

QQQ – Further Mechanics 2 – Chapter 1 – Circular Motion (Version 1)

Total Marks: 24

(24 = Platinum, 22 = Gold, 19 = Silver, 16 = Bronze)

1.

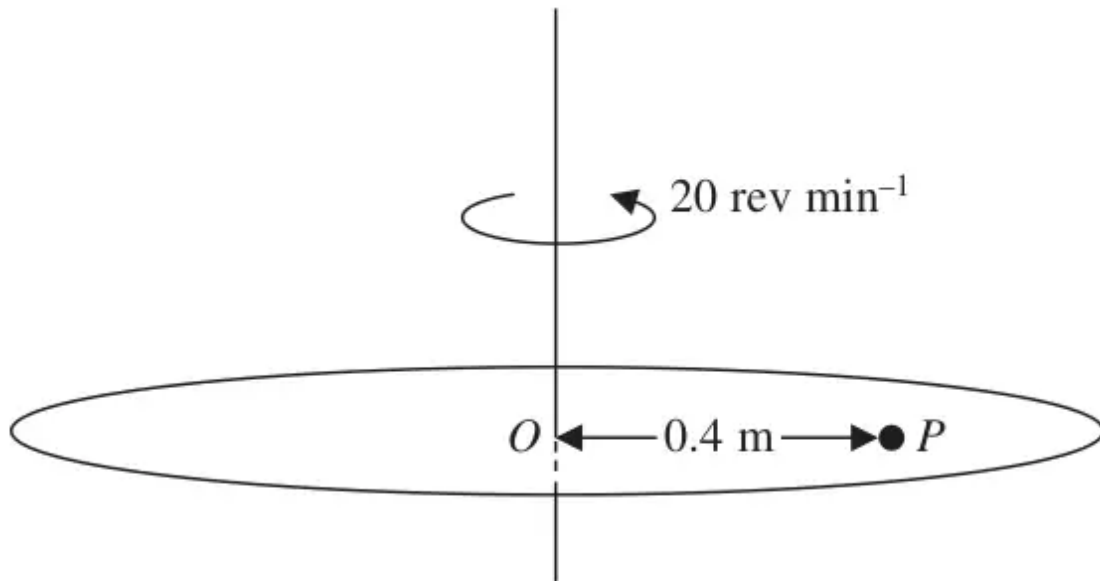


Figure 1

A rough disc is rotating in a horizontal plane with constant angular speed 20 revolutions per minute about a fixed vertical axis through its centre O . A particle P rests on the disc at a distance 0.4 m from O , as shown in Figure 1. The coefficient of friction between P and the disc is μ . The particle P is on the point of slipping.

Find the value of μ .

(6)

(Total 6 marks)

2. A car moves round a bend which is banked at a constant angle of θ° to the horizontal.

When the car is travelling at a constant speed of 80 km h^{-1} there is no sideways frictional force on the car. The car is modelled as a particle moving in a horizontal circle of radius 500 m.

(a) Find the value of θ . **(7)**

(b) Identify one limitation of this model. **(1)**

The speed of the car is increased so that it is now travelling at a constant speed of 90 km h^{-1}

The car is still modelled as a particle moving in a horizontal circle of radius 500 m.

(c) Describe the extra force that will now be acting on the car, stating the direction of this force. **(1)**

(Total 9 marks)

3.

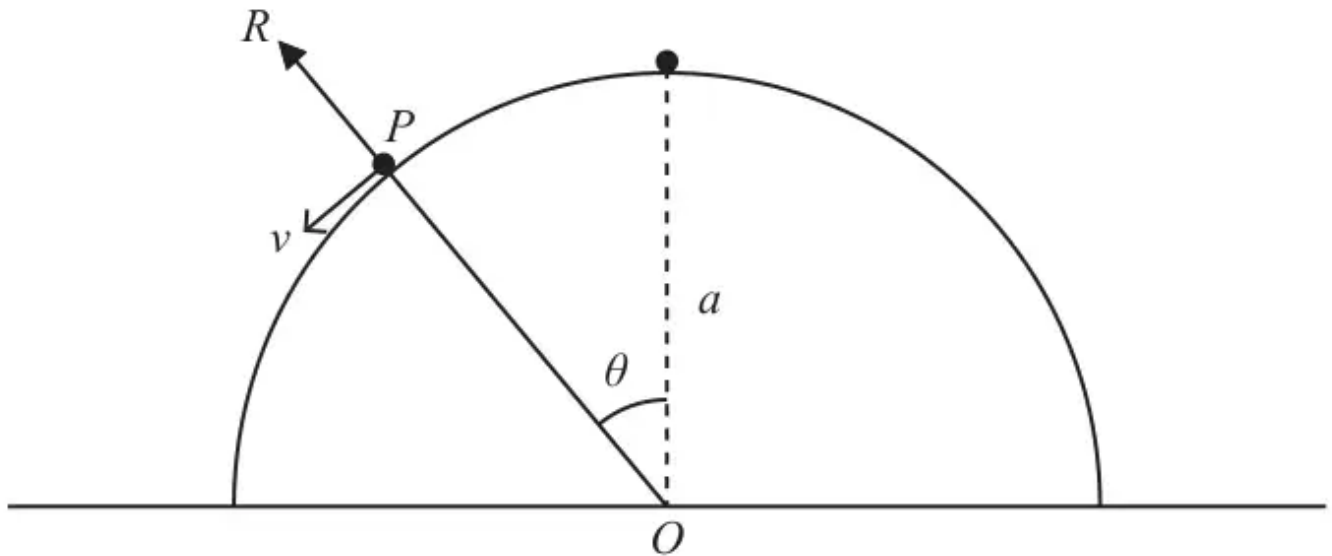


Figure 2

A smooth hemisphere of radius a is fixed on a horizontal surface with its plane face in contact with the surface. The centre of the plane face of the hemisphere is O .

A particle P of mass M is disturbed from rest at the highest point of the hemisphere.

When P is still on the surface of the hemisphere and the radius from O to P is at an angle θ to the vertical,

- the speed of P is v
- the normal reaction between the hemisphere and the particle is R , as shown in Figure 2.

(a) Show that $R = Mg(3 \cos \theta - 2)$ (6)

(b) Find, in terms of a and g , the speed of the particle at the instant when the particle leaves the surface of the hemisphere. (3)

(Total 9 marks)