Exercise walk-through

Energy, work and power ▪ 4.5

eXercise

You must be able to

- calculate work $W = Fd\cos\theta$, KE $= \frac{1}{2}mv^2$, PE $= mgh$
- use the work–energy principle (work done $=$ change in energy)
- use $P = Fv$ for power

Method — Energy & power

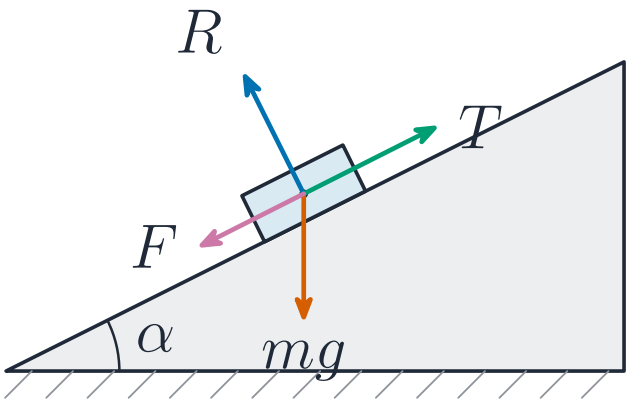
Engine 12 **kW, speed** 20 **m s**$^{-1}$ **on the level:** $P = Fv \Rightarrow F = \dfrac{12000}{20} = 600$ N.

Work–energy: (driving force work) $-$ (resistance work) $=$ change in KE.

Method — Energy & power

A roller coaster with a vertical loop trading PE for KE

Method — Energy & power



Work and energy on an inclined plane

Practice 2.1 ▪ 2 marks

Find the kinetic energy of a 2 kg body moving at 6 m s^{-1}.

Solution 2.1

Method: Energy & power

Worked steps

$\mathrm{KE} = \frac{1}{2}mv^2 = \frac{1}{2}(2)(36) = 36$ J M1 A1.

Practice 2.2 ▪ 1 mark

A force of 50 N moves a body 4 m in its own direction. Find the work done.

Solution 2.2

Method: Energy & power

Worked steps

$W = Fd = 50 \times 4 = 200$ J (B1).

Exam-style 3.1 ▪ 1 mark

A 1500 W motor raises a load at constant speed. In 10 s it does work of:

A 150 J

B 1500 J

C 15000 J

D 150000 J

Solution 3.1

Method: Energy & power

A 150 J

B 1500 J

C 15000 J ✓

D 150000 J

Worked steps

C. work = power × time = $1500 \times 10 = 15000$ J.

Exam-style 3.2 ▪ 3 marks

A car of mass 1200 kg accelerates from 10 m s^{-1} to 20 m s^{-1} on a level road.
(a) Find the increase in kinetic energy.
(b) If a constant resistance of 400 N acts over the 150 m taken, find the total work done by the engine.

Solution 3.2

Method: Energy & power

Worked steps

(a) $\Delta\text{KE} = \frac{1}{2}(1200)(20^2 - 10^2) = 600(400 - 100) = 600(300) = 180000$ J M1 M1 A1.

(b) work by engine $=$ ΔKE$+$ work against resistance $= 180000 + 400(150)$ M1 M1;
$= 180000 + 60000 = 240000$ J A1.

Exam-style 3.3 ▪ 4 marks

A cyclist and bicycle of total mass 90 kg freewheel from rest down a slope, dropping a vertical height of 20 m. Resistances do 9000 J of work.
(a) Using energy, find the speed at the bottom.

Solution 3.3

Method: Energy & power

Worked steps

(a) energy: $mgh - (\text{resistance work}) = \frac{1}{2}mv^2$ M1; $90(10)(20) - 9000 = \frac{1}{2}(90)v^2$ M1; $18000 - 9000 = 45v^2 \Rightarrow v^2 = 200$ M1; $v = 14.1$ m s^{-1} A1.