Power

Specification: AQA 7367: MC7 (with MC1–MC3) · Edexcel 9FM0: FM1 2.1 Work, energy and power

INDEPENDENT

You do

A · Power P = W/t; P = Fv; 1 kW = 1000 W.

1 A pump does 54 000 J of work in 1.5 minutes. Find its power.

2 A car's engine produces a driving force of 1800 N when the car moves at 25 m s^{-1}. Find the power of the engine in kilowatts.

3 A crane lifts a load of mass 250 kg vertically at a constant speed of 0.8 m s^{-1}. Take g = 9.8 m s^{-2}. Find the power of the crane.

4 A train's engine works at 900 kW. Find the driving force when the train moves at 108 km h^{-1}.

B · Maximum speed and acceleration D = P/v; P/v − R (− mg sin θ) = ma; maximum speed when a = 0.

5 A car of mass 1000 kg moves on a level road. Its engine works at 18 kW and the resistance is a constant 600 N.
(a) Find the maximum speed.
(b) Find the acceleration when the speed is 15 m s^{-1}.

6 A van of mass 1800 kg climbs a road inclined at 4° to the horizontal. Its engine works at 26 kW against a constant resistance of 700 N. Take g = 9.8 m s^{-2}.
(a) Find the maximum speed up the road.
(b) Find the acceleration when the speed is 8 m s^{-1}.

7 A lorry of mass 6000 kg has a maximum speed of 25 m s^{-1} on a level road, against a constant resistance of 2400 N.
(a) Find the power of its engine.
(b) Working at this power, find its acceleration when its speed is 15 m s^{-1}.

8 A car of mass 1200 kg has an engine of power 40 kW. The resistance is a constant 800 N. Its maximum speed up a hill inclined at θ to the horizontal is 20 m s^{-1}. Take g = 9.8 m s^{-2}. Find θ.

C · Reasoning (no calculator) Explain in words as well as numbers.

9 A car's engine works at a constant power on a level road against a constant resistance. Explain why the car cannot keep accelerating.

10 A car of mass 1000 kg has a maximum speed of 40 m s^{-1} on a level road when its engine works at 20 kW. The resistance is constant.
(a) Find the resistance.
(b) Find the acceleration when the speed is 20 m s^{-1}.

11 A cyclist working at 200 W has a top speed of 10 m s^{-1} on level ground. The resistance is kv N at speed v m s^{-1}.
(a) Find k.
(b) Find the power needed for a top speed of 20 m s^{-1}. Comment on your answer.

D · Show-that, kv and energy Set up F = ma along the road; use W = Pt for energy.

12 A vehicle of mass m climbs a road inclined at θ to the horizontal, working at a constant power P against a constant resistance R.
(a) Show that its maximum speed is $P/(R + mg\sin\theta)$.
(b) A car of mass 1200 kg has a maximum speed of 30 m s^{-1} on a level road and 20 m s^{-1} up a road with $\sin\theta = 1/20$, at the same power P and against the same resistance R. Take $g = 9.8$ m s^{-2}. Find R and P.

13 A car of mass 1200 kg works at 30 kW on a level road. The resistance is $15v$ N at speed v m s^{-1}.
(a) Find its maximum speed.
(b) Find its speed when its acceleration is 0.5 m s^{-2}.

14 A car of mass 1000 kg moves on a level road. Its engine works at a constant 20 kW for 12 s, and its speed rises from 8 m s^{-1} to 18 m s^{-1}.
(a) Find the work done by the engine.
(b) Find the work done against the resistance.
(c) Explain why you cannot use suvat to find the distance travelled.

15 A car of mass 1500 kg has a resistance of kv N at speed v m s^{-1}. With the engine off, it rolls down a hill with $\sin\theta = 1/30$ at a constant 25 m s^{-1}. Take $g = 9.8$ m s^{-2}.
(a) Find k.
(b) Find the power needed to drive up the same hill at a constant 15 m s^{-1}.

E · Exam-style question Show your method: marks are for working.

16 A lorry of mass 5000 kg has an engine with a maximum power of 80 kW. On a straight level road, with its engine at maximum power, its maximum speed is 32 m s^{-1}. The resistance to motion is a constant R N. Take $g = 9.8$ m s^{-2}.
(a) Show that $R = 2500$. [2]
(b) The lorry climbs a straight hill inclined at α to the horizontal, where $\sin\alpha = 1/25$, with its engine at maximum power and the same resistance. Find its acceleration when its speed is 10 m s^{-1}. [3]
(c) Find the maximum speed of the lorry up the hill. [2]
(d) State one way in which the model for the resistance could be improved. [1]