

GCSE Physics

Worksheet: Changes in energy

TIME 30 min	TOTAL 30 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
-----------------------	--------------------------	------------------------------	-----------------------------------

Topics: Changes in energy

NAME _____ **CLASS** _____ **DATE** _____

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Answer all questions in the spaces provided.
- In all calculations, show clearly how you work out your answer.
- The marks for questions are shown in brackets.

0 1

0 1 . 1

A trolley's kinetic energy is given by $E_k = \frac{1}{2}mv^2$.

Which **two** changes would double the kinetic energy of the trolley?

Tick (✓) **two** boxes.

Doubling the mass only

☐

Doubling the speed only

☐

Halving the mass and doubling the speed

☐

Doubling the mass and the speed

☐

[2 marks]

0 1 . 2

The elastic cord of a catapult behaves like a spring with a spring constant of 120 N/m. It is stretched by 0.12 m, without going beyond its limit of proportionality.

Calculate the elastic potential energy stored in the cord.

Use the Physics Equations Sheet.

.....

.....

.....

.....

Elastic potential energy = J

[2 marks]

0 1 . 3

The cord is then stretched so that its extension is twice as large. The limit of proportionality is still not exceeded.

What happens to the elastic potential energy stored in the cord?

Tick (✓) **one** box.

It halves.

☐

It stays the same.

☐

It doubles.

☐

It quadruples.

☐

[1 mark]

0 2

A student hangs a mass from a spring. The spring stretches.
The spring constant of the spring is 40 N/m.

0 2 . 1

What happens to the elastic potential energy stored in the spring as the extension increases?

Tick (✓) **one** box.

It decreases.

☐

It increases.

☐

It stays the same.

☐

[1 mark]

0 2 . 2

The extension of the spring is 0.15 m.

Calculate the elastic potential energy stored in the spring.

Use the equation:

$$\text{elastic potential energy} = 0.5 \times \text{spring constant} \times (\text{extension})^2$$

.....

.....

.....

.....

Elastic potential energy = J

[2 marks]

0 2 . 3

The student adds more mass so that the extension of the spring doubles.
The spring does not go past its limit of proportionality.
How many times greater is the elastic potential energy stored?

Tick (✓) **one** box.

2 times

☐

4 times

☐

8 times

☐

16 times

☐

[1 mark]

0 3

A rucksack of mass 11 kg is lifted onto a luggage rack 2 m higher.
Gravitational field strength = 9.8 N/kg

0 3 . 1

Calculate the increase in the gravitational potential energy of the rucksack.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

.....

.....

.....

.....

Increase in gravitational potential energy = J

[2 marks]

0 4

0 4 . 1

Which equation is used to calculate elastic potential energy?

Tick (✓) **one** box.

$E = m g h$

☐

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

☐

$E = \frac{1}{2} k e^2$

☐

$E = P t$

☐

[1 mark]

0 4 . 2

State the **two** factors that determine the kinetic energy of a moving object.

.....

.....

.....

.....

[2 marks]

0 4 . 3

A ball is lifted to twice the height above the ground.
Assuming gravitational field strength is constant, what happens to the gravitational potential energy store of the ball?

Tick (✓) **one** box.

It halves.

☐

It stays the same.

☐

It doubles.

☐

It quadruples.

☐

[1 mark]

0 5

A conker of mass 20 g falls from rest from a branch 6 m above the ground. Ignore air resistance.

Gravitational field strength = 9.8 N/kg

0 5 . 1

Calculate the speed of the conker just before it hits the ground.

.....

.....

.....

.....

.....

Speed = m/s

[3 marks]

0 6

A spring in a laboratory spring balance is stretched by 0.090 m, without going beyond its limit of proportionality. It then stores 0.26 J of elastic potential energy.

0 6 . 1

Calculate the spring constant of the spring.
Use the Physics Equations Sheet.

Spring constant = N/m

[3 marks]

0 7

A sprinter of mass 69 kg has 2700 J of kinetic energy.

0 7 . 1

Calculate the speed of the sprinter.

Speed = m/s

[3 marks]

0 8

A climber drops a karabiner of mass 79 g from rest from a ledge 21 m above the ground.
Ignore air resistance.

Gravitational field strength = 9.8 N/kg

0 8 . 1

Calculate the speed of the karabiner just before it hits the ground.

.....

.....

.....

.....

.....

Speed = m/s

[3 marks]

0 9

A shopping trolley of mass 28 kg has 14 J of kinetic energy.

0 9 . 1

Calculate the speed of the shopping trolley.

.....

.....

.....

.....

.....

Speed = m/s

[3 marks]

END OF QUESTIONS

Original practice questions written to match the specification. Not produced by, affiliated with or endorsed by AQA.

Mark scheme

GCSE Physics · Worksheet: Changes in energy · 30 marks

Question 1 (5 marks)

01.1 [2 marks]

Correct: Doubling the mass only; Halving the mass and doubling the speed

01.2 [2 marks]

Answer: 0.86 J

- $E_e = 0.5 \times 120 \times 0.12^2$ (1)
- $E_e = 0.86$ (J) (1)

Notes: Allow 0.864 (J).

01.3 [1 mark]

Correct: It quadruples.

Question 2 (4 marks)

02.1 [1 mark]

Correct: It increases.

02.2 [2 marks]

Answer: 0.45 J

- $E_e = 0.5 \times 40 \times 0.15^2$ (1)
- $E_e = 0.45$ (J) (1)

Notes: An answer of 0.45 J scores 2 marks. Allow 1 mark for 3 (J) (extension not squared).

02.3 [1 mark]

Correct: 4 times

Question 3 (2 marks)

03.1 [2 marks]

Answer: 215.6 J

- $E_p = 11 \times 9.8 \times 2$ (1)
 - $E_p = 215.6$ (J) (1)
-

Question 4 (4 marks)

04.1 [1 mark]

Correct: $E = \frac{1}{2} k e^2$

04.2 [2 marks]

Answer: Mass and speed.

- mass (of the object) (1)
 - speed (of the object) (1)
-

04.3 [1 mark]

Correct: It doubles.

Question 5 (3 marks)

05.1 [3 marks]

Answer: 10.8 m/s

- $E_p \text{ lost} = 0.02 \times 9.8 \times 6$ (= 1.176 J) (1)
- $E_p \text{ lost} = E_k \text{ gained}$: $1.176 = 0.5 \times 0.02 \times v^2$ (1)
- $v = 10.8$ (m/s) (1)

Notes: The mass cancels: allow $v = \sqrt{2 \times 9.8 \times 6}$ for full marks. Because the mass cancels, not converting grams to kilograms does not change the answer.

Question 6 (3 marks)

06.1 [3 marks]

Answer: 64.2 N/m

- $0.26 = 0.5 \times k \times 0.090^2$ (1)
 - $k = 0.26 \div (0.5 \times 0.090^2)$ (1)
 - $k = 64.2$ (N/m) (1)
-

Question 7 (3 marks)

07.1 [3 marks]

Answer: 8.85 m/s

- $2700 = 0.5 \times 69 \times v^2$ (1)
 - $v^2 = 78.3$ (1)
 - $v = 8.85$ (m/s) (1)
-

Question 8 (3 marks)

08.1 [3 marks]

Answer: 20.3 m/s

- $E_p \text{ lost} = 0.079 \times 9.8 \times 21$ (= 16.3 J) (1)
- $E_p \text{ lost} = E_k \text{ gained}$: $16.3 = 0.5 \times 0.079 \times v^2$ (1)
- $v = 20.3$ (m/s) (1)

Notes: The mass cancels: allow $v = \sqrt{2 \times 9.8 \times 21}$ for full marks. Because the mass cancels, not converting grams to kilograms does not change the answer.

Question 9 (3 marks)

09.1 [3 marks]

Answer: 1 m/s

- $14 = 0.5 \times 28 \times v^2$ (1)
 - $v^2 = 1$ (1)
 - $v = 1$ (m/s) (1)
-