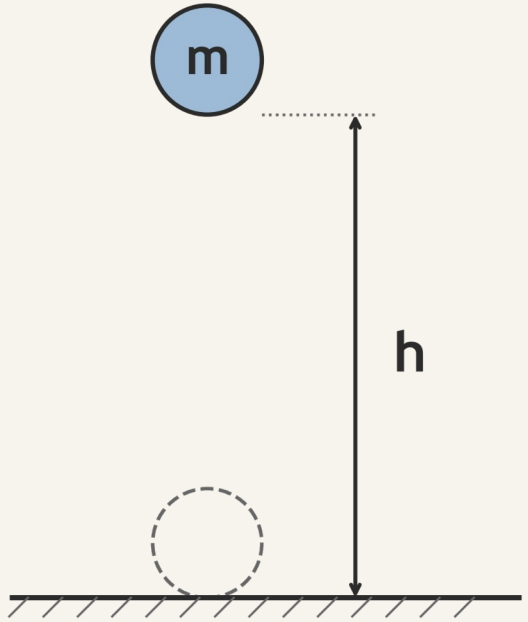
Delta Physics

Select a topic of your Choice

5 minutes – Individual

Energy and Power

Where does the energy go?

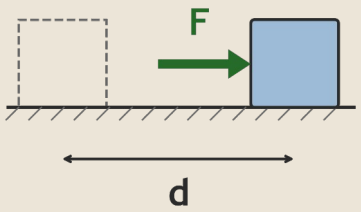


Higher Physics

Relationships (1 of 2)

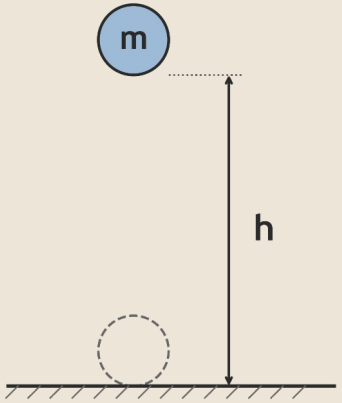
$$E_w = Fd$$

E_w work done (J)
F force (N)
d distance (m)



$$E_p = mgh$$

E_p gravitational potential energy (J)
m mass (kg)
g gravitational field strength (N kg^{-1})
h height (m)



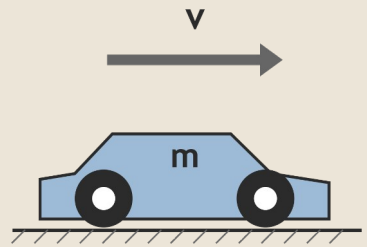
Relationships (2 of 2)

$$E_k = \frac{1}{2} m v^2$$

E_k kinetic energy (J)

m mass (kg)

v speed (m s^{-1})

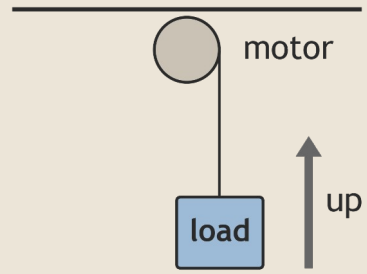


$$P = E/t$$

P power (W)

E energy (J)

t time (s)



Conservation of energy: E_p lost = E_k gained + work done against friction

Worked Example 1: Pulling at an Angle

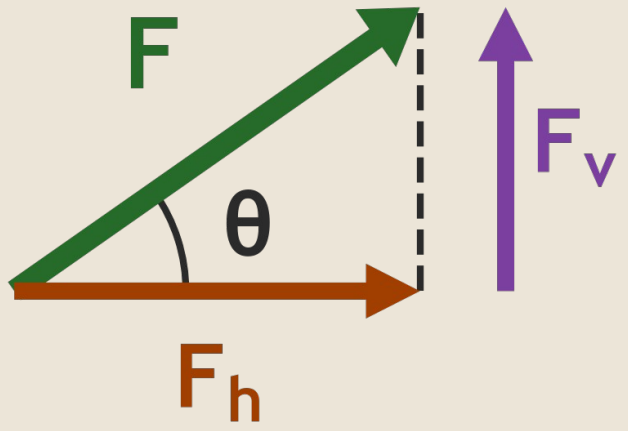
A rope pulls a sledge 20 m with a 45 N force at **30° above the horizontal. Calculate** the **work done.** **3**

$E_w = Fd$ **(1)**

$(F_h = 45 \cos 30° = 39 \text{ N})$

$E_w = 39 \times 20$ **(1)**

$E_w = 780 \text{ J}$ **(1)**



Worked Example 2: Speeding Up

A 1000 kg car speeds up **from 10 m s^{-1} to 20 m s^{-1}.** **4**

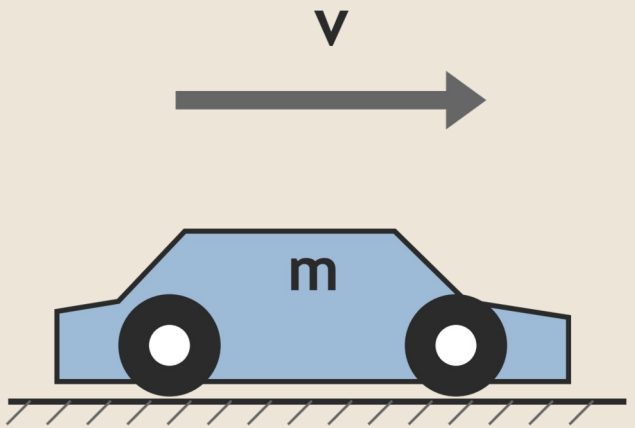
Calculate the **increase in its kinetic energy.**

$E_k = \frac{1}{2}mv^2$ **(1)**

$E_k = 0.5 \times 1000 \times 10^2 = 5.0 \times 10^4\ \text{J}$ **(1)**

$E_k = 0.5 \times 1000 \times 20^2 = 2.0 \times 10^5\ \text{J}$ **(1)**

$\text{increase} = 1.5 \times 10^5\ \text{J}$ **(1)**



Worked Example 3: A Falling Ball

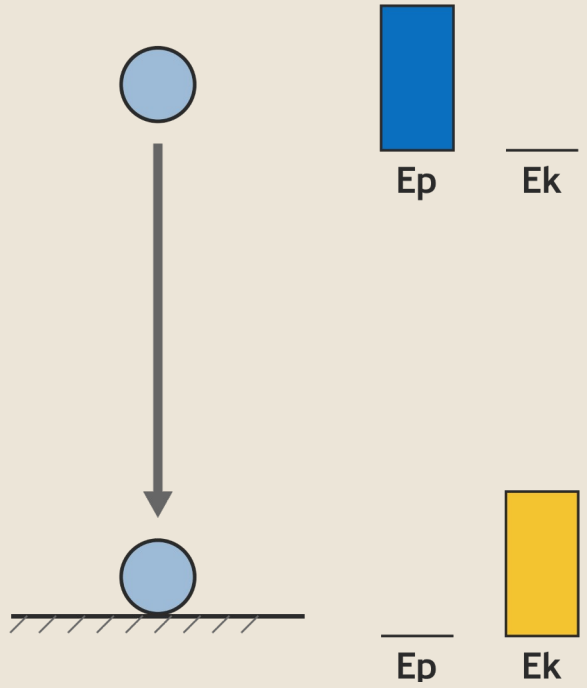
A 0.20 kg ball **falls from rest** through 5.0 m. **Calculate** its **speed just before landing.** **4**

$E_p = mgh$ **(1)**

$E_k = \frac{1}{2}mv^2$ **(1)**

$0.20 \times 9.8 \times 5.0 = 0.5 \times 0.20 \times v^2$ **(1)**

$v = 9.9\ \text{m s}^{-1}$ **(1)**



Worked Example 4: Braking Force

A 1200 kg car at 15 m s^{-1} **brakes to rest** in 30 m. **Calculate the average braking force.** **5**

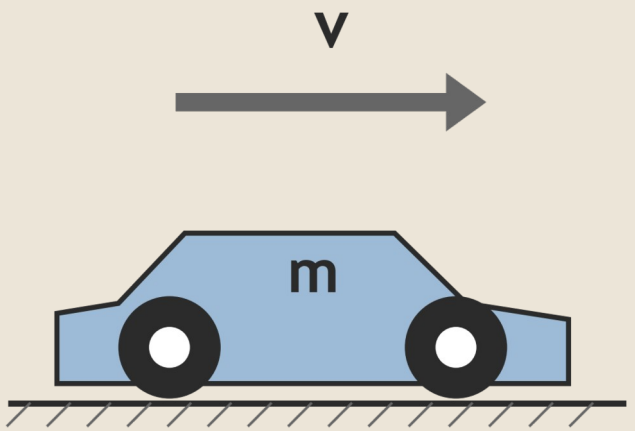
$E_k = \frac{1}{2}mv^2$ **(1)**

$E_k = 0.5 \times 1200 \times 15^2 = 1.35 \times 10^5\ \text{J}$ **(1)**

$E_w = Fd$ **(1)**

$1.35 \times 10^5 = F \times 30$ **(1)**

$F = 4500\ \text{N}$ **(1)**



Worked Example 5: Winching a Load

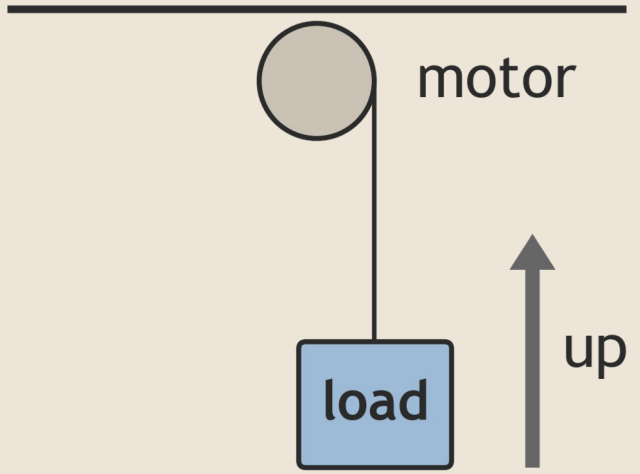
A 20 kg load is winched up 3.0 m **in 4.0 s. Calculate** the **power**. **3**

$P = E/t$ **(1)**

$(E = mgh = 20 \times 9.8 \times 3.0 = 588\ \text{J})$

$P = 588 \div 4.0$ **(1)**

$P = 150\ \text{W}$ **(1)**



Your Turn



1. A 60 N force at **20° above the horizontal** pulls a cart 15 m. **Calculate** the **work done.**

   850 J

2. A 70 kg runner speeds up **from 2.0 to 6.0 m s^{-1}.** **Calculate** their **gain in E_k.**

   1.1×10^3 J

3. A ball **falls from rest** through 2.0 m. **Calculate** its **speed at the bottom.**

   6.3 m s^{-1}

Your Turn



4 A 900 kg car at 20 m s^{-1} **brakes to rest** in 40 m. **Calculate** the **braking force**.

4500 N

5 A 1500 W motor lifts a 75 kg load 12 m. **Calculate** the **time taken**.

5.9 s

2025 Paper 1 Q5. An object of mass 0.20 kg is released from rest 1.6 m above the ground. Its maximum speed just before it hits the ground is



A $4.0\ \text{m s}^{-1}$

B $5.6\ \text{m s}^{-1}$

C $13\ \text{m s}^{-1}$

D $16\ \text{m s}^{-1}$

E $31\ \text{m s}^{-1}$

Answer B: $v^2 = 2 \times 9.8 \times 1.6$ — **so $v = 5.6\ \text{m s}^{-1}$**

2022 Paper 1 Q6. Water flows at 1.0×10^6 kg per second over the Victoria Falls, which are 120 m high. The total power delivered by the falling water is:



A 1.2×10^{12} W

B 1.2×10^{9} W

C 1.2×10^{8} W

D 8.5×10^{-10} W

E 8.5×10^{-11} W

Answer B: $1.0 \times 10^6 \times 9.8 \times 120$ J every second — **so 1.2×10^9 W**

2023 Paper 1 Q4. A pendulum bob of mass m is released from rest at height h. Neglecting air resistance, its speed at the lowest point is doubled by

A changing the height to 4h

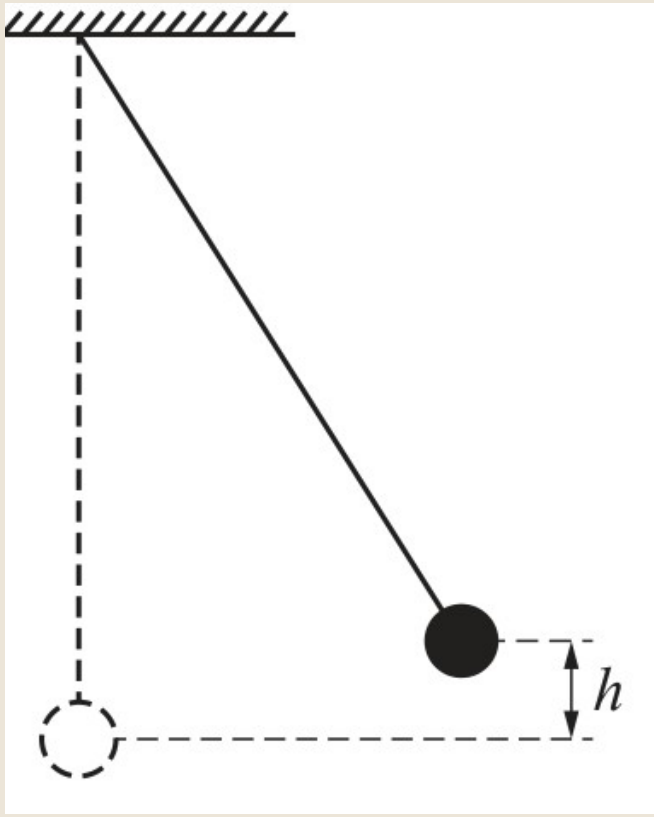
B changing the height to 2h

C changing the height to h/2

D changing the mass to 2m

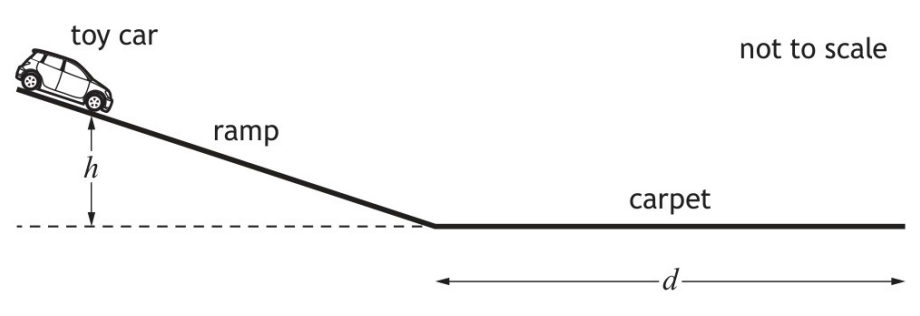
E changing the mass to m/2

Answer A: $v^2 \propto h$ — **so double v needs 4h**



Past Paper: 2016 Section 2 Q2

A student uses the apparatus shown to investigate the force of friction between the wheels of a toy car and a carpet. The toy car is released from rest, from a height h. It then travels down the ramp and along the carpet before coming to rest. The student measures the distance d that the car travels along the carpet.



Mass of car, m : (0.20 ± 0.01) kg

Height, h : (0.40 ± 0.005) m

Mean distance, d : 1.37 m

2016 Section 2 Q2 (c)

(c) (i) Calculate the potential energy of the toy car at height h.	**3**	0.78 J
(ii) Calculate the average force of friction acting between the toy car and carpet, as the car comes to rest.	**3**	0.57 N
(iii) State one assumption you have made in (c) (ii).	**1**	The ramp is frictionless

Marking Instructions: 2016 Q2 (c)(i) and (ii)

(c)(i) 3 marks

$E_p = mgh$ (1)

$E_p = 0.20 \times 9.8 \times 0.40$ (1)

$E_p = 0.78$ J (1)

Accept 0.8, 0.784

Treat −9.8 as wrong substitution unless h is also negative.

(c)(ii) 3 marks

$E_w = Fd$ (1)

$0.78 = F \times 1.37$ (1)

$F = 0.57$ N (1)

Or consistent with (a)(i) and (c)(i)

1 for ALL equations, 1 for ALL substitutions, 1 for correct answer

Marking Instructions: 2016 Q2 (c)(iii)

(c)(iii) 1 mark

All E_p converted to E_k

All E_p converted to E_W

Air resistance is negligible

Ramp is frictionless

Bearings in the wheels are frictionless

The carpet is horizontal

No energy/heat loss on the ramp

Only one correct statement required

Not accepted (0 marks):

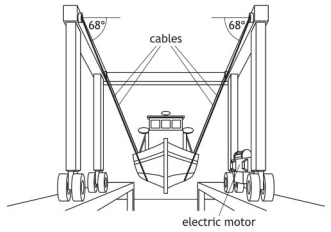
Energy is conserved on its own

No energy/heat loss on its own

Energy and Power in the Exam

4. A boat lift is used to raise a boat from the sea.

The lift has **four** cables, which attach to straps placed under the boat. The ends of the cables are attached to an electric motor that is used to raise the boat.



Each cable makes an angle of 68° to the horizontal.

The mass of the boat is 1400 kg.

2026 Paper 2 Q4(b)

5. In a hydroelectric power station water flows from a reservoir through turbines at a rate of 4.5×10^6 kg per minute.

The reservoir is 150 m above the turbines.

The total power delivered by the water in falling from the reservoir to the turbines is

A 3.0×10^4 W

B 7.5×10^4 W

C 1.1×10^8 W

D 6.6×10^9 W

E 4.0×10^{12} W.

2024 Paper 1 Q5

Past papers

6. Water flows at a rate of $6{\cdot}25 \times 10^8$ kg per minute over a waterfall.

The height of the waterfall is 108 m.

The total power delivered by the water in falling through the 108 m is

A $1{\cdot}13 \times 10^9$ W

B $1{\cdot}10 \times 10^{10}$ W

C $6{\cdot}62 \times 10^{11}$ W

D $4{\cdot}05 \times 10^{12}$ W

E $3{\cdot}97 \times 10^{13}$ W.

2015 Section 1 Q6

2. When a car brakes kinetic energy is turned into heat and sound.

In order to make cars more efficient some manufacturers have developed kinetic energy recovery systems (KERS). These systems store some of the energy that would otherwise be lost as heat and sound.

Estimate the maximum energy that could be stored in such a system when a car brakes.

Cleary show your working for the calculation and any estimates you have made.

Specimen Paper 2 Q2

More in the finder: forces, energy and power.

LOOKING AHEAD

Next: Momentum and Impulse

What happens when moving objects meet?

Course specification

- Use of the principle of conservation of energy and appropriate relationships to solve problems involving work done, potential energy, kinetic energy, and power.

The forces bullets are deck 2a.

Credits (1 of 2)

2025 Paper 1 Q5: © Qualifications Scotland (SQA). Higher Physics 2025, Paper 1, Question 5.

2022 Paper 1 Q6: © Qualifications Scotland (SQA). Higher Physics 2022, Paper 1, Question 6.

2023 Paper 1 Q4: © Qualifications Scotland (SQA). Higher Physics 2023, Paper 1, Question 4.

Past Paper: 2016 Section 2 Q2: © Qualifications Scotland (SQA). Higher Physics 2016, Section 2, Question 2.

Marking Instructions: 2016 Q2 (c)(i) and (ii): © Qualifications Scotland (SQA). Higher Physics 2016, Section 2, Question 2.

Marking Instructions: 2016 Q2 (c)(iii): © Qualifications Scotland (SQA). Higher Physics 2016, Section 2, Question 2.

Energy and Power in the Exam: © Qualifications Scotland (SQA). Higher Physics 2026 Paper 2 Q4; 2024 Paper 1 Q5; 2015 Section 1 Q6; Higher Physics Specimen Question Paper (S857) Paper 2 Q2.

Credits (2 of 2)

Course specification: © Qualifications Scotland (SQA). Higher Physics Course Specification v4.1 (September 2026), p.7

R Stewart - October 2026