

GCSE Combined Science: Trilogy

Worksheet: Changes in energy

TIME 35 min	TOTAL 31 marks	CALCULATOR Allowed	DIFFICULTY Easy, Medium
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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 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 1 . 2 State the **two** factors that determine the kinetic energy of a moving object.

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.....

.....

.....

[2 marks]

0 1 . 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 2

A runner of mass 60 kg is running at a speed of 7.0 m/s.

0 2 . 1

Calculate the kinetic energy of the runner.
Use the equation:

$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$

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Kinetic energy = J

[2 marks]

0 2 . 2

After the run, the runner lifts a box of mass 12 kg onto a shelf 1.5 m above the floor.

Gravitational field strength = 9.8 N/kg

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

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

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Increase in gravitational potential energy = J

[2 marks]

0 2 . 3

What is the unit of energy?

Tick (✓) **one** box.

joule

☐

kilogram

☐

newton

☐

watt

☐

[1 mark]

0 3

0 3 . 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 3 . 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.

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Elastic potential energy = J

[2 marks]

0 3 . 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 4

A sprinter has a mass of 78 kg and moves at a speed of 8.9 m/s.

0 4 . 1

Calculate the kinetic energy of the sprinter.

Use the equation:

$$\text{kinetic energy} = 0.5 \times \text{mass} \times (\text{speed})^2$$

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Kinetic energy = J

[2 marks]

0 5

A spring in a laboratory spring balance is stretched by 0.060 m, without going beyond its limit of proportionality. It then stores 0.18 J of elastic potential energy.

0 5 . 1

Calculate the spring constant of the spring.

Use the Physics Equations Sheet.

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Spring constant = N/m

[3 marks]

0 6

A skateboarder of mass 47 kg has 610 J of kinetic energy.

0 6 . 1 Calculate the speed of the skateboarder.

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Speed = m/s

[3 marks]

0 7

A crane lifts a load of mass 850 kg vertically upwards.

Gravitational field strength = 9.8 N/kg

0 7 . 1 Write down the equation that links gravitational field strength (g), gravitational potential energy (E_p), height (h) and mass (m).

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[1 mark]

0 7 . 2 The gravitational potential energy of the load increases by 50 kJ.
Calculate the height the load is lifted through.
Give your answer to 2 significant figures.

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Height = m

[3 marks]

0 7 . 3

The crane then lowers the load through 2.0 m.
Calculate the decrease in the gravitational potential energy of the load.

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.....

Decrease in gravitational potential energy = J

[2 marks]

0 8

A climber of mass 58 kg climbs vertically up a climbing wall. The gravitational potential energy of the climber increases by 6300 J.
Gravitational field strength = 9.8 N/kg

0 8 . 1

Calculate the height through which the climber is raised.
Give your answer to 2 significant figures.

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Height = m

[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 Combined Science: Trilogy · Worksheet: Changes in energy · 31 marks

Question 1 (4 marks)

01.1 [1 mark]

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

01.2 [2 marks]

Answer: Mass and speed.

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

01.3 [1 mark]

Correct: It doubles.

Question 2 (5 marks)

02.1 [2 marks]

Answer: 1470 J

- $E_k = 0.5 \times 60 \times 7.0^2$ (1)
- $E_k = 1470$ (J) (1)

Notes: An answer of 1470 J scores 2 marks. Allow 1 mark for 210 (J) (speed not squared).

02.2 [2 marks]

Answer: 176.4 J

- $E_p = 12 \times 9.8 \times 1.5$ (1)
- $E_p = 176.4$ (J) (1)

Notes: Allow 176 (J) or 180 (J).

02.3 [1 mark]

Correct: joule

Question 3 (5 marks)

03.1 [2 marks]

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

03.2 [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).

03.3 [1 mark]

Correct: It quadruples.

Question 4 (2 marks)

04.1 [2 marks]

Answer: 3089.19 J

- $E_k = 0.5 \times 78 \times 8.9^2$ (1)
 - $E_k = 3089.19$ (J) (1)
-

Question 5 (3 marks)

05.1 [3 marks]

Answer: 100 N/m

- $0.18 = 0.5 \times k \times 0.060^2$ (1)
 - $k = 0.18 \div (0.5 \times 0.060^2)$ (1)
 - $k = 100$ (N/m) (1)
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Question 6 (3 marks)

06.1 [3 marks]

Answer: 5.09 m/s

- $610 = 0.5 \times 47 \times v^2$ (1)
 - $v^2 = 26.0$ (1)
 - $v = 5.09$ (m/s) (1)
-

Question 7 (6 marks)

07.1 [1 mark]

Answer: $E_p = m g h$

- $E_p = m \times g \times h$ / gravitational potential energy = mass $\times$ gravitational field strength $\times$ height (1)

07.2 [3 marks]

Answer: 6.0 m

- $50\,000 = 850 \times 9.8 \times h$ (1)
- $h = 50\,000 \div 8330 (= 6.002 \text{ m})$ (1)
- $h = 6.0 \text{ (m)}$ given to 2 significant figures (1)

Notes: An answer of 6.0 m scores 3 marks. An answer of 6.002 (m) scores 2 marks. An answer of 0.0060 (m) (kJ not converted to J) scores 2 marks.

07.3 [2 marks]

Answer: 16 660 J

- $E_p = 850 \times 9.8 \times 2.0$ (1)
- $E_p = 16\,660 \text{ (J)}$ (1)

Notes: Allow 16 700 (J) or 17 000 (J).

Question 8 (3 marks)

08.1 [3 marks]

Answer: 11 m

- $6300 = 58 \times 9.8 \times h$ (1)
- $h = 6300 \div 568.4 (= 11.1 \text{ m})$ (1)
- $h = 11 \text{ (m)}$ given to 2 significant figures (1)

Notes: An answer of 11.1 (m), not rounded to 2 significant figures, scores 2 marks.