July 2008

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets.

1. Solve for x in the following equation:

   $2(x + 4) - 3(x - 5) = x - 7$ (8)

2. Pump A can fill a tank in 12 hours.
   Pump B can fill the same tank in 6 hours.
   Pump C can fill an identical tank in 3.5 hours.

   Calculate the time, in hours and minutes, to fill the tank if all the pumps are working together. (8)

3. The area of an annulus is given by the following formula:

   $$A = \frac{\pi D^2}{4} - \frac{\pi d^2}{4}$$ where D = major diameter, d= minor diameter.

   (a) Transpose the formula to make d the subject; (6)

   (b) Find the area of an annulus having a major diameter of 7cm and a minor diameter of 5cm. (4)

4. Calculate EACH of the following:

   (a) the perpendicular height of a right angled triangle having a base length of 7.34cm and a hypotenuse of 11.31 cm using Pythagoras Theorem; (5)

   (b) the area of the triangle in Q4(a) in m^2. (3)

5. An open ended cylinder, diameter 10cm and height 23cm, is half filled with liquid. A heavy metal sphere of 9.6cm diameter is now submerged in this liquid.

   Calculate the distance from the rim of the cylinder to the liquid level. (8)

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6. Calculate the diameter of pipe that will pass six times as great a volume of water as a pipe 1.25m in diameter.

Note: Assume the water velocity remains constant. (8)

7. A body starts from rest and reaches a speed of 54km/h in 32 seconds, continues at this speed for 1.5 minutes and then retards to come to rest in 45 seconds. Assume acceleration and retardation to be uniform.

(a) Draw the speed-time graph representing this movement. (3)

(b) Calculate EACH of the following:

(i) the total distance travelled in km; (3)

(ii) the retardation in m/s^2. (2)

8. A pump delivers $65m^3$ of sea water to a height of 28m in 6 minutes.

Calculate EACH of the following:

(a) the output power of the pump in kW; (5)

(b) the input power of the pump if the efficiency is 0.65. (3)

Note: Density of sea water 1025kg/m^J

9. A screwjack has a single start thread with a pitch of 5mm and is operated by a lever having an effective length of 285mm.

Calculate the efficiency of the machine when lifting a load of 290kg with an effort of 29.94N. (8)

10. A bulkhead is 7m high and is flooded to a height of 6.1 m with sea water on one side only.

Calculate EACH of the following:

(a) the hydrostatic pressure at the base of the bulkhead; (4)

(b) the hydrostatic force on a circular access door 740mm in diameter having its centre situated 5.9m down from the top of the bulkhead. (6)

Note: Density of sea water 1025kg/m^3

11. A vessel has an underwater volume of 3918m^3 in water of density 1021kg/m^3 and when a mass of 5.5 tonne, already on board, is moved 9.7m across the deck it causes the vessel to heel by 1.8°.

Calculate the distance from the keel to the transverse metacentre given KG = 3.75m and

$$GM = \frac{m \times d}{\Delta \tan \theta}$$

(8)

12. A vessel has a displacement of 1060 tonne. A double bottom tank on the centre line is 1.3m deep x 4.4m wide x 5.76m long and is completely flooded with water of density 1018kg/m^3.

Calculate EACH of the following:

(a) the mass of water added to the double bottom tank; (3)

(b) the new position of the ship's centre of gravity G when the tank is flooded, given that the original KG is 3.9m. (5)