Hydrostatics

Past Paper Questions

Q1. A box barge of length 50m and breadth 10m has a draft 5.2m in sea water. A cargo of 700 tonnes is now loaded thereby increasing the even keel draft. Determine the pressure, in KN/m^2, on the outside of the bottom plating. Take density of sea water as 1025 kg/m3 and gravitational acceleration as 9.81 m/sec2 -10m

Q2. a. State Archimedes Principle -4m

b. Some bodies float when placed in a fluid, others sink. Describe why this is so. Give examples to demonstrate your answer -6m

Q3. The submerged depth of an underwater vessel is 150m. The pressure on its hull is now required to be reduced down to 1MN/m2. Calculate the distance the vessel should travel at an angle of 30 above the horizontal level to be at the specified pressure. Take density of sea water as 1025 kg/m3 and gravitational acceleration as 9.81 m/sec2. -10m

Q4. A rectangle box barge of 20m beam and 40m length displaces 250 tonnes when empty. The maximum draft of the barge is 4.5m. Take SG sea water as 1.025. Calculate

a. the maximum weight of cargo that can be carried on a sea passage. -6m

b. the weight of that have to be removed from Q4 a. before a river passage -4m

Q5 a. Explain each of the following for an immersed surface.

i. Centre of Pressure -5m

ii. Centroid -3m

b. Explain why Centre of Pressure and centroid of an immersed surface differ in positon -2m

Q6. Explain with reference to Archimedes principle, how a ship constructed of steel with much greater density than water, is able to float on water. -10m

Q7. A tank of cubical shape 10mX10mX10m contains oil of relative density 0.85. The tank is pressed up and oil rises up the sounding pipe. The total load on the bottom of the tank due to oil is now 10006.2 KN. Calculate the height of oil in the sounding pipe from tank top. Take gravitational acceleration as 9.81 m/sec2. -10m

Q8. A loaded rectangular box barge has a draft of 6m and displacement of 3000 m3 whilst floating in sea water. The barge is to be moved to a river berth to discharge cargo. The depth of water at the berth is 5.8m. Calculate the required change in ballast in tonnes. Take density of sea water as 1025 kg/m3 and density of fresh water as 1005 kg/m3. -10m

Q9. One end of the water channel, 2m wide and 5m deep, is closed by a flap door hung from a spring loaded hinge at the top of the channel. The channel is filled with fresh water to a depth of 3m. Determine the moment on the hinge. Take gravitational acceleration as 9.81 m/sec2. - 10m

Q10. A rectangular tank 9.5m long, 4.5m wide and 6.0m deep contains liquid of relative density 0.86. State, in percentage, how full he tank will be when the total force acting on the bottom of the tank is 1298.4 KN. Take gravitational acceleration as 9.81 m/sec2. -10m

Q11. A rectangular pontoon barge of 20m beam and 20.3m long displaces 3000 tonnes in fresh water. The barge is to be moved to a sea water berth where Sg = 1.025. Assuming the barge floats evenly. Calculate

a. the Volume of barge upto water line in fresh water -3m

b. the draught of barge in fresh water -3m

c. the weight that must be added to maintain same draught when barge is moved to sea water -4m

Q12. A ballast tank and an oil tank are separated by a rectangular vertical bulkhead 8m wide. The oil tank has oil of SG = 0.88 to a depth of 5.2m and the ballast tank contains sea water (density = 1025 kg/m3). The Resultant thrust is 1329KN from sea water to oil side. (g = 9.81 m/sec2). Calculate the depth of sea water in the ballast tank. -10m

Q13. The Volume of a body, having irregular shape, is to be determined. In sea water, it has apparent mass of 151.9 kg, but in air the mass is 244.9 kg. Calculate the density of this object. Take density of sea water as 1025 kg/m3 and gravitational acceleration as 9.81 m/sec2. -10m

Q14. The pressure due to water on a rectangular dock gate varies linearly with the depth of water, ‘d’ , showing a triangular shape distribution. The center of pressure on the dock gates acts at centroid of this triangle. State, with reasons, the distance between the centroid and center of pressure on the dock gate in terms of water depth ‘d’. -10m

Q15. a. Arrange the following materials in increasing order of density

Steel, water, aluminum, balsa wood, mercury. -2m

b. Explain with respect to Archimedes principle, how a material which normally sinks in water can be made to float. -8m

Q16 A rectangular tank 9.5m long, 4.5m wide and 6.0m deep contain liquid of relative density 0.86. Calculate the total force acting on the bottom of the tank when the tank is 60% full. (Take g = 9.81m/sec2) -10m

Q17. A floating crane based on a rectangular pontoon measuring 30m by 25m displaces 1500 tons. The barge is moved from a location in a river, density = 1010 kg/m3, to a location in a estuary (density = 1025 kg/m3). The freeboard of pontoon is to be maintained by introduction of concrete ballast to compensate for move to the estuarial location. Calculate

a. the volume of pontoon up to waterline in river water -3m

b. the draft of pontoon in river -3m

c. the volume of concrete required to maintain the freeboard when in estuary (concrete density = 2300 kg/m3) -4m

Q18 A rectangular pontoon barge of 30m beam and 60m long displaces 250 tons. The barge is loaded with 500 tons of cargo whilst in river water and then undergoes a sea voyage

SG of sea water = 1.025

SG of freshwater = 1.002

Assuming the barge floats evenly, Calculate the change in draft

a. during loading -7m

b. when moving from river to sea -3m

Q19. A rectangular pontoon barge of 20m beam and 20.3m long displaces 2500 ton in sea water with SG = 1.025. The barge floats evenly and has a freeboard of 2.5m in this condition. Calculate:

a. the volume of the barge upto waterline -3m

b. the draft of barge -3m

c. the weight to be added to reduce the freeboard to 0.5m -4m

Q20. In sea water it has an apparent mass of 2.55kg, but in air the mass is 3.57kg. Calculate volume of this object. (Take density = 1025 kg/m3, g = 9.81 m/sec2) -6m

Q21. A box barge 50m long and 10m wide floats at a draft of 5.2m in sea water of density 1025 kg/m3. Determine the pressure in KN/m2, on the bottom plating after loading 1025 tons of cargo (Take g = 9.81 m/sec2) -10m