

QQQ – Further Mechanics 1 – Chapter 2 – Work, Energy & Power (Version 1)

Total Marks: 22

(22 = Platinum, 20 = Gold, 18 = Silver, 15 = Bronze)

1. A parcel of mass 2.5 kg is moving in a straight line on a smooth horizontal floor. Initially the parcel is moving with speed 8 m s^{-1} . The parcel is brought to rest in a distance of 20 m by a constant horizontal force of magnitude R newtons. Modelling the parcel as a particle, find

(a) the kinetic energy lost by the parcel in coming to rest, (2)

(b) the value of R . (3)

(Total 5 marks)

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2. A car of mass 1000 kg moves along a straight horizontal road at a constant speed $U \text{ m s}^{-1}$. The engine of the car is working at a rate of 20 kW.

The total resistance to the motion of the car is modelled as a constant force of magnitude 1600 N.

Using the model,

(a) find the value of U . (3)

Later on, the car moves down a straight road which is inclined to the horizontal at an angle α ,

where $\sin \alpha = \frac{1}{49}$

The total resistance to the motion of the car is again modelled as a constant force of magnitude 1600 N.

At the instant when the engine of the car is working at a rate of 20 kW and the speed of the car is 8 m s^{-1} , the acceleration of the car is $a \text{ m s}^{-2}$

Using the model,

(b) find the value of a . (4)

(c) State one improvement to the model that would make it more realistic. (1)

(Total 8 marks)

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3.

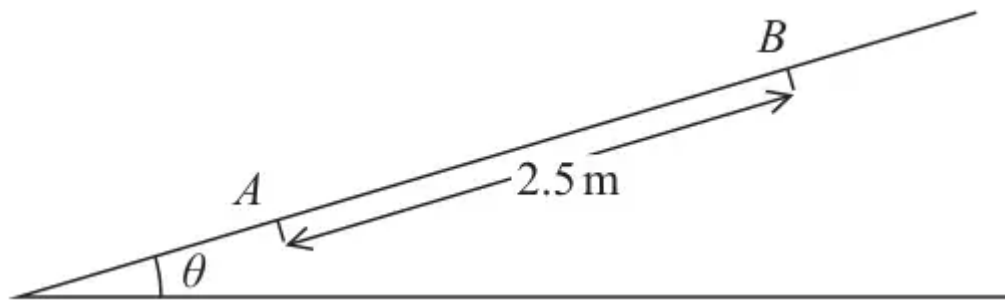


Figure 1

Figure 1 shows a ramp inclined at an angle θ to the horizontal, where $\sin \theta = \frac{2}{7}$

A parcel of mass 4 kg is projected, with speed 5 m s^{-1} , from a point A on the ramp.

The parcel moves up a line of greatest slope of the ramp and first comes to instantaneous rest at the point B , where $AB = 2.5 \text{ m}$.

The parcel is modelled as a particle.

The total resistance to the motion of the parcel from non-gravitational forces is modelled as a constant force of magnitude R newtons.

(a) Use the work-energy principle to show that $R = 8.8$ (4)

After coming to instantaneous rest at B , the parcel slides back down the ramp. The total resistance to the motion of the particle is modelled as a constant force of magnitude 8.8 N.

(b) Find the speed of the parcel at the instant it returns to A . (3)

(c) Suggest two improvements that could be made to the model. (2)

(Total 9 marks)