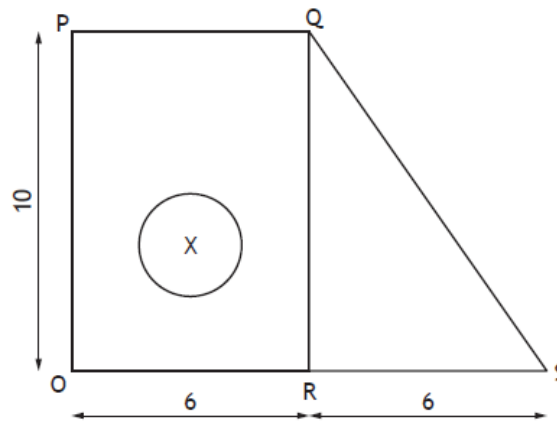


Homework 20

1)



A uniform lamina is made from a rectangle OPQR and a right-angled triangle RQS. A circular hole of radius 1 cm is removed as shown in the diagram. The centre X of the circular hole is 3 cm from both OS and OP.

- (a) Taking O as the origin, find the coordinates of the centre of mass of the lamina. 5
- (b) When the lamina is suspended from a point T on OP, it hangs in equilibrium with OS vertical. Give the length of OT. 1

2) Find the particular solution of the differential equation

$$\frac{dy}{dx} - 2y = e^{3x}$$

given the initial conditions $x = 0, y = 2$. 5

3) A force of $(6\mathbf{i} + 2\mathbf{j})$ newtons is applied to an object of mass 2kg. The initial velocity of the object is $(2\mathbf{i} - \mathbf{j})\text{ms}^{-1}$.

Determine the speed of the object after 3 seconds. 4

- 4) A vehicle of mass 800kg accelerates along a horizontal surface. The engine exerts a power of 6000 watts and the resistive force is $10v$ newtons, where v is the speed in ms^{-1} .

- a) Show that the motion can be modelled by the differential equation

$$\int \frac{80v}{600-v^2} dv = \int dt \quad \mathbf{3}$$

- b) Given that the vehicle has an initial speed of 10ms^{-1} , solve this differential equation to determine the speed of the vehicle after 20 seconds. **4**

- 5) A power of 18000 watts enables a vehicle of mass 400kg to move up a rough slope inclined at an angle of 15° to the horizontal at a constant speed of 10ms^{-1} .

Calculate the coefficient of friction. **3**