Dec 2005

GENERAL ENGINEERING SCIENCE I

Attempt ALL questions

Marks for each question are shown in brackets.

1. The perimeter of a rectangle is 800mm. When the length is halved and the breadth is doubled the perimeter is increased by 300mm.

   Calculate the dimensions for the original rectangle. (8)

2. The time of swing of a pendulum is given by the following formula:

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

   Transpose the formula to make g the subject. (8)

3. A plate is in the form of an equilateral triangle. The area of the plate is 1.93 m^2.

   Calculate the length of side of the triangle. (8)

4. A flywheel has a diameter of 660mm and rotates at 154 rad/s.

   Calculate EACH of the following:

   (a) the rotational speed of the flywheel in rev/min; (4)

   (b) the linear velocity of a point on the flywheel rim; (3)

   (c) the angular retardation if the flywheel slows uniformly from running speed to rest in 25 seconds. (3)

5. Table Q5 give the load carrying capacity of roller bearing journals running at speed.

Bore (mm)	25	35	55	65
Safe load (kg)	626	1031	2182	3143

Table Q5

(a) Plot the graph from the tabular values. (6)

(b) Estimate, using the graph in Q5(a), the safe load in kg for a roller bearing having a bore of 45mm. (2)

Suggested scale: *1 cm = 2.5mm bore*
1 cm = 250kg load

6. Fig Q6 shows a section of a vertical support column having a wall thickness of 9mm. A vertical load of 3.6 tonne is applied at the top of the column.

Calculate EACH of the following:

(a) the stress in the column in N/mm^2 (6)

(b) the strain in the column given that the modulus of elasticity E for the material is $201GN/m^2$. (4)

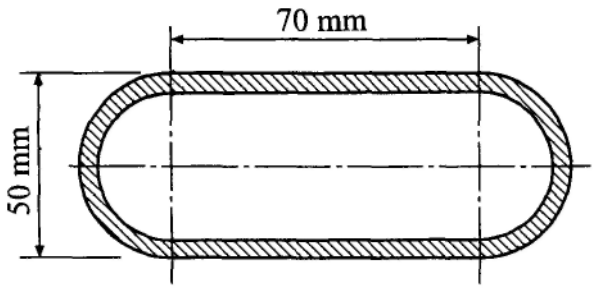

Fig Q6

7. A bulkhead is 27m wide and 18m deep and is flooded to the top on one side only with water of density $1023kg/m^3$.

Calculate EACH of the following:

(a) the pressure at a point 16m below the water surface; (3)

(b) the length of a rectangular plate, 1m high, positioned with its lower edge 15.5m below the surface if the hydrostatic force is not to exceed 0.3MN. (5)

8. Calculate the distance a mass of cast iron, 1.25m long x 0.88m x 0.8m, already on board, must be moved across the deck to cause a vessel of 844 tonne to heel by 0.7°. (8)

Note: *KG = 4.7m* *KM = 5.9m* *density of CI = 7.2 x 10^3 kg/m^3*

9. A box barge 18m long and 6m beam has a displacement of 550 tonnes and floats in water of density 1018 kg/m^3.

Calculate the height of the transverse metacentre above the keel. (8)

Given $BM = \frac{I}{V}$ and $I = \frac{LB^3}{12}$

L = length (m)

B = beam (m)

V = underwater volume (m^3)

10. The coefficient of friction between a mass of 25kg and a horizontal plane is 0.18.

Calculate EACH of the following:

(a) the least horizontal force to just cause motion; (2)

(b) the acceleration if the force is now increased to 320N; (3)

(c) the time taken to travel 8.5m from rest under the action of the accelerating force. (3)

11. Fig Q11 shows a simply supported beam AB.

Calculate the distance *x* metres such that the reaction R_B is 10 kN less than reaction R_A. (8)

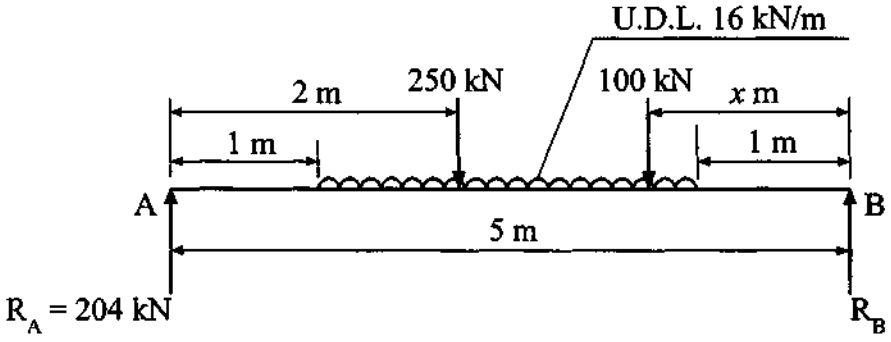

Fig Q11

12. Fig Q12 shows two forces acting at a point *P*.

Calculate the resultant force in both magnitude and direction. (8)

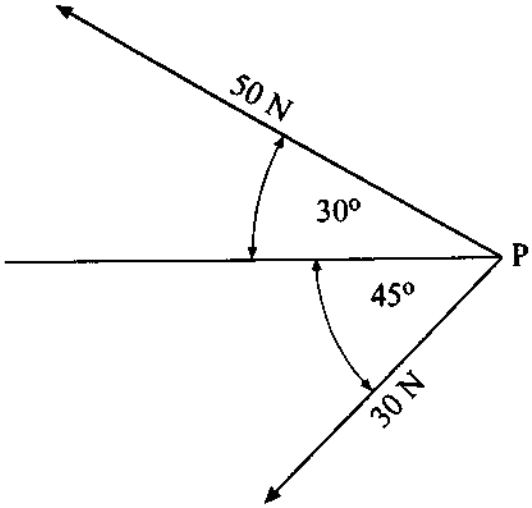

Fig Q12