1. Nov/2022/Paper_9709_41/No.3

A constant resistance of magnitude 1400 N acts on a car of mass 1250 kg.

(a) The car is moving along a straight level road at a constant speed of $28\,m\,s^{-1}$.

Find, in kW, the rate at which the engine of the car is working. [2]

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(b) The car now travels at a constant speed up a hill inclined at an angle of θ to the horizontal, where $\sin\theta = 0.12$, with the engine working at 43.5 kW.

Find this speed. [3]

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(c) On another occasion, the car pulls a trailer of mass 600 kg up the same hill. The system of the car and the trailer is modelled as particles connected by a light inextensible cable. The car's engine produces a driving force of 5000 N and the resistance to the motion of the trailer is 300 N. The resistance to the motion of the car remains 1400 N.

Find the acceleration of the system and the tension in the cable. [4]

2. Nov/2022/Paper_9709_42/No.1

A cyclist is riding a bicycle along a straight horizontal road AB of length 50 m. The cyclist starts from rest at A and reaches a speed of $6\,m\,s^{-1}$ at B. The cyclist produces a constant driving force of magnitude 100 N. There is a resistance force, and the work done against the resistance force from A to B is 3560 J.

Find the total mass of the cyclist and bicycle. [3]

3. Nov/2022/Paper_9709_42/No.4

A car of mass 1200 kg is travelling along a straight horizontal road AB. There is a constant resistance force of magnitude 500 N. When the car passes point A, it has a speed of $15\,\text{m s}^{-1}$ and an acceleration of $0.8\,\text{m s}^{-2}$.

(a) Find the power of the car's engine at the point A. [3]

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The car continues to work with this power as it travels from A to B. The car takes 53 seconds to travel from A to B and the speed of the car at B is $32\,\text{m s}^{-1}$.

(b) Show that the distance AB is 1362.6 m. [3]

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4. Nov/2022/Paper_9709_43/No.2

A box of mass 5 kg is pulled at a constant speed of $1.8\,m\,s^{-1}$ for 15 s up a rough plane inclined at an angle of 20° to the horizontal. The box moves along a line of greatest slope against a frictional force of 40 N. The force pulling the box is parallel to the line of greatest slope.

(a) Find the change in gravitational potential energy of the box. [2]

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(b) Find the work done by the pulling force. [2]

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5. Nov/2022/Paper_9709_43/No.6

A car of mass 1750 kg is pulling a caravan of mass 500 kg. The car and the caravan are connected by a light rigid tow-bar. The resistances to the motion of the car and caravan are 650 N and 150 N respectively.

(a) The car and caravan are moving along a straight horizontal road at a constant speed of 24 m s^{-1}.

(i) Find the power of the car's engine. [2]

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(ii) The engine's power is now suddenly increased to 40 kW.

Find the instantaneous acceleration of the car and caravan and find the tension in the tow-bar. [5]

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(b) The car and caravan now travel up a straight hill, inclined at an angle $\sin^{-1} 0.14$ to the horizontal, at a constant speed of v m s^{-1}. The car's engine is working at 31 kW. The resistances to the motion of the car and caravan are unchanged.

Find v. [3]