

## 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. Explain the effects of the addition of EACH of the following alloying elements to improve the characteristics of steels:
  - (a) chromium; (2)
  - (b) manganese; (2)
  - (c) molybdenum; (2)
  - (d) nickel; (2)
  - (e) vanadium. (2)
  
2. With reference to pneumatically operated control valves:
  - (a) state FOUR reasons for fitting a valve positioner; (4)
  - (b) explain valve hysteresis, stating how it affects the process; (2)
  - (c) state the immediate action to be taken to restore control upon failure of the positioner bellows; (2)
  - (d) state the difference between *fail safe* and *fail set*. (2)
  
3. Describe, with the aid of a sketch, the principle of operation of a radial lip stern tube sealing arrangement for an oil filled stern tube, which incorporates an air space and is designed to prevent pollution. (10)
  
4. Describe in detail 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)
  
5.
  - (a) Sketch a rotary vane steering and hydraulic circuit showing 2 x 50% units and the directional control valves. (6)
  - (b) Describe how the system in part (a) can still operate should an oil leak occur. (2)
  - (c) State the advantages of rotary vane compared to four ram steering gear. (2)

6. With reference to ships air conditioning plants:
- state the temperatures and relative humidities at EACH of the points that are regarded as the boundaries of the comfort zone; (2)
  - explain how the temperatures and relative humidities could be maintained within the comfort zone when the ship is in EACH of the following locations:
    - North West Europe in winter; (2)
    - Arabian Gulf in summer; (2)
  - state, with reasons, FOUR locations within the accommodation that conditioned air must not be recirculated. (4)
7. With reference to hydraulic deck machinery and cargo handling systems:
- state FOUR possible types of contamination of the oil, describing how the contamination may have occurred; (4)
  - state FOUR possible effects of oil contamination on the system; (4)
  - state how the system oil may be monitored for contamination. (2)
8. Accidents have occurred due to premature or accidental release of CO<sub>2</sub> into the machinery spaces.
- State the safety procedures that the Chief Engineer Officer should adopt with respect to maintenance being carried out on the system by shore contractors. (3)
  - Explain why the Chief Engineer Officer and ship's staff should still have to check on work carried out by shore contractors. (2)
  - State how the liquid levels in the CO<sub>2</sub> bottles may be checked in situ and how often this test should be carried out. (2)
  - Explain why ship's general service air should not be used for blowing through and testing CO<sub>2</sub> operating lines and suggest a suitable alternative. (3)

## Section B

9. With reference to overcurrent protection for electrical circuits:
- explain THREE methods of protection, stating where EACH may be used; (6)
  - explain, with the aid of a diagram, the meaning of the term *inverse current time characteristic*. (4)
10. (a) State the consequences of using direct on line starters for comparatively large sized a.c. induction motors. (2)
- (b) Describe, with the aid of a sketch, an electronic soft starting system that may be used for large sized a.c. induction motors. (8)
11. With reference to insulation testing of electrical equipment:
- state the reasons for insulation testing and why it is carried out on a regular basis; (2)
  - describe the procedure for taking a set of insulation readings on an electric motor in-situ, stating the minimum acceptable readings; (6)
  - explain the term *Polarisation Index*. (2)

## Section C

12. With reference to drainage from a ship's external structure, explain EACH of the following:
- (a) why scuppers are located in close proximity to the superstructure, whereas freeing ports are generally located at open areas of the weather deck; (3)
  - (b) why it is essential that scuppers and freeing ports are operational at all times; (4)
  - (c) why oil tankers have handrails on the main cargo deck other than for reasons of personnel safety. (3)
13. With reference to cargo hatch covers on large container ships:
- (a) describe how they are tested for watertightness; (2)
  - (b) explain how the weight of the hatch and containers is transferred to the ship's 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)
14. During sea trials, extensive noise measurements are taken in accordance with the *Code of Practice for Noise Levels in Ships*.
- (a) State and explain the unit of sound measurement. (2)
  - (b) State the noise level above which personnel are required to wear ear protection. (1)
  - (c) Explain how a ship's crew may be made aware of the hazards posed by exposure to excessive noise. (2)
  - (d) Explain how the noise levels can be reduced in the design of EACH of the following:
    - (i) diesel generators; (3)
    - (ii) ventilation fans and trunkings. (2)