

Work & Energy Overview (19/6/21)

Q1 [4 Marks]

A car of mass 1 tonne starts to climb a hill at 20ms^{-1} . The slope of the hill is a constant θ , where $\sin\theta = \frac{1}{10}$. If the car is not accelerating (or braking) and there is a constant resistance to motion of 1000N , find the speed of the car when it has gained a height of 5m . Assume that $g = 10$.

Q2 [11 Marks]

A car of mass 1200kg pulls a trailer of mass 400kg . There are resistances of 400N and 100N on the car and trailer, respectively.

(i) If an acceleration of 0.2ms^{-2} is possible when travelling at 20ms^{-1} , find the maximum speed of the car. [6 marks]

(ii) If the trailer is connected to the car by means of a rope, what is the maximum deceleration that is possible? [5 marks]

Q3 [5 Marks]

A car of mass 1200kg starts to descend a slope at 10ms^{-1} . The slope is at a constant angle θ to the horizontal, where $\sin\theta = \frac{1}{10}$. If the car is not accelerating or braking, and there is a constant resistance to motion of 500N , find the speed of the car when it has travelled 100m . Assume that $g = 10\text{ms}^{-2}$. [5 marks]

Q4 [16 Marks]

A block of mass 5kg is initially ascending a slope at a speed of 2ms^{-1} . The slope has a gradient of 0.75 , and the only resistance to motion is a frictional force of 20N .

(i) How far up the slope does the block travel? [6 marks]

(ii) What is the total time taken for the block to travel up the slope and return to its starting point? [10 marks]