

**CERTIFICATES OF COMPETENCY IN THE MERCHANT NAVY -
MARINE ENGINEER OFFICER**

EXAMINATIONS ADMINISTERED BY THE
SCOTTISH QUALIFICATIONS AUTHORITY
ON BEHALF OF
MARITIME AND COASTGUARD AGENCY

SECOND ENGINEER (UNLIMITED)

042-27 - ENGINEERING KNOWLEDGE - GENERAL

MONDAY, 10 December 2012

0915-1215 hrs

Examination paper inserts:

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Notes for the guidance of candidates:

Candidates are required to obtain 50% of the total marks allocated to this paper to gain a pass AND also obtain a minimum 40% in Sections A, B and C of the paper.

Materials to be supplied by examination centres:

Candidate's examination workbook

ENGINEERING KNOWLEDGE - GENERAL

Attempt TEN questions only as follows:

SIX questions from section A

TWO questions from section B

TWO questions from section C

Marks for each part question are shown in brackets

Section A

1. Describe, with the aid of a sketch, a two stage emergency fire pump which utilises a hydraulic pump and motor and is suitable for use in very large ships. (10)

2. With reference to propeller shaft support bearings:
 - (a) sketch a bearing of the tilting pad design, showing how the oil pressure is distributed; (6)
 - (b) explain why this type of bearing evolved, stating the advantages over plain bearings. (4)

3.
 - (a) Sketch a four ram electro-hydraulic steering gear system. (5)
 - (b) Explain the operations necessary to enable a four ram system to operate on two rams only. (3)
 - (c) State the regulations pertaining to the main and auxiliary steering gear with reference to the rudder angle and time of operation. (2)

4. With reference to positive displacement pumps suitable for bilge duties:
 - (a) sketch a progressive cavity (Mono) pump; (5)
 - (b) explain why the pump drive requires universal joints; (3)
 - (c) state the consequences of this type of pump being allowed to run dry. (2)

5. Explain how EACH of the following conditions affect the performance of lubricating oil centrifuges:
- (a) worn friction pads; (2)
 - (b) impurities build up in the bowl; (2)
 - (c) excess feed rate to the bowl; (2)
 - (d) incorrect oil temperature; (2)
 - (e) incorrect paring disc height. (2)
6. Describe how a ship's refrigeration system is charged with refrigerant gas, stating whether the gas is zeotropic or azeotropic. (10)
7. With reference to lifeboat engines:
- (a) state THREE reasons that may contribute to difficulty in starting; (3)
 - (b) explain why a short run as part of routine testing does not give a true indication of the engine condition; (4)
 - (c) describe how the engines are kept at a state of full readiness. (3)
8. With reference to hydraulic deck machinery and cargo handling systems:
- (a) state FOUR possible types of contamination of the oil, describing how the contamination may have occurred; (4)
 - (b) state FOUR possible effects of oil contamination on the system; (4)
 - (c) state how the system oil may be monitored for contamination. (2)

Section B

9. (a) Sketch a labelled block diagram of essential services provided from an emergency generator. (7)
- (b) State the regulations pertaining to the emergency generator starting and running requirements. (3)
10. Explain, with the aid of a circuit diagram, the operation of a synchroscope. (10)
11. With reference to a.c. induction motors:
- (a) state, with reasons, the type of fuses used for protection; (3)
- (b) explain the effects of single phasing; (2)
- (c) describe how thermistors can be used to protect the motor; (3)
- (d) sketch a thermistor as described in part (c). (2)

Section C

12. With reference to weathertight doors:
- (a) sketch a weathertight door; (4)
 - (b) sketch the edge sealing arrangement; (2)
 - (c) state the routine maintenance required; (2)
 - (d) describe how the function may be tested. (2)
13. (a) State why bulwarks are fitted to ships' decks. (2)
- (b) Sketch EACH of the following types of bulwark:
- (i) open; (4)
 - (ii) floating. (4)
14. With reference to ship construction, explain the purpose of EACH of the following, stating where they are located:
- (a) duct keel; (2)
 - (b) bilge keel; (2)
 - (c) collision bulkhead; (2)
 - (d) deck camber; (2)
 - (e) bow flare. (2)

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DRAFT PAPER, Paper 73-15 Oct 2012

- hrs

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Section A

1. (a) Describe, with the aid of a sketch, an oil content monitor suitable for sensing 15 ppm of oil in an oily water separator discharge. (5)
- (b) State THREE operations that are required to be logged in the oil record book. (3)
- (c) State an example of ONE of the entries stated in part (b). (2)

2. (a) Sketch a block diagram for a closed loop control circuit. (3)
- (b) Describe how the system sketched in part (a) operates. (4)
- (c) Explain why a system would include the controller integral and derivative action. (3)

3. With reference to a vapour compressor refrigeration system:
 - (a) describe, with the aid of a sketch, the operation of a high pressure cut out device; (6)
 - (b) state FOUR possible faults that could cause the cut out to operate. (4)

4. (a) Sketch and label all the major parts of a nine litre portable extinguisher for class A fires. (5)
- (b) List the maintenance tasks required for the extinguisher sketched in part (a). (3)
- (c) State the minimum range and discharge time. (2)

5. (a) Sketch a four ram electro hydraulic steering gear system. (5)
- (b) State why EACH of the following is fitted to a four ram steering gear:
- (i) brake or locking device; (1)
 - (ii) stock or tiller relief valve; (1)
 - (iii) steering gear stops or rudder stop. (1)
- (c) State the requirements of the legislation to the main and auxiliary steering gear with reference to rudder angle and time of operation. (2)
6. Describe EACH of the following processes for medium carbon steel and its effects:
- (a) Hardening; (3)
 - (b) Tempering; (3)
 - (c) Annealing; (2)
 - (d) Normalising. (2)
7. With reference to gland sealing on centrifugal pumps for fresh water duties:
- (a) compare the advantages and disadvantages of mechanical seal to soft packing; (4)
 - (b) sketch a cross section of a mechanical seal, labelling all main components. (6)
8. (a) List the essential items of a fireman's outfit. (4)
- (b) Describe the checks that should be carried out prior to firefighters entering a smoke filled atmosphere. (6)

Section B

9. With reference to insulation testing of electrical equipment:
- (a) state the reason for insulating testing and why it is carried out on a regular basis; (2)
 - (b) describe the procedure for taking a set of insulation readings on an electric motor in-situ, stating the minimum acceptable readings; (6)
 - (c) state the additional precautions to be taken when testing an a.c. generator. (2)
10. Describe, with the aid of a circuit diagram, the operation of a direct on line starter. (10)
11. (a) Sketch a circuit diagram showing how power failure is detected, the emergency generator started and connected to emergency switchboard. (7)
- (b) State the minimum time by which the emergency generator must be capable of supplying full emergency load. (3)

Section C

12. As Second Engineer Officer, explain to a new crew member how to pass safely through a hydraulically operated watertight door. (10)
13. (a) Explain the effects of pounding and panting at the fore end of a ship. (4)
(b) Sketch the constructional details designed to resist panting and pounding. (6)
14. With reference to water drainage from the deck areas:
- (a) explain EACH of the following:
- (i) why scuppers are fitted in close proximity to the super structure whereas freeing port are generally fitted to open areas of the weather deck; (3)
- (ii) why it is essential that scuppers and freeing port are operational at all times; (4)
- (b) state which certificate relates to part (a) (i) and (ii). (3)

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STCW 95 SECOND ENGINEER REG. III/2 (UNLIMITED)

042-27 – ENGINEERING KNOWLEDGE - GENERAL

MONDAY, 26 MARCH 2012

0915- 1215 hrs

Examination paper inserts:

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ENGINEERING KNOWLEDGE - GENERAL

Attempt TEN questions only as follows:

SIX questions from Section A

TWO questions from Section B

TWO questions from Section C

Marks for each part question are shown in brackets

All questions carry equal marks

SECTION A

Attempt SIX questions only from this section

1. List FIVE elements that may be added to steel to improve its physical properties, explaining the effects of EACH. (10))

2. Describe, with the aid of a sketch, a waterjet, transverse, thruster. (10)

3. Sketch EACH of the following fire detector heads, describing their operation:
 - (a) rate of temperature rise; (5)
 - (b) flame detector. (5)

4. Describe, with the aid of a sketch, a central priming system. (10)

5. State, with reasons, the suitability of EACH of the following courses of action in the event of an overheated main transmission bearing:
 - (a) reduction of shaft speed; (2)
 - (b) cooling with a fire hose; (2)
 - (c) changing the lubricating oil; (2)
 - (d) adjusting the height of the bearing; (2)
 - (e) adjusting the height of adjacent bearings. (2)

6. Describe, with the aid of a sketch, an instrument to measure temperature that uses the variation of resistance with the application of heat. (10)

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7.
 - (a) State TWO reasons that will necessitate the opening up and entry of a large biological sewage system. (2)
 - (b) Explain the precautions to be taken when entering a sewage treatment plant. (6)
 - (c) State TWO hazards that personnel may be exposed to if entering a sewage unit. (2)

8. With reference to the gland sealing of pumps:
 - (a) state the advantages and disadvantages of mechanical seals verses soft packing; (5)
 - (b) sketch a cross section of a mechanical seal. (5)

SECTION B

Attempt TWO questions only from this section

9. With reference to the rotor of an induction motor:
- (a) state TWO reasons why the conductors are angled; (2)
 - (b) state the consequences of the air gap between the rotor and the stator being:
 - (i) too large; (2)
 - (ii) too small; (2)
 - (c) explain how rotor leakage flux takes place and its effect on motor operation. (4)
10. (a) Describe EACH of the following:
- (i) an insulated distribution system; (4)
 - (ii) an earthed distributed system. (4)
- (b) Explain a method of earthing high voltage installations. (2)
11. (a) Sketch a single cell of a nickel cadmium battery of the sealed type. (2)
- (b) State the chemical reactions that occur in the battery described in Q11(a). (2)
- (c) Explain how a nickel cadmium battery is able to operate sealed, under normal charged conditions. (4)
- (d) Sketch a battery charging system operated from the a.c. mains. (2)

SECTION C

Attempt TWO questions only from this section

12. Describe the examination of a rudder whilst the ship is in drydock. (10)
13. With reference to the engineroom gantry crane:
- (a) describe, with the aid of a sketch, an engineroom gantry crane depicting how it is secured to the ship's structure; (5)
 - (b) state how damage to the forward and aft bulkheads of the engineroom casing is prevented; (2)
 - (c) describe the checks that should be carried out prior to using an engineroom gantry crane. (3)
14. (a) Describe, with the aid of a sketch, the braking arrangements fitted for the controlled lowering of lifeboats. (7)
- (b) Describe how the braking arrangements fitted to lifeboats are tested. (3)

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STCW 95 SECOND ENGINEER REG. III/2 (UNLIMITED)

042-27 – ENGINEERING KNOWLEDGE - GENERAL

MONDAY, 16 JULY 2012

0915- 1215 hrs

Examination paper inserts:

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TWO questions from Section C

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SECTION A

Attempt SIX questions only from this section

1. Sketch EACH of the following electric arc welding defects, stating the cause of EACH defect:
 - (a) undercutting; (2)
 - (b) porosity; (2)
 - (c) lack of penetration; (2)
 - (d) lack of fusion; (2)
 - (e) slag inclusion. (2)

2. (a) Explain the meaning of EACH of the following terms:
 - (i) two step control; (2)
 - (ii) proportional control action; (2)
 - (iii) integral control action. (2)(b) State, with reasons, a typical shipboard application for EACH of the following:
 - (i) two step control action; (2)
 - (ii) proportional plus integral action. (2)

3. (a) Describe, with the aid of a sketch, the constructional difference and operation of a Screw Down Non-Return valve and a Screw Lift valve of similar size. (5)
(b) State THREE properties of the gland packing material used in a Globe Valve for sea water duties. (3)
(c) Explain why non- return valves are used in engine room bilge systems. (2)

4. (a) Describe a method of checking main transmission shaft alignment which does not involve the removal of coupling bolts. (5)
- (b) State why the shaft alignment should be checked when the ship is afloat in a light condition. (1)
- (c) A shaft system is excessively misaligned so as to cause serious bending of the shaft. State what effect this could have on EACH of the following:
- (i) the shaft coupling bolts; (1)
- (ii) the shaft bearings. (1)
- (d) State, with reasons, which of the effects stated in Q4(c) would cause most concern. (2)
5. Describe, with the aid of a sketch, a twin rotor screw type pump suitable for fuel oil duties detailing any protective devices that would be fitted to a pump of this type. (10)
6. With reference to a four ram steering gear:
- (a) sketch a cross section through a ram crosshead showing the trunion and tiller arm bearings and how clearances are accommodated; (6)
- (b) state a typical value for EACH of the following:
- (i) wear-down clearance; (1)
- (ii) jumping clearance; (1)
- (c) explain the consequences of EACH of the clearances stated in Q6(b) being reduced. (2)

7. With reference to Fig Q7, explain the purpose of the device and describe how it is set to operate. (10)

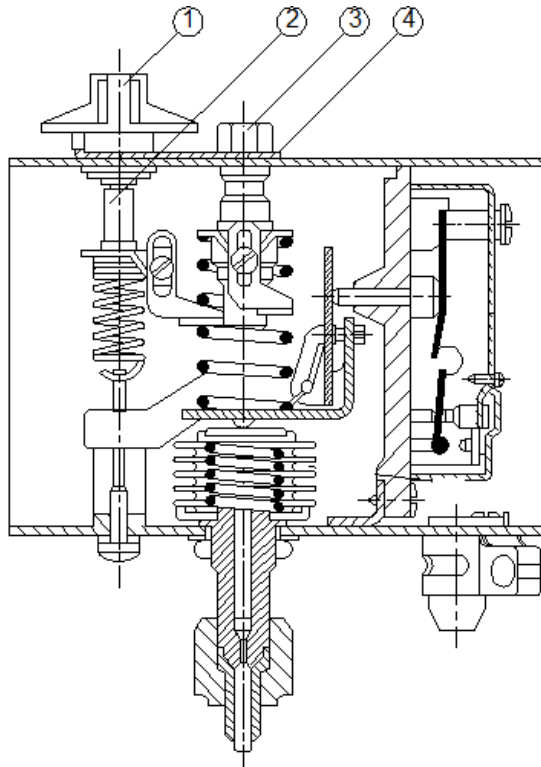


Fig Q7

8. (a) Describe, with the aid of a block diagram, an engine room High Fog smothering system. (9)
- (b) State the major advantage of the system sketched in Q8(a) over systems which employ an inert gas. (1)

SECTION B

Attempt TWO questions only from this section

9. With reference to lighting circuits:
- (a) state the effects of using lamps rated at 240 volts in a 220 volt system; (2)
 - (b) (i) explain the stroboscopic effect of discharge lamps and the hazards associated with this effect; (3)
 - (ii) describe how stroboscopic effects may be alleviated. (5)
10. (a) Describe, with the aid of a sketch, the constructional details of a squirrel cage rotor as fitted in an induction motor. (8)
- (b) Explain why some rotors have a double cage. (2)
11. (a) Describe, with the aid of a sketch, the operation of a single phase motor that employs a starting circuit with a leading current. (6)
- (b) Explain how the start, run and common terminals on the motor described in Q11(a) could be identified if there were no markings on the terminals. (4)

SECTION C

Attempt TWO questions only from this section

12. With reference to structural fire protection in passenger ship accommodation spaces:
- (a) define the meaning of EACH of the following:
 - (i) Class A bulkheads; (3)
 - (ii) Class B bulkheads; (3)
 - (b) where Class A bulkheads have to be penetrated, explain how the integrity of the bulkhead is retained with respect to EACH of the following:
 - (i) doors; (2)
 - (ii) ventilation trunking. (2)
13. Describe, with the aid of a sketch, EACH of the following types of rudder:
- (a) unbalanced; (3)
 - (b) semi-balanced; (3)
 - (c) balanced. (4)
14. With reference to ship's lifeboats:
- (a) sketch a main brake; (5)
 - (b) state safety features incorporated in the brake should the operator:
 - (i) let go of the brake handle completely during lowering; (1)
 - (ii) attempt to lower the lifeboat too quickly; (1)
 - (c) state the maximum rate of descent when launching; (1)
 - (d) explain how the lifeboat is protected from falling back into the water if the power fails when hoisting the boat. (2)