Q1 (16 marks)

(a) With reference to the underwater surface of a ship's hull

(i) Describe a hull plate roughness analyser system.

(ii) State the significance of the roughness profile and compare the typical roughness values for a new ship and a ship eight years old. (8)

(b) Which reference to the application of self-polishing paint in dry dock

(i) Describe the plate preparation necessary. (8)

(ii) State the defects that may occur in the if it is not correctly applied.

Dry-dock

Q2 (16 marks)

With reference to membrane tanks for the carriage of liquefied gas at very low temperatures.

(a) Describe with the aid of a sketch, ONE method of building up the insulation: (6)

(b) State with reasons the alloy, which is used for the membrane. (4)

(c) Describe with the aid of a sketch, how the tanks are located and supported. (6)

(i) Longitudinally

(ii) Transversely

Q3 (16 marks)

State FOUR terms used to describe the conditions that relate to the distortion of a ship's hull undergoes in heavy seas, stating in EACH case the type of stresses involved and where the stresses occur. (16)

Stresses

Q4 (16 marks)

With respect to trim and stability, describe the following:

(a) Effects on centre of gravity of slack tanks. (4)

(b) Effect on stability of ice formation on superstructure. (4)

(c) Effects of wind and waves on ship's stability. (4)

(d) Effect of water absorption by deck cargo and retention of water on deck. (4)

Stability

Q5 (16 marks)

With reference to the prevention of hull corrosion discuss:

(a) Surface preparation and painting of new ship plates. (6)

(b) Design of the ships structure and its maintenance. (5)

(c) Cathodic protection by sacrificial anodes, of the internal and external areas of the ship. (5)

Q6 (16 marks)

(a) Describe how the distribution of mass within the ship affects the rolling period. (6)

(b) The righting moments of a ship at angles of heel of 0, 15°, 30°, 45°, and 60° are 0, 1690, 5430, 9360 and 9140 kN-m respectively. Calculate the dynamical stability at 60°. (10)

Calculations

Q7 (16 marks)

(a) Describe briefly the significance of the factor of subdivision. (6)

(b) A ship 120m long has a light displacement of 4000 tonne and LCG in this condition 2.5m aft of midships. The following items are then added: (10)

Cargo 10000 tonne LCG 3.0m forward of midships

Fuel 1500 tonne LCG 2.0 m aft of midships

Water 400 tonne LCG 8.0m aft of midships

Stores 100 tonnes LCG 10.0m forward of midships

Using the following hydrostatic data, calculate the final draughts:

Draught (m)

Displacement (t)

MCT1cm (tm)

LCB from midships

LCF from midships

8.50

1.94F

1.29A

8.00

2.10F

0.60F

Calculations

Q8 (16 marks)

(a) Explain the effect of trim on tank soundings. (6)

(b) A ship of 6600 tonne displacement has KG 3.6m and KM 4.3m. A mass of 50 tonne is now lifted from the quay by one of the ship's derricks whose head is 18 m above the keel. The ship heels to a maximum of 9.5° while the mass is being transferred. Calculate the outreach of the derrick from the ship's centreline. (10)

Calculations

Q9 (16 marks)

(a) Explain the effect on GM during the filling of a double–bottom tank (6)

(b) A ship of 8,000 tonnes displacement has KM 7.5 m, and KG 7.0 m. A double bottom tank is 12 meters long 15 meters wide and 1 meter deep. The tank is divided longitudinally at the centre line and both sides are full of salt water. Calculate the list if one side is pumped on until it is half empty. (10)

Calculations

Q10 (16 marks)

A ship of 9,900 tonnes displacement has KM = 7.3 m and KG = 6.4 m, she has yet to load two 50 tonne lifts with her own gear and the first lift is to be placed on deck on the inshore side (KG 9 m and center of gravity 6m out from the center line). When the derrick plumbs the quay its head is 15m above the keel an 12m out from the center line.

Calculate the maximum list during operation. (16)

Calculations