 hp auxiliary turbine is supplied superheated steam at 600 psia and 750ºF (h = 1,380 BTU/lb). The turbine exhausts to an auxiliary exhaust line at 30 psia at saturated conditions (h = 1,164 BTU/lb). If the turbine has an overall efficiency of 60 %, the steam mass flow rate of the turbine (lbs per hour) is most nearly:

A) 500
B) 3,000
C) 5,000
D) 10,000

Sample NAME Exam Problem No.46

Subject: Auxiliary Equipment Selection

A marine engineer is tasked to check the design of a single-pass, counter-flow heat exchanger used to cool lube oil. The oil enters the heat exchanger at 190ºF and is cooled to 150ºF while the sea water enters at 85ºF and leaves at 120ºF. The log mean temperature difference for the heat exchanger is most nearly:

A) 30
B) 60
C) 67
D) 105

Sample NAME Exam Problem No.47

Subject: Auxiliary Equipment Selection

A consulting marine engineer is tasked by a client to evaluate the performance of a ship's ventilation system in order to assess maintenance requirements. After installation of a mounted pitot tube into an inspection port of a 24 inch by 36 inch ventilation fan outlet duct, a measurement indicates a velocity pressure of 0.45 inches of water. The marine engineer calculated that the air flow rate (CFM) was most nearly:

A) 900
B) 10,800
C) 16,100
D) 51,000

Sample NAME Exam Problem No.48

Subject: Piping System Design

A ship's fire main supplies two fire hoses located on the flying bridge level with a sea-water flow rate of 300 gpm. The flying bridge hydrants are located 85 feet vertically above the elevation of the fire pump discharge. The piping system between the fire pump discharge and the hydrant outlets consists of 200 linear feet of 4-inch, Schedule 40 welded steel pipe, six (6), standard 90-degree elbows, two (2) gate valves and one (1) angle valve, all valves being fully open when providing service. The pressure drop (psi) between the pump discharge and the hydrant outlets is most nearly:

A) 43
B) 44
C) 45
D) 46

Sample NAME Exam Problem No.49

Subject: Piping System Design

A ship's fire and sanitary pump, its discharge located 8-feet above the ship's Base Line, discharges seawater into a 6-inch I.D. fire main. For fire protection, the fire main system supplies two, hand-held, 2-1/2 inch fire-hoses fitted with 0.75-inch diameter nozzles located on the ship's Flying Bridge, 115 feet above the Base Line, with a 75 psi nozzle pitot tube pressure.

The pumping capacity (gallons per minute) required in order to supply the two fire nozzles with the pitot tube pressure stated is most nearly:

A) 150
B) 300
C) 450
D) 600

Sample NAME Exam Problem No.50

Subject: Piping System Design

A ship's fire and sanitary pump, its discharge located 8-feet above the ship's Base Line, discharges seawater into a 6-inch I.D. fire main. For fire protection, the fire main system supplies two, hand-held, 2-1/2 inch fire-hoses fitted with 0.75-inch diameter nozzles located on the ship's Flying Bridge, 115 feet above the Base Line, with a 75 psi nozzle pitot tube pressure.

Assuming the pressure drop in the fire main due to fluid flow losses between the pump discharge and the Flying Bridge nozzles is 25 psi, and ignoring the fluid flow velocity head at the pump discharge, the pump discharge pressure (psi) while supplying the two fire hoses is most nearly:

A) 100
B) 125
C) 150
D) 175

Sample NAME Exam Problem No.51

Subject: Piping System Design

100 gpm of water at 68 degree F. flows through 500 feet of a clean 2- inch schedule 40 steel pipe, having a nominal surface roughness of 150 x 10^{-6} ft. The pressure drop (pounds per square inch) over this length is most nearly:

A) 8
B) 35
C) 75
D) 150

Sample NAME Exam Problem No.52

Subject: Electrical Systems

An electrically driven circulating pump delivers 800 gpm of sea water to a lubricating oil cooler. The total head of 45 feet is developed by the pump. If the pump efficiency is 75%, the brake horsepower (hp) required to drive the pump is most nearly:

A) 10
B) 12.5
C) 15
D) 20

Sample NAME Exam Problem No.53

Subject: Piping System Design

A ship having a mean draft of 28 feet has a 300 gpm centrifugal pump that has its suction eight (8) feet above the ship's baseline. The pump suction is connected to a 4" schedule 40 pipe and delivers 60ºF sea water to a heat exchanger. The vapor pressure of 60ºF sea water, P_v = 0.2561 psi. The Net Positive Suction Head Available (ft) at the pump inlet is most nearly:

A) 20
B) 34
C) 53
D) 61

Sample NAME Exam Problem No. 54

Subject: Auxiliary Equipment Selection

A ship's fire and sanitary pump, its discharge located 8-feet above the ship's Base Line, discharges seawater into a 6-inch I.D. fire main. For fire protection, the fire main system supplies two, hand-held, 2-1/2 inch fire hoses fitted with 0.75-inch diameter nozzles located on the ship's Flying Bridge, 115 feet above the Base Line, with a 75 psi nozzle pitot tube pressure.

Assuming the pump has a suction head of 12 feet, an 85 percent pumping efficiency, η_p, and discharges 300 gpm at a discharge pressure of 150 psig, the pump's required input shaft horsepower is most nearly:

A) 15
B) 20
C) 25
D) 30

Sample NAME Exam Problem No. 55

Subject: Ocean Engineering

A designer is assigned the task to evaluate the seakeeping performance qualities of a proposed 23-knot ship in an operating area where specifically appropriate spectral wave data are not available. It is suggested that the two-parameter Bretschneider Spectrum be used for observed conditions in the proposed ship's operating area, including a most probable wave height, H_v, of 6.0 meters with an 11.0 second observed wave period, T_v. Based on these values, the Bretschneider Spectrum will have significant wave height, $H_{1/3}$, (meters) and modal value, ω_m, (radians per second) most nearly:

A) 5.5 and 0.47
B) 6.0 and 0.50
C) 6.4 and 0.54
D) 7.1 and 0.57

Sample NAME Exam Problem No. 56

Subject: Propulsion and Power Generation

A preliminary design is being developed for a 26-knot containership. Model tests have resulted in a predicted propulsion thrust requirement of 330,000 pounds. If the vessel form has an estimated propulsion efficiency of 72 % and the line shafting incurs losses of 2 %, the required shaft horsepower to be delivered by the main engine is most nearly:

A) 37,000
B) 35,000
C) 27,000
D) 25,000

Sample NAME Exam Problem No. 57

Subject: Propulsion and Power Generation

A marine engineer is tasked to estimate the required fuel capacity for a new 24 knot vessel planned for operation between ports on the North American continent and Australia. It is expected that a round-trip voyage would cover 22,000 nautical miles with stops at eight (8) ports. The vessel is to be powered by a 45,000 SHP diesel main engine having a specific fuel consumption of 0.35 lbs. per shaft horsepower-hour. It is planned that the fuel to be used will be low-sulfur Bunker C residual, 13 degrees API gravity, bunkering in North American ports, with an estimated heating value of 18,500 BTU/Lb. The required fuel capacity (L.Tons) is most nearly:

A) 7,000
B) 6,000
C) 5,000
D) 4,000

Sample NAME Exam Problem No.58

Subject: Propulsion and Power Generation

A set of spur gears is to transmit 35 horsepower with a pinion speed of 1750 RPM. The pitch diameter of the pinion is 6 inches and the diametral pitch is 3. The pitch diameter of the driven gear is 24 inches and its diametral pitch is 3. The contact force (pounds) at the line of contact is most nearly:

A) 35
B) 105
C) 210
D) 420

Sample NAME Exam Problem No.59

Subject: Propulsion and Power Generation

A ship's propeller tail-shaft has been removed to the shipyard's shop where it is to be fitted with a bronze liner. The shaft diameter is 0.254m and the liner, which is 0.0127 m thick, is to be shrink-fitted on to the shaft. The bronze material has a linear coefficient of thermal expansion of $\alpha = 21.24 \times 10^{-6}$ m/m degree Celsius. If the liner is bored for an internal diameter of 253.8 mm and heated to 165 degrees C. above the shop's ambient temperature of 22 degrees C., so as to facilitate its fitting onto the shaft, the liner's clearance (mm) during its fitting will be most nearly:

A) 0.31
B) 0.70
C) 0.89
D) 1.07

Sample NAME Exam Problem No.60

Subject: Welds/Connections/Corrosion

Fretting corrosion of main propulsion line shafting caused by minute movements between mating parts may produce sites for fatigue crack initiation. Fatigue life of tailshafts subject to fretting can be greatly improved by:

A) Case Hardening the tailshaft
B) Using High Strength steel
C) Cold Rolling the shaft surface
D) Normalizing and Tempering the tailshaft

Sample NAME Exam Problem No.61

Subject: Auxiliary Equipment Selection

Using the Psychrometric Chart below, and assuming the specific volume of dry air is approximately fourteen cubic feet per pound, the moisture content (Lbs per hour) of an air flow of 5,000 CFM when the dry bulb temperature is 75 degrees Fahrenheit and the relative humidity is 60 % is most nearly:

A) 214
B) 235
C) 257
D) 278

<u>Sample NAME Exam Problem No.62</u>

Subject: Auxiliary Equipment Selection

The air conditioning system for a ship's accommodation spaces delivers 4,800 cfm. If the system takes in 15% outside air at a temperature of 90 degrees F and 80% relative humidity, the additional thermal loading of the system (BTU/Hr.) in order to deliver the outside air at 68 degrees F and 50% relative humidity is most nearly:

A) 20,000
B) 40,000
C) 60,000
D) 80,000

<u>Sample NAME Exam Problem No.63</u>

Subject: Electrical Systems

A 3-phase, 60 hz, 440V/120V step-down transformer provides 25 KVA to a 0.8 power factor load. The transformer is connected Delta-Wye. The line current (Amps) feeding the transformer is most nearly:

A) 56.8
B) 45.5
C) 32.8
D) 26.2

<u>Sample NAME Exam Problem No.64</u>

Subject: Electrical Systems

The table on the following page is extracted from an actual electric power load analysis.

Two high-pressure air compressors requiring 25 HP each and powered by 25 HP, 3 phase, 90% efficient motors are to be installed as additional ship's auxiliary machinery. Under normal SHORE conditions, one of the compressors will be on standby. The system air requirements are such that the operating compressor cycles on/off 50% of the time. The ship's new calculated electrical load (kW) seen by the power plant in the normal SHORE mode is most nearly:

A) 70
B) 80
C) 90
D) 110

Line No.	Call No.	Name of Equipment	Qty	Rated Hp	Conn KW	SHORE LF	SHORE KW	ANCHOR LF	ANCHOR KW	POSITIONED LF	POSITIONED KW	CRUISE LF	CRUISE KW	CARGO OPER. LF	CARGO OPER. KW	EMERGENCY LF	EMERGENCY KW
235	0	SS/CONTROL AIR COMPSR	2	20.0	34.00	0.0	0.00	0.1	3.40	0.1	3.40	0.1	3.40	0.1	3.40	0.0	0.00
236	0	SS/CONTROL AIR DRYER	2	0.0	3.00	0.1	0.30	0.1	0.30	0.1	0.30	0.1	0.30	0.1	0.30	0.0	0.00
237	0	BRONIRE PROPORTIONER	2	0.2	0.40	0.1	0.04	0.1	0.04	0.1	0.04	0.1	0.04	0.1	0.04	0.0	0.00
238	0	RECIRC BROMINE SYS	1	0.2	0.20	0.5	0.10	0.5	0.10	0.5	0.10	0.5	0.10	0.5	0.10	0.0	0.00
239	0	STORES REFR PLANT	2	25.0	42.00	0.3	12.60	0.3	12.60	0.3	12.60	0.3	12.60	0.3	12.60	0.0	0.00
240	0	REFR SP CIRC FAN	2	0.2	0.40	0.9	0.36	0.9	0.36	0.9	0.36	0.9	0.36	0.9	0.36	0.0	0.00
241	0	REFR SP DEFR HTR	2	0.0	2.00	0.1	0.20	0.1	0.20	0.1	0.20	0.1	0.20	0.1	0.20	0.0	0.00
242	0	FREEZE RM DRAIN MTR	1	0.0	0.60	0.9	0.54	0.9	0.54	0.9	0.54	0.9	0.54	0.9	0.54	0.0	0.00
243	0	D/G PRELUBE PMP	7	2.0	12.60	0.1	1.26	0.1	1.26	0.1	1.26	0.1	1.26	0.1	1.26	0.0	0.00
244	0	DIESEL GEN HEATERS	7	0.0	21.00	0.8	16.80	0.8	16.80	0.6	12.60	0.6	12.60	0.2	4.20	0.0	0.00
245	0	EMER D/G J.W. HTR	1	0.0	1.00	0.9	0.90	0.9	0.90	0.9	0.90	0.9	0.90	0.9	0.90	1.0	1.00
246	0	VALVE HYDR PWR PACK	2	10.0	17.00	0.1	1.70	0.1	1.70	0.1	1.70	0.1	1.70	0.3	5.10	0.0	0.00
247	0	VEHICLE WASH FW PUMP	2	7.5	13.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.3	3.90	0.0	0.00
248	0	VEHICLE F.O. PUMP	1	1.5	1.40	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.3	0.42	0.0	0.00
249	0	CATHODIC PROT SYS	4	0.0	37.20	0.9	33.48	0.9	33.48	0.9	33.48	0.0	0.00	0.0	0.00	0.0	0.00
250	0	SUBMERSIBLE PUMP	2	5.0	8.80	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
251	0	SUBMERSIBLE PUMP	1	5.0	4.40	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
252	0	EDG/BT/INC FO XFR PMP	1	1.5	1.40	0.1	0.14	0.1	0.14	0.1	0.14	0.1	0.14	0.1	0.14	0.0	0.00
253	0	INCINERATOR	1	20.0	17.00	0.0	0.00	0.1	1.70	0.1	1.70	0.1	1.70	0.1	1.70	0.0	0.00
		SUMS =			217.40		68.42		73.52		69.32		35.84		35.16		1.00

Sample NAME Exam Problem No.65

Subject: Electrical Systems

An electrical power plant of a containership consists of three 1,700 KW, 480/3/60 diesel generators that provide electrical power for propulsion auxiliaries, lighting, hotel loads, and refrigerated cargo containers. Normal operation is for two of the generators to operate in parallel, equally sharing the load, and the third generator for standby operation.

Assuming no circulating currents, if the propulsion auxiliaries consume 1,200 KW at a 0.75 lagging power factor, the hotel and lighting loads consume 300 KW at a 0.80 lagging power factor, and the refrigerated cargo containers consume 1,500 KW at a 0.60 lagging power factor, the system power factor is most nearly:

(A) 0.59 lagging
(B) 0.63 lagging
(C) 0.67 lagging
(D) 0.71 lagging

Sample NAME Exam Problem No.66

Subject: Electrical Systems

The compressors of a ship's refrigeration system are driven by four (4) 25 hp, 1750 rpm electric motors. The refrigeration compressors require an input torque of 66 foot-pounds at 1750 rpm under normal, at-sea operating conditions, on a 20-minute per half-hour cycle. The motor efficiency is approximately 80% at half rated load, 86% at 75% rated load and 90% at 100% rated load. The contribution to the at-sea electric power load analysis (kW) for the refrigeration system is most nearly:

A) 12
B) 22
C) 50
D) 90

Sample NAME Exam Problem No.67

Subject: Electrical Systems

A marine engineer is tasked to perform an electrical load analysis for a machinery system design. The machinery space ventilation system has port and starboard fans driven by 60 horsepower squirrel cage induction motors operating on 240 volt, 60 Hz, 3-phase power. During at-sea operations, the service factor is 0.85 and the motor efficiency is 91%. The contribution to the at-sea electrical load analysis (kW) is most nearly:

A) 44.8
B) 49.2
C) 76.1
D) 83.6

Sample NAME Exam Problem No.68

Subject: Structural Design

A W Shape I-Beam section is to be used for support of a ship's stores crane operating from a vessel's side port. The crane lifting capacity is to be 2 L.tons, and the beam is to extend 15 feet outboard of the support located just inside the ship's side, the inboard support being located 10 feet farther inboard. The lightest weight W-Shape I-Beam section that will have a maximum shear stress not to exceed 13.6 ksi and a maximum normal stress not to exceed 20 ksi is most nearly

A) W 24 x 55
B) W 21 x 44
C) W 16 x 36
D) W 10 x 39

Sample NAME Exam Problem No. 69

Subject: Structural Design

An insulated aluminum LNG tank having a diameter of 35 meters is to be cooled from 75 degrees Fahrenheit above zero to 260 degrees Fahrenheit below zero while the supporting steel structure remains at ambient temperature. If the average coefficient of thermal expansion of aluminum over that temperature range is $\alpha = 11 \times 10^{-6}$, the relative vertical shrinkage (Inches) of the tank with respect to the support structure will be most nearly:

A) 0.5
B) 2.5
C) 5.0
D) 25

Sample NAME Exam Problem No.70

Subject: Welds/Connections/Corrosion

Uncoated steel structure in a saltwater ballast tank has a nominal wastage of about 0.1 mm per year. The surface wastage on a vessel's ballast tank spaces over a 25-year service life will weigh (kilograms per 1000 square meters) most nearly:

A) 20
B) 200
C) 2,000
D) 20,000

Sample NAME Exam Problem No.71

Subject: Hydrodynamics

A passenger ferry steaming at sixteen knots across the eight-mile wide inlet channel of a bay to its southern terminal encounters an incoming tide of 4.5 knots. If the pilot wishes to maintain a course made good of 180 degrees and the tidal current flows due west, the course (degrees true) to be steered is most nearly:

A) 186
B) 180
C) 164
D) 74

Sample NAME Exam Problem No.72

Subject: Ocean Engineering

An oceangoing supply vessel anchor windlass is to be driven by an electric motor. The vessel has an anchor weighing 480 kg with 150 meters of 22 mm diameter anchor chain, weighing 13.5 kg per meter. It is required that the windlass be capable of weighing anchor when fully paid-out at a speed of 1 meters per second. If the friction coefficient for drawing the anchor chain through the hawse pipe is 0.25, the required power (kw) of the windlass motor is most nearly:

A) 61.4
B) 53.4
C) 30.7
D) 26.7

Sample NAME Exam Problem No.73

Subject: Hull Outfitting

A ship owner is interested in modifying his ship's steering system by adding an auxiliary steering gear for emergency use with the ship's speed at 19 knots and the rudder angle restricted to 10 degrees. Sea trial data were used to establish a rudder torque of 23.4 x 10^6 pound-inches when the ship's speed was 19 knots and its rudder angle was 45 degrees, based on the following relationships:

Rudder Force = (4.6 K A V^2 Sin α)/(0.39 + 0.61 Sin α)
Where K = Constant
A = Rudder Area (Square Feet)
V = Ship Speed (Knots)
α = Rudder Angle (Degrees)

and,

Moment Arm = (0.195 + .305 Sin α) x Rudder Width

The estimated rudder torque value (pound-inches x 10^6) at a ship speed of 19 knots and rudder angle of 10 degrees is most nearly:

A) 15
B) 10
C) 6
D) 2

Sample NAME Exam Problem No.74

Subject: Hull Outfitting

A shipyard is planning to fabricate sub-assembly sections consisting of a longitudinally stiffened 9/16-inch thick plate with inverted L8 x 4 x 9/16 angles welded to the plate. The stiffeners are equally spaced at 30 inches. The plate is 108 inches wide and 45 feet long. The lifting and transporting capacities (Short Tons) of the shipyard in order to transport this sub-assembly, will be most nearly:

A) 5.0
B) 6.0
C) 7.0
D) 10.0

Sample NAME Exam Problem No.75

Subject: Structural Design

A welded plate/shape sub-assembly is to be produced in the plate shop. The fabrication will join two 20-millimeter thick plates each having a width of 3 meters and a length of 15 meters. They will be longitudinally stiffened by 200mm x 100mm x 12mm inverted angles at 750 mm equal spacing. Upon completing the fabrication, one of the shop cranes will be used to move it to another location for further work. The minimum crane capacity (tonnes) required to safely make this move is most nearly:

A) 15.0
B) 17.5
C) 20.0
D) 25.0

Sample NAME Exam Problem No.76

Subject: Welds/Connections/Corrosion

A shipyard Plate Shop is tasked to plan for production of longitudinally stiffened 30.6 lb. shell plates, each to be fitted with 4 - 8" x 4" x 19.6 lb inverted angles. The angles are to be 3/8" double fillet welded to the plate, which is 9 feet wide and 45 feet long. A plate shop automatic welding machine, capable of double-fillet welding has a 3/16" filler rod feed rate of 15 feet per minute for each fillet weld. Neglecting set-up time, production of each stiffened plate will take (minutes) most nearly:

A) 15
B) 30
C) 45
D) 60

Sample NAME Exam Problem No.77

Subject: Hull Outfitting

A shipyard plate shop planning production of stiffened plates requires adequate crane capacity for handling the following fabrication. Four 225 mm x 100 mm x 15 mm inverted angles, double fillet welded to a 3 m x 15 m x 25 mm plate. The required crane Safe Working Capacity (tonnes) for handling this fabrication is most nearly:

A) 2.5
B) 5.0
C) 10
D) 15

Sample NAME Exam Problem No. 78

Subject: Rules and Regulations

A longitudinally framed vessel having a 15.5 m molded depth to the freeboard deck, a 10.25m design draft and a 750 mm side frame spacing supported by transverse frames spaced at 3.0 meters, requires, at a distance of 6m below the design waterline, a stiffener section modulus (cm^3) most nearly:

A) 210
B) 460
C) 570
D) 625

Refer to the construction rules below. Assume Q=1 and the vessel is over 90m (295 ft).

Excerpts from: ABS Rules for Building and Classing Marine Vessels ®, 2026

PART 3 Hull Construction and Equipment
CHAPTER 2 Hull Structures and Arrangements
SECTION 5 Frames

3.17 Longitudinal Frames *(2024)*

The section modulus SM of each longitudinal side frame below the bulkhead deck is to be not less than obtained from the following equation:

$$SM = 7.8chs\ell^2 Q\text{cm}^3$$

$$SM = 0.0041chs\ell^2 Q\text{in}^3$$

where

s	=	spacing of longitudinal frames, in m (ft)	
c	=	c_1	for vessels under 90 m (295 ft) in length
	=	c_2	for steel vessels 90 m (295 ft) in length and above
c_1	=	0.915	
c_2	=	0.95	
h	=	h_1	for vessels under 90 m (295 ft) in length
	=	h_2	for steel vessels 90 m (295 ft) in length and above
h_1	=	vertical distance, in m (ft), from the frame to the freeboard deck at side, but not less than $0.02L + 0.46$ m ($0.02L + 1.5$ ft)	
h_2	=	above $0.5D$ from the keel, the vertical distance, in m (ft), from the longitudinal frame to the bulkhead or freeboard deck, but is not to be taken as less than 2.1 m (7.0 ft).	
	=	at and below $0.5D$ from the keel, 0.75 times the vertical distance, in m (ft), from the longitudinal frame to the bulkhead or freeboard deck, but not less than $0.5D_s$.	
ℓ	=	the unsupported span, in m (ft)	

Sample NAME Exam Problem No. 79

Subject: Rules and Regulations

A naval architect is tasked to determine the materials for the hull of a container vessel, having a Length Between Perpendiculars of 273 meters (777 feet) and a design draft of 10.7 meters (35 feet). At a location on the bottom shell 60 meters aft of the forward perpendicular the plating is chosen to be 35.7 lb/sq. ft. plate. Refer to the Tables 1 and 2 and Notes below to determine the required minimum quality of plating material as:

A) A, AH
B) B, AH
C) D, DH
D) E, EH

Excerpts from: ABS Rules for Building and Classing Marine Vessels ®, 2026

PART 3 Hull Construction and Equipment
CHAPTER 2 General
SECTION 3 General Requirements

3 Application Of Steel Materials 150 Mm (6.0 In.) And Under In Thickness *(2021)*

3.1 Selection Of Material Grade *(2024)*

i. Steel materials for particular locations are not to be lower grades than those required by [TABLE 1] for the material class given in [TABLE 2A], [TABLE 2B], or [TABLE 3] depending on the length (*L*) of the vessel.

ii. The provision in [3.1]) is not required for vessels in length (*L*) under 61 m (200 ft). For vessels under 61 m (200 ft) in length, material is to be per [1.3.1]. ASTM A36 steel otherwise manufactured by an ABS-approved steel mill, tested and certified to the satisfaction of ABS may be used in lieu of Grade A for a thickness up to and including 12.5 mm (0.5 in.) for plate and 19 mm (0.75 in.) for sections. In addition, the dimensions for ASTM A36 steel are to comply with [ABS-RL-MATL 2-1-1/15].

iii. When tensile stresses through the thickness (Z direction) exceed approximately 50% of the minimum specified yield stress (as defined in the applicable ABS Rules), consideration is to be given to applying Z grade steel (refer to [ABS-RL-MATL 2-1-1/17] of the ABS *Rules for Materials and Welding (Part 2)*). Alternatives to applying Z grade may be proposed provided it is demonstrated by ultrasonic testing before and after welding that no through thickness tearing has occurred, and/or the welding preparation, weld size and bead sequence is such that damaging through thickness loads induced by weld shrinkage are avoided.

Commentary:

When fatigue loading is present, the effective strength of higher-strength steel in welded construction may not be greater than that of ordinary-strength steel.

Precautions against corrosion fatigue may also be necessary.

End of Commentary

TABLE 1
Material Grades *(2024)*

Plate Thickness t	*Material Class*		
mm (in.)	I	II	III
$t \leq 15 (t \leq 0.60)$	A[2], AH	A, AH	A, AH
$15 < t \leq 20 (0.60 < t \leq 0.79)$	A, AH	A, AH	B, AH
$20 < t \leq 25 (0.79 < t \leq 0.98)$	A, AH	B, AH	D, DH
$25 < t \leq 30 (0.98 < t \leq 1.18)$	A, AH	D, DH	D [1], DH
$30 < t \leq 35 (1.18 < t \leq 1.38)$	B, AH	D, DH	E, EH
$35 < t \leq 40 (1.38 < t \leq 1.57)$	B, AH	D, DH	E, EH
$40 < t \leq 100 (1.57 < t \leq 4.00)$	D, DH	E, EH	E, EH
$100 < t \leq 150 (4.00 < t \leq 6.00)$[3]	E, EH	E, EH	E, EH

Notes:

1. Grade D, of these *plate* thicknesses, is to be normalized.
2. ASTM A36 steel otherwise manufactured by an ABS approved steel mill, tested and certified to the satisfaction of ABS may be used in lieu of Grade A for a thickness up to and including 12.5 mm (0.5 in.) for plate and up to and including 19 mm (0.75 in.) for sections.
3. Rolled plates over 100 mm (4 in.) thick are to be in accordance with [ABS-RL-MATL 2-1-1/16] of the ABS *Rules for Materials and Welding (Part 2)*.

TABLE 2A
Material Class or Grade of Structural Members
for Vessels ≥ 90 m (295 ft) in Length *(2026)*

Line No.	*Structural Members*	*Within 0.4L amidships*	*Outside 0.4L amidships*
		Material Class (8) or Grade	*Material Class or Grade*
A	**Secondary**		
A1	Longitudinal bulkhead strakes, other than those belonging to the Primary category	I	A(10)/AH
A2	Deck plating exposed to weather, other than that belonging to the Primary or Special category		
A3	Side plating (12)		
B	**Primary**		
B1	Bottom plating, including keel plate	II	A(10)/AH
B2	Strength deck plating, excluding that belonging to the Special category (13)		
B3	Continuous longitudinal plating of strength members above strength deck, excluding hatch coamings (13, 14)		
B4	Uppermost strake in longitudinal bulkhead		
B5	Vertical strake (hatch side girder) and uppermost sloped strake in top wing tank		
C	**Special**		
C1	Sheer strake at strength deck (1, 9, 13)	III	II (I outside *0.6L* amidships)
C2	Stringer plate in strength deck (1, 9, 13)		
C3	Deck strake at longitudinal bulkhead (2, 9, 13)		
C4	Strength deck plating at outboard corners of cargo hatch openings in container carriers and other ships with similar hatch opening configurations (3, 13)		
C5	Strength deck plating at corners of cargo hatch openings in bulk carriers, ore carriers, combination carriers and other ships with similar hatch opening configurations (4, 13)		
C6	Trunk deck and inner deck plating at corners of openings for liquid and gas domes in membrane type liquefied gas carriers (4, 14)		
C7	Bilge strake (5, 6, 9)		
C8	Longitudinal hatch coamings of length greater than 0.15*L* including coaming top plate and flange(7)		
C9	End brackets and deck house transition of longitudinal cargo hatch coamings (7)		
D	**Other Categories**		
D1	Plating materials for stern frames supporting rudder and propeller boss, rudders, rudder horns, steering equipment (15), propeller nozzles, thruster tunnels, and shaft brackets	-	II(11)
D2	Strength members not referred to in A, B, C, D1, and D3(17), Deckhouses, Helicopter Decks and supporting structure, Equipment foundations which are integral to the hull, Foundations for Engines having a rated power greater than 375 kW, Shell Doors, and Large Watertight Doors on Vehicle Carriers.	A(10)/AH	A(10)/AH
D3	Equipment foundations (not integral to the hull), Boiler Foundations, Watertight Doors, Weathertight Doors, Hawse Pipes, Bollards, Fairleads and Chocks, Non-hull structure, Appurtenant structures	(16)	(16)

Notes:

1. Not to be less than grade E/EH[9] within 0.4L amidships in ships with length exceeding 250 m (820 ft).
2. Excluding deck plating in way of inner-skin bulkhead of double hull ships.
3. Not to be less than class III within the length of the cargo region.
4. Not to be less than class III within 0.6L amidships and class II within the remaining length of the cargo region.
5. May be of class II in ships with a double bottom over the full breadth and with length less than 150 m (492 ft).
6. Not to be less than grade D/DH within 0.4L amidships in ships with length exceeding 250 m (820 ft).
7. Not to be less than grade D/DH.
8. Special consideration will be given to vessels of restricted class.
9. Single strake required to be class III or E/EH are to have breadths not less than 800 + 5L mm (31.5 + 0.06L in.), but need not exceed 1800 mm (71 in.), unless limited by the geometry of the vessel's design.
10. ASTM A36 steel otherwise manufactured by an ABS approved steel mill, tested and certified to the satisfaction of ABS may be used in lieu of Grade A for a thickness up to and including 12.5 mm (0.5 in.) for plates and up to and including 19 mm (0.75 in.) for sections.
11. For rudder and rudder body plates subjected to stress concentrations (e.g., in way of lower support or at upper part of spade rudders), class III is to be applied.
12. Single side strakes for ships exceeding 150 m (492 feet) without inner continuous longitudinal bulkheads between bottom and the single strength deck are not to be less than grade B/AH within cargo region in ships.
13. Not to be less than grade B/AH for members contributing to the longitudinal strength within 0.4L amidships in ships with length exceeding 150 m (492 feet) and single strength deck.
14. Not to be less than grade B/AH for inner deck plating and plating between the trunk deck and inner deck for members contributing to the longitudinal strength within 0.4L amidships in membrane type liquefied gas carriers and other similar ship types with a double deck arrangement above the strength deck and with length exceeding 150 m (492 feet). See [FIGURE 1].
15. Steering equipment components other than rudders, as described in Section 3-2-14.
16. Materials are to be in accordance with a recognized standard. Non-ABS grade steel such as ASTM A36, ASTM A572, EN S235J2, or other recognized standard approved by ABS in the design, may be used based on verification of material certificates and traceability. Materials are to be furnished to the attending Surveyor with certificates issued by the mill or the material manufacturer, indicating, as a minimum, the material specification, grade, mechanical and chemical properties, identification numbers, test results, and as applicable, heat treatment details. Materials are preferably to be from an ABS approved mill.
17. Deck plating below the strength deck at corners of cargo hatch openings immediately forward and aft of the engine room and/or deck house in container carriers and other ships with similar hatch opening configurations, is not to be less than Class I.

Sample NAME Exam Problem No. 80

Subject: Piping System Design

A cylindrical tank 50 inches in diameter is to be used for a ship's Main Engine Starting Air storage. The normal starting air pressure is maintained at 600psi. The tank is to be fabricated from rolled steel plate with a welded longitudinal seam and elliptical heads having a circumferentially welded seam. Using an allowable shear stress of 13.6 ksi for the welded longitudinal and circumferential seams, the required thickness (inches) of the tank's plate is most nearly:

A) 1-1/4
B) 1-1/16
C) 9/16
D) 5/16

Extra Examination Questions:

The PE Exam typically has five ungraded questions that can have different material than what is given in the handbook. To simulate this, the following questions are included as an extra opportunity for self-study.

Sample NAME Extra Exam Problem 1

Subject: Economics

A shipyard engineer is tasked to carry out an investigation of an installation of a proposed solar-electric generating system on the shipyard's administration building roof. The administration building uses 750 kilowatts of electric power for 12 hours a day, on average, under normal environmental conditions. The monthly maintenance expenses of the candidate system are estimated to be $15.00 per kilowatt capacity per month, and remain essentially constant over its 20-year expected life. With a cost of utility-delivered power at $0.10 per kilowatt hour, how much money will the new system save per year?

A) $193,500
B) $138,750
C) $135,000
D) $27,375

Sample NAME Extra Exam Problem 2

Subject: Structures

A longitudinally stiffened section of 20.4 pound deck plating, and having a yield strength of 36 ksi, is fitted with 8 x 4 x 9/16 inverted angles stiffeners, spaced on 30 inch centers. A naval architect is tasked to check the buckling stress (ksi) and finds it to be most nearly:

A) 33
B) 30
C) 27
D) 24

Sample NAME Extra Exam Problem 3

Subject: Propulsion and Power Generation - 3

A Water-Jet propulsion installation for a small, sea-going vessel moving at 40 knots has an intake area of 3.5 square feet and a discharge nozzle diameter of 8 inches. Neglecting flow losses, the delivered thrust and horsepower of the Water-Jet is most nearly:

A) 140,0002,872
B) 160,0002,955
C) 280,000 585
D) 320,000 654

Sample NAME Extra Exam Problem 4

Subject: Electrical Systems – 4

An Electrical Power circuit provides service to 440 Volt, 60 Hz, 25 hp squirrel cage steering gear motor. The motor has an efficiency of 90% and a power factor of 0.83. The 12 gauge feeder line has a load center length of 175 feet and has a cross section of 6,530 circular mils. The percent voltage drop for the circuit is most nearly:

A) 0.05
B) 0.3
C) 0.5
D) 3.0

Sample NAME Extra Exam Problem 5

Subject: Hydrodynamics – 5

A mid-sized passenger vessel is to be fitted with a set of port and starboard activated-fin stabilizers. The vessel, having a 75 foot beam and a displacement of 25,000 tons usually has a GM of 4 ft. and is expected to be stabilized when operating at 20 knots in a wave system having a nominal wave length of 1,000 feet and a wave height of 15 feet. If the distance from the vessel's center of gravity to the mid-length of the activated fin is approximately 50 feet, the projected area (square feet) of each activated fin should be most nearly:

A) 55
B) 70
C) 85
D) 90

SAMPLE SOLUTIONS

The solutions given below have not been reviewed or timed by a subject matter expert and do not necessarily reflect any specific problems that have been or may in future be on a NAME examination. More than 6 minutes may be required to solve some of them. They are presented for personal study only. Comments and suggestions regarding errors, manner of presentation or other improvements will be appreciated. It is believed that if you can successfully solve all of these problems, you will be reasonably well prepared for taking the examination. You have our best wishes for a successful effort!

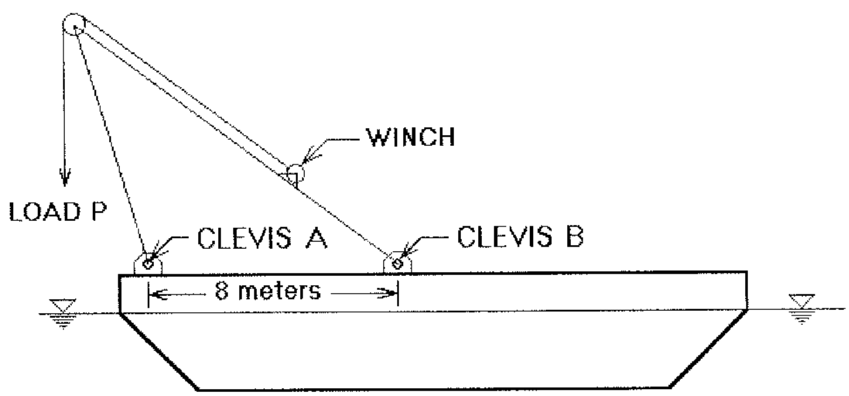
SAMPLE NAME EXAMINATION SOLUTIONS

Sample NAME Exam Problem No. 1, Solution

Subject: Structural Design

A shear leg, composed of three pipe sections in a tilted tripod arrangement, is mounted at the bow of a square-ended barge (as indicated in the figure below), so to be suitable for hoisting and lowering mooring anchors and buoys in a mooring field. The design calls for a lift capacity of 5 tonnes. The forward two side-legs are 10 meters long and their base connections (in clevises) are set 12 meters apart. The third leg is 12.8 meters long with its base attached 8 meters aft of the axis of the other two legs' bases. The third leg is attached to its base connection with a round pin connected through a clevis. The pin is thus in double shear. The hoisting cable passes over a sheave at the apex of the tripod and is attached to a winch mounted on the third leg as shown. The design shear stress of the pin is 16 MPA. The required diameter (mm) of the third leg's clevis-pin is most nearly:

A) 10
B) 20
C) 30
D) 40



MOORING BARGE

Solution:

With the two forward legs 10 meters long and their base attachments 12 meters apart, there is a 3/4/5 triangle, thus the distance from their base attachment axis (A) to the apex (C) is 8 meters. The distance from the two legs' axis (through Clevis A) to the third leg clevis (lets call this point B) is given as 8 meters, thus the triangle shown in the elevation is an isosceles triangle. The third leg is 12.8 meters long. Thus, the perpendicular distance from the axis "A" to the third leg is given by $(8^2 - 6.4^2)^{1/2} = 4.8$ meters.

The acute angle of the triangle will be arcsine (4.8/8) = 36.87 degrees and thus the angle the forward legs make with the horizontal is 73.74 degrees and the distance from the axis "A" to the line of action of the 5 tonne load is 8 cosine 73.74 degrees = 2.24 meters.

Summing moments about the axis "A" we obtain the force in the member at "B" as,
5 x 2.24 – F x 4.8 = 0, or F = 2.333 tonnes. = 2,333 kg = 22890 Newtons since a Kilogram mass x 9.81 m/sec^2 produces 9.81 Newtons force in the gravitation field.

With an allowable stress of 16 Mpa or 16 N/mm^2, the shear area required in the clevis pin becomes 22890/16 = 1430.625 mm^2. The clevis pin is, however, in double shear, so the shear area only needs to be 715.3125 mm^2.

The clevis pin is round so that the shear cross-section area = $\pi D^2/4$
Thus, the clevis pin diameter must be $(715.312 \times 4/\pi)^{1/2}$ = 30.18 mm

Therefore, the correct answer is C)

It should be noted here that the distracters given in the problem statement are only partially arbitrary as 10 mm results from neglecting gravity, 40 results from neglecting a factor of four in cross-sectional and 20 is arbitrarily selected.

Sample NAME Exam Problem No.2, Solution

Subject: Structural Design

A commercial vessel is to be outfitted with a radar antenna, of 250 kg mass, atop a 10-meter stayed mast that is mounted on the flying bridge. The flying bridge is located 30 meters above the ship's base line and the vessel has a design draft of 10 meters. The installation is to be designed to sustain a roll-amplitude of 35 degrees with a 6 second period of roll. The mast is to be simply supported at its base and stayed transversely and fore and aft by shrouds connected at its top that are attached to flying bridge structure five meters fore and aft and outboard Port and Starboard from the mast base. The design loading of the transverse shrouds (kilonewtons) due to vessel rolling is most nearly:

A) 5
B) 14
C) 28
D) 50

Solution:

Assume that the vessel's rolling takes place about its waterplane centerline axis and thus the radar unit is located 30 + 10 – 10 = 30 meters above the axis of roll. With a 6 second period of roll (T) and a roll amplitude of 35 degrees the rolling motion can be described as $\phi = (35\pi/180)\text{sine}(2\pi t/T)$. When the vessel is heeled at 35 degrees and accelerating back upright, the angular acceleration, α, acting on the radar unit can be computed as $d^2\phi/dt^2 = (35\pi/180)(2\pi/T)^2 \sin(2\pi t/T)$ directed perpendicular to the mast's axis. The lateral acceleration experienced by the unit will be $r\alpha$ where r is the distance of the unit from the axis of rolling, or 30 meters. Thus the lateral acceleration force will be:
$F_l = m*r*\alpha = 250*30*(35\pi/180)(2\pi/T)^2 = 5024.16$ Newtons

The weight of the radar unit that is directed vertically downward and is $W_g = 250 * 9.81 = 2452.5$ newtons and it exerts a force component perpendicular to the mast axis of W_g sin (35 degrees) or 1406.7 Newtons.

The total lateral component of force is thus 5024.16 + 1406.7 = 6,430.86 newtons.

The shroud makes an angle with the flying bridge of β = arctan 2 = 63.43 degrees, so the force in the shroud has a component perpendicular to the mast axis of F cosine (63.43 degrees), or 0.4472 *F. Thus, 0.4472*F = 6430.86 newtons or F = 14.379 kilonewtons.

The correct answer is B)

Sample NAME Exam Problem No.3, Solution

Subject: Structural Design

A 10 short-ton plate-yard crane is to be mounted on a light-weight, simply supported beam having a 40 foot span. In order to provide adequate beam stiffness, a design criterion restricts mid-span deflection to 1/360 of the span. The lightest weight W-Shape Standard I-Beam that meets this criterion is most nearly:

A) W 24 x 62
B) W 24 x 55
C) W 21 x 57
D) W 18 x 55

Solution:

The mid-span deflection under mid-span loading of a simply supported beam is determined by the equation:

$\delta = PL^3/48EI$, where:
δ = mid-span deflection in inches
P = mid-span load in pounds
L = span length in inches
E = beam material elastic modulus in pounds per square inch
I = Moment of Inertia of the beam section in $inches^4$

This equation can be re-written to determine required beam section moment of inertia as follows:
$I = PL^3/48\ E\delta$
From the data, P = 2,000 pounds per ton * 10 tons = 20,000 pounds;
L = 40 feet * 12 inches per foot = 480 inches
$E = 29.6 * 10^6$ pounds per square inch
$\delta = 40*12/360 = 1.333$ inches

Thus $I = 20{,}000 * 480^3 / 48 * 29.6 * 10^6 * 1.3333 = 1167.6$ $inches^4$

From the PE Handbook Pg 27/28, it is found that the W-Shape I-Beam section W 21 x 57 has a moment of inertia of 1170 $inches^4$, and the W-Shape I-Beam section W 24 x 55 has a moment of inertia of 1350 $inches^4$. However, since the area of the W 24 x 55 is smaller than the W 21 x 57, it will have a lower weight.

The correct answer is B)

Sample NAME Exam Problem No. 4, Solution

Subject: Environmental Considerations

Refer to the excerpt from 40 CFR on the following pages. A twelve-cylinder low-speed diesel engine with an MCR of 18.4 MW, a 600mm bore and 2000 mm stroke, which was manufactured in 2012 would fall into which engine category?

A) Uncategorized
B) Category 1
C) Category 2
D) Category 3

(a) The emission standards of this part 1042 for freshly manufactured engines apply for new marine engines starting with the model years noted in the following table:

Expand Table

TABLE 1 TO § 1042.1—PART 1042 APPLICABILITY BY MODEL YEAR

Engine category	Maximum engine power [a]	Displacement (L/cyl) or application	Model year
Category 1	kW < 75	disp.< 0.9	[b] 2009
	75 ≤ kW ≤ 3700	disp.< 0.9	2012
		0.9 ≤ disp. < 1.2	2013
		1.2 ≤ disp. < 2.5	2014
		2.5 ≤ disp. < 3.5	2013
		3.5 ≤ disp. < 7.0	2012
	kW > 3700	All	2014
Category 2	kW ≤ 3700	7.0 ≤ disp. < 15.0	2013
	kW > 3700	7.0 ≤ disp. < 15.0	2014
	All	15 ≤ disp. < 30	2014
Category 3	All	disp. ≥ 30	2011

[a] *See § 1042.140, which describes how to determine maximum engine power.*

[b] *See Table 1 of § 1042.101 for the first model year in which this part 1042 applies for engines with maximum engine power below 75 kW and displacement at or above 0.9 L/cyl.*

(b) New engines with maximum engine power below 37 kW and originally manufactured and certified before the model years identified in Table 1 to this section are subject to emission standards as specified in appendix I of this part. The provisions of this part do not apply for such engines, except as follows beginning June 29, 2010:

(1) The allowances of this part apply.

(2) The definitions of “new marine engine” and “model year” apply.

(As per eCFR.gov, displaying title 40, up to date as of 7/09/2026. Title 40 was last amended 7/09/2026.)

(c) Marine engines originally meeting Tier 1 or Tier 2 standards as specified in appendix I of this part remain subject to those standards. This includes uncertified engines that meet standards under 40 CFR 1068.265. Those engines remain subject to recall provisions as specified in 40 CFR part 1068, subpart F, throughout the useful life corresponding to the original certification. Also, tampering and defeat-device prohibitions continue to apply for those engines as specified in 40 CFR 1068.101. The remanufacturing provisions in subpart I of this part may apply for remanufactured engines originally manufactured in model years before the model years identified in Table 1 to this section.

(d) [Reserved]

(e) The requirements of subpart I of this part apply to remanufactured Category 1 and Category 2 engines beginning July 7, 2008.

(f) The marine engines listed in this paragraph (f) are subject to all the requirements of this part even if they do not meet the definition of "compression-ignition" in § 1042.901. The following engines are deemed to be compression-ignition engines for purposes of this part:

(1) Marine engines powered by natural gas or other gaseous fuels with maximum engine power at or above 250 kW. Note that gaseous-fueled engines with maximum engine power below 250 kW may or may not meet the definition of "compression-ignition" in § 1042.901.

(2) Marine gas turbine engines.

(3) Other marine internal combustion engines that do not meet the definition of "spark-ignition" in § 1042.901.

(g) Some of the provisions of this part may apply for other engines as specified in 40 CFR part 1043.

(h) Starting with the model years noted in Table 1 of this section, all of the subparts of this part, except subpart I, apply as specified in 40 CFR part 60, subpart IIII, to freshly manufactured stationary compression-ignition engines subject to the standards of 40 CFR part 60, subpart IIII, that have a per-cylinder displacement at or above 10 liters and below 30 liters per cylinder. Such engines are considered Category 2 engines for purposes of this part 1042.

[75 FR 22994, Apr. 30, 2010, as amended at 76 FR 37977, June 28, 2011; 81 FR 74142, Oct. 25, 2016; 86 FR 34507, June 29, 2021]

(As per eCFR.gov, displaying title 40, up to date as of 7/09/2026. Title 40 was last amended 7/09/2026.)

A 2000mm stroke and 600mm bore means each cylinder has a size of:

$V = h \times \pi \times r^2 = 2.0\text{m} \times \pi \times (0.6\text{m} / 2)^2 = .535\ \text{m}^3 = 535\ \text{L}$

A manufacture date of 2012 and a > 30L/cylinder displacement means the engine falls into Category 3.

The correct answer is C)

Sample NAME Exam Problem No. 5, Solution

Subject: Structural Design

A longitudinally stiffened section of deck plating is composed of 20mm plate fitted with 200mm x 100mm x 13mm inverted angles, spaced on 750mm centers. The plate stiffener Section Modulus (10^3 mm^3) is most nearly:

A) 4550
B) 3980
C) 439
D) 407

	Dimensions	Area	y	A*y	A*y^2 (10^6)	I_o (10^6)
Plate Element	20 x 750	15000	-10	-150000	1.500000	.500000
Web	200 x 13	2600	+100	+260000	26.00000	8.666666
Flange	13 x 87	1131	+193.5	+218848	43.347184	.0159248
Total		18731		+328848	70.847184	

Solution:

Make a Base Line axis at the interface of the plate and the shape and set up a table as below:

9.182594

yBar = A*y/A = 328848/18731 = 17.556mm

$I_{BL} = \Sigma(Ay^2 + I_o) = 70.847184 + 9.182594 = 80.029778 \times 10^6 \text{ mm}^4$

The distance from the neutral axis to the plate shape interface is 17.556 mm therefore the moment of inertia about the N.A. is I_{BL} – A*$yBar^2$ = 80.029778*10^6 -18731*17.556^2

I_{NA} = 80.029778 - 5.773140 = 74.256638*10^6 mm^4

Therefore the Section Modulus referring to the flange becomes:

S = I_{NA}/c = 74.256638/(200-17.556) = 74.256638/182.444 (10^6) = 407010.5 mm^3 = 407.01 (10^3 mm^3)

The correct answer is D)

Sample NAME Exam Problem No. 6, Solution

Subject: Electrical Systems

An electric motor drives a saltwater circulating pump through a coupling connecting their shafts. The motor delivers 150 horsepower at 900 RPM. The steady state torque transmitted (foot-pounds) by the shaft coupling is most nearly:

A) 1750
B) 875
C) 91.7
D) 15.1

Solution:

Power = Torque * Angular Velocity
1 Horsepower = 550 ft-lbs/second or 33,000 ft-lbs/minute
Angular Velocity = 2 π RPM radians/minute

Therefore, Torque = 33,000 SHP/2π RPM = 5252 SHP/RPM
Torque = 33,000 * 150/2π*900 = 875 ft-lbs

The correct answer is B)

Sample NAME Exam Problem No. 7, Solution

Subject: Structural Design

A longitudinally stiffened 'Tween deck is to be designed to carry a live load of 1200 pounds per square foot. The supporting arrangement of the deck consists of a set of longitudinal girders (spaced at 25 feet) and main-transverse web-frames (spaced at 30 feet). At the intersection of each longitudinal girder and main-transverse web-frame, a pillar (or stanchion) is placed to support the load. The longitudinal stiffener spacing is 30 inches. Neglecting the dead load of the structure, the axial load on a pipe-section stanchion (Long Tons) and the longitudinal stiffener design load (Pounds per foot) are most nearly:

A) 450, 1.5
B) 450, 300
C) 400, 1200
D) 400, 3000

Solution:

As the longitudinal girder spacing is 25 feet and the main transverse web-frame spacing is 30 feet, the design load of the stanchion will include 12.5 feet to either side of the longitudinal girder and 15 feet fore and aft of the main transverse web-frame, or be 25 x 30 x 1200 = 900,000 pounds, or 401.8 Long Tons.

With a longitudinal stiffener spacing of 30 inches and a live loading of 1200 pounds per square foot, the design load for the longitudinal will include 15 inches to either side of the longitudinal and be 1200 x 30/12 = 3,000 pounds per foot of length.

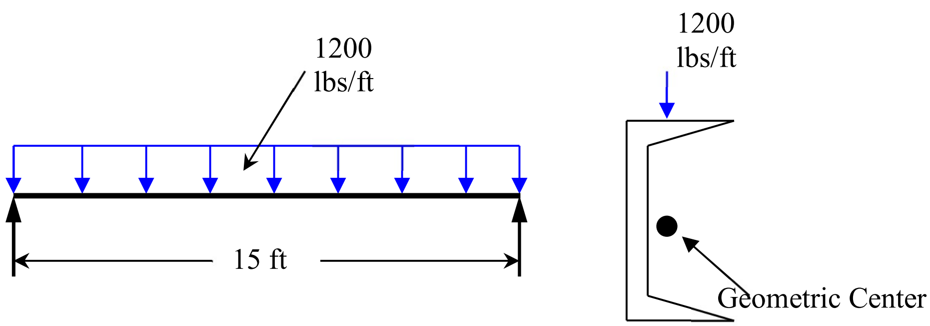
Thus the correct answer is D)

Sample NAME Exam Problem No. 8, Solution

Subject: Structural Design

A channel section (C 15x50) is loaded as shown below with the lateral loading in line with the section center of gravity, the geometric center of the section. In addition to the vertical shear and bending considerations, a twisting moment is generated (inch-pounds per foot) that is most nearly:

A)	1,700
B)	960
C)	700
D)	550



Solution:

The section Centroid of a C-Channel is listed in the handbook as 0.798 inches to the right of the back surface while the Shear Center location, e_o is indicated as 0.583 inches to the left of the back surface. Therefore, the twisting moment being generated about the Shear Center will be T = (0.798 + 0.583) x 1,200 = 1.381 x 1,200 = 1,657 in-lbs/foot

The correct answer is A)

Sample NAME Exam Problem No.9, Solution

Subject: Hull Outfitting

A luffing and slewing crane, to be located on a vessel's foredeck for anchor handling and other miscellaneous work, is to have a capacity of 5 tons when extended horizontally to its maximum length of 45 feet. Crane luffing is controlled by a hydraulic cylinder ram attached 6 feet below the connection between the crane boom and the pedestal and 6 feet outboard of the connection. In the fully extended position stated, the load (Tons) on the hydraulic ram is most nearly:

A) 40
B) 50
C) 200
D) 300

Taking moments about the joint connecting the Boom heel and the Crane post, the moments of the 5-ton load at boom end and the force in the hydraulic ram must be in equilibrium.
Thus F_R * 6 ft * cosine 45° = 5 tons * 45 ft or,

$$F_R = 5 * 45/(6*\text{cosine } 45^o)$$
$$F_R = 53.04 \text{ Tons}$$

The correct answer is B)

Sample NAME Exam Problem No.10

Subject: Structural Design

The transverse bulkhead of a single-shell salt-water ballast deep tank, extending from the deck to the bottom, of a liquid cargo barge (20 feet deep) is horizontally stiffened. The stiffeners are at a 24-inch spacing and supported by vertical webs 12 feet apart. The tank vent extends to 36 inches above the deck. The design load on the bottom-most stiffener (pounds per foot) is most nearly:

A) 2700
B) 2300
C) 1300
D) 1100

Solution

The specific weight of seawater is generally taken as 64 pounds per cubic foot. The lowest stiffener is located 24 inches above the bottom shell plating, or 18 feet below the deep tank top. For the case when the tank is filled to overflow, the depth of water from the overflow level to the lowest stiffener is 20 feet minus 2 feet plus 3 feet or 21 feet. The pressure at that depth is 64 x 21 = 1344 pounds per square foot. With a stiffener spacing of 24 inches, the loading on the lowest stiffener is 2 x 1344 or 2688 pounds per foot.

The correct answer is A)

Sample NAME Exam Problem No.11, Solution

Subject: Hydrodynamics

A container vessel proceeding in a seaway experiences pitch amplitudes of 12 degrees with a pitch period of 7 seconds. The vessel is 870 feet long and the center of flotation is located 0.08 L aft of midships. The maximum vertical acceleration (g) deck cargoes experience on the foredeck at 0.05L aft of the Forward Perpendicular due to the pitching is most nearly:

A) 1.0
B) 2.4
C) 3.0
D) 3.4

Solution:

The pitch motion of the vessel can be described as $\Phi = A\ \pi/180 \sin(2\ \pi\ t/T)$ where:
$A = 12$ degrees
$T = 7$ seconds

Angular acceleration, α, will then be $d^2\Phi/dt^2 = -(A\ \pi/180) * (2\pi/T)^2 \sin(2\pi t/T)$
Substituting values, $\alpha = -(12\ \pi/180) * (2\ \pi\ /\ 7)^2 =$ 0.20944 radians* .80568 per second squared = 0.1687 radians per second squared.

Assuming the pitching motion takes place about the Center of Flotation, the pitching arm is (0.08L + 0.5L -0.05L) or (69.6 + 435 – 43.5) feet = 461.1 feet and the acceleration due to pitching becomes 461.1 * 0.1687 = 77.806 feet per second squared.

When the vessel is pitched down and pitching up, this acceleration adds to the gravitational acceleration of 32.174 feet per second squared for a total acceleration of 109.98 feet per second squared or 3.418 g.

The correct answer is D)

Sample NAME Exam Problem No.12, Solution

Subject: Welds/Connections

A 150 H.P. electric motor is to drive a main circulating pump with a maximum speed of 900 RPM. The motor and pump shafts are connected by a flanged coupling having six, ½ inch diameter steel bolts. If the shear stress in the coupling bolts is not to exceed 13.5 ksi, with a factor of safety of 4.0, the bolt circle diameter (inches) must be not less then:

A) 4
B) 5
C) 6
D) 7

Solution:

A 150 horsepower electric motor rotating at 900 RPM develops a torque T = 33,000 x H.P./(2 π x RPM) = 33,000 x 150/(3.14159 x 1800) = 1875 ft-lbs = 10,504 inch-lbs.
The polar moment of inertia of the six coupling bolts = J = 6 x r^2 x A = 6 x r^2 x $\pi d^2/4$ = 6 x r^2 x 3.14159 x $0.5^2/4$ = 1.178 r^2
The stress in the bolts t = T c/J = 13,500/4 = 3,375 psi = 10,504 x r/1.178 r^2 . Solving for r yields r = 2.2642 inches. Thus the bolt circle diameter must not be less than 5.284 inches.

The correct answer is C)

Sample NAME Exam Problem No.13, Solution

Subject: Welds/Connections

An Upper Engine Room hoisting winch for use in main engine overhaul work is to be mounted on a removable I-beam that spans the 20-foot wide engine room casing. The hoist is to have a 5 S.Ton capacity, and the connection brackets at each end of the I-beam are to be fitted with bolts adequate to resist the shear force and bending moments generated when the hoist is located at mid-span with the maximum shearing force in the bolts not to exceed 13,500 psi. The bracket bolts are to be six in number and in a single line with 3-inch spacing. The diameter of the bolts (eighths of an inch) need to be not less than:

A) 8
B) 10
C) 12
D) 14

Solution:

When the hoist is at mid-span, the vertical shear force acting on the bracket bolts is half of the 5 S.T. hoist capacity or F_d = 5,000 lbs and the direct shear stress in the six bolts will be $\tau_d = F_d/6A =$ 5,000/6A = 833/A.

Whether the bolts are aligned vertically or horizontally, the polar moment of inertia for the array is $J = \Sigma\ Ar^2 = 2A(1.5^2 + 4.5^2 + 7.5^2) = 157.5$ A. The bending moment on the array WL/4 = 5 x 2,000 x 20 x 12/4 = 600,000 inch-pounds. For the horizontally arranged bolts, the stress from direct shear load and from bending moment will directly superimpose. For the bending moment, the shear stress τ_b = Tc/J = 600,000 x 7.5/157.50A = 28571/A.

A = (28571+833)/13500 = 2.178 in^2 = $\pi d^2/4$. d = (4 x 2.178 /π)$^{1/2}$ = 1.665 inches…1.665/0.125 = 13.32 therefore round up to 14 eighths.

The correct answer is D)

Sample NAME Exam Problem No.14, Solution

Subject: Environmental Considerations

A "noise pollution" case involves the airborne noise emitted from the propulsion gas turbines of a high-speed ferry. As part of an investigation, it is noted that in the open, sound intensity falls off inversely:

A) as the square of the distance from the source
B) as the cube of the distance from the source
C) as the fourth power of the distance from the source
D) Directly proportionally to the distance from the source

Solution:

This is an example of a common knowledge problem. Noise (dB) drops of at a rate of 1/x^2.

The correct answer is A)

Sample NAME Exam Problem No.15, Solution

Subject: Ocean Engineering

A Pierson Moskowitz spectrum has a wave period of 7 seconds and a spectral ordinate of 1.18 m^2-s. What does this correspond to on the Beaufort scale?

A) 5
B) 6
C) 7
D) 8

Solution:

If T = 7 seconds, ω = 2 x π / 7 = 0.897 1/s.

Rearranging the Pierson-Moskowitz spectrum to solve for wind speed gives the following equation:

$$V_W = \frac{g}{\left(\frac{\ln\left(\frac{S(\omega)\times\omega^5}{\alpha\times g^2}\right)}{-\beta}\right)^{\frac{1}{4}}}$$

$$V_W = \frac{9.81\ m/s2}{\left(\frac{\ln\left(\frac{1.18\ m2 - s\times(0.898\ 1/s)^5}{8.1\times10^{-3}\times(9.81\ m/s2)^2}\right)}{-.74}\right)^{\frac{1}{4}}}$$

Which gives V_w = 15.28 m/s, or 30 kts, which corresponds to a 7 on the Beaufort scale.

The correct answer is C)

Sample NAME Exam Problem No.16, Solution

Subject: Environmental Considerations

Given the below except from MARPOL Annex IV, which of the following is not an acceptable means of dealing with untreated onboard sewage without the use of a sewage treatment plant?

A) Discharging sewage onboard an in-use lifeboat
B) Holding sewage for more than 90 days in a holding tank
C) Discharging sewage 19 miles from the nearest land, moving at 3 knots.
D) Discharging sewage 8 miles from the nearest land, mixed with wastewater to dilute it

Solution:

If a lifeboat is in-use, it is compliant via Regulation 9 Section (a). There is no restriction to how long sewage can be held in a holding tank. The minimum discharge distance from land is 12 miles. Mixing sewage with other wastes to dilute it does not decrease this distance.

The correct answer is D)

Regulation 8

Discharge of sewage

(1) Subject to the provisions of regulation 9 of this Annex, the discharge of sewage into the sea is prohibited, except when:

(a) the ship is discharging comminuted and disinfected sewage using a system approved by the Administration in accordance with regulation 3(1)(a) at a distance of more than 4 nautical miles from the nearest land, or sewage which is not comminuted or disinfected at a distance of more than 12 nautical miles from the nearest land, provided that in any case, the sewage that has been stored in holding tanks shall not be discharged instantaneously but at a moderate rate when the ship is *en route* and proceeding at not less than 4 knots; the rate of discharge shall be approved by the Administration based upon standards developed by the Organization; or

(b) the ship has in operation an approved sewage treatment plant which has been certified by the Administration to meet the operational requirements referred to in regulation 3(1)(a)(i) of this Annex, and

(i) the test results of the plant are laid down in the ship's International Sewage Pollution Prevention Certificate (1973);

(ii) additionally, the effluent shall not produce visible floating solids in, nor cause discoloration of, the surrounding water; or

(c) the ship is situated in the waters under the jurisdiction of a State and is discharging sewage in accordance with such less stringent requirements as may be imposed by such State.

(2) When the sewage is mixed with wastes or waste water having different discharge requirements, the more stringent requirements shall apply.

Regulation 9

Exceptions

Regulation 8 of this Annex shall not apply to:

(a) the discharge of sewage from a ship necessary for the purpose of securing the safety of a ship and those on board or saving life at sea; or

(b) the discharge of sewage resulting from damage to a ship or its equipment if all reasonable precautions have been taken before and after the occurrence of the damage, for the purpose of preventing or minimizing the discharge.

Regulation 10
Reception facilities

(1) The Government of each Party to the Convention undertakes to ensure the provision of facilities at ports and terminals for the reception of sewage, without causing undue delay to ships, adequate to meet the needs of the ships using them.

(2) The Government of each Party shall notify the Organization for transmission to the Contracting Governments concerned of all cases where the facilities provided under this regulation are alleged to be inadequate.

Regulation 11
Standard discharge connections

To enable pipes of reception facilities to be connected with the ship's discharge pipeline, both lines shall be fitted with a standard discharge connection in accordance with the following table:

Standard dimensions of flanges for discharge connections

Description	*Dimension*
Outside diameter	210 mm
Inner diameter	According to pipe outside diameter
Bolt circle diameter	170 mm
Slots in flange	4 holes 18 mm in diameter equidistantly placed on a bolt circle of the above diameter, slotted to the flange periphery. The slot width to be 18 mm
Flange thickness	16 mm
Bolts and nuts: quantity and diameter	4, each of 16 mm in diameter and of suitable length
The flange is designed to accept pipes up to a maximum internal diameter of 100 mm and shall be of steel or other equivalent material having a flat face. This flange, together with a suitable gasket, shall be suitable for a service pressure of 6 kg/cm^2	

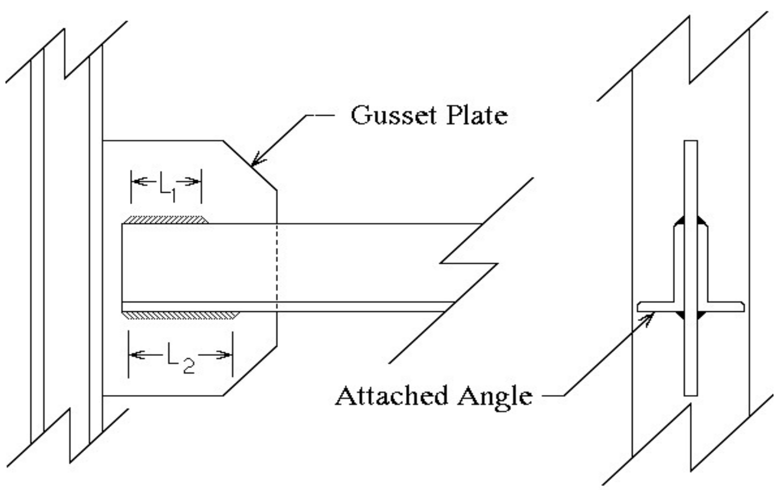
For ships having a moulded depth of 5 m and less, the inner diameter of the discharge connection may be 38 mm.

Sample NAME Exam Problem No.17, Solutions

Subject: Welds/Connections

Two mild steel 3-in by 2.5-in by 1/2-in angles are to be welded to a 1/2 –in thick gusset plate as indicated in the sketch below with 5/16-in welds. The yield strength of the material is 33 ksi and the allowable shear stress through the weld throats is 13.6 ksi. The required length of weld L_1 (inches) will be most nearly:

A) 27.5
B) 18.3
C) 12.2
D) 9.1



Plan View of Gusset Plate with Two Angles Attached

Solution:
From the PE Handbook, we obtain the information that a 3-in by 2.5-in by 1/2-in angle has a cross-section area A = 2.50 square inches. Thus, when the angle is stressed to its yield strength, the total load on the welds is:
$F = \tau_{yp}*A$, or $F = 33$ ksi * 2.50 in^2 = 82.5 kips
The weld throat is .707 times the weld leg or
t = 0.707 * .3125 in, or 0.2209 inches.
The total length of weld then becomes
$L*t * \tau_{allowable} = F$, or $L = F/(t * \tau_{allowable})$

L = 82.5/(.2209 * 13.6) = 27.46 inches

In order that the force in the angle and the resultant of the forces in the weld throats is balanced, the centroid of the weldment forces must align with the centroid of the angle section.

From the PE Handbook we obtain the distance of the centroid from the bottom of the extended flange as 1.00 inches. Therefore, we obtain:

$L_1*t*\tau_{allowable}$ * (3.00 -1.00)-in = $L_2*t*\tau_{allowable}$ * 1.00 -in

Thus, L_1 = 1.00 /(3.00-1.00)*L_2 = 0.5 L_2 , or L_{Total} = 1.5 L_2, L_2 = 27.46/1.5 = 18.31 in. and L_1 = 9.15 in

Alternatively, by taking moments about the bottom of the flange, we have
$F * 1.00 = L_1 * t * \tau_{allowable} * 3.0$
$L_1 = F * 1.00 /(t * \tau_{allowable} * 3.0)$
$L_1 = 82.5 * 1.00/0.2209 * 13.6 * 3.0) = 9.15$ in.

The correct answer is D)

Sample NAME Exam Problem No.18, Solution

Subject: Propulsion and Power Generation

A marine engineer is tasked to determine the vibration characteristics of a ship's propeller and propulsion shafting system. The 30 meter long, steel propeller shaft is hollow, having an outside diameter of 0.6m and an inside diameter of 0.3 m. As part of a simple mass-spring vibrating system, the effective linear spring constant, k_{eq} (N/m) of the shafting acting with the propeller mass is most nearly:

A) 5800×10^6
B) 1940×10^6
C) 1850×10^6
D) 1410×10^6

Solution:

The elastic modulus of Steel is $E = 200 \times 10^9$ N/m^2 (200 GPa)
The effective spring constant, k_e, is determined as $k_e = P/\delta$, or $k_e = AE/L$
Thus, $k_{eq} = (\pi/4)(0.6^2 – 0.3^2)(200 \times 10^9)/30 = 1{,}413.7 \times 10^6$ N/m

The correct answer is D)

Sample NAME Exam Problem No.19, Solution

Subject: Propulsion and Power Generation

A motor generator set, weighing 1,900 pounds, is mounted at mid-span of a simply-supported deck beam having a moment of inertia of 26.0 inches^4, a section modulus of 8.7 inches^3 and a length of 12 feet. The lowest motor rotating speed (RPM) capable of exciting the fundamental mode of a simple mass-beam system is most nearly:

A) 1,500
B) 1,000
C) 500
D) 250

Solution:

The deflection of a centrally loaded simple beam is defined by $\delta = PL^3/48\ EI$, and the mass-beam Spring Constant $k_e = P/\delta = 48\ EI/L^3$, or $k_e = 48 \times 29.6 \times 10^6 \times 26.0/(12 \times 12)^3$ lb/inch . Thus, $k_e =$ 12,371.399 lb/inch.
The lowest vibration frequency of the mass beam system is given by the relationship
$Hz = (1/2\pi)(k_e/m)^{0.5}$, where m = W/g. = (1,900/12*32.174) = 1,900/386 = 4.921 Hz =
$(1/2\pi)(12{,}371.399/4.921)^{0.5} = (1/2\pi)50.13 = 7.97987$ Hz or 478.79 Cycles per Minute or RPM

The correct answer is C)

Sample NAME Exam Problem No.20, Solution

Subject: Propulsion and Power Generation

A 20,000 ton displacement cargo vessel having a four bladed propeller is estimated to have vertical vibration natural frequencies (Hertz), as follows: 2-noded, 1.2, 3-noded, 2.2, 4-noded, 3.0 and 5-noded, 4.0. The vertical mode of vibration most likely to be excited when the vessel is in the maneuvering mode at 60 RPM is:

A) 2-noded
B) 3-noded
C) 4-noded
D) 5-noded

Solution:

The four-bladed propeller will have each blade pass through the unsteady wake of the vessel in such a manner that there would be a pulse variation four times per propeller revolution, or 240 times per minute. A natural frequency of one Hertz is equal to 60 cycles per minute, and equivalent to 60 RPM. Therefore, the five-nodded mode with a 4.0 Hertz or 240 cycles per minute frequency would be most likely to be excited.

Note that 1.2 Hertz becomes 72 cycles per minute while 2.2 Hertz becomes 132 cycles per minute and 3.0 Hertz becomes 180 cycles per minute. In this case, a 3-bladed propeller at 60 RPM would be expected to excite the the 4-noded mode of vibration.

The correct answer is D)

Sample NAME Exam Problem No.21, Solution

Subject: Hydrostatics and Stability

A vessel having the characteristics listed below has an Initial GM of 3.2 feet when all fuel and water tanks are pressed up to 98% capacity.

Length Between Perpendiculars	580 feet
Beam	72 feet
Draft	24 feet
Double Bottom Depth	5 feet
Displacement	20,600 L.Tons
KM	31.6 feet

The vessel has four cargo deep tanks, each 35 feet long, 36 feet wide and 14 feet deep. A cargo of molasses (specific gravity 1.4) is loaded into the deep tanks until the tanks are filled to a depth of 10 feet. Assuming that KM remains the same, the apparent GM, with the deep tanks partially filled with molasses, is (feet) most nearly:

A) 4.71
B) 3.86
C) 2.44
D) 2.23

Solution:

KM – KG = GM = 3.2 feet, therefore KG = 31.6 - 3.2 = 28.4 feet
Molasses weight = 4 x 35 x 36 x 10 x 1.4 / 35.9 = 1,965 L. Tons
New KG = (20,600 x 28.4 + 1965 (5+ 10/2))/22,565 = 26.798 feet
Free Surface Correction = (I x sp.gr.)/V = (4 x 35 x 36^3/12)(1.4)/(35.9 x 22,565) = 0.941
KM_{app} = KM – KG – FSC = 31.6 – 26.798 - 0.941 = 3.86

The correct answer is B)

Sample NAME Exam Problem No.22, Solution

Subject: Hydrostatics and Stability

A cargo ship having a rolling period of 14 seconds sustains an accident that causes the flooding of one of its holds. After the accident, the rolling period is 21 seconds. The percent loss of transverse GM is most nearly:

E) 35
F) 45
G) 55
H) 65

Solution:

The rolling period of a vessel is approximately defined as:

$$T_\phi = 2\pi\ K/(g\ GM_T)^{0.5}$$

The ratio of periods is inversely proportional to the square roots of the transverse GM, other factors remaining unchanged. Therefore,

$T_2/T_1 = 21/14 = 1.5 = (GM_{T1}/GM_{T2})^{0.5}$
Or, $(GM_{T1}/GM_{T2}) = (T_2/T_1)^2 = (3/2)^2 = 2.25$
$GM_{T2} = GM_{T1}/2.25 = 0.4444GM_{T1}$
The percent loss of $GM_T = (1\text{-}0.4444)*100 = 55.55\ \%$

The correct answer is C)

Sample NAME Exam Problem No.23, Solution

Subject: Hydrostatics and Stability

A vessel having the characteristics given below has 250 tonnes of fuel transferred from the No. 2 Center Double Bottom tank, located 32 meters aft of the F.P. to the No. 6 Center Double Bottom tank, located 96 meters aft of the F.P., a distance of 64 meters.

Vessel characteristics:

LBP	165 meters
Beam	23.5 meters
Displacement	24,300 tonnes
Block Coefficient	0.72
Longitudinal Center of Flotation	-6.2% of LBP (aft of midships)
TPcm	28.50
MTcm	557 tonne-meters

If the vessel is initially on an even keel with a mean draft of 8.5 meters, the draft forward (meters) after completing the fuel transfer will be most nearly:

A) 8.213
B) 8.339
C) 8.356
D) 8.374

Solution

The trimming moment generated by the fuel transfer is: $M_t = 250 \times 64 = 16{,}000$ tonne-meters.
The change in trim is $\delta t = M_t/MTcm = 16{,}000/557 = 28.725$ cm
The F.P. distance from the Longitudinal Center of Flotation is: $0.062 \times 165 + 165/2 = 92.73$ m
The draft reduction forward due to fuel transfer will be $(92.73/165) \times 28.725 = 16.14$ cm
The draft forward will be $8.5 - 0.1614$ m $= 8.3386$ m

The correct answer is B)

Sample NAME Exam Problem No.24, Solution

Subject: Hydrostatics and Stability

An oceangoing vessel has the following characteristics:

Length Between Perpendiculars	193 meters
Beam	26.066 meters
Draft	9.495 meters
Displacement	30,743 tonnes
Sea Water Density	1.025 tonnes per cubic meter

Half-Breadths of the vessel's Waterplane are as given in the tabulation below.

Station	Half-Breadth (m)
0	0.171
½	1.300
1	3.807
2	8.300
3	11.696
5	13.033
7	12.965
8	12.211
9	8.815
9-1/2	6.106
10	2.914

Using Simpson's First Rule, the vessel's Tonnes per Centimeter Immersion (TPcm) (tonnes) is most nearly:

A) 19.5
B) 37.1
C) 39.0
D) 58.5

Solution:
The solution should be set up on an Excel Spreadsheet format as follows:

TPcm = A_{wp} Sp.Gr./100 = 3803.11*1.025/100 = 38.98

Solution Spreadsheet for Determining Waterplane Area

Station	Half-Breadth	Simpson Multiplier	HB x SM
0	0.171	0.5	0.0855
0.5	1.3	2	2.6
1	3.807	1.5	5.7105
2	8.3	4	33.2
3	11.696	3	35.088
5	13.033	8	104.264
7	12.965	3	38.895
8	12.211	4	48.844
9	8.815	1.5	13.2225
9.5	6.106	2	12.212
10	2.914	0.5	1.457
Total			295.5785

Water[lane Area = (2/3)*(L/10)(Total)
= 3803.11 square meters

Note that this is a more time-consuming problem than is likely to be on an examination. If, however, the examinee understands where the Simpson's Multipliers come from and how they are used in this solution, the application to a simpler problem should be easily carried out.

The correct answer is C)

Sample NAME Exam Problem No.25, Solution

Subject: Hydrostatics and Stability

A coastal cargo vessel has the following particulars:

Displacement (Tons, Salt Water)	7,500
Length Between Perpendiculars (Ft.)	350
Beam (Ft.)	50
Draft (Ft.)	20

The vessels Block Coefficient (C_B) is most nearly:

A) 0.73
B) 0.75
C) 0.77
D) 0.79

Solution:

The displaced volume in salt water of a vessel weighing 7,500 tons when the specific weight of salt water is 64 pounds per cubic foot and the specific volume of salt water is thus 35 cubic feet per long ton is 7,500 x 35 = 262,500 cubic feet.

The displacement volume of the vessel $V_D = C_B \times L \times B \times T = C_B \times 350 \times 50 \times 20$
Or, $C_B = V_D /(L \times B \times T) = 262{,}500 /(350 \times 50 \times 20) = 0.75$

The correct answer is B)

Sample NAME Exam Problem No.26, Solution

Subject: Hydrostatics and Stability

The structure and loadings of a rectangular tank barge having dimensions of 100m x 20m x 10mm requires reviewing. The barge has four (4) transverse bulkheads that subdivide it longitudinally into five tank compartments, each 20m in length. It has a double bottom structure of one (1) meter depth and a light displacement of 2,000 tonnes. The basic structure is of single side shell construction and has the following nominal plate thicknesses:

Deck	12mm
Side Shell	10mm
Innerbottom	10mm
Bottom Plate	14mm

The barge is loaded in its three middle tanks to a depth of 6m with a liquid cargo having a specific gravity of 1.5 for transport on a coastwise voyage. The displaced weight (tonnes) and draft (meters) of the barge in salt water are most nearly:

	Displacement	Draft
A)	5600	2.73
B)	9200	3.51
C)	12800	6.24
D)	18000	8.78

Solution:

The cargo weight is 3 x 20m x 20m x 6m x 1.5 tonnes per cubic meter = 10,800

The light ship weight is 2,000

So the total displaced weight is 12,800

The displaced volume of salt water having a density of 1.025 tonnes per cubic meter is:

T x L x B x γ = 12,800, or T = 12,800/ L x B x γ

T = 12,800/100 x 20 x 1.025 = 6.2439 meters

The correct answer is C)

Sample NAME Exam Problem No.27, Solution

Subject: Hydrostatics and Stability

A yacht designer wishes to scale an existing yacht as a prototype for a new 55' LOA design. The parent vessel has the following particulars:

Length Over All	45' 11"
Waterline Length (LWL)	42' 04"
Displaced Weight (lbs)	25,500
Sail Area (Ft^2)	975
Ballast (lbs)	11,000

The new, 55' design will have particulars most nearly:

	Sail Area	Ballast
A)	1,170	13,200
B)	1,240	15,800
C)	1,400	18,900
D)	1,645	24,100

Solution:

Scaling of the yacht particulars requires the ratio of lengths to be set first, or
$L_{\text{new design}}/L_{\text{prototype}} = 55/45.917 = 1.1978$

The displaced weight of the new design $\Delta_{\text{new design}} = (1.1978)^3 * \Delta_{\text{prototype}}$
or, $\Delta_{\text{new design}} = 1.7186 * 25{,}500 = 43{,}824$ lbs.

The new design should also have the same ballast /displacement ratio, or 11,000/25,500 = .431
The ballast for the new design would then be 0.431 * 43824 = 18,904 lbs.

For sail power, the Sail Area /Displacement ratio should be the same.
For the prototype, this is S.A./ (Displaced volume of Sea Water)$^{2/3}$ in order to have a dimensionless ratio. or, $975/(25{,}500 * 35/2240)^{2/3} = 18.0066$
and the new design's Sail Area should be $18 * (43{,}824 * 35/2240)^{2/3} = 1{,}398$

Therefore the correct answer is C)

Sample NAME Exam Problem No.28, Solution

Subject: Auxiliary System Selection

In a 50 ton vapor-compression-cycle single-box refrigeration system using R-134a, the refrigerant leaves the condenser as a saturated liquid at a temperature of 80° F, and it leaves the evaporator with 10° F of superheat at a temperature of 0° F. The compression efficiency is 65%. Ignore any sub-cooling in the receiver and pressure drops in the piping, condenser, and evaporator. The system is not fitted with a liquid-suction heat exchanger. The heat absorbed in the evaporator (BTU/lb-m) is most nearly:

A) 65
B) 80
C) 95
D) 110

Solution:

$T_{sat\ evap} = T_{leaving\ evap}$ - Superheat

T = temperature = 0° F - 10° F = - 10° F

from p - h diagram for R-134a: $h_{leaving\ evap} = h_1$ = 103 BTU/lb-m

$T_{leaving\ condenser}$ = 80° F

$h_{leaving\ condenser} = h_{entering\ evap} = h_3$ = 38 BTU/lb-m

heat absorbed in evap = $Q_{evap} = h_1 - h_3$ = 103 BTU/lbm – 38 BTU/lb-m = 65 BTU/lb-m

The correct answer is A)

Sample NAME Exam Problem No.29, Solution

Subject: Hydrostatics and Stability

A small catamaran harbor ferry has a hull form consisting of two tubular hulls 15 meters long and 1.0 meter in diameter. The hull centerlines are spaced 8 meters apart. When loaded with passengers until the vessel draft is 0.5 meters, the vessel's metacenter is located above the vessel's keel (meters) most nearly:

A) 10.4
B) 20.4
C) 20.8
D) 41.2

Solution:

The catamaran ferry, when loaded to half depth of the cylindrical hulls has a displacement of: the two hulls equal to:
$2\ (\pi/8)\ D^2\ L$ where $D = 1.0$ meters and $L = 15$ meters = $2\ (3.14159/8)\ 1^2 \times 15 = 11.78$ meters^3
The moment of inertia of the catamaran's waterplane, I_{wp}, is:
$2\ (\ bh^3/12 + \ bh \times (B/2)^2)$, where $b = 15$ meters, $h = 1$ meter, $B = 8$ meters,
$I_{wp} = 2 \times (15 \times 1/12 + 1 \times 15 \times 16) = 482.5$ meters^4
The height of the metacenter above the vessel's center of buoyancy is
$BM = I_{wp}/V = 482.5/11.78 = 40.9559$ meters
The centroid of the vessel's displaced volume is found from Mechanics to be located
$(4/3)(D/2\pi) = 0.2122$ meters below the waterplane, or $0.5\text{-}.2122 = 0.2878$m above the vessel's bottom.
Thus, the vessel's metacenter is located $40.9559 + 0.2878 = 41.2437$ meters above the vessel's bottom.

The correct answer is D)

Sample NAME Exam Problem No.30, Solution

Subject: Hydrodynamics

A mono-hull sailing yacht having a waterline length of 72 feet and a nominal hull speed of 11.4 knots is to be towing-tank tested using a 12-foot model. The towing tank carriage speed (feet per second) for testing the 12-foot model at the same Froude Number is most nearly:

A) 3.4
B) 3.9
C) 6.8
D) 7.9

Solution:

For a 12 foot model to be tested at the same Froude Number as the full scale yacht, the Froude Number of the yacht must be determined as:

$F_R = V_Y/(gL)^{0.5} = 11.4 * (6080/3600)/(32.174 * 72)^{0.5} = 0.400$

$0.400 = V_M/(32.174*12)^{0.5}$;

$V_M = 0.400\ (32.174*12)^{0.5} = 7.86$ fps

The correct answer is D)

Sample NAME Exam Problem No.31, Solution

Subject: Hydrodynamics

A fuel barge is scheduled to be towed by a harbor tug at an average speed of 6 knots, the barge requiring a tow force at 6-knots estimated to be 88 Tons. Four tugs are available, each having a propulsive efficiency estimated to be 65%. The tug most nearly able to meet the tow power requirements will have (horsepower) available for towing:

A) 2,500
B) 3,250
C) 5,000
D) 6,500

Solution:

HorsePower = Force (Pounds) * Velocity (Feet per Minute)/33,000 (Ft Lbf per Min./Hp)
Velocity = 6 knots * 6080 Feet per Nautical Mile /60 Minutes per Hour
= 608 feet per Minute
Force = 88 Tons * 2,000 Pounds per Ton = 176,000 Pounds
Towing Horse Power = 176,000 * 608/33,000 = 3,242.7
The Tug Horsepower must then be 3,242/0.65 = 4,988

The correct answer is C)

Sample NAME Exam Problem No.32, Solution

Subject: Hydrodynamics

Open water model tests of a ship's propeller indicate that $K_T = 0.225$ and $K_Q = 0.031$ when the advance ratio, J, is 0.6. The open water propeller efficiency, η_o is most nearly:

A) 0.55
B) 0.60
C) 0.65
D) 0.70

Solution:

The open water propeller efficiency is defined as $\eta_o = (J/2\pi)(K_T/K_Q)$, or
$\eta_o = (0.6/(2 \times 3.14159))(0.225/0.031) = 0.693$

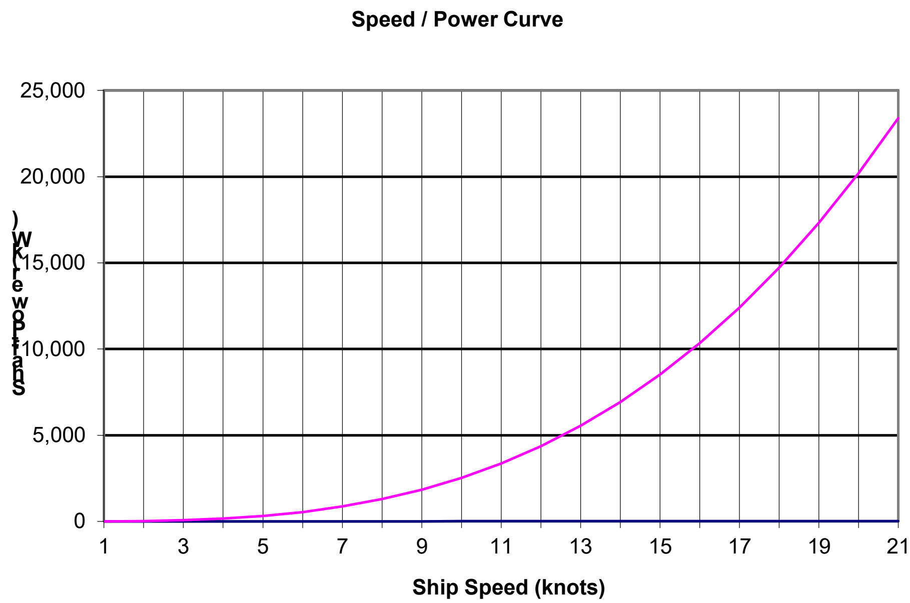
The correct answer is D)

Sample NAME Exam Problem No.33, Solution

Subject: Environmental Considerations

The International Maritime Organization (IMO) has established a power-based maximum allowable NO_X emission rate of 3.4 g NO_X per kW for <130 RPM engines for ships constructed after 2016. A given diesel-powered vessel has an average fuel consumption of 180 g/kWh, and a normal cruise speed of 18 knots. A proposed regulation would require the vessel to operate at 12.5 knots to further reduce NO_X production. Using the Speed/Power Curve below, and assuming a linear relationship between engine horsepower and NO_X emissions, the estimated percent reduction in NO_X per hour of steady state operation is most nearly:

A) 33%
B) 44%
C) 50%
D) 66%



Solution:

Avg. NO_X emission rate, kg NO_X/kWh	17
Initial ship speed, knots	18
Engine power, kW (from Speed/Power Curve)	14,700
Reduced ship speed, knots	12.5
Engine power, kW (from Speed/Power Curve)	5,000

Assume NO_X varies linearly with power reduction = 5,000/14,700 = 34% remaining

NO_X reduction, %	66%

The correct answer is D)

Sample NAME Exam Problem No.34, Solution

Subject: Hydrodynamics

A naval architect is tasked to select a propeller for a vessel designed to have a sea speed of 23 knots. Model tests show that the Block 0.60 hull form of interest has a Taylor Wake Fraction of 0.24. The selection of a suitable propeller would be based upon a Speed of Advance (Knots) most nearly:

A) 17.5
B) 18.9
C) 19.5
D) 20.9

Solution:

The Taylor Wake Fraction is defined as $w_T = (V-V_A)/V$
Thus the Speed of advance $V_A = V(1-w_T) = 23 \times (1-0.24) = 17.48$

The correct answer is A)

Sample NAME Exam Problem No.35, Solution

Subject: Hydrodynamics

A naval architect is tasked to make an evaluation of the performance of one of his company's vessels on the company's trade route and plan for appropriate drydocking. Log book analysis shows that the ship's propeller, which has a pitch of 31 feet, turns at 90 RPM, when steaming at full power. The vessel log also notes that the vessel had a distance made good of 650 nautical miles in 24 hours of fair weather travel. Analysis shows that the vessel's apparent slip (%) is most nearly:

A) 0.8
B) 1.7
C) 11
D) 16

Solution:

The distance traveled by the propeller is:
Distance = (Propeller Pitch x RPM x 60min/hr x 24hr/day)/6076 nautical miles
Distance the vessel traveled = 650 nautical miles
Apparent Propeller Slip = (Propeller distance – Navigation distance)/propeller distance
= ((31 x 90 x 60 x 24)/6076) – 650)/ ((31 x 90 x 60 x 24)/6076)
= 1.6975%

The correct answer is B)

Sample NAME Exam Problem No. 36, Solution

Subject: Ocean Engineering

The speed (Feet per Second) and Period (Seconds) of a harmonic deep-sea wave 800 feet long is most nearly:

A) 64, 12.5
B) 91, 12.5
C) 64, 8.8
D) 91, 8.8

Solution:

The period of a wave, T_w, is given by the expression $T_w = L_w/V_c$ where L_w is the wave length and V_c is the wave velocity, or celerity. This may also be expressed as:
$T_w = (2\pi L_w/g)^{1/2}$, where g is acceleration due to gravity, 32.174 feet per second squared or 9.81 meters per second squared. The circular frequency $\omega = 2\pi/T_w$.
Thus, the wave period is $T_w = (2\ \pi\ 800/32.174)^{1/2}$ = 12.5 seconds, and the wave velocity is $V_c = L_w/T_w = 800/12.5 = 64$ feet per second

Reference: PNA, Vol III, Chapter VIII, Section 2, Ocean Waves, by authors Beck, Cummins, Dalzell, Mandel and Webster

The correct answer is A)

Sample NAME Exam Problem No. 37, Solution

Subject: Hydrodynamics

A naval architect is tasked to evaluate fore deck structural loadings of a container vessel having a length between perpendiculars of 230 meters traveling into head seas at 24 knots, and experiencing a nominal period of encounter of 7 seconds with a pitch amplitude of 10 degrees. The forward most containers are secured in position 0.05 L aft of the forward perpendicular. If the waterplane centroid is located 0.08L aft of midships, the range of vertical acceleration (g), augmented by vessel pitching, and thereby inducing loads on the hull structure, experienced by the forwardmost container will be most nearly:

A) -1.75g to + 1.75g
B) -2.75g to + 0.75g
C) -.75g to + 2.75g
D) -2.75g to + 1.75g

Solution:

The pitching motion of a ship can be approximated by the expression:
$\theta = A \sin(2\pi t/T)$, where A is the amplitude, 10 degrees, or $(10/180)\pi$ radians and T is the pitch period of 7 seconds.
The pitching acceleration = $d^2\theta/dt^2 = -(10/180)\pi \times (2\pi/T)^2 \sin(2\pi t/T)$
The foremost container is located forward of the waterplane centroid, the center of pitching motion a distance of $(L/2) - 0.05\,L + 0.08L = (0.5 - 0.05 + 0.08)L = 0.53L = 121.9$ meters.
And the amplitude of linear acceleration at the location of the foremost container would be
$(10/180)\pi \times 121.9\text{m} \times (2\pi/T)^2 = 21.27556\text{m} \times 0.80568/\text{sec}^2 = 17.14\ \text{m/sec}^2$
This acceleration equals 17.14/9.81 g = 1.747g which is superimposed upon the acceleration due to 1g gravitational attraction
The superposition of 1.75g accelerations due to pitching motion on the 1.0g acceleration due to gravity will result in structural loadings on the fore deck structure equivalent to 1.0 + 1.75 = 2.75g, while pitched down and accelerating upwards and 1.0 - 1.75 = 0.75g while pitched up and accelerating downward.

The correct answer is B)

Sample NAME Exam Problem No.38, Solution

Subject: Rules and Regulations

The American Bureau of Shipping (ABS) in the Mobile Offshore Drilling Units rules defines the wind force on vessels as:

$P = 0.00338\ V_k^2\ C_h\ C_s$ lbf/ft^2
$F = P\ A$ lbf
P = wind pressure
V_k = wind velocity in knots
C_h = height coefficient
C_s = shape coefficient
F = wind force
A = projected area in ft^2 of all exposed surfaces in either the upright or heeled condition

A 500-foot long vessel with a mean draft of 20 feet has a lateral area of the above water portion of 7,500 ft^2. Assuming a shape coefficient of 1.0 and an average height coefficient of 1.10. The wind force (in long tons) and heeling moment (in long ton-feet) on the vessel in a beam wind of 55 miles/hour is most nearly:

A)	8.5	285
B)	8.5	500
C)	28.5	285
D)	28.5	500

Solution:
The Wind pressure is determined to be $P = 0.00338\ (55 \times 5280/6076)^2 \times 1.1 \times 1.0 = 8.493$ lbf/Ft.^{2}. Thus the force = 8.493 x 7,500/2240 = 28.436 L.Tons.
Assuming the center of effort of the underwater body is at about mid-draft and the center of effort of the above water wind force is at about mid-height of the freeboard profile, or
7,500/(500*2) = 7.5 ft., the heeling moment would be about (10 + 7.5) * 28.436 = 497.6 long ton-feet.

The correct answer is D)

Sample NAME Exam Problem No. 39, Solution

Subject: Hydrodynamics

A tanker of 250m LWL steams ahead at 17 knots. It encounters a train of deep-water waves having a period of 7 seconds advancing towards the tanker from 50 degrees off the tanker's starboard stern. The tanker's period of encounter (Seconds) is most nearly:

A)	3.05
B)	6.28
C)	14.4
D)	16.0

Solution:

The vessel velocity U_O = (17 nm/hr x 6076 ft/nm)/3600 sec/hr = 28.69 fps

The length of a Wave whose period is 7 seconds = $L_W = T^2 g/2\,\pi$ = 250.9 ft.

The frequency of the waves $\omega = (2\,\pi\,g\,/L_W)^{1/2} = 2\,\pi\,/\,T_W$ = 0.8976 radians/sec

The Frequency of Encounter $\omega_e = \omega - (\omega^2\,U_O\cos\mu)/g$, where μ = 50 degrees off the tanker's stern.

ω_e = 0.8976 – (0.80568 x 28.69 x 0.642787)/32.174 = 0.8976- 0.4618 = 0.43579 radians per second.

The period of Encounter therefore becomes $T_e = 2\,\pi/\,\omega_e$ = 14.418 seconds

The correct answer is C)

Sample NAME Exam Problem No.40, Solution

Subject: Structural Design

The structure and loadings of a rectangular tank barge having nominal dimensions of 100m x 20m x 10m requires reviewing. The barge is subdivided longitudinally into five tank compartments, each 20m in length. It has a double bottom structure of one (1) meter depth and a light displacement of 1,000 tonnes. The basic structure has the following nominal thicknesses:

Deck	12mm
Side Shell	10mm
Innerbottom	10mm
Bottom Plate	14mm

The barge is loaded in the three middle tanks to a depth of 6m with a liquid cargo having a specific gravity of 1.5. The barge is to be used to transport the cargo on a coastwise voyage. The midship section moment of inertia (meters^4) is most nearly:

A) 14
B) 17
C) 29
D) 31

Solution:

Ignoring the moment of inertia of the deck, inner bottom and bottom plates about their own centroidal axes we compute as follows, using the base line as the reference plane:

	Dimensions		A	y	Ay	Ay^2	Io
Bottom plate	.014 x 20	.28	0	0	0	0	
Inner Bottom	.010 x 20	.2	1.0	0.2	.2	0	
Deck	.012 x 20	.24	10	2.4	24	0	
Side Shell (2)	.020 x 10	.2	5	1.0	5.	1.67	
Totals			.92		3.6	29.2	1.67

$\Sigma(Ay^2 + I_o) = 30.87$ meters^4

yBar = $\Sigma Ay/\Sigma A = 3.6/.92 = 3.91$ meters above the base line

$I_{NA} = 30.87 - 0.92 \times 3.91^2 = 16.78$ meters^4

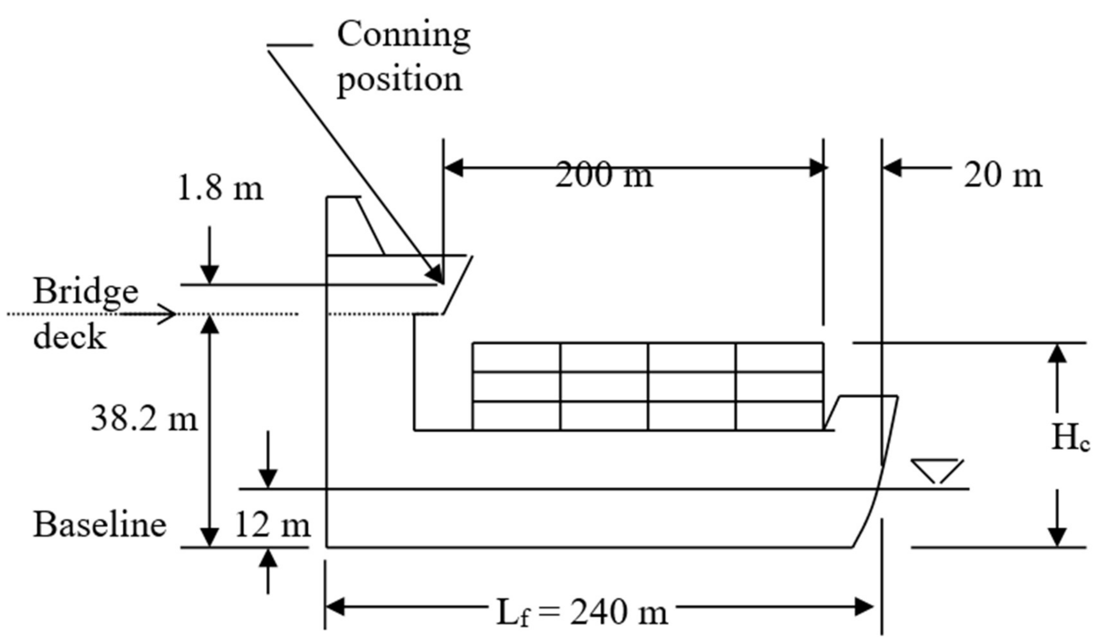
The correct answer is B)

Sample NAME Exam Problem No.41, Solution

Subject: Rules and Regulations

Check the navigation bridge visibility of a new oceangoing ship design using ABS Rules. The ship particulars are as follows:

Height of Bridge Deck above baseline	38.2 m
Height of conning position above Bridge Deck	1.8 m
Distance from conning position to forward end of containers	200 m
Distance from forward end of containers to bow	20 m
Vessel freeboard length, L_f	240 m
Draft	12 m
Trim	0 m



Using the ABS regulations provided below, the maximum allowable height above baseline, H_c (meters) of the forward most container stack is most nearly:

A) 20
B) 23
C) 29
D) 32

Excerpts from: ABS Rules for Building and Classing Marine Vessels ®, 2026

PART 3 Hull Construction and Equipment
CHAPTER 6 Navigation
SECTION 1 Visibility

2 Navigation Bridge Visibility *(2024)*

Vessels of not less than 55 m (180 ft) in length overall are to meet the following requirements for visibility from navigation bridge, unless they are navigating solely the Great Lakes of North America and their connecting and tributary waters as far east as the lower exit of the St. Lambert Lock at Montreal in the Province of Quebec, Canada. Special consideration may be given to vessels that operate only on domestic or on short, limited, international voyages.

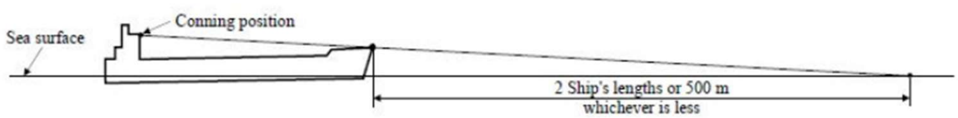
2.1 Field Of Vision

2.1.1 Conning Position

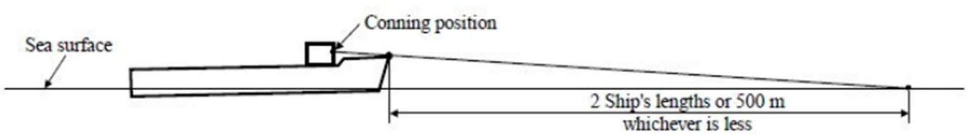
2.1.1(a)

The view of the sea surface from the conning position is not to be obscured by more than 2 L_{OA} (Length Overall) or 500 m (1640 ft), whichever is the less, forward of the bow to 10° on either side for all conditions of draft, trim and deck cargo under which the particular vessel is expected to operate. See [FIGURE 1] as applicable.

FIGURE 1



(a)



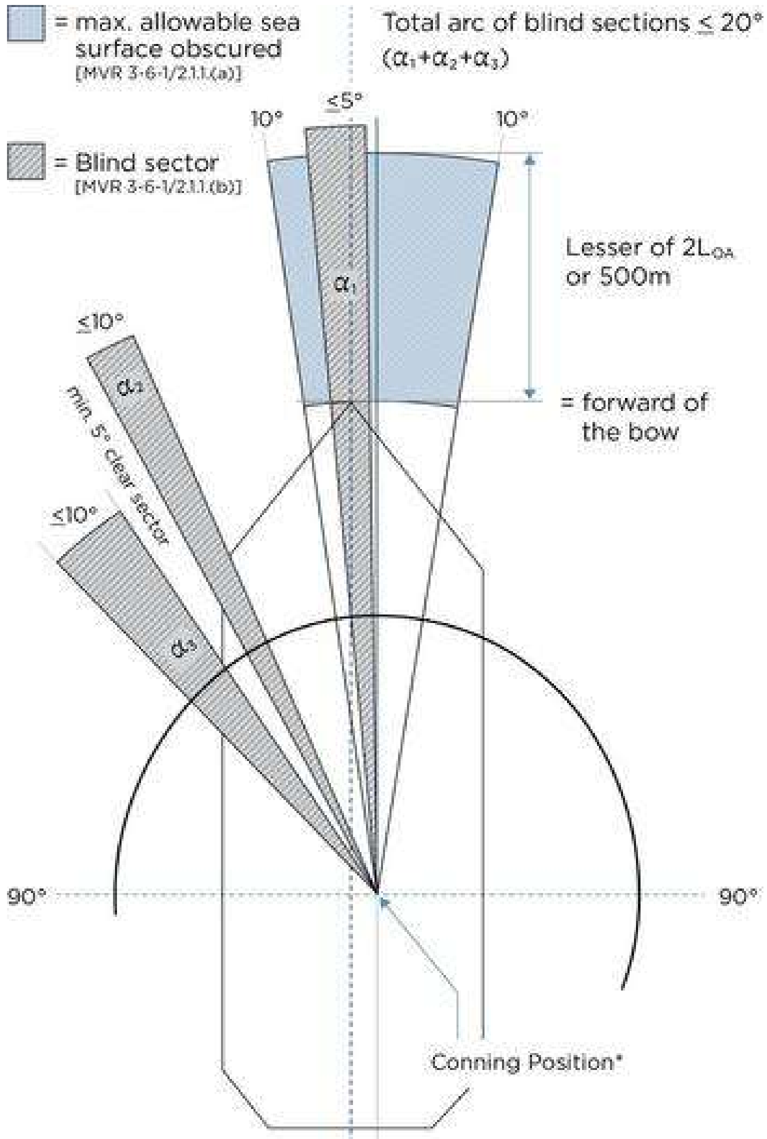
(b)

Notes:

1. A conning position is a place on the bridge with a commanding view and which is used by navigators when commanding, maneuvering and controlling a vessel.
2. Attention is drawn to flag Administrations requiring lengths of less than 2 L_{OA} .

2.1.1(b) ***(2024)***

No blind sector caused by cargo, cargo gear, specialist equipment, support for helicopter deck or other obstructions outside of the wheelhouse forward of the beam which obstructs the view of the sea surface as seen from the conning position is to exceed 10°. The total arc of blind sectors is not to exceed 20°. The clear sectors between blind sectors are to be at least 5°. However, in the view described in [1.1.1(a)], each individual blind sector is not to exceed 5°. See 3-6-1/Figure 1A.



Commentary:

The obstruction by the forward bulwark is to be checked for compliance with the above requirements. If the bulwark does not create a blind sector more than 5°, then it is acceptable to exclude this portion of the bulwark in determining the line of sight from the conning position to the sea surface reference point.

End of Commentary

2.1.1(c)

The horizontal field of vision from the conning position is to extend over an arc of not less than 225°, that is, from right ahead to not less than 22.5° abaft the beam on either side of the vessel. See [FIGURE 3], as applicable.

From ABS Rules, 3-6-1/2.1.1a, *"The view of the sea surface from the conning position is not to be more than $2L_f$ or 500 m, whichever is less."*

Solving for similar triangles:

$$\frac{(480 + 20)}{(H_c - 12\text{ m})} = \frac{200}{(38.2 + 1.8 - H_c)}$$

$H_c = 32$ m

The correct answer is D)

Sample NAME Exam Problem No.42, Solution

Subject: Hydrostatics and Stability

A ship having a beam of 32.2 meters and a design draft of 12.2 meters has a bilge radius of 4.5 meters and a Dead Rise of 0.5 meters. The ship's midship section coefficient (C_m) is most nearly:

A) 0.987
B) 0.978
C) 0.956
D) 0.912

Solution:

A dead rise of 0.5 meters in a half beam of 16.1 meters given the vessel an angle of deadrise of arcsin(0.5/16.1) = 1.779658 degrees.
The lost section area due to Dead Rise becomes 2 x 16.1 x 0.5/2 = 8.05 meter^2
The turn of bilge area with a radius of 4.5 meters minus 1.779658 degrees can be approximated as: 90 - 1.779658 = 88.2203 degrees thus the $4.5^2 - ((88.2203/90)\pi/4)R^2 = 20.25 - 15.5989 = 4.66$ m^2
The section area would then be reduced by 2 x (4.025 + 4.66) = 2 x 8.685 m^2 = 17.37m^2
The net section area is thus (32.2 x 12.2) - 2(8.685) = 375.47 m^2
The Midship Section Coefficient becomes C_m = 375.47/(32.2 x 12.2) = 0.956

The correct answer is C)

Sample NAME Exam Problem No.43, Solution

Subject: Hydrostatics and Stability

A small vessel for ocean service is to be inclined to determine its GM. The vessel dimensions are as follows:

LBP = 75 meters
Beam = 12.5 meters
Draft = 4.5 meters

The vessel's Block Coefficient, $C_B = 0.72$
A 7.5 metric tonne weight is moved transversely a distance of 5.2 meters, causing the vessel to heel 2.6 degrees.

The vessel's GM (meters) is most nearly:

A) 0.15
B) 0.30
C) 0.45
D) 0.66

Solution:

The vessel's displacement is equal to C_B x LBP x B x T ρ = 0.72 x 75 x 12.5 x 4.5 x 1.025 = 3,113.4 tonnes
Heeling Moment = 7.5 x 5.2 tonne meters = 39 tonne-meters
Heeling moment = Displacement x GM x tan Θ
39 = 3113.4 x GM x 0.0454
GM = 0.276 meters

The correct answer is B)

Sample NAME Exam Problem No.44, Solution

Subject: Hydrostatics and Stability

A vessel about to be drydocked in a graving dock has characteristics as listed below:

LBP	150 meters
Beam	20 meters
Draft	4.52 meters Forward; 5.36 meters Aft
TPcm	22.14
MTcm	125
LCF	0.08L aft of midships
Landing Point	0.45L aft of midships

The keel loading at the landing point just prior to being fully landed of the docking blocks is most nearly:

A) 130
B) 140
C) 155
D) 190

Solution:

In order to land on the docking blocks of a graving, the vessel must be trimmed to an even keel. As the MTcm is given as 125 tonne meters per centimeter, the change in trim will be 5.36-4.52 meters = 0.84 meters = 84 centimeters.
The moment to change trim is thus 84 x 125 = 10,500 tonne meters
The vessel will trim about the center of flotation, i.e., the centroid of the waterplane, LCF.
The distance from the LCF to the landing point is 0.45 L- 0.08 L = 0.37 L = 0.37 x 150 = 55.5 meters
The landing force will be 10,500/55.5 = 189.19 tonnes

The correct answer is D)

Sample NAME Exam Problem No.45, Solution

Subject: Propulsion and Power Generation

A 250 hp auxiliary turbine is supplied superheated steam at 600 psia and 750ºF (h = 1,380 BTU/lb). The turbine exhausts to an auxiliary exhaust line at 30 psia at saturated conditions (h = 1,164 BTU/lb). If the turbine has an overall efficiency of 60 %, the steam mass flow rate of the turbine (lbs per hour) is most nearly:

A) 500
B) 3,000
C) 5,000
D) 10,000

Solution

The relationship between the power developed and the steam mass flow rate is expressed as:

$$BHP = \text{mass rate } (h_{in} - h_{out})\ \eta_{ot}/2545 \text{ btu/hp-hr}$$

Where BHP = 250

$$\eta_{ot} = 0.60$$

mass rate = 2545 BHP/(0.6 (1380-1164)) = 636250/129.6 = 4,909 Lbm/Hr

The correct answer is C)

Sample NAME Exam Problem No.46, Solution

Subject: Auxiliary Equipment Selection

A marine engineer is tasked to check the design of a single-pass, counter-flow heat exchanger used to cool lube oil. The oil enters the heat exchanger at 190ºF and is cooled to 150ºF while the sea water enters at 85ºF and leaves at 120ºF. The log mean temperature difference for the heat exchanger is most nearly;

A) 30
B) 60
C) 67
D) 105

Solution:

The Log Mean Temperature Difference (LMTD) for a single-pass, counter-flow heat exchanger is defined as:

$LMTD = (\Delta T_{max} - \Delta T_{min})/Ln(\Delta T_{max}/\Delta T_{min})$

$LMTD = ((T_{oil\text{-}in} - T_{sw\text{-}out}) - (T_{oil\text{-}out} - T_{sw\text{-}in}))/Ln((T_{oil\text{-}in} - T_{sw\text{-}out})/(T_{oil\text{-}out} - T_{sw\text{-}in}))$

$LMTD = ((190 - 120) - (150 - 85))/Ln((190 - 120)/(150 - 85))$

$LMTD = (70 - 65)/Ln\ (70/65) = 70/0.0741 = 67.469°F$

The correct answer is C)

Sample NAME Exam Problem No.47, Solution

Subject: HVAC/Refrigeration

A consulting marine engineer is tasked by a client to evaluate the performance of a ship's ventilation system in order to assess maintenance requirements. After installation of a mounted pitot tube into an inspection port of a 24 inch by 36 inch ventilation fan outlet duct, a measurement indicates a velocity pressure of 0.45 inches of water. The marine engineer calculated that the air flow rate (CFM) was most nearly:

A) 900
B) 10,800
C) 16,100
D) 51,000

Solution:

Velocity pressure is equal to the stagnation pressure minus to the static pressure. Assuming a standard air density of 0.0752 lbm/ft^3, we can calculate:

$V = (2 \text{ x } P_V / \rho)^{1/2} =$

(2 x 0.45 in water x .0361 lbf/in2-in water x 32.2 lbm-ft/lbf-s^2 / (0.752 lbm/ft^3 x 1 ft^2 / 144 in^2))$^{1/2}$ = 44.74 fps.

The air flow in the duct is thus 2 ft x 3 ft x 44.74 ft/s x 60 s/min= 16,107 cfm

The correct answer is C)

Sample NAME Exam Problem No.48, Solution

Subject: Piping System Design

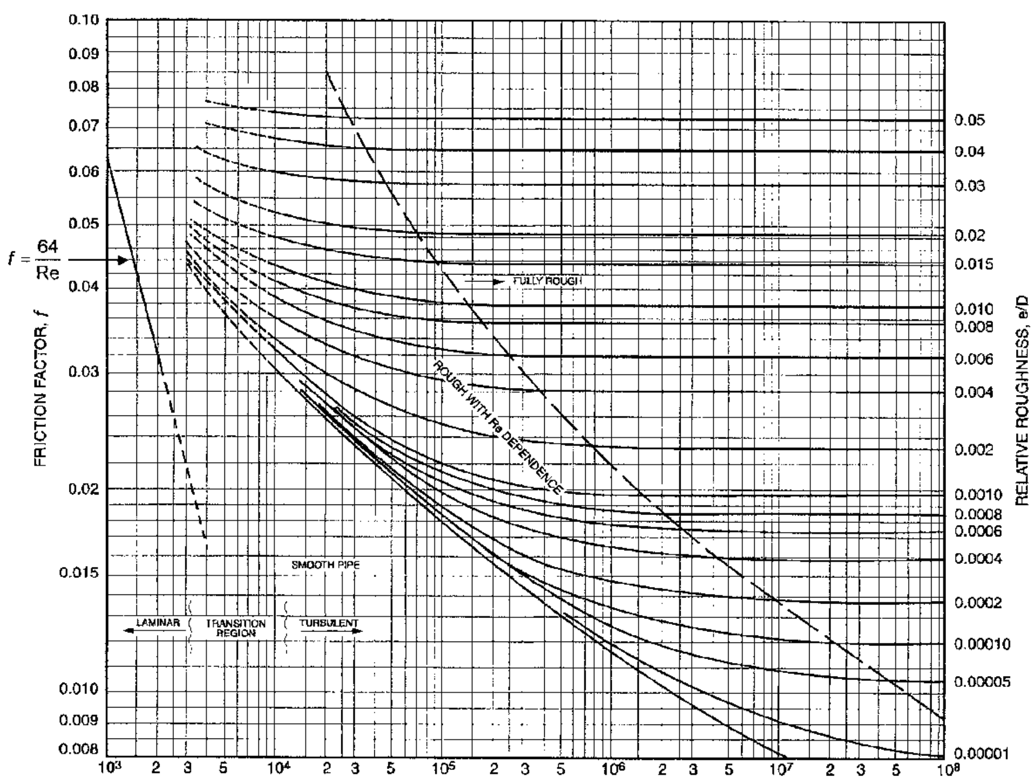
A ship's fire main supplies two fire hoses located on the flying bridge level with a sea-water flow rate of 300 gpm. The flying bridge hydrants are located 85 feet vertically above the elevation of the fire pump discharge. The piping system between the fire pump discharge and the hydrant outlets consists of 200 linear feet of 4-inch, Schedule 40 welded steel pipe, six (6), standard 90-degree elbows, two (2) gate valves and one (1) angle valve, all valves being fully open when providing service. The pressure drop (psi) between the pump discharge and the hydrant outlets is most nearly:

A)	43
B)	44
C)	45
D)	46

Solution:

Reference the Moody (Stanton) Diagram on page 157 of the PE Handbook, duplicated below

MOODY (STANTON) DIAGRAM



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The inside diameter of the 4 inch, Schedule 40 pipe is 4.026 in. = 4.026/12 = 0.3355 ft.
The pipe cross section A = $\pi d^2/4$ = 12.73 in^2 = 0.0884 ft^2
The flow rate of 300 gpm = 300 gpm x 231 in^3/gal /1728 in^3/ft^3 = 40.104 ft^3/min =

$40.104\ ft^3/min/60\ sec/min = 0.06684\ ft^3/sec$.
The flow velocity $V = Q/A = 0.06684\ ft^3/sec/0.0884\ ft^2 = 7.5607\ ft/sec$
The Reynold's Number $R_e = VD/\nu$, where $\nu = 1.1883 \times 10^{-6} m^2/sec$ or $1.2791 \times 10^{-5}\ ft^2/sec$.
Thus, $Re = 7.5607 \times (4.026/12)/1.2791 \times 10^{-5} = 1.983 \times 10^5$
Referring to the Moody (Stanton) Diagram, with the relative roughness
$\varepsilon/D = 0.00015\ ft/(4.026/12) = 0.0004471$, and the R_e above, it is determined that the Frication Factor f = approximately 0.0185

Note that Reynolds number is not high enough to reach the 0.016 horizontal asymptote listed on page 151 of the PE handbook.

The head loss in the piping and valve system can then be determined. From the PE handbook, we find:
Standard 90º elbow-----------30 x f
Gate Valve---------------------8 x f
Angle Valve-------------------55 x f

The head loss can be determined as:
$h = f(200/0.3355 + 6 \times 30 + 2 \times 8 + 1 \times 55)\ V^2/2g =$
$= 0.0185(596.1 + 180 + 16 + 55) \times 7.5607^2/64.34 = 13.723$ psi
Adding this value to the change in head due to elevation, the total head loss becomes
$h_{total} = 14.581 + 85 = 98.723$ ft.
This value can be converted into pressure loss as $h_{press} = h_{total} \times 64\ lbs/ft^3/144in^2/ft^2$
Total pressure loss = $99.581 \times 64/144 = 43.9$ psi

The correct answer is B)

Sample NAME Exam Problem No.49, Solution

Subject: Piping System Design

A ship's fire and sanitary pump, its discharge located 8-feet above the ship's Base Line, discharges seawater into a 6-inch I.D. fire main. For fire protection, the fire main system supplies two, hand-held, 2-1/2 inch fire-hoses fitted with 0.75-inch diameter nozzles located on the ship's Flying Bridge, 115 feet above the Base Line, with a 75 psi nozzle pitot tube pressure.

The pumping capacity (gallons per minute) required in order to supply the two fire nozzles with the pitot tube pressure stated is most nearly:

A) 150
B) 300
C) 450
D) 600

Solution:

Use Bernoulli's Equation,

At the nozzle,

$$z_1 + v_1^2/2g + p_1/\gamma = z_2 + v_2^2/2g + p_2/\gamma$$

$z_1 = z_2$,

Assume that the fluid velocity in the 2-1/2 inch diameter hose is sufficiently small in relation to the fluid velocity thru the 0.75-inch nozzle that it may be safely ignored. Then,

p_2 = atmospheric pressure = 0.0 psig,

$v_1 = 0.0$,

Therefore, $p_1/\gamma = v_2^2/2g$

$p_1 = 75\ \text{lbf/in.}^2 \times 144\ \text{in.}^2/\text{ft.}^2 = 10{,}800\ \text{lbf/ft.}^2$

$g = 32.174\ \text{ft./sec.}^2$

$\gamma = 64\ \text{lbm/ft.}^3$ (for sea water)

$v_2 = (2gp_1/\gamma)^{1/2} = (2 \times 32.174 \times 75 \times 144/64)^{1/2} = 104.2$ fps

$A_2 = (\pi/4)(0.75)^2 /144 = 0.441786\ \text{in.}^2/144\ \text{in}^2/\text{ft}^2 = 0.00306796\ \text{ft}^2$

$Q = A_2\, v_2 = (0.00306796\ \text{ft.}^2) \times 104.2\ \text{ft./sec.} = 0.319697\text{ft}^3/\text{sec.}$

$Q= 0.3197\ \text{ft.}^3/\text{sec.} \times 60\ \text{sec./min.} \times 1728\ \text{in.}^3/\text{ft.}^3/231\ \text{in.}^3/\text{gal.} = 143.49$ gal./ min.

For two fire hose nozzles, the pumping capacity would have to be <u>286.98 gal. / min.</u>

The correct answer is therefore B)

Sample NAME Exam Problem No.50, Solution

Subject: Piping System Design

A ship's fire and sanitary pump, its discharge located 8-feet above the ship's Base Line, discharges seawater into a 6-inch I.D. fire main. For fire protection, the fire main system supplies two, hand-held, 2-1/2 inch fire-hoses fitted with 0.75-inch diameter nozzles located on the ship's Flying Bridge, 115 feet above the Base Line, with a 75 psi nozzle pitot tube pressure.

Assuming the pressure drop in the fire main due to fluid flow losses between the pump discharge and the Flying Bridge nozzles is 25 psi, and ignoring the fluid flow velocity head at the pump discharge, the pump discharge pressure (psi) while supplying the two fire hoses is most nearly:

A) 100
B) 125
C) 150
D) 175

Solution:

Assume the specific weight of seawater can be taken as 64 lbm/ft^3. The vertical head loss from pump discharge to fire hose location = 115-8 = 107 ft. which is equivalent to a pressure drop of
107ft. x 64lbsf/ft.^{3} / 144in.^{2}/ft.^{2} = 47.55 lbsf/in.^{2}
Thus, the fire and sanitary pump discharge pressure:

p_d= 25 + 47.55 + 75 =<u>147.55 psig.</u>

The correct answer is therefore C)

Sample NAME Exam Problem No.51, Solution

Subject: Piping System Design

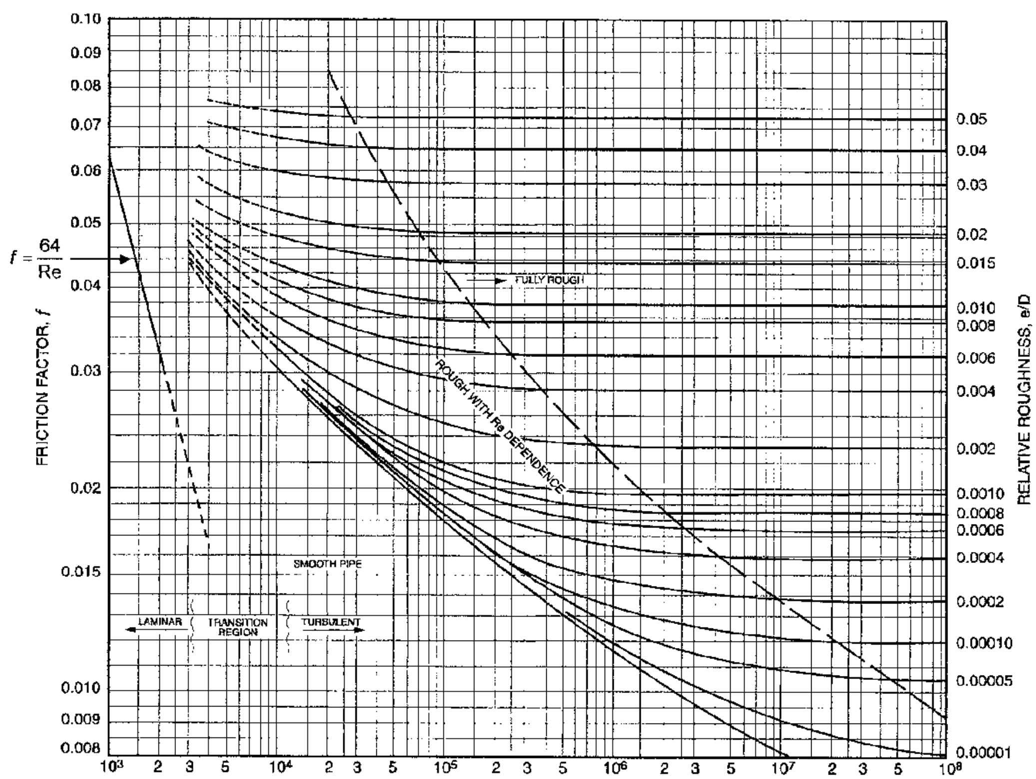
100 gpm of water at 68 degree F. flows through 500 feet of a 2- inch schedule 40 steel pipe, having a nominal surface roughness of 150 x 10^{-6} ft. The pressure drop (pounds per square inch) over this length is most nearly:

A) 8
B) 15
C) 75
D) 150

Solution

Reference the Moody (Stanton) Diagram on page 157 of the PE Handbook, duplicated below

MOODY (STANTON) DIAGRAM



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100 gpm = 100 *(231 in^3/gal)/1728 in^3/ft^3 = 13.368 ft^3 per minute
2 inch Schedule 40 steel pipe has an inside diameter of 2.067 inches = 2.067/12 = .17225 feet
The steel has a roughness, e = 150 x 10^{-6} feet. Therefore the e/D = 150x10^{-6}/0.17225 = 0.0008708

The fluid velocity in the pipe is V = Q/A = (13.368ft^3/min)/ ((π/4)D^2) = 573.66 Ft/min
Or (573.66 ft/min)/(60 sec/min) = 9.56 ft/sec
Checking the Reynolds number as Re = $\rho VD/\mu$ = 1.937 $*$ 9.56 $*$ (2.067/12) /20.96$*10^{-6}$ = 1.522 x 10^5

We see the flow is almost fully turbulent and the friction factor, f, should be about 0.02, or just a bit more: Head Loss $\Delta h = kV^2/2g$ where $k = f\ L/D = 0.02*500/(2.067/12) = 58.055$
$\Delta h = 58.055 * (9.56^2 ft^2/sec^2) /2*32.174\ ft/sec^2 = 82.45$ ft.
But a 1-ft head is equivalent to 62.4/144 = 0.4333 psi. Thus the pressure drop over the 500ft becomes 0.4333 * 82.45 = 35.7 psi

The correct answer is B)

Sample NAME Exam Problem No.52, Solution

Subject: Electrical Systems

An electrically driven circulating pump delivers 800 gpm of sea water to a lubricating oil cooler. The total head of 45 feet is developed by the pump. If the pump efficiency is 75%, the brake horsepower (hp) required to drive the pump is most nearly:

A) 10
B) 12.5
C) 15
D) 20

Solution

The required electric motor horsepower can be determined from the expression:

$$P_{req} = \frac{H\,(Q)\,sg}{3960\,(\eta_p)}$$

Where: H = 45 feet

$Q = 800$ gpm
$Sg = 1.025$
$\eta_p = 0.75$

Power required = 45 (800) 1.025/3960 (0.75) = 12.4 hp

The correct answer is B)

Sample NAME Exam Problem No.53, Solution

Subject: Piping System Design

A ship having a mean draft of 28 feet has a 300 gpm centrifugal pump that has its suction eight (8) feet above the ship's baseline. The pump suction is connected to a 4" schedule 40 pipe and delivers 60ºF sea water to a heat exchanger. The vapor pressure of 60ºF sea water, $P_v = 0.2561$ psi. The Net Positive Suction Head Available (psi) at the pump inlet is most nearly:

A) 20
B) 34
C) 53
D) 61

Solution

The diameter of a 4" schedule 40 steel pipe is 4.026 inches therefore the cross section area of the inlet pipe is $A_i = \pi D^2/4 = 12.73\ in^2 = 0.0884\ ft^2$

The fluid flow is 300 gpm = 300 x $231 in^3/gal/1728\ in^3/ft^3 = 40.1\ ft^3/min = 0.6684\ ft^3/sec$

The inlet velocity is thus $V_i = Q/A_i = 0.6684/0.0884 = 7.56$ ft/sec

The inlet water head = 28 ft – 8 ft = 20 ft

Atmospheric pressure is taken at 14.7 psi, = $P_s = 14.7$

Specific Gravity (sg) for sea water is taken at 1.025

$Z_s = 28$ ft – 8 ft = 20 ft

$Z_{fs} = 0.0$ as we are looking at the conditions at the pump suction, ignoring inlet friction loss

$$NPSHA = (P_s - P_v)/(0.433\ (sg)) + V^2/2g + Z_s - Z_{fs}$$
$$= (14.7 - .2561)/0.433\ (1.025) + 7.56^2/2(32.174) + (20) - 0.0$$
$$= 32.52 + 0.888 + 20 = 53.408 \text{ ft.}$$

The correct answer is C)

Sample NAME Exam Problem No. 54, Solution

Subject: Auxiliary Equipment Selection

A ship's fire and sanitary pump, its discharge located 8-feet above the ship's Base Line, discharges seawater into a 6-inch I.D. fire main. For fire protection, the fire main system supplies two, hand-held, 2-1/2 inch fire hoses fitted with 0.75-inch diameter nozzles located on the ship's Flying Bridge, 115 feet above the Base Line, with a 75 psi nozzle pitot tube pressure.

Assuming the pump has a suction head of 12 feet, an 85 percent pumping efficiency, η_p, and discharges 300 gpm at a discharge pressure of 150 psig, the pump's required input shaft horsepower is most nearly:

A) 15
B) 20
C) 25
D) 30

Solution:

Q = 300 gpm,

p_d = 150 psig;

p_s = 12ft. x 64 lbsf/ft.^{3}/144in.^{2}/ft.^{2}
= 5.33 psi
Bhp = Q x (p_d - p_s)/(1714 x η_p)
Bhp = 300 x (150 - (12 x 64/144) / (1714 x η_p)
= 29.79 hp

Or, alternatively:

Q = 300 gpm x 231 in.^{3}/gal. x (64 lbm/ft.^{3}/1728 in.^{3}/ft.^{3}) = 2,566.66 lbm/min.
H = 150 lbf/in.^{2} x 144 in.^{2}/ft.^{2}/ 64 lbm/ft.^{3} - 12 = 325.5 ft.
Bhp = Q x H / (33,000 ft-lb/min. x η_p)
= 2,566.66 x 325.5/ (33,000 x 0.85) = 29.79 hp

The correct answer is therefore D)

Sample NAME Exam Problem No. 55, Solution

Subject: Ocean Engineering

A designer is assigned the task to evaluate the seakeeping performance qualities of a proposed 23-knot ship in an operating area where specifically appropriate spectral wave data are not available. It is suggested that the two-parameter Bretschneider Spectrum be used for observed conditions in the proposed ship's operating area, including a most probable wave height, H_v, of 6.0 meters with an 11.0 second observed wave period, T_v. Based on these values, the Bretschneider Spectrum will have significant wave height, $H_{1/3}$, (meters) and modal value, ω_m, (radians per second) most nearly:

A) 5.5 and 0.47
B) 6.0 and 0.50
C) 6.4 and 0.54
D) 7.1 and 0.57

Solution:

The Bretschneider Spectrum is defined, and the Significant Wave Height, $H_{1/3}$, and Modal Value, ω_m, are defined in terms of observed values of wave height, H_v, and observed wave period, T_v, as follows:

$$H_{1/3} = 1.68\ H_v^{0.75}$$

$$\omega_m = 5.44/T_v^{0.96}$$

Thus for the above given values, $H_{1/3} = 1.68 \times 6.0^{0.75} = 6.44$ meters, and
The modal value $\omega_m = 5.44/11.0^{0.75} = 0.544$ radians per second

The correct answer is (C)

Distracters:
If observed wave height, H_v, is confused with significant wave height, then $H_{1/3} = 6.0$ meters
If the factor 1.68 is used erroneously as 1.86, then $H_{1/3} = 7.13$ meters
If the observed period is confused with the modal period, then the modal value
$\omega_m = 2\pi/T_m$, or $2 \times 3.14159/11.0 = 0.571$
If the observed period is not raised to the 0.96 power, then $\omega_m = 5.44/11 = 0.495$

Sample NAME Exam Problem No. 56, Solution

Subject: Propulsion and Power Generation

A preliminary design is being developed for a 26-knot containership. Model tests have resulted in a predicted propulsion thrust requirement of 330,000 pounds. If the vessel form has an estimated propulsion efficiency of 72 % and the line shafting incurs losses of 2 %, the required shaft horsepower to be delivered by the main engine is most nearly:

E) 37,000
F) 35,000
G) 27,000
H) 25,000

Solution:

Power is simply defined as force x velocity. A 26-knot velocity translates to 26 x 6080/3600 = 43.91 feet/second and the thrust power of the vessel would then be P = 330,000 x 43.91/550 = 14,490,000/550 horsepower = 26,346.
Given a propulsive efficiency of 72 %, and line shafting losses of 2 %, the engine would have to deliver 26346/(.72 x .98) = 37,339 H.P.

The correct answer is A)

Sample NAME Exam Problem No. 57, Solution

Subject: Propulsion and Power Generation

A marine engineer is tasked to estimate the required fuel capacity for a new 24 knot vessel planned for operation between ports on the North American continent and Australia. It is expected that a round-trip voyage would cover 22,000 nautical miles with stops at eight (8) ports. The vessel is to be powered by a 45,000 SHP diesel main engine having a specific fuel consumption of 0.35 lbs. per shaft horsepower-hour. It is planned that the fuel to be used will be low-sulfur Bunker C residual, 13 degrees API gravity, bunkering in North American ports, with an estimated heating value of 18,500 BTU/Lb. The required fuel capacity (L.Tons) is most nearly:

A) 7,000
B) 6,000
C) 5,000
D) 4,000

Solution:

At 45,000 SHP x 0.39 lbs per SHP-Hr, fuel consumption = 45,000 x 0.39 x 24 = 421,200 lbs per day = 180.036 L.Tons per day
Distance traveled is 24 x 24 = 576 nautical miles per day
Time at sea for 22,000 nautical miles = 22,000/576 = 38.19 days at sea
Fuel consumption becomes 38.19 x 180.036 = 7,181.92 L.Tons

The correct answer is A)

Sample NAME Exam Problem No.58, Solution

Subject: Propulsion and Power Generation

A set of spur gears is to transmit 35 horsepower with a pinion speed of 1750 RPM. The pitch diameter of the pinion is 6 inches and the diametral pitch is 3. The pitch diameter of the driven gear is 24 inches and its diametral pitch is 3. The contact force (pounds) at the line of contact is most nearly:

A) 35
B) 105
C) 210
D) 420

Solution:

At 1750 RPM, the torque being transmitted is:
$T = 33{,}000 * 35/2\pi*RPM = 33{,}000 * 35/2*3.14159*1750 = 105.04$ ft-lbs.
The torque is developed as the pitch radius * contact force, or
$F_C = T/R$; $F_C = 105.04$ ft-lbs/(3/12) = 420 lbs.

The correct answer is D)

Sample NAME Exam Problem No.59, Solution

Subject: Propulsion and Power Generation

A ship's propeller tail-shaft has been removed to the shipyard's shop where it is to be fitted with a bronze liner. The shaft diameter is 0.254m and the liner, which is 0.0127 m thick, is to be shrink-fitted on to the shaft. The bronze material has a linear coefficient of thermal expansion of $\alpha = 21.24 \times 10^{-6}$ m/m degree Celsius. If the liner is bored for an internal diameter of 253.8 mm and heated to 165 degrees C above the shop's ambient temperature of 22 degrees C., so as to facilitate its fitting onto the shaft, the liner's clearance (mm) during its fitting will be most nearly:

A) 0.31
B) 0.70
C) 0.89
D) 1.07

Solution:

Thermal expansion in a homogeneous material is equal in all directions. Therefore all dimensions change proportionately. The liner's internal diameter will expand to a dimension $D_T = D_O (1 + \alpha\ \delta T) = 253.8 (1 + 0.00002124 \times 165) = 253.8 (1.0035046) = 254.689$ mm. The shaft-liner clearance will therefore be 254.689-254 = .689mm.

The correct answer is therefore B)

Sample NAME Exam Problem No.60, Solution

Subject: Corrosion

Fretting corrosion of main propulsion line shafting caused by minute movements between mating parts may produce sites for fatigue crack initiation. Fatigue life of tailshafts subject to fretting can be greatly improved by:

A) Case Hardening the tailshaft
B) Using High Strength steel
C) Cold Rolling the shaft surface
D) Normalizing and Tempering the tailshaft

Solution:

The use of Case Hardening is typically for increasing wear resistance.
The use of High Strength steel does not materially increase the corrosion-fatigue life of a tailshaft as the fatigue life of High Strength steel in not materially different from that of lower strength steels. Propulsion shafting for merchant ships is usually made from annealed, normalized or normalized and tempered plain carbon steel forgings.
Cold Rolling of tailshafts "may not eliminate the formation of fatigue cracks; it does, however, produce residual compressive stresses in the surface layer of the shaft, and this retards the propagation of fatigue cracks if they do form."

The correct answer is C)
For a discussion on shafting, refer to Section 6.9, Chapter XXII of Marine Engineering by Harrington, SNAME 1992

Sample NAME Exam Problem No.61, Solution

Subject: HVAC/Refrigeration

Using the Psychrometric Chart below, and assuming the specific volume of dry air is approximately fourteen cubic feet per pound, the moisture content (Lbs per hour) of an air flow of 5,000 CFM when the dry bulb temperature is 75 degrees Fahrenheit and the relative humidity is 60 % is most nearly:

A) 214
B) 235
C) 257
D) 278

Solution:

Assuming that the specific volume of air is 14 cubic per pound , the specific weight of air is about 0.0714 pounds per cubic foot. Thus, 5,000 CFM is 300,000 cubic feet per hour and reading from the Chart, and it is seen that the moisture content is most nearly 0.0110 pounds of moisture per pound of air.

The moisture content is therefore 300,000 x 0.011/14 = 235.7 pounds of moisture.

The correct answer is B)

Sample NAME Exam Problem No.62, Solution

Subject: HVAC/Refrigeration

The air conditioning system for a ship's accommodation spaces delivers 4,800 cfm. If the system takes in 15% outside air at a temperature of 90 degrees F and 80% relative humidity, the additional thermal loading of the system (BTU/Hr.) in order to deliver the outside air at 68 degrees F and 50% relative humidity is most nearly.

A) 20,000
B) 40,000
C) 60,000
D) 80,000

Solution:

Using the Psychrometric chart, it is found that the enthalpy of the outside air is approximately 49.8 BTU/Lb. and the enthalpy of the delivered air is approximately 24.6 BTU/Lb. Thus the required reduction in enthalpy is 49.8-24.6 = 25.2 BTU/Lb.
The outside air delivered = 0.15 x 4,800 = 720 cfm
With a nominal specific volume of air at 14 ft^3 per Lb, the outside air would weigh 720/14 = 51.42 lbs/minute.

The enthalpy reduction would be 51.42 x 25.2 = 1295.78 BTU/minute = 77,747 BTU/Hr.

The correct answer is D)

Sample NAME Exam Problem No.63, Solution

Subject: Electrical Systems

A 3-phase, 60 hz, 440V/120V step-down transformer provides 25 KVA to a 0.8 power factor load. The transformer is connected Delta-Wye. The line current (Amps) feeding the transformer is most nearly:

A) 56.8
B) 45.5
C) 32.8
D) 26.2

Solution:

As the phase 1 will have the same voltage as the line voltage, $V_{phase\ 1} = V_{line\ 1} = 440$ V , the line current will be $I_{line\ 1} = 25KVA/\ (3^{1/2})*440V = \ 32.8$

The correct answer is C)

Sample NAME Exam Problem No.64, Solution

Subject: Electrical Systems

The table on the following page is extracted from an actual electric power load analysis:

Two high-pressure air compressors requiring 25 HP each and powered by 25 HP, 3 phase, 90% efficient motors are to be installed as additional ship's auxiliary machinery. Under normal SHORE conditions, one of the compressors will be on standby. The system air requirements are such that the operating compressor cycles on/off 50% of the time. The ship's new calculated electrical load (kW) seen by the power plant in the normal SHORE mode is most nearly:

A) 70
B) 80
C) 90
D) 110

Solution:

KW = HP x .746 / motor eff.
= 25 x .746 / .90
= 20.72 kW

254	0	HP AIR COMPSR (RUNNING)	1	25.0	20.72	0.5	10.36
255	0	HP AIR COMPSR (STANDBY)	1	25.0	20.72	0.0	0.00
							10.36
		Existing plant, SHORE MODE					68.42
		Summation					78.78

The correct answer is B)

Line No.	Call No.	Name of Equipment	Qty	Rated Hp	Conn KW	SHORE LF	SHORE KW	ANCHOR LF	ANCHOR KW	POSITIONED LF	POSITIONED KW	CRUISE LF	CRUISE KW	CARGO OPER. LF	CARGO OPER. KW	EMERGENCY LF	EMERGENCY KW
235	0	SS/CONTROL AIR COMPSR	2	20.0	34.00	0.0	0.00	0.1	3.40	0.1	3.40	0.1	3.40	0.1	3.40	0.0	0.00
236	0	SS/CONTROL AIR DRYER	2	0.0	3.00	0.1	0.30	0.1	0.30	0.1	0.30	0.1	0.30	0.1	0.30	0.0	0.00
237	0	BRONIRE PROPORTIONER	2	0.2	0.40	0.1	0.04	0.1	0.04	0.1	0.04	0.1	0.04	0.1	0.04	0.0	0.00
238	0	RECIRC BROMINE SYS	1	0.2	0.20	0.5	0.10	0.5	0.10	0.5	0.10	0.5	0.10	0.5	0.10	0.0	0.00
239	0	STORES REFR PLANT	2	25.0	42.00	0.3	12.60	0.3	12.60	0.3	12.60	0.3	12.60	0.3	12.60	0.0	0.00
240	0	REFR SP CIRC FAN	2	0.2	0.40	0.9	0.36	0.9	0.36	0.9	0.36	0.9	0.36	0.9	0.36	0.0	0.00
241	0	REFR SP DEFR HTR	2	0.0	2.00	0.1	0.20	0.1	0.20	0.1	0.20	0.1	0.20	0.1	0.20	0.0	0.00
242	0	FREEZE RM DRAIN MTR	1	0.0	0.60	0.9	0.54	0.9	0.54	0.9	0.54	0.9	0.54	0.9	0.54	0.0	0.00
243	0	D/G PRELUBE PMP	7	2.0	12.60	0.1	1.26	0.1	1.26	0.1	1.26	0.1	1.26	0.1	1.26	0.0	0.00
244	0	DIESEL GEN HEATERS	7	0.0	21.00	0.8	16.80	0.8	16.80	0.6	12.60	0.6	12.60	0.2	4.20	0.0	0.00
245	0	EMER D/G J.W. HTR	1	0.0	1.00	0.9	0.90	0.9	0.90	0.9	0.90	0.9	0.90	0.9	0.90	1.0	1.00
246	0	VALVE HYDR PWR PACK	2	10.0	17.00	0.1	1.70	0.1	1.70	0.1	1.70	0.1	1.70	0.3	5.10	0.0	0.00
247	0	VEHICLE WASH FW PUMP	2	7.5	13.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.3	3.90	0.0	0.00
248	0	VEHICLE F.O. PUMP	1	1.5	1.40	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.3	0.42	0.0	0.00
249	0	CATHODIC PROT SYS	4	0.0	37.20	0.9	33.48	0.9	33.48	0.9	33.48	0.0	0.00	0.0	0.00	0.0	0.00
250	0	SUBMERSIBLE PUMP	2	5.0	8.80	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
251	0	SUBMERSIBLE PUMP	1	5.0	4.40	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
252	0	EDG/BT/INC FO XFR PMP	1	1.5	1.40	0.1	0.14	0.1	0.14	0.1	0.14	0.1	0.14	0.1	0.14	0.0	0.00
253	0	INCINERATOR	1	20.0	17.00	0.0	0.00	0.1	1.70	0.1	1.70	0.1	1.70	0.1	1.70	0.0	0.00
		SUMS =			217.40		68.42		73.52		69.32		35.84		35.16		1.00

Sample NAME Exam Problem No.65, Solution

Subject: Electrical Systems

An electrical power plant of a containership consists of three 1,700 KW, 480/3/60 diesel generators that provide electrical power for propulsion auxiliaries, lighting, hotel loads, and refrigerated cargo containers. Normal operation is for two of the generators to operate in parallel, equally sharing the load, and the third generator for standby operation.

Assuming no circulating currents, if the propulsion auxiliaries consume 1,200 KW at a 0.75 lagging power factor, the hotel and lighting loads consume 300 KW at a 0.80 lagging power factor, and the refrigerated cargo containers consume 1,500 KW at a 0.60 lagging power factor, the system power factor is most nearly:

(A) 0.59 lagging
(B) 0.63 lagging
(C) 0.67 lagging
(D) 0.71 lagging

Solution:

$$PF = KW_{total} / KVA_{total}$$

$$KW_{total} = 1{,}200 + 300 + 1{,}500 = 3{,}000 \text{ KW}$$

$$KVA_{total} = \frac{KW_1}{PF_1} + \frac{KW_2}{PF_2} + \frac{KW_3}{PF_3}$$

$$= \frac{1200}{0.75} + \frac{300}{0.80} + \frac{1{,}500}{0.60}$$

$$= 4{,}475 \text{ KVA}$$

$$PF = \frac{3{,}000}{4{,}475}$$

$$= 0.670 \text{ lagging}$$

The correct answer is C)

Sample NAME Exam Problem No.66, Solution

Subject: Electrical Systems

The compressors of a ship's refrigeration system are driven by four (4) 25 hp, 1750 rpm electric motors. The refrigeration compressors require an input torque of 66 foot-pounds at 1750 rpm under normal, at-sea operating conditions, on a 20-minute per half-hour cycle. The motor efficiency is approximately 80% at half rated load, 86% at 75% rated load and 90% at 100% rated load. The contribution to the at-sea electric power load analysis (kW) for the refrigeration system is most nearly:

A) 12
B) 22
C) 50
D) 90

Solution:

Motor output Power required = Tft.lbsf x ω rad/sec/550 ft-lbf/sec = $(66 \times 1750 \times 2\pi / 60)/550 = 66 \times 183 / 550 = 21.99$ hp
Motor Utilization = 21.99/25 = 0.8796
Motor Efficiency = ((0.8796-0.75)/0.25)(0.90-0.86) + 0.86 = 0.8807

Motor Input Power = 21.99/0.8807 = 24.967
Motor Use Factor = 20/30, therefore nominal load = 24.967 x 2/3 = 16. 645 hp = 16.645 x 746
= 12.417 Watts

But for the 4 motors, the total Load will be 4 x 12.417 = 49.668 kW

The correct answer is C)

Sample NAME Exam Problem No.67, Solution

Subject: Electrical Systems

A marine engineer is tasked to perform an electrical load analysis for a machinery system design. The machinery space ventilation system has port and starboard fans driven by 60 horsepower squirrel cage induction motors operating on 240 volt, 60 Hz, 3-phase power. During at-sea operations, the service factor is 0.85 and the motor efficiency is 91%. The contribution to the at-sea electrical load analysis (kW) is most nearly:

A) 44.8
B) 49.2
C) 76.1
D) 83.6

Solution:

$$KW = 2 * 60 * .746 * 0.85/0.91 = 83.6kW$$

The correct answer is D)

Sample NAME Exam Problem No.68, Solution

Subject: Structural Design

A W Shape I-Beam section is to be used for support of a ship's stores crane operating from a vessel's side port. The crane lifting capacity is to be 2 L.tons, and the beam is to extend 15 feet outboard of the support located just inside the ship's side, the inboard support being located 10 feet farther inboard. The lightest weight W-Shape I-Beam section that will have a maximum shear stress not to exceed 13.6 ksi and a maximum normal stress not to exceed 20 ksi is most nearly

A) W 24 x 55
B) W 21 x 44
C) W 16 x 36
D) W 10 x 39

Solution:

The beam bending moment loading will be 2 x 15 = 30 L. ton-feet = 806,400 inch-lbs. At the outer support point while the beam shear force loading from the load point to the first support will be 2 L. tons = 4480 lbs, and from that point inboard to the inner end it will be 2 x 15/10 = 3 L.tons or 6720 lbs.

.

For the cantilever beam, the required Section Modulus will be

$I/c = M/\sigma_{All} = M/20{,}000 = 806{,}400/20{,}000 = 40.32$ inches ^{3}

The section W 16 x 36 is the lightest weight W Shape that meets the normal stress requirement. Its properties show a web thickness of .295 inches, a flange width of 6.99 inches, thickness of .43 inches and depth of 15.9 inches.

We can check the shear stress by $\tau = VQ/It$ where

V = 6720 lbs,

I = 272 inches^4, and

t = 0.4375

$Q = \Sigma (A_i * y_i) = 6.99*0.43*(15.9/2 - 0.43/2) + 0.295*(15.9/2 - 0.43/2)^2/2$

$= 23.25 + 8.825 = 32.075$ inches^3

Therefore the maximum shear stress = 6720*32.075/(272*0.295) = 2686.2 psi, well below the allowable shear stress.

The correct answer is therefore C)

Sample NAME Exam Problem No. 69, Solution

Subject: Structural Design

An insulated aluminum LNG tank having a diameter of 35 meters is to be cooled from 75 degrees Fahrenheit above zero to 260 degrees Fahrenheit below zero while the supporting steel structure remains at ambient temperature. If the average coefficient of thermal expansion of aluminum over that temperature range is $\alpha = 11 \times 10^{-6}$, the relative vertical shrinkage (Inches) of the tank with respect to the support structure will be most nearly:

A) 0.5
B) 2.5
C) 5.0
D) 25

Solution:

Thermal changes are homogeneous, i.e., as the material is considered to be homogeneous, so too are the changes that take place due to temperature change.

The 35 meters diameter, D, is 35 m x 39.37 in/m =1377.95 inches.

The change in diameter is computed as:

$$\delta D = \alpha\, \delta T\, D = 11 \times 10^{-6} \times (75 - (-260)) \times 1377.95$$
$$= 5{,}077{,}745.75 \times 10^{-6} \text{ inches} = 5.0777 \text{ inches}$$

The correct answer is C)

Sample NAME Exam Problem No.70, Solution

Subject: Corrosion

Uncoated steel structure in a saltwater ballast tank has a nominal wastage of about 0.1 mm per year. The surface wastage on a vessel's ballast tank spaces over a 25-year service life will weigh (kilograms per 1000 square meters) most nearly:

A) 20
B) 200
C) 2,000
D) 20,000

Solution
With a wastage of 0.1 mm per year, the wastage over 25 years will be 2.5 mm and on a surface area of 1,000 square meters, it will amount to 2.5 mm x 1,000 m = 2.5 cubic meters. The specific gravity of steel is about 7.85 so a cubic meter of steel would weigh about 7.85 Tonnes or 7,850 kilograms. Thus, the wastage would weigh about 2.5 x 7,850 = 19,625 kilograms.

The correct answer is D)

Sample NAME Exam Problem No. 71, Solution

Subject: Hydrodynamics

A passenger ferry steaming at sixteen knots across the eight-mile wide inlet channel of a bay to its southern terminal encounters an incoming tide of 4.5 knots. If the pilot wishes to maintain a course made good of 180 degrees and the tidal current flows due west, the course (degrees true) to be steered is most nearly:

A) 186
B) 180
C) 164
D) 74

Solution:

By drawing a vector diagram showing the 180 degree course made good pointing downward, with the 4.5 knot current velocity indicated horizontally to the right, the sixteen knot vessel speed would be indicated as the hypotenuse of the right triangle, the base being the 4.5 knot current velocity and the triangle altitude being the vessel speed made good on the 180 degree course. It can be seen that 4.5 knots divided by 16 knots is the sin of the angle representing the course change necessary to maintain the 180 degree course desired. That is, asin (4.5/16) = 16.3348 degrees. Thus, in order to maintain a course made good of 180 degrees when traveling at sixteen knots in a 4.5 knot current, the pilot would have to steer a course of 180 - 16.3348 = 163.6652, or approximately 164 degrees.

The correct answer is C)

Sample NAME Exam Problem No.72, Solution

Subject: Hull Outfitting

An oceangoing supply vessel anchor windlass is to be driven by an electric motor. The vessel has an anchor weighing 480 kg with 150 meters of 22 mm diameter anchor chain, weighing 13.5 kg per meter. It is required that the windlass be capable of weighing anchor when fully paid-out at a speed of 1 meters per second. If the friction coefficient for drawing the anchor chain through the hawse pipe is 0.25, the required power (kw) of the windlass motor is most nearly:

A) 61.4
B) 53.4
C) 30.7
D) 26.7

Solution

The anchor chain has a weight of 13.5 kg per meter and it is150 meters long so that its weight is $W_{C\,=}$ 150 * 13.5 = 2025 kg and the total weight of anchor and chain is 2505 kg.

With a hawse friction factor or 0.25, the effective weight of anchor and chain when being hoisted will be (1.25)*2505 = 3131,25 kg. However, the anchor and chain when fully payed out will be assumed to be immersed in the seawater (there is no information indicating how much of the chain may be in air) and its effective weight will be reduced by the buoyancy of the displaced seawater. As the steel anchor and chain have a specific gravity of about 7.85 and the seawater has a specific gravity of about 1.025, the effective weight will be reduced by the factor (7.85-1.025)/7.85 = 0.8694. The effective weight of immersed anchor and chain will therefore be 0.8694*3131.25 = 2722.4 kg.

Hoisting the anchor at a velocity of 1 meter per second requires 2722.4 kgf-meters/second. From a power conversion table we find that 1 kgf-meter/sec = 0.009807 kW. Therefore the windlass motor power required will be 2722.4 *0.009807 = 26.698 kW.

The correct answer is D)

Sample Exam Problem No.73, Solution

Subject: Hull Outfitting

A ship owner is interested in modifying his ship's steering system by adding an auxiliary steering gear for emergency use with the ship's speed at 19 knots and the rudder angle restricted to 10 degrees. Sea trial data were used to establish a rudder torque of 23.4 x 10^6 pound-inches when the ship's speed was 19 knots and its rudder angle was 45 degrees, based on the following relationships:

Rudder Force = (4.6 K A V^2 Sin α)/(0.39 + 0.61 Sin α)

Where K = Constant

A = Rudder Area (Square Feet)

V = Ship Speed (Knots)

α = Rudder Angle (Degrees)

and,

Moment Arm = (0.195 + .305 Sin α) x Rudder Width

The estimated rudder torque value (pound-inches x 10^6) at a ship speed of 19 knots and rudder angle of 10 degrees is most nearly:

A) 15
B) 10
C) 6
D) 2

Solution

As the terms 4.6 K A V^2 and rudder width are constant, the torque at various rudder angles for a constant 19 knot ship speed can be determined as follows:

Torque = Force x Arm or $T_1 = F_1 \times MA_1$ and $T_2 = F_2 \times MA_2$

Therefore, $T_2/T_1 = (F_2 x MA_2)/(F_1 \times MA_1)$; $T_2 = T_1(F_2 \times MA_2)/F_1 \times MA_1)$

The 4.6 KAV^2 terms cancel and the rudder width terms cancel

$$T_2 = 23.4 \times 10^6 \frac{((\text{Sin } \alpha_2)/(0.39 + 0.61 \text{ Sin } \alpha_2))(0.195 + 0.305 \text{ Sin } \alpha_2)}{((\text{Sin } \alpha_1)/(0.39 + 0.61 \text{ Sin } \alpha_1))(0.195 + 0.305 \text{ Sin } \alpha_1)}$$

where α_1 = 45 degrees and α_2 = 10 degrees

Substituting values we obtain:

$$T_2 = 23.4 \times 10^6 \frac{((0.173648)/(0.39 + 0.61 \times 0.173648))(0.195 + 0.305 \times 0.173648)}{((0.707107)/(0.39 + 0.61 \times 0.707107))(0.195 + 0.305 \times 0.707107)}$$

T2 = 23.4 x 10^6 x ((0.086824/0.353553)) = 0.2455756 = 5.746469 x 10^6

The correct answer is C)

Sample NAME Exam Problem No.74, Solution

Subject: Outfitting

A shipyard is planning to fabricate sub-assembly sections consisting of a longitudinally stiffened 9/16-inch thick plate with inverted L8 x 4 x 9/16 angles welded to the plate. The stiffeners are equally spaced at 30 inches. The plate is 108 inches wide and 45 feet long. The lifting and transporting capacities (Short Tons) of the shipyard in order to transport this sub-assembly, will be most nearly:

A)	5.0
B)	6.0
C)	7.5
D)	10.0

Solution:
With a plate width of 108 inches and a stiffener spacing of 30 inches, the maximum number of stiffeners that can be fitted to the plate will be four (4). With a symmetrical spacing on the plate the first stiffener would be 9 inches in from the plate edge and the subsequent stiffeners would be placed at 39 inches, 69 inches and 99 inches, leaving 9 inches from the farthest edge.

The 9/16 inch thick plate has a weight per square foot 40.8 * 9/16 or 22.95 lbs/square foot. Thus the total plate weight is (108/12) x 45 x 22.95 = 9294.75 lbs.

The weight of a L8 x 4 x 9/16 is 21.9 lbs per foot of length (See the AISC Manual of Steel Construction). The total weight of angle stiffeners is then 4 x 45 x 21.9 = 3942 lbs.

Ignoring the weight of the weld metal, and any overhang of the stiffeners beyond the plate edges, the approximate total weight of the stiffened plate is 9294.75 + 3942 = 13,236.75 lbs., or 6.61 Short Tons (5.909 Long Tons). Yard crane capacity is typically rated in Short Tons.

The correct answer is: C)

Sample NAME Exam Problem No.75, Solution

Subject: Structural Design

A welded plate/shape sub-assembly is to be produced in the plate shop. The fabrication will join two 20-millimeter thick plates each having a width of 3 meters and a length of 15 meters. They will be longitudinally stiffened by 200mm x 100mm x 12mm inverted angles at 750 mm equal spacing. Upon completing the fabrication, one of the shop cranes will be used to move it to another location for further work. The minimum crane capacity (tonnes) required to safely make this move is most nearly:

A)	15.0
B)	17.5
C)	20.0
D)	25.0

Steel has a specific gravity of about 7.85 or a specific weight of about 7.85 tonnes per cubic meter in a standard gravitational field. Thus, the plate weight of the 20 mm plate is about 7850 kg x .020 = 157 kg per square meter. The two plates therefore weigh about 2 x 3 x 15 x 157 = 14130 kg or 14.13 tonnes.

The angle stiffeners have a cross section area of about 3456 mm^2 while a rod of one (1) square millimeter cross-section area and one (1) meter length weighs 7850 x 10^{-6} kg. Thus the angle stiffener weighs 3456 x 7850 x 10^{-6} kg, or 27.13 kg per meter of length in a standard gravitational field (9.81 m/sec^2 gravitational acceleration).

With the two plates joined, the width of 6 meters can have a maximum of 8 stiffeners fitted. Note that there must be a reasonable distance from the plate edge to the first and from the last stiffener. Thus the weight of the 8 stiffeners will be about 8 x 15 x 27.13 = 3255.6 kg and the total weight of the fabrication will be 3255.6 + 14130 = 17385.6 kg or 17.3856 tonnes.

The correct answer is B)

Sample NAME Exam Problem No.76, Solution

Subject: Welds and Connection

A shipyard Plate Shop is tasked to plan for production of longitudinally stiffened 30.6 lb. shell plates, each to be fitted with 4 - 8" x 4" x 19.6 lb inverted angles. The angles are to be 3/8" double fillet welded to the plate, which is 9 feet wide and 45 feet long. A plate shop automatic welding machine, capable of double-fillet welding has a 3/16" filler rod feed rate of 15 feet per minute for each fillet weld. Neglecting set-up time, production of each stiffened plate will take (minutes) most nearly:

A) 15
B) 30
C) 45
D) 60

Solution:

The fillet weld volume for the 4 inverted angles will be $V_f = 4 \times 45' \times 12$inches per foot x 3/8" x 3/8"
$V_f = 303.75$ cubic inches
The filler rod volume $V_r = 2 \times 15 \times 12 \times \pi D^2/4 = 9.94$ cubic inches per minute.
The production time for one stiffened plate will be 303.75/9.94 = 30.55 minutes.

The correct answer is B)

Sample NAME Exam Problem No.77, Solution

Subject: Hull Outfitting

A shipyard plate shop planning production of stiffened plates requires adequate crane capacity for handling the following fabrication. Four 225 mm x 100 mm x 15 mm inverted angles, double fillet welded to a 3 m x 15 m x 25 mm plate. The required crane Safe Working Capacity (tonnes) for handling this fabrication is most nearly:

A) 2.5
B) 5.0
C) 10
D) 15

Solution:

Neglecting the volume of the double fillet weld, the volume of the 4- 225 x 100 x 15 inverted angles is:
$V_{angles} = 4 \times (0.225 + .085) \times .015 \times 15 = 0.279$ cubic meters
The volume of the 25 mm plate is: $V_{plate} = 3 \times 15 \times 0.025 = 1.125$ cubic meters
The total volume of the fabrication is thus 1.125 + 0.279 = 1.404 cubic meters.
The specific gravity of steel is about 7.83-5 so the total weight of the fabrication is 10.99 to 11.02 tonnes.

The correct answer is D)

Sample NAME Exam Problem No.78, Solution

Subject: Rules and Regulations

A longitudinally framed vessel having a 15.5 m molded depth to the freeboard deck, a 10.25m design draft and a 750 mm side frame spacing supported by transverse frames spaced at 3.0 meters, requires, at a distance of 6m below the design waterline, a stiffener section modulus (cm^3) most nearly:

A) 210
B) 460
C) 570
D) 625

Refer to the construction rules below. Assume Q=1 and the vessel is over 90m (295 ft).

Excerpts from: ABS Rules for Building and Classing Marine Vessels ®, 2026

PART 3 Hull Construction and Equipment
CHAPTER 2 Hull Structures and Arrangements
SECTION 5 Frames

3.17 Longitudinal Frames *(2024)*

The section modulus SM of each longitudinal side frame below the bulkhead deck is to be not less than obtained from the following equation:

$$SM = 7.8chs\ell^2Q\text{cm}^3$$

$$SM = 0.0041chs\ell^2Q\text{in}^3$$

where

s = spacing of longitudinal frames, in m (ft)

c = c_1 for vessels under 90 m (295 ft) in length

= c_2 for steel vessels 90 m (295 ft) in length and above

c_1 = 0.915

c_2 = 0.95

h = h_1 for vessels under 90 m (295 ft) in length

= h_2 for steel vessels 90 m (295 ft) in length and above

h_1 = vertical distance, in m (ft), from the frame to the freeboard deck at side, but not less than 0.02L + 0.46 m (0.02L + 1.5 ft)

h_2 = above $0.5D$ from the keel, the vertical distance, in m (ft), from the longitudinal frame to the bulkhead or freeboard deck, but is not to be taken as less than 2.1 m (7.0 ft).

= at and below $0.5D$ from the keel, 0.75 times the vertical distance, in m (ft), from the longitudinal frame to the bulkhead or freeboard deck, but not less than $0.5D_s$.

ℓ = the unsupported span, in m (ft)

Solution:

The molded depth to the freeboard deck is denoted D = 15.5 m and the frame spacing, s, is 750 mm or .75 m. h is equal to 15.5m – 10.25 m + 6 m = 11.25 m and the length of span, l, is given as 3 m.

Substituting values into the equation, SM = $7.8*0.95*11.25*\ .75*3^2 = 562.7$

The correct answer is C)

Sample NAME Exam Problem No. 79, Solution

Subject: Rules and Regulations

A naval architect is tasked to determine the materials for the hull of a container vessel, having a Length Between Perpendiculars of 273 meters (777 feet) and a design draft of 10.7 meters (35 feet). At a location on the bottom shell 60 meters aft of the forward perpendicular the plating is chosen to be 35.7 lb/sq. ft. plate. Refer to the Tables 1 and 2 and Notes below to determine the required minimum quality of plating material as:

A) A, AH
B) B, AH
C) D, DH
D) E, EH

Excerpts from: ABS Rules for Building and Classing Marine Vessels ®, 2026

PART 3 Hull Construction and Equipment
CHAPTER 2 General
SECTION 3 General Requirements

3 Application Of Steel Materials 150 Mm (6.0 In.) And Under In Thickness *(2021)*

3.1 Selection Of Material Grade *(2024)*

i. Steel materials for particular locations are not to be lower grades than those required by [TABLE 1] for the material class given in [TABLE 2A], [TABLE 2B], or [TABLE 3] depending on the length (*L*) of the vessel.

ii. The provision in [3.1]) is not required for vessels in length (*L*) under 61 m (200 ft). For vessels under 61 m (200 ft) in length, material is to be per [1.3.1]. ASTM A36 steel otherwise manufactured by an ABS-approved steel mill, tested and certified to the satisfaction of ABS may be used in lieu of Grade A for a thickness up to and including 12.5 mm (0.5 in.) for plate and 19 mm (0.75 in.) for sections. In addition, the dimensions for ASTM A36 steel are to comply with [ABS-RL-MATL 2-1-1/15].

iii. When tensile stresses through the thickness (Z direction) exceed approximately 50% of the minimum specified yield stress (as defined in the applicable ABS Rules), consideration is to be given to applying Z grade steel (refer to [ABS-RL-MATL 2-1-1/17] of the ABS *Rules for Materials and Welding (Part 2)*). Alternatives to applying Z grade may be proposed provided it is demonstrated by ultrasonic testing before and after welding that no through thickness tearing has occurred, and/or the welding preparation, weld size and bead sequence is such that damaging through thickness loads induced by weld shrinkage are avoided.

Commentary:

When fatigue loading is present, the effective strength of higher-strength steel in welded construction may not be greater than that of ordinary-strength steel.

Precautions against corrosion fatigue may also be necessary.

End of Commentary

TABLE 1
Material Grades *(2024)*

Plate Thickness t mm (in.)	*Material Class*		
	I	II	III
$t \leq 15 (t \leq 0.60)$	A[2], AH	A, AH	A, AH
$15 < t \leq 20 (0.60 < t \leq 0.79)$	A, AH	A, AH	B, AH
$20 < t \leq 25 (0.79 < t \leq 0.98)$	A, AH	B, AH	D, DH
$25 < t \leq 30 (0.98 < t \leq 1.18)$	A, AH	D, DH	D [1], DH
$30 < t \leq 35 (1.18 < t \leq 1.38)$	B, AH	D, DH	E, EH
$35 < t \leq 40 (1.38 < t \leq 1.57)$	B, AH	D, DH	E, EH
$40 < t \leq 100 (1.57 < t \leq 4.00)$	D, DH	E, EH	E, EH
$100 < t \leq 150 (4.00 < t \leq 6.00)^{(3)}$	E, EH	E, EH	E, EH

Notes:

1. Grade D, of these *plate* thicknesses, is to be normalized.
2. ASTM A36 steel otherwise manufactured by an ABS approved steel mill, tested and certified to the satisfaction of ABS may be used in lieu of Grade A for a thickness up to and including 12.5 mm (0.5 in.) for plate and up to and including 19 mm (0.75 in.) for sections.
3. Rolled plates over 100 mm (4 in.) thick are to be in accordance with [ABS-RL-MATL 2-1-1/16] of the ABS *Rules for Materials and Welding (Part 2)*.

TABLE 2A
Material Class or Grade of Structural Members
for Vessels ≥ 90 m (295 ft) in Length *(2026)*

Line No.	*Structural Members*	*Within 0.4L amidships* — *Material Class [8] or Grade*	*Outside 0.4L amidships* — *Material Class or Grade*
A	**Secondary**		
A1	Longitudinal bulkhead strakes, other than those belonging to the Primary category	I	A[10]/AH
A2	Deck plating exposed to weather, other than that belonging to the Primary or Special category		
A3	Side plating [12]		
B	**Primary**		
B1	Bottom plating, including keel plate	II	A[10]/AH
B2	Strength deck plating, excluding that belonging to the Special category [13]		
B3	Continuous longitudinal plating of strength members above strength deck, excluding hatch coamings [13, 14]		
B4	Uppermost strake in longitudinal bulkhead		
B5	Vertical strake (hatch side girder) and uppermost sloped strake in top wing tank		
C	**Special**		
C1	Sheer strake at strength deck [1, 9, 13]	III	II (I outside *0.6L* amidships)
C2	Stringer plate in strength deck [1, 9, 13]		
C3	Deck strake at longitudinal bulkhead [2, 9, 13]		
C4	Strength deck plating at outboard corners of cargo hatch openings in container carriers and other ships with similar hatch opening configurations [3, 13]		
C5	Strength deck plating at corners of cargo hatch openings in bulk carriers, ore carriers, combination carriers and other ships with similar hatch opening configurations [4, 13]		
C6	Trunk deck and inner deck plating at corners of openings for liquid and gas domes in membrane type liquefied gas carriers [4, 14]		
C7	Bilge strake [5, 6, 9]		
C8	Longitudinal hatch coamings of length greater than 0.15*L* including coaming top plate and flange[7]		
C9	End brackets and deck house transition of longitudinal cargo hatch coamings [7]		
D	**Other Categories**		
D1	Plating materials for stern frames supporting rudder and propeller boss, rudders, rudder horns, steering equipment [15], propeller nozzles, thruster tunnels, and shaft brackets	-	II[11]
D2	Strength members not referred to in A, B, C, D1, and D3[17], Deckhouses, Helicopter Decks and supporting structure, Equipment foundations which are integral to the hull, Foundations for Engines having a rated power greater than 375 kW, Shell Doors, and Large Watertight Doors on Vehicle Carriers.	A[10]/AH	A[10]/AH
D3	Equipment foundations (not integral to the hull), Boiler Foundations, Watertight Doors, Weathertight Doors, Hawse Pipes, Bollards, Fairleads and Chocks, Non-hull structure, Appurtenant structures	[16]	[16]

Notes:

1. Not to be less than grade E/EH(9) within 0.4*L* amidships in ships with length exceeding 250 m (820 ft).
2. Excluding deck plating in way of inner-skin bulkhead of double hull ships.
3. Not to be less than class III within the length of the cargo region.
4. Not to be less than class III within 0.6*L* amidships and class II within the remaining length of the cargo region.
5. May be of class II in ships with a double bottom over the full breadth and with length less than 150 m (492 ft).
6. Not to be less than grade D/DH within 0.4*L* amidships in ships with length exceeding 250 m (820 ft).
7. Not to be less than grade D/DH.
8. Special consideration will be given to vessels of restricted class.
9. Single strake required to be class III or E/EH are to have breadths not less than 800 + 5*L* mm (31.5 + 0.06*L* in.), but need not exceed 1800 mm (71 in.), unless limited by the geometry of the vessel's design.
10. ASTM A36 steel otherwise manufactured by an ABS approved steel mill, tested and certified to the satisfaction of ABS may be used in lieu of Grade A for a thickness up to and including 12.5 mm (0.5 in.) for plates and up to and including 19 mm (0.75 in.) for sections.
11. For rudder and rudder body plates subjected to stress concentrations (e.g., in way of lower support or at upper part of spade rudders), class III is to be applied.
12. Single side strakes for ships exceeding 150 m (492 feet) without inner continuous longitudinal bulkheads between bottom and the single strength deck are not to be less than grade B/AH within cargo region in ships.
13. Not to be less than grade B/AH for members contributing to the longitudinal strength within 0.4*L* amidships in ships with length exceeding 150 m (492 feet) and single strength deck.
14. Not to be less than grade B/AH for inner deck plating and plating between the trunk deck and inner deck for members contributing to the longitudinal strength within 0.4L amidships in membrane type liquefied gas carriers and other similar ship types with a double deck arrangement above the strength deck and with length exceeding 150 m (492 feet). See [FIGURE 1].
15. Steering equipment components other than rudders, as described in Section 3-2-14.
16. Materials are to be in accordance with a recognized standard. Non-ABS grade steel such as ASTM A36, ASTM A572, EN S235J2, or other recognized standard approved by ABS in the design, may be used based on verification of material certificates and traceability. Materials are to be furnished to the attending Surveyor with certificates issued by the mill or the material manufacturer, indicating, as a minimum, the material specification, grade, mechanical and chemical properties, identification numbers, test results, and as applicable, heat treatment details. Materials are preferably to be from an ABS approved mill.
17. Deck plating below the strength deck at corners of cargo hatch openings immediately forward and aft of the engine room and/or deck house in container carriers and other ships with similar hatch opening configurations, is not to be less than Class I.

Solution:

The thickness of a 35.7 lb/sq. ft. plate is 35.7/40.8 = 0.875 inches. Referring to Table 1, it is seen that for plates of that thickness, the minimum quality of plates must meet A, AH for plates of material classes I and II, or B, AH for material class III. It is next noted that 60 meters aft of the forward perpendicular is about 22 % of length aft of the FP, which is 28% of length forward of amidships. Referring to Table 2, it is seen that for Bottom Plating outside the 0.4L amidships the requirement calls for minimum quality of A, AH.

Therefore, the correct answer is A)

Sample NAME Exam Problem No. 80, Solution

Subject: Piping System Design

A cylindrical tank 50 inches in diameter is to be used for a ship's Main Engine Starting Air storage. The normal starting air pressure is maintained at 600psi. The tank is to be fabricated from rolled steel plate with a welded longitudinal seam and elliptical heads having a circumferentially welded seam. Using an allowable shear stress of 13.6 ksi for the welded longitudinal and circumferential seams, the required thickness (inches) of the tank's plate is most nearly:

A) 1-1/4
B) 1-1/16
C) 9/16
D) 5/16

Solution:

The longitudinal seam is critical as the "hoop" stress is twice the end stress. The "hoop" stress = σ_t psi = pr/t = 600 x 25/t
The shear stress in the welded seam is half the "hoop" (or tangential stress) stress, therefore the allowable "hoop" stress = 27ksi
The plate thickness t = 600 x 25/27,000 = 0.555inches
As 9/16 inches = 0.5625 inches,

The correct answer is C)

Sample NAME Extra Exam Problem 1, Solution

Subject: Economics – 1

A shipyard engineer is tasked to carry out an investigation of an installation of a proposed solar-electric generating system on the shipyard's administration building roof. The administration building uses 750 kilowatts of electric power for 12 hours a day, on average, under normal environmental conditions. The monthly maintenance expenses of the candidate system are estimated to be $15.00 per kilowatt capacity per month, and remain essentially constant over its 20-year expected life. With a cost of utility-delivered power at $0.10 per kilowatt hour, how much money will the new system save per year?

A)	$193,500
B)	$137,750
C)	$135,000
D)	$27,375

Solution:

The 750 kW solar power installation is expected to produce power for 12 hours per day or
750 x 12 = 9,000 kW-hr per day for 365 days per year.
Annual output becomes 9,000 x 365 = 3,285,000 kW-hr. per year having a value of
3,285,000 x $0.10 = $328,500 per year.

Monthly maintenance costs are $15 x 750 x 12 = $135,000 per year.

The net benefit becomes $328,500 - $135,000 = $193,500 per year

The correct answer is A)

Sample NAME Extra Exam Problem 2, Solution

Subject: Structural Design – 2

A longitudinally stiffened section of 20.4 pound deck plating, and having a yield strength of 36 ksi, is fitted with 8 x 4 x 9/16 inverted angles stiffeners, spaced on 30 inch centers. A naval architect is tasked to check the buckling stress (ksi) and finds it to be most nearly:

A)	33
B)	30
C)	27
D)	24

Solution:

Steel has an Elastic Modulus (E) of approximately 29.6 x 10^6 psi and a Poisson's Ratio (ν) of about 0.3.

For a long, simply-supported plate, of thickness t, under longitudinal compression loading, the buckling critical stress is approximately defined by

$\sigma_{cr} = 4\,\pi^2\,D/(b^2\,t)$ where $D = E\,t^3/12(1-\nu^2) = 0.3388 \times 10^6$

$\sigma_{cr} = 0.3388 \times 10^6 \times 4 \times 9.8696 / (30^2 \times .5) = 29{,}725$ psi

The correct answer is B)

Sample NAME Extra Exam Problem 3, Solution

Subject: Powering and Power Generation – 3

A Water-Jet propulsion installation for a small, sea-going vessel moving at 40 knots has an intake area of 3.5 square feet and a discharge nozzle diameter of 8 inches. Neglecting flow losses, the delivered thrust and horsepower of the Water-Jet is most nearly:

A) 140,0002,872
B) 160,0002,955
C) 280,000 585
D) 320,000 654

Solution:

$Q_1 = Q_2$

$A_1V_1 = A_2V_2$ where $A_1 = 3.5$ ft^2 and $V_1 = 6076$ ft/kt mi x 40kts/hr/3600 sec./hr = 67.51 feet/sec.

$A_2 = \pi D^2/4 = \pi \times 8^2/4 = 50.26$ in^2 = 0.349 ft^2

$V_2 = 67.51 \times 3.5/0.349 = 677$ feet/sec.

Thrust $F = \rho\ A_2\ V_2(V_2\text{-}V_1)$ where $\rho = 1.989$ pound seconds^2 per foot^4, $A_2 = .349$ feet^2

$V_2 = 677$ feet/second; $V_1 = 67.51$ feet /second

Thrust $F = \rho A V_2(V_2\text{-}V_1)$ (Hydrodynamics in Ship Design, Saunders Vol. I, Sect 34.13)

Thus, F = 1.989 x 0.349 x 677 (677 – 67.61) = 286,428 pounds

The power being delivered = HP = (F x V_1)/33,000 = 286,428 x 67.51 / 33,000

HP = 586 Horsepower

The correct answer is C)

Sample NAME Extra Exam Problem 4, Solution

Subject: Electrical Systems – 4

An Electrical Power circuit provides service to 440 Volt, 60 Hz, 25 hp squirrel cage steering gear motor. The motor has an efficiency of 90% and a power factor of 0.83. The 12 gauge feeder line has a load center length of 175 feet and has a cross section of 6,530 circular mils. The percent voltage drop for the circuit is most nearly:

A) 0.05
B) 0.3
C) 0.5
D) 3.0

Solution

The % Voltage Drop = $(3^{1/2}$ 12* I* L* 100)/ CM* V, where

I = current
L = Load Center Length in feet
CM = circular mil wire size
V = Voltage

I = (25*0.746*KW)/($3^{1/2}$*440V*0.83) = 0.02948 KVA = 29.48 amps

Therefore, the percent voltage drop becomes:

%V.D. = ($3^{1/2}$ * 29.48*175*100)/(6,530*440) = 3.11%

The correct answer is D)

Sample NAME Extra Exam Problem 5, Solution

Subject: Hydrodynamics - 5

A mid-sized passenger vessel is to be fitted with a set of port and starboard activated-fin stabilizers. The vessel, having a 75 foot beam and a displacement of 25,000 tons usually has a GM of 4 ft. and is expected to be stabilized when operating at 20 knots in a wave system having a nominal wave length of 1,000 feet and a wave height of 15 feet. If the distance from the vessel's center of gravity to the mid-length of the activated fin is approximately 50 feet, the projected area (square feet) of each activated fin should be most nearly:

A) 55
B) 70
C) 85
D) 90

Solution:

Referring to Marine Engineering edited by Harrington, 1992, Chapter 18, Section 6, Ship Roll Stabilization, pp708-709.

The rolling moment induced by the seaway is $M_\theta = 2240 * \Delta * GM * \sin\theta$, Equation (5)

Where $\theta = \arcsin \pi h/\lambda$ and h = 15 feet and λ = 1,000 feet; θ = arcsin 3.14159 * 15/1000 = 2.701 degrees.

Therefore, M_θ = 2240 * 25000 * 4 * 0.047123 = 10,555,751 ft-lb.

The stabilizing moment developed by the fin stabilizers is $M_s = N * a * L$, Equation (6)

Where M_s = fin stabilizing moment , ft. lbs.

N = number of fins

a = lever arm between resultant lift force and ship's center of gravity, ft.

M_s = 2 * 50 * L; L = 10,555,751/100 = 105,557.5 lb.

The lift force developed, $L = C_L * \rho A V^2/2$, Equation (7), where C_L = a non-dimensional lift coefficient, 1.1 for non-articulated fins and 1.4 for flapped fins.

ρ = water mass density, lb-sec/ft^4

A = area of one fin, ft^2

V = water velocity used in fin design, fps. $V_{fps} = 1.689\ V_{knots}$

A = 105,557.5/ (1.1* 64* (1.689 * 20)^2)/64.34 = 84.54 square feet

The correct answer is C)

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