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Small Vessel Machinery Operator Examination Study Guide

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TABLE OF CONTENTS

SCOPE AND APPLICATION

1.1 PURPOSE

1) To provide clarification to seafarers and marine training institutions regarding the syllabus of the examination in general engineering knowledge of small vessels, required to be written by candidates prior to certification as a Small Vessel Machinery Operator.

1.2 SCOPE

1) Seafarers seeking information on the general engineering knowledge exam for a Small Vessel Machinery Operator.

1.3 AUTHORITY

1) Section 16 of the *Canada Shipping Act, 2001* provides for the Minister of Transport to specify the manner in which Canadian maritime documents are issued.

2) The *Marine Personnel Regulations* were made by the Governor in Council under section 100 of the *Canada Shipping Act 2001*, in order to specify the crewing and certification requirements onboard vessels.

3) Section 151 of the *Marine Personnel Regulations* outlines the requirements for an applicant as a Small Vessel Machinery Operator.

4) Item 3 of the Table in Subsection 151(1), requires an applicant to pass an examination on general engineering knowledge of small vessels.

5) Transport Publication 2293, Chapter 33.3 outlines the syllabus and structure of this exam.

1.4 DOCUMENTS REPLACED

1) None

1.5 REVISIONS

1) None

PROCEDURE

2.1 EXAMINATION STRUCTURE

1) The examination in general engineering knowledge of small vessels consists of sixty (60) multiple-choice questions.

2) The questions are constructed using the subject areas of knowledge that are in the syllabus, as found in TP 2293 Chapter 33.3.

3) Each question is provided with four possible answers. The candidate is to read each possible answer carefully and select the most appropriate answer.

2.2 USING THE GUIDE

1) Section 3 of this guide includes nineteen (19) subsections which correspond with the subject areas listed in the exam syllabus.

2) Each subsection contains a list of discussion questions on a particular subject area.

3) The intent is for the candidate to research the answers for these questions, and in doing so, obtain a **basic** understanding of the subject area. This understanding of the subject area will then enable the answering of the multiple-choice questions contained in the exam.

4) At the end of each section, a sample multiple-choice question is included, pertaining to the particular subject matter, similar to which will be contained on the exam.

NOTE: Each of these areas of study in the field of Marine Engineering can be researched to great depths, **which is not the intent of this guide**. Therefore, it should be understood that an applicant for a Small Vessel Machinery Operator should have a level of knowledge to enable the comprehension of technical terms, recognize the function of different machinery, and feel comfortable working safely with and around a vessel's equipment.

2.3 RESOURCE MATERIALS

1) There are many resources available to candidates that may be used to obtain an understanding of the subject areas, or answering the questions contained in this guide. These include, but are not limited to:

   a) Public libraries, or local marine schools, will have resource material and books relative to the field of Marine Engineering that may offer guidance to the candidate. Some of these resource materials include:

      (1) *Marine Engineering Series*, by A.J. Wharton

      (2) *Kemp & Young Series*, by Kemp & Young

      (3) *Reed's Marine Engineering For Deck Officers*, by William Embleton

      (4) *Introduction to Marine Engineering*, by D.A. Taylor

   b) The Internet:

      (1) Utilizing any of the basic search engines found on the Internet, and entering a given subject area, will yield a series of results, or "hits," which may offer legitimate sources of information.

      (2) Various Marine Engineering organizations list resource material and explanations of engineering subject matter on their individual websites.

      (3) The Transport Canada Website has links to *The Canada Shipping Act 2001*, and subsequent Regulations which govern the operations of vessels in Canada. *The Canada Shipping Act 2001* may be located directly by following this link: http://www.tc.gc.ca/acts-regulations/GENERAL/C/csa2001/menu.htm.

   c) Discussions with certified Marine Engineers who, through their schooling and experiences, will have obtained sufficient knowledge to explain the subject areas to the level of detail required for a Small Vessel Machinery Operator.

SYLLABUS

3.1 CONSTRUCTION MATERIALS

1) Candidates should be able to answer the following questions, or have an understanding of the following areas, concerning the materials used onboard vessels for construction of various components:

   a) Steel is an alloy consisting mainly of which two materials?

   b) Why is the percentage of carbon content in steels varied? How does increasing the content of carbon affect the steel?

   c) Which type of metal is deemed to be easier to weld; plain carbon steel or cast iron? Why?

   d) What is “stainless steel”?

   e) What is meant by the term “corrosion,” and which types of metals are most and least susceptible to corrosion?

   f) What are some common methods of reducing corrosion in tanks and piping onboard vessels?

   g) What is meant by the term “non-ferrous metal”?

   h) What are some common uses for copper?

   i) Brass and bronze are classed as “alloys.” Which two metals make up these alloys, and generally what is the percentage of each?

   j) What are some common uses of zinc, brass and aluminium onboard vessels?

   k) What are some common uses of cast iron onboard vessels?

   l) Where onboard a vessel could plastics or resins be used in the construction of parts or components?

2) SAMPLE QUESTION

   Of the four materials listed below, the preferred material for tubes of a large, tubular heat exchanger for engine cooling water is:

   (1) pure aluminium;

   (2) pure copper;

   (3) aluminium brass;

   (4) aluminium zinc.

   The correct answer would be (3) Aluminium Brass.

3.2 RECOGNITION OF FIRE HAZARDS

1) Candidates should be able to answer the following questions, or have an understanding of the following areas, in regards to the recognition of fire hazards onboard a vessel:

   a) What are the differences between Classes A, B and C fires?

   b) What is meant by the term “flash point”? Which fuel has a higher flash point, gasoline or diesel? Which is the preferred fuel to be used onboard vessels and why?

   c) What is meant by the term “spontaneous combustion”?

   d) Why is a heat protective lagging placed on exhaust manifolds of engines?

   e) What hazards do soiled and oily rags improperly stored onboard a vessel pose?

f) High-pressure fuel injection lines fitted to diesel engines are often doubled. What is the purpose of doing this?

g) Where is the preferred location to store paint and paint cleaning chemicals onboard a vessel? What is normally fitted in these special areas?

h) How should spare and small quantities of lubricants, greases and oils be stored onboard a vessel? What sort of hazards may they present if improperly stored?

i) Vents, which are fitted to a fuel tank, are normally terminated in which location on a vessel? What special arrangements are fitted at the termination point of these vents?

j) What good engineering practices help reduce the possibility of fires in the engine room?

k) What fire hazards are associated with bunkering operations and how are they minimized?

l) What are some common stores that are carried onboard vessels that may create a fire hazard?

2) SAMPLE QUESTION

The termination point of fuel tank vents are often fitted with a fine gauge wire mesh, the principle purpose of which is to:

(1) prevent the entry of dirt into the tank;

(2) prevent the entry of flames into the tank;

(3) prevent the overflow of fuel from the tank;

(4) reduce the contamination of fuel from the sea atmosphere.

The correct answer would be (2) prevent the entry of flames into the tank.

3.3 SAFETY AND FIRE EQUIPMENT

1) Candidates should be able to answer the following questions, or have an understanding of the following areas, in regards to fire fighting equipment fitted onboard vessels:

a) What is the purpose of fire doors fitted to a ship, and how are they maintained?

b) What special precautions should be taken in the operation and maintenance of **automatic** closing fire doors?

c) What is the purpose of watertight doors, and how do they differ in construction from weather-tight doors?

d) What are the main and back-up activation systems for watertight doors? From which points on the vessel are the doors normally operated?

e) What maintenance is required on watertight doors?

f) What alarms are fitted to the opening and closing activation system of watertight doors?

g) What special precautions should be taken when passing through watertight doors?

h) Ventilation closures or fire dampers are normally fitted where? What is their purpose? What maintenance do they require? How are they normally indicated or marked?

i) What types of fire detectors are fitted onboard a vessel, and are certain types more useful in certain areas than others? What is the appropriate manner in which each of these detectors are tested?

j) What is the normal alarm used to indicate a fire?

k) A smothering system fitted to an engine room is fitted with an alarm. What are some reasons for doing this, and what are some common forms of this alarm?

l) Where is the activation point for a fire smothering system normally fitted onboard a vessel? Who onboard the vessel has the authority to operate the system, and what would be the normal procedures?

m) Where are sprinkler systems usually fitted onboard a vessel, and how is the system operated? What are some normal points to check in reference to a sprinkler system?

n) How are the emergency exits from an Engine Room located, and how are they indicated? What are some precautions that should be taken to ensure the exits are accessible at all times?

o) Which machinery fitted in an engine room is normally capable of being stopped from outside the machinery space? Why?

p) Which tanks onboard a vessel must be fitted with a quick-closing valve, and where are they normally located?

q) What is a "Fire Main"? What pumps are generally connected to supply water to the fire main?

r) Where is the fire pump normally fitted onboard a vessel, and how is it indicated as such?

s) Various fuel tanks onboard a vessel are fitted with an "extended spindle" which extends to the upper decks. Why is this arrangement necessary?

t) What are "quick closing valves," and where and why are they fitted? Where is the activation of these valves normally located?

2) SAMPLE QUESTION

The emergency engine stops and emergency fuel shut offs are located:

(1) near the purifiers;

(2) in a space outside the engine room;

(3) in a control cabinet on the bridge;

(4) in a control console in galley.

The correct answer would be (2) in a space outside the engine room.

3.4 SAFE WORKING PRACTICES

1) Candidates should be able to answer the following questions, or have an understanding of the following areas in regards to performing tasks onboard a vessel in a safe manner:

a) Candidates should become familiar with "**WHMIS**." Why is "**WHMIS**" important for work which is performed in the Engine Room?

b) Candidates must become familiar with Occupational Health and Safety. In particular, what are the three basic rights of every worker under the Canada and Provincial Labour Codes?

c) What are examples of personal protective equipment that persons employed in the engine room of a vessel must wear? What are the normal circumstances that require a worker to wear this equipment?

d) How is an engine room maintained daily to reduce the likelihood of accidents?

e) How must an operator be clothed when working onboard the vessel, especially while working in the vicinity of rotating machinery?

f) How must cleaning chemicals and solvents be stored so as to reduce the likelihood of accidents relating to them?

g) Why is it necessary to refer to a Manufacture's manual when performing maintenance on a particular piece of machinery? In respect to safety, what are the precautions that must be taken prior to performing maintenance on any machinery?

h) What are the standard safe practices to be taken when performing hot work onboard a vessel?

i) How must lifting tools, straps and slings used for lifting in an engine room be maintained and tested?

j) What is meant by the term "confined space"? What precautions are required before entry into a "confined space" may be permitted?

2) SAMPLE QUESTION

To ensure safety, before beginning the servicing or repair of machinery, the most important point to ensure of the four listed below is:

(1) the auto system is locked out to prevent accidental start-up;

(2) all available repair manuals are the most current;

(3) the machinery has completed the required running hours;

(4) there are sufficient spares onboard the vessel.

The correct answer would be (1) the auto system is locked out to prevent accidental start-up.

NOTE: Although other answers in this instance may also be correct, in the case of questions of this type, always ensure that the **MOST** appropriate answer is chosen. In the example given, the other three answers show good engineering practices, but the question refers directly to safety, and in that light, (1) would be the most appropriate.

3.5 POLLUTION PREVENTION

1) Candidates should be familiars with the *Regulations for the Prevention of Pollution from Ships and for Dangerous Chemicals*. This regulation may be found on the Transport Canada website at: http://www.tc.gc.ca/acts-regulations/GENERAL/C/csa/regulations/400/csa450/csa450.html. Candidates at the level of a Small Vessel Machinery Operator should be able to answer the following questions in reference to this regulation:

a) What is meant by the terms: ppm, garbage, sludge, oily substance, sewage, transfer operation?

b) What precautions must be taken before and during bunkering operations (taking on fuel)?

c) What is an *Oil Record Book* and what information is required by law to be entered into it?

d) When may bilges be pumped from a vessel?

e) What precautions must be taken when discharging ballast from a vessel?

f) What is the purpose of an oily-water separator? According to the Regulations mentioned above, when may it be operated?

g) Oil Tankers in excess of 150 tons and any other vessel in excess of 400 tons are required to have onboard a *Shipboard Oil Pollution Emergency Plan* (SOPEP). What information is usually contained in this plan? When would this plan normally be put into effect?

h) If your vessel pollutes, or you suspect it has polluted, to whom should the incident be reported?

2) SAMPLE QUESTION

Prior to commencing a bunkering operation the most important point to ensure is that:

(1) all crew members are onboard;

(2) that the visibility is in excess of 5 nautical miles;

(3) clear communication is established and able to be maintained between the shore and the vessel;

(4) there are no vessels in the immediate vicinity.

The correct answer would be (3) clear communication is established and able to be maintained between the shore and the vessel.

3.6 PUMPS

1) Candidates should be able to answer the following questions, or have an understanding of the following areas related to the installation and operation of pumps onboard a vessel:

   a) What is meant by the term “priming” when referring to pumps?

   b) What types of pumps are normally self-priming?

   c) What is a positive displacement pump?

   d) What is a gear pump and where would it normally be fitted?

   e) Answer the questions listed below for each of the following pumps: Reciprocating, Centrifugal, Screw, Displacement.

      (1) What is the principle of operation, (how is fluid pumped)?

      (2) For which service or systems onboard a vessel is each pump used?

      (3) What are the pumping characteristics? i.e.; flow rates; operating pressures?

      (4) If a pump is failing to operate, or is operating at reduced capacity, what are some points to confirm, or parts of the pump to check?

2) SAMPLE QUESTION

   Which of the following statements is true:

   (1) Reciprocating pumps are suitable for very high suction heads at a low flow rate.

   (2) Reciprocating pumps are very tolerant to contamination and are suitable for pumping fluids containing solid particles.

   (3) Reciprocating pump produce a very smooth linear flow without pulsations.

   (4) Reciprocating pumps are not self-priming and require an external method of priming.

   The correct answer would be (1) Reciprocating pumps are suitable for very high suction heads at a low flow rate.

3.7 PIPING

1) Candidates should be able to answer the following questions, or have an understanding of the following areas in regards to various piping systems fitted onboard a vessel:

   a) What is the purpose of a Bilge System? What types of valves, fittings, and pumps would be fitted in the system?

   b) If a bilge pump fails to lower the level of bilge water in a particular compartment, what are the steps to locate and rectify the problem?

   c) What is the purpose of a Ballast System? What types of valves, fittings, and pumps would be fitted in the system?

   d) What are the main differences between a pressure gauge and a vacuum gauge? Where would each be fitted in a piping system?

   e) What are some important points to consider when operating, and putting into operation, a piping system containing a hot liquid or vapour?

   f) What is a non-return valve, and where would it likely be fitted in a piping system?

   g) What is water hammer and how can it be minimized or prevented? Why is water hammer dangerous?

   h) When pumping out, or filling any tank, why is it important to ensure the vents are clear?

i) What is the purpose of fitting an accumulator tank in a domestic water piping system? How can the operator be assured the tank is working properly?

j) How would you familiarize yourself with the layout and operation of various piping systems onboard a new vessel?

k) Certain piping systems can allow for the usage of the system for different purposes onboard a vessel, for example; components of a ballast system may be used as bilge system or a fire system. How is piping arranged for this, and what precautions should the operator bear in mind when performing these operations?

2) SAMPLE QUESTION

When a hot liquid or gas is allowed to flow through a section of steel piping, the length of piping will tend to:

(1) increase in length;

(2) decrease in length.;

(3) remain the same, with no tendency to change length or size;

(4) none of the above.

The correct answer would be (1), increase in length. The increase in temperature has a tendency to force the metal to expand, and try and force the section of piping to lengthen slightly.

3.8 POWER TRANSMISSION

1) Candidates should be able to answer the following questions, or have an understanding of the following areas in relation to the shafting and power transmission onboard a vessel:

a) What is meant by the term “Propeller Pitch”, and the acronym “R.P.M.”?

b) What are the important safety concerns to consider when clutching in or out a Main Engine?

c) What is the purpose of a Thrust Block?

d) What are the important checks to be made on a gearbox before start up?

e) What are the steps to be taken in the event of an overheated gearbox?

f) How are intermediate bearings or “pillow blocks” lubricated?

g) What are some different ways to connect sections of main shafting together onboard a vessel?

h) What are some possible methods of lubricating a propeller shaft?

i) What are some common ways to determine contamination of lubricating oil for shaft bearings?

j) What are some possible arrangements to prevent water from entering the vessel around the propeller shaft? If it is by means of a packed gland, what are the important aspects to consider during operation?

k) What periodic checks are required on shafting systems when the vessel is in operation?

l) How could misaligned shafting be apparent in a vessel while in operation?

m) What special arrangements are made in way of the shafting when a variable pitch propeller is fitted?

n) What does “balancing of a propeller,” mean? What would be some indications that a propeller was out of balance?

2) SAMPLE QUESTION

A water-cooled stern tube is found to have a slight leak around the packing gland, allowing a trace of water to enter the bilges. The most correct action for the operator to take would be to:

(1) place a small container under the gland, and dispose of the water over the ship's side when the container is full;

(2) tighten the gland so that all the water stops leaking;

(3) monitor the temperature of the gland, and the flow of water. Adjust the gland as necessary to minimize water flow, while not overheating the gland;

(4) call the shore support Engineer and arrange for a dry-docking of the vessel.

The most appropriate answer would be (3). Monitor the temperature of the gland, and the flow of water. Adjust the gland as necessary to minimize water flow, while not overheating the gland.

3.9 STEERING GEAR

1) Candidates should be able to answer the following questions, or have an understanding of the following areas concerning the construction, operation, and maintenance of steering gears:

a) What is the purpose of a rudder and how is it attached to a vessel?

b) What are some methods of indicating the position of the rudder to the operator, and how is this position measured?

c) How is water prevented from entering the vessel in way of the rudder, and how is the weight of the rudder supported?

d) What checks are required on a mechanical steering system before the departure of a vessel? What additional pre-checks are required on a vessel with hydraulic steering?

e) What types of equipment would be located in a steering compartment to ensure safe operation of the vessel after a power loss?

f) What are the important points to verify or check when doing an inspection of a steering gear compartment fitted with a hydraulic steering gear?

g) What is a "Hunting Gear," and what is its role in a hydraulically operated steering gear system?

h) Movement of a hydraulic steering gear should be smooth and uniform. If the system is operating in an erratic or "jerky" fashion, what is this generally an indication of? How can this problem be rectified?

i) How much spare hydraulic fluid should be maintained onboard for the steering gear system? Where and how should this fluid be maintained?

j) How is emergency steering provided in the event of loss of the main steering gear?

2) SAMPLE QUESTION

During a round in the steering compartment, the operator notices that the hydraulic lines fitted to the steering gear system are slightly warm to the touch. The corrective action would be:

(1) cool the lines by pouring water over them;

(2) relieve the pressure in the lines;

(3) rid the lines of the entrapped air;

(4) continue to monitor the situation, as some warming is normal.

The correct answer would be (4).

3.10 UNDER WATER FITTINGS

1) Candidates should be able to answer the following questions, and have an understanding of the following areas in regards to the fittings of a vessel located below the water line:

   a) What is the purpose of a Kort nozzle and where is it attached to a vessel?

   b) What is meant by the “keel” of a vessel? What are “keel coolers”? Where are they located on a vessel?

   c) What is the fundamental difference between a fixed and variable pitch propeller?

   d) What is a “bow-thruster”? What are some common ways this machinery is operated?

   e) What is meant by the terms “Sea Chest” and “Sea-Bay”?

   f) What are some different methods of attaching valves to a vessel’s side plating?

   g) What are some possible methods of preventing icing of overboard valves in freezing conditions?

   h) What are all the fittings attached to the hull of a vessel to permit the entry and discharge of sea water for the operation of various systems?

   i) What is meant by the term “Stern Tube”?

2) SAMPLE QUESTION

   A fixed pitch propeller is one which:

   (1) is constructed from stainless steel only;

   (2) is never fitted to a vessel;

   (3) has a set pitch which cannot be changed;

   (4) has a pitch which must be fixed in place by the operator before leaving the dock.

   The most appropriate answer would be (3).

3.11 DECK MACHINERY

1) Candidates should be able to answer the following questions, or have an understanding of the following areas in reference to deck machinery fitted onboard a vessel:

   a) How is the anchor of a vessel secured in place while a vessel is sailing?

   b) What piece of machinery is used to raise the vessel’s anchor?

   c) What are some precautions to be taken when working around operating winches on the deck of a vessel?

   d) The master of the vessel requests a check of the hydraulic winch fitted on the deck prior to operating. What checks would you perform?

   e) What is the purpose of a capstan?

   f) What are the safety precautions to be taken when working around a crane?

   g) What precautions are there to be taken before, and during, maintenance is performed on a crane?

   h) What would be some possible reasons to heat the oil stored in a reservoir for deck machinery?

   i) What are some typical methods of controlling the operation of deck equipment? From which points on the vessel are winches and capstans normally operated?

2) SAMPLE QUESTION

The level of oil in a hydraulic reservoir for a deck winch is found to be very low. The best course of action for the operator would be to:

(1) isolate the winch and perform a check in the immediate area of the winch and any hoses connected to it to determine if there is an obvious leak;

(2) refill the reservoir immediately;

(3) verify and possibly eliminate the presence of water in the tank;

(4) relieve pressure build up in the tank due to fuel expansion.

The correct answer would be (1). The primary concern here is to prevent damage to the winch, and ensure that any oil that may have leaked is contained so as not to pollute the environment.

3.12 FUELS

1) Candidates should be able to answer the following questions, or have an understanding of the following areas regarding the usage and storage of fuels onboard a vessel:

a) What are the reasons diesel fuel is preferred to gasoline for use onboard a vessel?

b) What are the safety precautions to be used when gasoline in stored onboard a vessel?

c) How are sounding pipes used in the calculation of the amount of fuel onboard a vessel? Where are the sounding pipes fitted in relation to the tanks to which they are connected?

d) What special arrangement is fitted to the sounding pipe of a fuel tank that terminates in the engine room? What are the precautions to be followed in relation to this arrangement?

e) How will the list or trim of a vessel have an effect on fuel soundings?

f) What are the precautions to be taken when transferring fuel from one tank to another?

g) What is the purpose of a “Day Tank”? Where is it fitted on a vessel in relation to the machinery it serves?

h) What is the purpose of a fuel purifier or centrifuge?

i) What are some possible ways to determine if fuel has been contaminated with water?

j) How is it possible to verify the level of contamination of an in service fuel filter? What arrangements are usually in place to permit the continued operation of an engine with a clogged fuel filter?

k) What is meant by the term “specific gravity”? What is the average specific gravity of fuel oil, and why is this important to the storage of fuel onboard a vessel?

l) What are the safety precautions to be taken by an operator when handling fuel or components contaminated with fuel?

m) What are “Fuel Bugs”? How are they formed? How would you know if fuel bugs were present in fuel, and why should they be avoided?

2) SAMPLE QUESTION

Water that contaminates a quantity of fuel will:

(1) if allowed to separate, and settle, will gravitate to the bottom of the fuel;

(2) if allowed to separate, and settle, will float to the top of the fuel;

(3) increase the calorific value of the fuel;

(4) cause the bilge alarm to activate.

The correct answer would be (1), water is “heavier” than fuel, and will “sink” to the bottom of the fuel.

3.13 LUBRICANTS

1) Candidates should be able to answer the following questions, or have an understanding of the following areas in relation to lubricants used onboard a vessel:

   a) What is meant by the term “weight” of an oil?

   b) Why is it important to add the correct weight of oil to a particular piece of machinery? Where can the information regarding the oil requirements of a piece of machinery be found?

   c) What are the precautions to be taken concerning the storage of oil to ensure it is fit for service in machinery?

   d) What are the precautions to be taken in the transfer of oil onboard of a vessel?

   e) How is the level of contamination of an in service oil filter determined? What arrangements are usually in place to permit the continued operation of an engine with a clogged oil filter?

   f) What are the precautions to be taken when handling the oil to be added to the crankcase of an engine? What are the precautions to be taken when handling used engine oil? How should this oil be disposed? How must used oil filters be disposed?

   g) What are some ways in which hydraulic oil differs from engine oil? Can the two be used interchangeably?

   h) What is the purpose of a lubricating oil purifier?

   i) Why is it sometimes desirable to heat engine oil and how can this be accomplished?

   j) Why is undesirable to allow lubricating oil to become contaminated with water? What are some ways it can be detected?

   k) What are the procedures to be followed when greasing a piece of machinery with a grease gun? How often should this operation be performed?

2) SAMPLE QUESTION

   Lubricating oil is noticed to have a milky white texture on the dipstick of a diesel engine. This is an indication that:

   (1) overheating of the oil has occurred;

   (2) the oil has become contaminated with water;

   (3) the engine oil is normal;

   (4) the fuel has become contaminated.

   The correct answer would be (2), water has probably entered the oil crankcase and this condition should be reported and investigated further.

3.14 COOLING SYSTEMS

1) Candidates should be able to answer the following questions, or have an understanding of the following areas in relation to cooling systems:

   a) What is the purpose of the following components in a fresh water cooling system for a diesel engine:

      - Circulating Pump
      - “Header” or “Expansion” tank
      - Thermostat
      - Heater
      - Cooler

b) What is the purpose of a "radiator cap" fitted to an air-cooled radiator? How is a malfunctioning cap detected or noticed on a running engine?

c) Why are additives often added to the cooling water contained in a cooling system?

d) Where are some areas in cooling systems that are sources of leaks? How are leaks normally detected in a cooling system, and what are some common corrective measures that may be taken?

e) Why is it not desirable to use seawater to cool the internals of a diesel engine?

f) What fittings are employed on a ship's hull to permit the entry of seawater into a vessel to be used as a cooling medium?

g) Why is there a strainer fitted to a seawater circulating system, and where is this strainer located?

h) What types of coolers are often fitted to allow for heat transfer between fresh cooling water and seawater?

i) Why is an expansion or header tank fitted at the highest point in the system?

2) SAMPLE QUESTION

The water temperature of the cooling system fitted to main engine is noticed to be increasing to a higher than normal temperature. From the list of answers, which is the most probable source of this problem.

(1) the oil level in the engine sump is low;

(2) the main thermostat is malfunctioning;

(3) the fuel viscosity is high;

(4) the ambient air temperature in the engine room is low.

The correct answer would be (2) the main thermostat is malfunctioning.

3.15 ELECTRICITY

1) Candidates should be able to answer the following questions, or have an understanding of the following areas in regards to the installation, operation, and maintenance of electrical systems onboard vessels:

a) What is the definition of the following terms:

- Volt
- Amp
- Watt
- Ohm

b) A voltmeter is used to measure which component of an electric circuit? How is the device used, and what precautions are necessary when measuring?

c) An ammeter is used to measure which component of an electric circuit? How is the device used, and what precautions are necessary when measuring?

d) An ohmmeter is used to measure which component of an electric circuit? How is the device used, and what precautions are necessary when measuring?

e) Why are fuses fitted in an electric circuit? What precautions must be taken when replacing blown fuses?

f) What is the purpose of circuit breakers? When should a tripped circuit breaker be reset?

g) What is an electrical ground? How is a grounded circuit on a ship's electrical distribution system located using earth lamps?

h) How is the electric load on a generator measured?

i) What does the term “paralleling generators” mean, and how is it accomplished? Why is it done?

j) What precautions are necessary to be taken when working with electrical circuits?

k) What is meant by the following terms:

- Black-out
- Essential Bus
- Emergency Bus

l) What kind of liquid would be used to replenish the liquid level in a storage cell?

m) How are batteries rated for capacity?

n) Briefly describe the construction of a battery, and state the components of the plates and electrolyte.

o) What gas is generated due to the charging of batteries? What are the precautions to be taken before entering a battery room?

2) SAMPLE QUESTION

If the ship service generator becomes overloaded, the first thing that is likely to occur is:

(1) all emergency lights will illuminate.

(2) the main breaker will reset.

(3) the bridge lights will flash intermittently.

(4) the non-essential breaker, (if fitted) will open.

The correct answer would be (4) the non-essential breaker, (if fitted) will open.

NOTE: Although it may be argued that there may be other things that will occur in the instance described, the **MOST** appropriate and logical answer of those available is (4).

3.16 HYDRAULIC SYSTEMS

1) Candidates should be able to answer the following questions, or have an understanding of the following areas, in regards to hydraulic installations onboard vessels:

a) Why is the cleanliness of the oil in a hydraulic system so crucial? How is it maintained in an acceptable condition?

b) What are some of the common types of operating valves fitted in a hydraulic control system?

c) Why is air entrapment in a hydraulic system undesirable? How is it detected, or observed while the system is operating?

d) What are the physical qualities that are required of a hydraulic fluid?

e) What are some points to consider for extending the service life and operation of a hydraulic ram?

f) Why is it important to ensure lengths of hydraulic pipes and hoses are not left unsupported?

g) What are considered as the normal operating conditions of a hydraulic system when in operation in regards to sounds and temperatures?

h) How can leaks in hydraulic hoses be detected? What are the important safety precautions for the operator in detection of these leaks?

i) What are the important points to consider when topping off, or filling a hydraulic reservoir?

2) SAMPLE QUESTION

The master of a vessel reports that the steering system is acting erratically, and the controls feel "spongy." This condition is an indication that:

(1) the system is operating correctly;

(2) the Master is unfamiliar with the controls;

(3) there is air entrained in the system;

(4) there is a correct level of fluid in the system.

The correct answer would be (3) the symptoms describe are usually indicative of air entrainment.

3.17 PNEUMATIC SYSTEMS

1) Candidates should be able to answer the following questions, or have an understanding of the following areas in relation to pneumatic systems as fitted to vessels:

a) Describe briefly how an air compressor is constructed, and how it operates.

b) Before verifying the oil level in the sump of an air compressor what are some essential points to consider?

c) What governs the starting and stopping operation of an air compressor fitted to charge the main and auxiliary air receivers on a vessel?

d) What could be some possible causes for an air compressor to be running excessively, or short cycling?

e) What safety devices are fitted to an air receiver?

f) What maintenance is required to be completed on an air receiver frequently to prevent corrosion and erratic operation of air components?

g) On engines fitted with an air starting system using direct injection, how can a leaking cylinder non-return valve be detected? Why is it important to detect this situation? How can the effects of this defect be minimized?

h) What is the purpose of an air reducing station and how is a defective station detected?

i) Where can the maximum operating pressure for an air receiver be found? At what opening pressure should a relief valve be set? When may this setting be changed?

j) What is the purpose of an intercooler fitted to an air compressor?

k) What is the purpose of an un-loader when fitted to an air compressor?

2) SAMPLE QUESTION

Starting Air Compressors are arranged to start up with the:

(1) compressor drains open slightly;

(2) air relief valve on air receiver opened;

(3) air receiver drains opened;

(4) compressor unloaded.

The correct answer would be (4) the compressor unloaded.

3.18 INTERNAL COMBUSTION ENGINES

1) Candidates should have knowledge of the construction and operation of an internal combustion engine, and be able to answer the following questions, or have an understanding of the following areas:

   a) Describe the operation of a four-stroke internal combustion engine.

   b) Describe the operation of a two-stroke internal combustion engine.

   c) What are the main differences between the construction and operation of diesel and gasoline engines?

   d) What are some examples of the normal operating temperatures and pressures of a diesel engine?

   e) What valves are fitted to the combustion chamber of a diesel engine? How are they operated? What is meant by the term “valve lash”?

   f) What is meant by the term “scavenging,” and what are some common ways it is performed?

   g) What are the relative operating pressures between lubricating oil, fresh water and seawater in the cooling system of a diesel engine? What is the advantage of maintaining them at different pressures?

   h) What governs the power output of a diesel engine? How is the speed of a diesel engine regulated?

   i) What are some common protective devices fitted to diesel engines on vessels?

   j) What are the checks required to be performed on a diesel engine prior to start-up? What is the primary item to verify upon start-up?

   k) What is a “Crankcase Explosion”? What are some of the signs and symptoms this phenomenon is about to occur? What steps are to be taken if you suspect a crankcase explosion has occurred?

   l) Why are pistons in a diesel engine fitted wit compression and scraper rings? What are the causes of low compression and how can low compression be rectified?

   m) What could be some possible causes of an engine that runs but produces low power?

   n) Describe the routine maintenance that is performed on diesel and gasoline engines.

   o) What could be some possible causes if the engine is turned and does not start?

   p) What is the ideal or normal color from the exhaust of a diesel engine? What could be some possible causes if the exhaust is black? Blue? White?

   q) Why is it important to record the running hours of an engine?

   r) What are some actions and checks to be taken in event of the following alarms or occurrences:

      - Low lube oil pressure
      - High cooling water temperature
      - Low lube oil level

   s) What are the running checks required on a diesel engine when in operation?

   t) How are engines constructed and arranged to permit the cooling of the engine by water?

   u) What is a turbocharger, and why is it sometimes fitted to an engine?

2) SAMPLE QUESTION

The master of the vessel reports to the operator that the exhaust coming from the main engine appears to be black. The most probable cause of this occurrence would be:

(1) the cylinder head gasket has failed and water is entering the engine cylinder;

(2) the engine has shut down;

(3) the engine is overloaded;

(4) the engine is operating normally.

The correct answer would be (3) the engine is overloaded.

NOTE: Although there may be other reasons for the exhaust to appear black, the answer chosen is the **MOST** appropriate answer of those given.

3.19 WATCH KEEPING PROCEDURES

1) Candidates should be able to answer the following questions, or have an understanding of the following areas regarding diligent surveillance of machinery onboard a vessel:

a) Vessels operating with a Small vessel Machinery Operator are required to have a continual radio contact with the home base of the operation of the vessel. What situations in the engine room would warrant contacting the home base immediately?

b) What are some checks to be made to the main machinery and exterior machinery spaces prior to the commencement of a voyage?

c) What are the checks to be made to running machinery in an engine room, such as compressors, engines, and generators?

d) What is an Engine Room Log Book? What is the purpose of this book, and what records are maintained in it? If there were an accident in the engine room, how would it be recorded and reported?

e) What are some methods used to calculate the amount of fuel onboard a vessel?

f) Where are some possible locations throughout a vessel to start and stop machinery located in the engine room?

g) What are some possible risks and dangers with allowing excessive water to be collected in the bilges? What should be done with water that has accumulated in the bilges?

h) If the engine room is fitted with a smothering system for fire protection, how is the system activated? Who is authorized to activate this system and when would it be done? What are some important points to consider prior to activating the system?

i) What are some precautions that should be taken in regards to walkways and deck plates in the engine room to ensure people can work safely?

j) What are the steps to take if you feel a bump in the engine room and it is suspected that the vessel has made contact with the ocean floor?

k) How can an operator verify that the fuel that is to be used during the voyage does not contain water or is not otherwise contaminated?

l) What are the steps to be taken if a fire is discovered in the engine room?

m) If the main engine were to shut down unexpectedly, what actions should be taken?

n) What are the steps to ensure maintenance that is performed on machinery is completed in a safe manner, and as required?

o) What are the actions required if the control of the main engines from the wheelhouse was suddenly disconnected?

p) What would be the recommended actions to take in each of the following circumstances:

- Low oil pressure alarm, main engine
- High Jacket water temperature, main engine
- Low cooling water level, main engine
- High bilge alarm, engine room
- Fire alarm, engine room

q) What are the requirements in regards to the position of watertight doors, (if fitted), while the vessel is operating?

2) SAMPLE QUESTION

Under normal conditions, it is advisable to verify the oil level in the main engine crankcase:

(1) prior to start-up of the engine;

(2) at the end of a voyage;

(3) at regular intervals throughout the voyage;

(4) all of the above.

The correct answer would be (4), all of the above.