Feb 2001

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each part question are shown in brackets

1. The following formula relates to simple harmonic motion

$$t = 2\pi\sqrt{\frac{L}{g}}$$

where L = displacement and g = gravitational acceleration.

(a) Transpose the formula to make L the subject. (4)

(b) Calculate the value of L when $g = 9.81$, $t = 2.005$ and $\pi = 3.14$. (4)

2. A flywheel has a diameter of 0.68 m and turns at 1400 rev/min.

Calculate EACH of the following:

(a) the angular velocity in rad/s; (4)

(b) the linear velocity in m/s of a point on the flywheel rim. (4)

3. Determine the pressure, in bars, on the flat outer bottom plating of a ship in the loaded condition. Draft may be taken as 28 metres in sea water of density 1025 kg/m^3. (8)

4. Pump A can empty a tank in 12 hours.

Pump B can empty the same tank in 8 hours.

Pump C can empty the tank in 9 hours.

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

5. Fig. Q.5 shows a square of 1.9 m side to be cut from a circular plate.

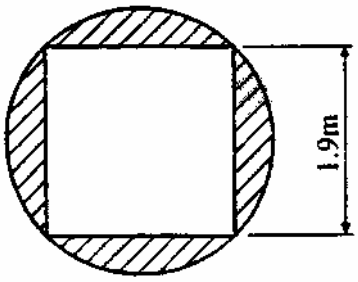

Fig. Q.5

Express the area of waste plate, shown hatched, as a percentage of the original plate. (8)

6. (*a)* Plot the graph using the data in Table Q.6. (4)

x	0	1	2	3
y	−10	0	10	20

Table Q.6

Use scales: x axis: 4 cm = 1
y axis: 2 cm = 5

(b) Obtain from the graph in Q.6(a) EACH of the following:

(i) the value of x when y = -5; (1)
(ii) the value of y when *x* = 2.6. (1)

(c) Determine the law of the graph in Q.6(a). (2)

7. A vertical pile is set in a river bed.

The pile has 1/3 of its total length in the river bed, 25% of its total length in the water, and 2.3 metres above the water.

Determine the length of the pile. (8)

8. Fig. Q.8 shows a simply supported beam.

Determine EACH of the following:

(a) the maximum value of load W if the reaction R_B is not to exceed 38 kN. (5)

(c) the value of the reaction R_A. (3)

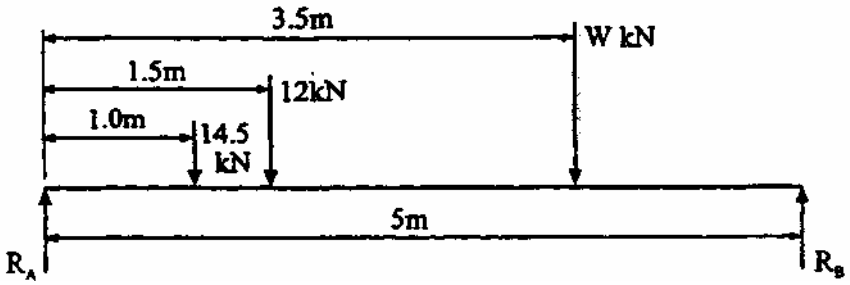

Fig. Q.8

9. A Weston differential pulley block has a small wheel of 87.5 mm radius and a velocity ratio of 16.

Determine EACH of the following:

(a) the diameter of the large wheel; (5)

(b) the efficiency of the machine, as a percentage, if the mechanical advantage is 6.4. (3)

10. *(a)* Define EACH of the following terms as applied to a box shaped vessel:

(i) centre of gravity; (2)

(ii) centre of buoyancy; (2)

(iii) metacentre. (2)

(b) A vessel has a displacement of 1248 tonne. When a mass of 5 tonne is moved 4 metres across the deck it causes the vessel to heel by 2°.

Determine the value of GM given $m \times d = \Delta GM \tan \theta$. (4)

11. A ship of displacement 4800 tonne has its centre of gravity G positioned 4.6 m above the keel.

Determine the new position of the centre of gravity above the keel when a mass of 59 tonne is loaded on board as deck cargo with its centre of gravity 7.3 m above the keel. (8)

12. A steel block requires a horizontal force of 78.5 N to just cause motion along a horizontal plane.

The coefficient of friction, μ between block and plane may be taken as 0.2.

(a) Determine the mass of the block to the nearest whole kilogram for the stated conditions. (3)

(b) The horizontal force is now increased to 158.5N.

Calculate the distance the block will move from rest in 15 seconds. (7)