FM1 (Year 1) - Power Exam Questions (Edexcel)

Q1.

A lorry of mass 1800 kg travels along a straight horizontal road. The lorry's engine is working at a constant rate of 30 kW. When the lorry's speed is 20 m s^{-1}, its acceleration is 0.4 m s^{-2}. The magnitude of the resistance to the motion of the lorry is R newtons.

(a) Find the value of R.

(4)

The lorry now travels up a straight road which is inclined at an angle a to the horizontal, where $\sin a = \frac{1}{12}$. The magnitude of the non-gravitational resistance to motion is R newtons. The lorry travels at a constant speed of 20 m s^{-1}.

(b) Find the new rate of working of the lorry's engine.

(5)

(Total 9 marks)
(Q02 6678/01, Jan 2013)

Q2.

A car of mass 800kg is moving on a straight road which is inclined at an angle θ to the horizontal, where $\sin\theta = \frac{1}{20}$. The resistance to the motion of the car from non-gravitational forces is modelled as a constant force of magnitude R newtons. When the car is moving up the road at a constant speed of 12.5ms^{-1}, the engine of the car is working at a constant rate of $3P$ watts. When the car is moving down the road at a constant speed of 12.5ms^{-1}, the engine of the car is working at a constant rate of P watts.

(a) Find

(i) the value of P,
(ii) the value of R.

When the car is moving up the road at 12.5ms^{-1} the engine is switched off and the car comes to rest, without braking, in a distance d metres. The resistance to the motion of the car from non-gravitational forces is still modelled as a constant force of magnitude R newtons.

(b) Use the work-energy principle to find the value of d.

(4)

(Total for question = 4 marks)

(Q02 6678/01, June 2016)

Q3.

A car of mass 1000 kg moves with constant speed V m s^{-1} up a straight road inclined at an angle θ to the horizontal, where $\sin\theta = \frac{1}{30}$. The engine of the car is working at a rate of 12 kW. The resistance to motion from non-gravitational forces has magnitude 500 N. Find the value of V.

(5)

(Total 5 marks)
(Q02 6678/01, June 2011)

Q4.

A cyclist and his bicycle have a combined mass of 90 kg. He rides on a straight road up a hill inclined at an angle α to the horizontal, where $\sin \alpha = \frac{1}{21}$. He works at a constant rate of 444 W and cycles up the hill at a constant speed of 6 m s^{-1}.

Find the magnitude of the resistance to motion from non-gravitational forces as he cycles up the hill.

(4)

(Total for question = 4 marks)

(Q02 6678/01, June 2007)

Q5.

A lorry of mass 2000 kg is moving down a straight road inclined at angle α to the horizontal, where $\sin \alpha = \frac{1}{25}$. The resistance to motion is modelled as a constant force of magnitude 1600 N. The lorry is moving at a constant speed of 14 m s^{-1}.

Find, in kW, the rate at which the lorry's engine is working.

(6)

(Total 6 marks)

(Q02 6678/01, June 2008)

Q6.

A car of mass 1200 kg pulls a trailer of mass 400 kg up a straight road which is inclined to the horizontal at an angle a, where

$\sin a = \frac{1}{14}$. The trailer is attached to the car by a light inextensible towbar which is parallel to the road. The car's engine works at a constant rate of 60 kW. The non-gravitational resistances to motion are constant and of magnitude 1000 N on the car and 200 N on the trailer.

At a given instant, the car is moving at 10 m s^{-1}. Find

(a) the acceleration of the car at this instant,

(5)

(b) the tension in the towbar at this instant.

(4)

The towbar breaks when the car is moving at 12 m s^{-1}.

(c) Find, using the work-energy principle, the further distance that the trailer travels before coming instantaneously to rest.

(5)

(Total 14 marks)

(Q03 6678/01, June 2012)

Q7.
A truck of mass 1800 kg is towing a trailer of mass 800 kg up a straight road which is inclined to the horizontal at an angle α where $\sin \alpha = \frac{1}{20}$. The truck is connected to the trailer by a light inextensible rope which is parallel to the direction of motion of the truck. The resistances to motion of the truck and the trailer from non-gravitational forces are modelled as constant forces of magnitudes 300 N and 200 N respectively. The truck is moving at constant speed v m s^{-1} and the engine of the truck is working at a rate of 40 kW.

(a) Find the value of v.

(5)

As the truck is moving up the road the rope breaks.

(b) Find the acceleration of the truck immediately after the rope breaks.

(4)

(Total 9 marks)

(Q01 6678/01, June 2014)

Q8.
A van of mass 750 kg is moving along a straight horizontal road. At the instant when the van is moving at v m s^{-1}, the resistance to the motion of the van is modelled as a force of magnitude λvN, where λ is a constant.

The engine of the van is working at a constant rate of 18 kW.
At the instant when $v = 15$, the acceleration of the van is 0.6 m s^{-2}

(a) Show that $\lambda = 50$

(4)

The van now moves up a straight road inclined at an angle to the horizontal, where

$$\sin \alpha = \frac{1}{15}$$

At the instant when the van is moving at v m s^{-1}, the resistance to the motion of the van from non-gravitational forces is modelled as a force of magnitude $50v$ N.
When the engine of the van is working at a constant rate of 12 kW, the van is moving at a constant speed V m s^{-1}

(b) Find the value of V.

(5)

(Total for question = 9 marks)

(Q03 8FM0/25, June 2018)

Q9.

A car of mass 1200 kg moves up a straight road that is inclined to the horizontal at an angle α, where $\sin \alpha = \frac{1}{15}$

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

At the instant when the engine of the car is working at a rate of 32 kW and the speed of the car is 20 m s^{-1} , the acceleration of the car is 0.5 m s^{-2}

Find the value of R

(Total for question = 5 marks)

(Q01 8FM0/25, June 2022)

Q10.

A caravan of mass 600 kg is towed by a car of mass 900 kg along a straight horizontal road. The towbar joining the car to the caravan is modelled as a light rod parallel to the road. The total resistance to motion of the car is modelled as having magnitude 300 N. The total resistance to motion of the caravan is modelled as having magnitude 150 N. At a given instant the car and the caravan are moving with speed 20 m s^{-1} and acceleration 0.2 m s^{-2}.

(a) Find the power being developed by the car's engine at this instant.

(5)

(b) Find the tension in the towbar at this instant.

(2)

(Total 7 marks)

(Q02 6678/01/R, June 2013)

Q11.

Unless otherwise indicated, whenever a numerical value of g is required, take $g = 9.8$ m s^{-2} and give your answer to either 2 significant figures or 3 significant figures.

[*In this question use g =10 m* s^{-2}]

A jogger of mass 60 kg runs along a straight horizontal road at a constant speed of 4 m s^{-1}. The total resistance to the motion of the jogger is modelled as a constant force of magnitude 30 N.

(a) Find the rate at which the jogger is working.

(3)

The jogger now comes to a hill which is inclined to the horizontal at an angle α, where $\sin\alpha = \frac{1}{15}$. Because of the hill, the jogger reduces her speed to 3 m s^{-1} and maintains this constant speed as she runs up the hill. The total resistance to the motion of the jogger from non-gravitational forces continues to be modelled as a constant force of magnitude 30 N.

(b) Find the rate at which she has to work in order to run up the hill at 3 m s^{-1}.

(5)

(Total for question = 8 marks)

(Q03 8FM0/2J/A, Specimen papers)