

CLASS 1	EK GENERAL
----------------	-------------------

SENIOR MARINE EXAMINATIONS

Past Papers

CLASS 1

EK GENERAL

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. As a prerequisite to its promotion programme, the head office of your company requests prospective Chief Engineer Officers to submit a letter, detailing the responsibilities of a Chief Engineer Officer.

As an aspiring Chief Engineer Officer compile such a letter. (10)

2. The steering gear operation of a vessel that recently experienced a heavy storm is found to be abnormally sluggish.
 - (a) State FOUR reasons for possible malfunction of the gear. (4)
 - (b) State the corrective actions that may be carried out at sea, that will allow the vessel to continue to the nearest port. (4)
 - (c) Explain the tests that should be carried out prior to returning the gear to service. (2)

3. With reference to a centralised indirect refrigeration system for cargo containers:
 - (a) describe, with the aid of a sketch, such a system; (6)
 - (b) state the possible consequences if the density of the secondary refrigerant is not kept within close limits; (2)
 - (c) state the required density of the secondary refrigerant and how the cooling coils are defrosted. (2)

4. (a) List the destructive laboratory tests that may be carried out on specimens of steel for ships' plate, stating the reasons for these tests. (6)
- (b) The basic composition of two ships' plate is given in Table Q4(b). One is an example of modern practice whilst the other is a specification of an older ship that split in two due to brittle fracture.

State, with reasons, which of these two steels would be most resistant to brittle failure. (4)

	C	Mn	Si	S	P	Al	N
Steel A	0.18%	0.7%	0.3%	0.04%	0.04%	0.015%	0.005%
Steel B	0.19%	0.57%	0.3%	0.1%	0.042%	0.005%	0.008%

Table Q4(b)

5. List the instructions for the operation, maintenance and monitoring of a bilge water processing unit to ensure compliance with the current MARPOL convention on the discharge of oily bilge water. (10)
6. Describe, with the aid of a block diagram, a vacuum stripping system for the cargo tanks of a products carrier. (10)
7. With reference to CO₂ gas provided for fire fighting purposes:
- (a) describe, with the aid of a sketch, a system for the detection and extinguishment of hold fires; (7)
- (b) state how the amount of gas to be released into the hold space is estimated. (3)
8. (a) State, with reasons, the control actions that may be suitable for EACH of the following processes:
- (i) settling tank oil temperature; (2)
- (ii) jacket water temperature; (2)
- (iii) temperature of oil being purified. (2)
- (b) Sketch a block diagram of ONE of the control circuits for ONE of the processes in Q8(a). (4)

SECTION B

Attempt TWO questions only from this section

9. (a) Explain the meaning of EACH of the following types of electrical safety equipment:
- (i) intrinsically safe; (2)
 - (ii) flameproof; (2)
 - (iii) increased safety; (2)
- (b) State the electrical tests for equipment in hazardous areas, describing the safety precautions. (4)
10. (a) Sketch a cross-section of a silicon controlled rectifier. (6)
- (b) Describe, with the aid of a diagram, the operation of a silicon controlled rectifier. (4)
11. Sketch the layout of an electric propulsion system for a large passenger vessel employing synchro-convertors. (10)

SECTION C

Attempt TWO questions only from this section

12. (a) State reasons why crack propagation may occur in propeller shaft *A brackets* or *spectacle frames*. (5)
- (b) Explain why the adequate provision of deck scuppers and freeing ports is as critical to seaworthiness as watertight integrity. (5)
13. With reference to arresting the headway of vessels of considerable mass, explain EACH of the following:
- (a) why full power availability for astern running of the propeller is inconsequential; (4)
- (b) why results have been disappointing in those instances where rudders have been adapted as retarders; (4)
- (c) why discreet use of transverse thrusters may reduce stopping distances. (2)
14. (a) Explain why the International Maritime Organisation is banning the use of Tributyltin antifouling (T.B.T.) coatings for ship's hulls. (4)
- (b) List FOUR requirements of a suitable coating for a ship's underwater surface. (4)
- (c) State the base elements of TWO alternative coatings to T.B.T. antifouling. (2)

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. Describe, with the aid of a sketch, the principle of operation of a capacitance electrode level measuring transmitter. (10)

2. With reference to tunnel type bow thrusters:
 - (a) explain why some vessels are fitted with more than one bow thruster; (2)
 - (b) describe the options available in terms of prime mover and transmission systems. (8)

3.
 - (a) Sketch a hydraulically tensioned shaft coupling bolt which incorporates a tapered sleeve fitted between the bolt and the coupling holes. (4)
 - (b) Describe how the bolt assembly sketched in Q3(a) is fitted. (3)
 - (c) State the advantages of this type of arrangement compared to conventional bolt assemblies. (3)

4. State the inspections and maintenance that should be carried out on main sea water pipelines, strainers and ship's side valves to minimise the risks of engine room flooding. (10)

5.
 - (a) Sketch an outboard radial lip seal as fitted to an oil lubricated stern tube. (5)
 - (b) Explain the procedure for replacing the seal sketched in Q5(a) whilst the ship is afloat. (5)

[OVER

6. (a) With reference to ship's air conditioning systems, state the effects of EACH of the following faults:
- (i) corroded return air trunkings; (2)
 - (ii) blocked evaporator drains; (2)
 - (iii) defective capacity control. (2)
- (b) State the MAIN health danger that may arise in an air conditioning plant and the measures that should be taken to prevent it occurring. (4)
7. (a) List SIX alarms/trips that are fitted on an auxiliary boiler, describing how EACH would be tested. (6)
- (b) Describe how the safety valves would be tested under working conditions. (4)
8. Describe the items and examinations that are carried out during a safety equipment survey with regards to fire safety. (10)

SECTION B

Attempt TWO questions only from this section

9. Describe, with the aid of a circuit diagram, the operation of an automatic voltage regulator which employs thyristors. (10)
10. (a) With reference to an alkaline battery cell:
- (i) describe a typical cell, listing the materials involved; (4)
 - (ii) describe the electro-chemical process that takes place during discharge and charge; (2)
 - (iii) state the effect of overcharge. (2)
- (b) State ONE advantage and ONE disadvantage of an alkaline cell compared with a lead acid cell. (2)
11. During a complete loss of electrical power, essential services can be maintained by means of an Uninterruptible Power Supply (UPS).
- (a) Describe, with the aid of a block diagram, an a.c. input UPS arrangement. (7)
 - (b) List THREE essential services that the UPS may support. (3)

SECTION C

Attempt TWO questions only from this section

12. Describe the reasons why prefabrication of sub assemblies, which are then joined together to form block assemblies, have replaced the more traditional methods of ship construction. (10)
13. As Chief Engineer Officer of an older vessel which has recently been purchased, state, in a letter to the Superintendent Engineer, the items that should be inspected to ensure that the *conditions of assignment* are satisfactorily complied with. (10)
14. With reference to a cargo tank of a liquefied petroleum gas (LPG) carrier:
- (a) sketch a half transverse cross section through the hull; (6)
 - (b) describe a method of building up the thermal insulation. (4)

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. Describe, with the aid of a diagram, the following types of material failure, stating ONE practical example of EACH:
 - (a) creep; (5)
 - (b) fatigue. (5)

2.
 - (a) Describe TWO methods of priming centrifugal pumps. (6)
 - (b) List the advantages of the priming methods described in Q2(a). (4)

3.
 - (a) Sketch a block diagram showing how fuel oil viscosity is controlled. (5)
 - (b) Describe the operation of the system sketched on Q3(a). (5)

4. With reference to main propulsion shaft systems:
 - (a) describe a method of hydraulic jacking to check bearing loads; (5)
 - (b) sketch the Bearing Load versus Shaft Lift Dial Gauge Reading graph obtained by the method described in Q4(a), explaining how the characteristic bearing load is obtained. (5)

5. With reference to refrigeration systems:
 - (a) explain why undercooling of the refrigerant at the condenser outlet is desirable; (3)
 - (b) describe, with the aid of a sketch, how a heat exchanger could be incorporated in the circuit to enhance undercooling; (5)
 - (c) explain the possible consequences of the refrigerant having a dryness fraction at the compressor suction. (2)

[OVER

6. With reference to a ram type steering gear, explain how it may be determined that defective steering may be due to EACH of the following, stating the immediate actions that should be taken to maintain steering capability:
- (a) a twisted rudder stock; (5)
 - (b) worn pump internals; (3)
 - (c) air in the system. (2)
7. With reference to heat exchangers, describe how EACH of the following design aspects promote heat transfer:
- (a) material selection; (5)
 - (b) flow patterns; (3)
 - (c) extended surface areas. (2)
8. As Chief Engineer Officer appointed to a newly acquired vessel, write a letter to the Superintendent Engineer describing the inspection that should be carried out to ensure satisfactory condition and operation of the ship's fire fighting equipment. (10)

SECTION B

Attempt TWO questions only from this section

9. (a) Explain THREE methods of overcurrent protection for electrical circuits. (6)
- (b) Explain, with the aid of a diagram, the meaning of the term *inverse current time characteristic*. (4)
10. (a) Sketch a circuit diagram of a self excited a.c. generator. (5)
- (b) Describe the operation of the circuit sketched in Q10(a). (5)
11. With reference to electrical equipment in potentially flammable atmospheres:
- (a) explain why conventional equipment is considered hazardous; (2)
- (b) explain the concept of *intrinsic safety*; (3)
- (c) describe, with the aid of a sketch, a safety barrier for an electrical power supply. (5)

SECTION C

Attempt TWO questions only from this section

12. (a) Explain why some vessels may be subjected to an *in water survey*. (2)
- (b) List the criteria that must be fulfilled before a vessel is eligible for an *in water survey*, outlining the inspections that would be carried out. (8)
13. With reference to roll reduction systems, explain the principles of operation of EACH of the following, stating the advantages and disadvantages:
- (a) bilge keels; (5)
- (b) passive uncontrolled tanks. (5)
14. With reference to cargo hatch covers on large container ships:
- (a) describe how they are tested for water tightness; (2)
- (b) explain how the weight of the hatch and containers is transferred to the ships structure whilst allowing for deflections of the hull in a seaway; (3)
- (c) describe, with the aid of a sketch, the type and location of damage that can occur due to wear of the hatch supporting arrangements. (5)

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. An older vessel has a recent record of high overall fuel costs. The owners are anxious to reduce this expenditure whilst maintaining service speed and services. To this end they have recently drydocked the vessel for hull cleaning and propeller polishing. Results from this have improved consumption but not to a satisfactory level.

As Chief Engineer Officer write a letter to the company explaining how fuel consumption could be further improved. (10)

2. (a) Describe, with the aid of a sketch, a plate type heat exchanger. (6)

(b) Explain TWO advantages and TWO disadvantages of plate coolers compared with shell and tube coolers. (4)

3. (a) With reference to salt water circulating systems fitted with two speed centrifugal pumps, sketch typical discharge characteristics showing variation of throughput as discharge head and speeds are altered both in high speed mode and low speed mode, explaining why these characteristics are desirable. (6)

(b) Explain how system losses in a circulating system may be minimised. (4)

4. (a) Describe, with the aid of a sketch, an oily water separator. (6)

(b) With reference to oil/water mixtures, describe the effectiveness of dynamic separation compared with static separation. (4)

[OVER

5. With reference to the taking of bunkers:
- (a) state the safety precautions that should be observed when bunkering; (4)
 - (b) explain the importance of taking samples when bunkering; (2)
 - (c) describe a preferred method of taking samples; (1)
 - (d) State the effect of EACH of the following in a fuel oil:
 - (i) high density; (1)
 - (ii) high pour point; (1)
 - (iii) high water content. (1)
6. (a) Explain EACH of the following control systems:
- (i) cascade; (3)
 - (ii) split range. (3)
- (b) Describe a control system that may be enhanced by the inclusion of cascade and split range control. (4)
7. (a) Explain how power is transmitted through main shafting. (2)
- (b) State FOUR operational factors that may induce high stress in coupling bolts. (4)
- (c) Sketch a hydraulic type coupling bolt. (4)
8. (a) Accidents have occurred due to premature or accidental release of CO₂ into machinery spaces. State the safety procedure that the Chief Engineer Officer should adopt with respect to EACH of the following:
- (i) contractors working on the system; (2)
 - (ii) the understanding between bridge and engineroom in event of fire; (2)
 - (iii) the procedure prior to release of gas; (2)
- (b) Describe the factors that should be considered prior to re-entry of the machinery spaces after the release of CO₂ gas. (4)

SECTION B

Attempt TWO questions only from this section

9. With reference to voltage variation profiles caused by load changes imposed on alternating current generators when starting large motors direct on line:
- (a) sketch a voltage dip, showing an acceptable recovery time; (2)
 - (b) outline FOUR salient factors that cause the variation in Q9(a); (4)
 - (c) outline FOUR salient factors that assist recovery from the deviation shown in Q9(a). (4)
10. (a) Outline the operation of a Ward Leonard speed control system. (4)
- (b) Explain how the Ward Leonard system may be modified to provide electronic control for electric propulsion systems. (6)
11. With reference to polyphase induction motors:
- (a) describe, with the aid of a sketch, a torque/speed profile for an electric motor driving a centrifugal pump; (6)
 - (b) indicate on the sketch of Q11(a) the effects of voltage variation. (4)

[OVER

SECTION C

Attempt TWO questions only from this section

12. (a) Describe the method of attachment of bilge keels. (5)
- (b) State THREE reasons for not extending bilge keels the entire length of the vessel. (3)
- (c) Explain TWO principles of roll damping that bilge keels exploit. (2)
13. (a) Describe, with the aid of a sketch, a mechanism designed to operate hatch covers. (7)
- (b) State how water tightness and security of the hatch covers is ensured before proceeding to sea. (3)
14. With reference to roll on, roll off ferries:
- (a) explain why these vessels are prone to free surface effect; (2)
- (b) describe the means of clearing water from the vehicle decks; (2)
- (c) outline methods for improving the stability and survivability of these vessels. (6)