Work & Energy – Q1 [4 marks](8/6/21)

Exam Boards

OCR : Mechanics (Year 1)

MEI: Mechanics a

AQA: Mechanics (Year 1)

Edx: Mechanics 1 (Year 1)

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 $g = 10$. [4 marks]

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Solution

Method 1

By the Work-Energy principle,

Gain in KE = Work done by forces,

so that $\frac{1}{2}(1000)(v^2 - 20^2) = -1000g(5) - 1000\left(\frac{5}{sin\theta}\right)$

[2 marks]

$\Rightarrow 500v^2 = 200000 - 50000 - 50000$

$\Rightarrow v^2 = 200 \Rightarrow v = 14.1\ ms^{-1}\ (3sf)$ [2 marks]

Method 2

By Conservation of Energy,

Gain in PE = loss of KE − work done against resistance

$\Rightarrow 1000g(5) = \frac{1}{2}(1000)(20^2 - v^2) - 1000\left(\frac{5}{sin\theta}\right)$

which gives the same equation.