Chapter 2 Test – FM1 – Work, Energy & Power – www.m4ths.com

(Take $g = 9.8ms^{-2}$ when not exact)

(1) A particle of mass $0.5kg$ is dropped from a height of h and hits the floor with speed vms^{-1}. The particle experiences constant resistance of $4N$ from air resistance throughout its motion.

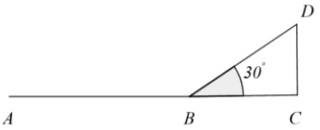
(a) Explain why you would not use the principle of the *Conservation of Mechanical Energy* for this question.

(b) Show that v satisfies the equation $v = \sqrt{2h(g-8)}$

(c) State one criticism with the model.

(2) A small toy car of mass $2kg$ moves along a rough horizontal surface. The engine of the car is working a constant rate of $600W$. The coefficient of friction between the car and the surface is 0.25. The car also experiences and **additional** constant resistance of $10N$ independent of friction. Show that the maximum speed of the car doesn't exceed $41ms^{-1}$.

(3) A boy pedals his bike from rest from the point D to B where $DB = 40m$. He then continues to the point A where $AB = 100m$ as shown in the diagram below.



You can assume that ABC is a straight horizontal road and that DC is perpendicular to AC.

The boy and his bike have a combined mass of $80kg$ and the boy is pedalling with a constant pedalling force from point D to point A. The boy experiences constant resistance of $100N$ throughout the journey. Given that his speed is $10ms^{-1}$ when he reaches A, find the pedalling force the boy produces.

(4) A particle of mass $4kg$ is pulled up the greatest slope of a rough plane inclined at an angle θ where $\tan\theta = \frac{5}{12}$ by a constant force XN. The coefficient of friction between the particle and the plane is μ. The initial speed of the particle is $2ms^{-1}$ and after the particle has travelled a distance of d metres the speed of the particles has halved.

(a) Show, using the *Work-Energy Principle,* that μ satisfues the equation $\mu = \frac{d(13X-20g)+78}{48gd}$

(b) When $d = 10$ show that $\frac{941}{65} < X \leq \frac{3293}{65}$ giving a justification for your answer.

(5) A model van of mass $10kg$ is travelling down a rough straight road inclined at an angle of α to the horizontal when $\tan\alpha = 0.1$ with a constant speed of $6ms^{-1}$. The engine of the van is working at a rate of $2kW$ and experiences constant resistances to motion of XN which act parallel to the road.

(a) Find the value of X to 3S.F.

The van now increases the rate at which the engine is working to $3kW$. Given that the resistances experienced by the van don't change

(b) Find the initial acceleration of the van.