AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.1.1.2

Changes in energy

Past-paper questions

Tier	**Foundation**
Question groups	**16**
Available paper years	**2018–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

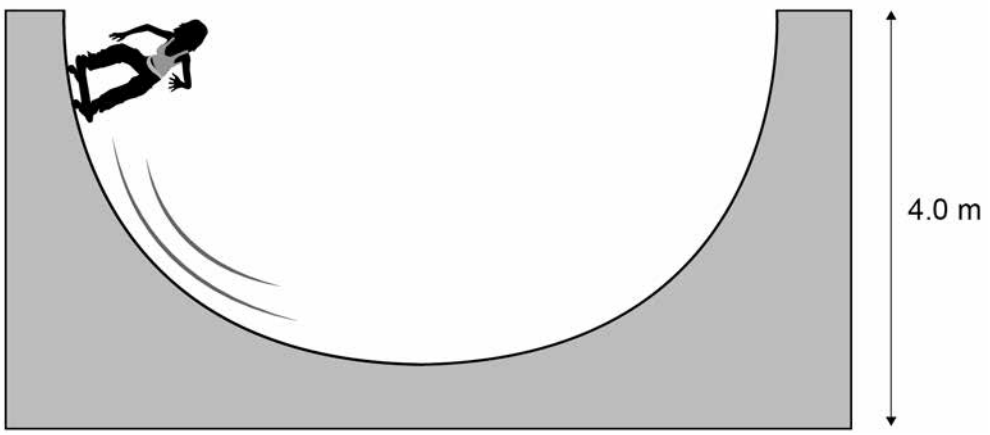
6.1.1.2 Changes in energy

Question 01

June 2018 | 8464/P/1F | Original Q3

0 3 **Figure 5** shows a girl skateboarding on a semi-circular ramp.

Figure 5



The girl has a mass of 50 kg

0 3 . 1 Calculate the gravitational potential energy (g.p.e.) of the girl at the top of the ramp.

Use the equation:

g.p.e. = mass × gravitational field strength × height

gravitational field strength = 9.8 N/kg

[2 marks]

g.p.e. = _____ J

0 3 . 2 The girl has a speed of 7 m/s at the bottom of the ramp.

Calculate the kinetic energy of the girl at the bottom of the ramp.

Use the equation:

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

[2 marks]

Kinetic energy = _____ J

6.1.1.2 Changes in energy

Question 01 · continued

June 2018 | 8464/P/1F | Original Q3

0 3 . 3 Not all of the g.p.e. has been transferred to kinetic energy.

Which **two** statements explain why?

[2 marks]

Tick **two** boxes.

- Some energy is wasted. ☐
- The mass of the girl is too low. ☐
- The ramp is not high enough. ☐
- The g.p.e. of the girl is not zero. ☐
- The speed of the girl is too great. ☐

0 3 . 4 Explain how lubricating the wheels of the skateboard can increase the speed of the girl.

Use ideas about energy in your explanation.

[3 marks]

9

6.1.1.2 Changes in energy

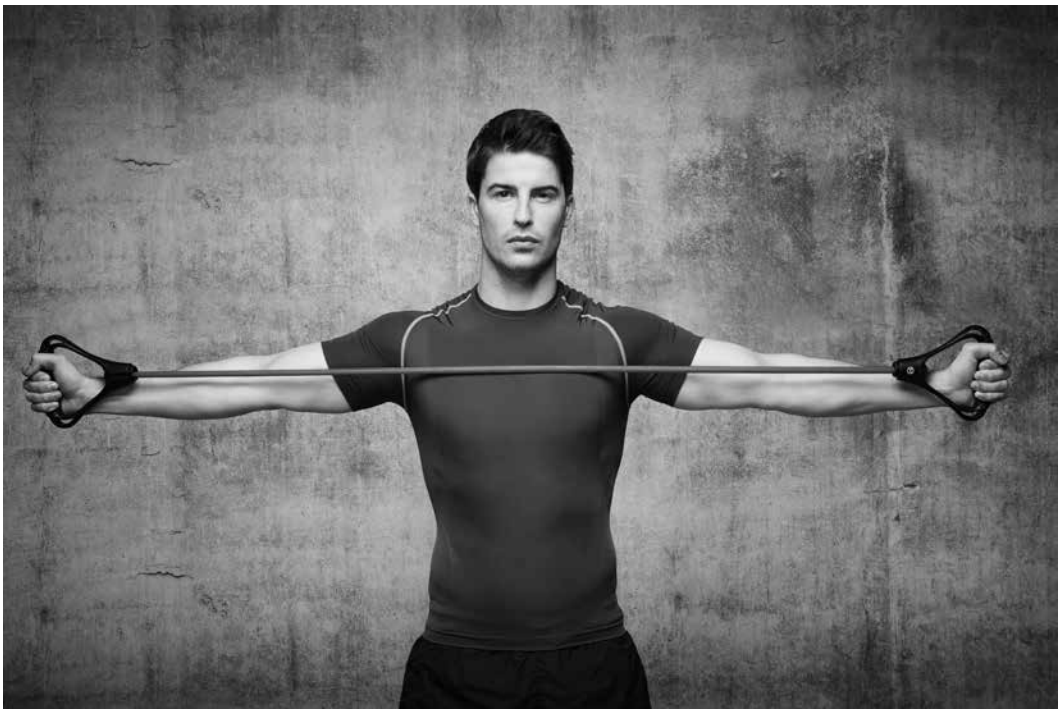
Question 02

June 2018 | 8464/P/2F | Original Q5

0 5 **Figure 6** shows a man using a resistance band when exercising.

The resistance band behaves elastically.

Figure 6



0 5 . 1 What happens to the store of elastic potential energy of the resistance band when the band is stretched?

[1 mark]

0 5 . 2 Explain what happens to the resistance band as it is released.

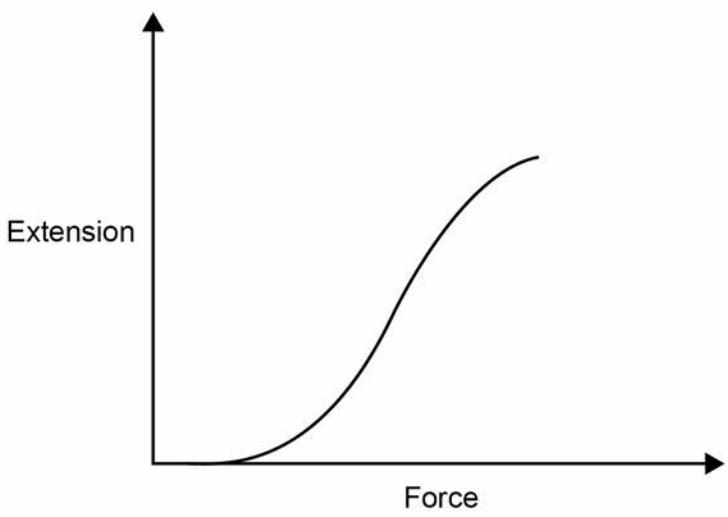
[2 marks]

6.1.1.2 Changes in energy

Question 02 · continued

0 5 . 3 **Figure 7** shows how the extension of the resistance band changes as the force applied changes.

Figure 7



Describe the trend shown in the graph.

[2 marks]

Question 5 continues on the next page

6.1.1.2 Changes in energy

Question 02 · continued

Figure 8 shows a chest expander.

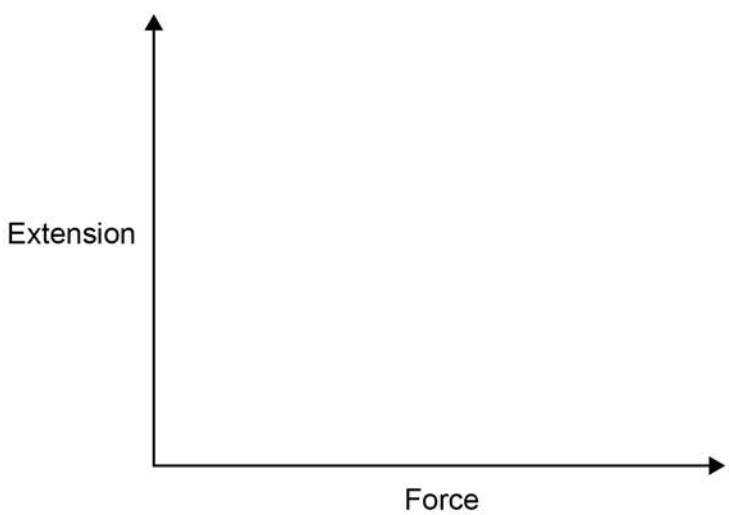
Figure 8



0 5 . 4 Sketch a graph on **Figure 9** to show how the extension of a spring in the chest expander changes as the force applied changes.

[2 marks]

Figure 9



6.1.1.2 Changes in energy

Question 02 · continued

When a force is applied to a spring, the spring extends by 7.5 cm

0 5 . 5 Write down the equation that links extension, force and spring constant.

[1 mark]

0 5 . 6 Calculate the force applied to the spring.

The spring has a spring constant of 1 600 N/m

Use your equation from question **05.5**

[3 marks]

Force = _____ N

11

6.1.1.2 Changes in energy

Question 03

June 2019 | 8464/P/1F | Original Q5

0 5 **Figure 7** shows a toaster.

Figure 7



The toaster is connected to the mains supply using a three-core cable.

0 5 . 1 What is the function of the earth wire inside the cable?

[1 mark]

Tick (✓) **one** box.

To carry the current from the supply to the toaster ☐

To complete the circuit in the toaster ☐

To melt if a fault occurs inside the toaster ☐

To stop the metal case of the toaster becoming live if a fault occurs ☐

0 5 . 2 Complete the sentences.

Choose answers from the box.

[3 marks]

blue	**brown**	**orange**	**white**	**yellow**

The insulation around the earth wire is green and _____ .

The insulation around the live wire is _____ .

The insulation around the neutral wire is _____ .

6.1.1.2 Changes in energy

Question 03 · continued

0 5 . 3 The toaster is switched on for 120 seconds.

The power of the toaster is 850 watts.

Calculate the energy transferred by the toaster.

Use the equation:

energy transferred = power × time

[2 marks]

Energy transferred = _____ J

0 5 . 4 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**kinetic**	**thermal**

When bread is lowered into the toaster, a spring is stretched. The stretched spring stores _____ energy.

After the bread is toasted, the spring makes the toast move upwards. As the speed of the toast increases, the _____ energy of the toast increases.

6.1.1.2 Changes in energy

Question 03 · continued

June 2019 | 8464/P/1F | Original Q5

0 5 . 5 Write the equation which links gravitational field strength, gravitational potential energy, height and mass.

[1 mark]

0 5 . 6 The toast was moved upwards by the spring.

The change in gravitational potential energy of the toast was 0.049 J

The mass of the toast was 0.050 kg

gravitational field strength = 9.8 N/kg

Calculate the change in height of the toast.

[3 marks]

Change in height = _____ m

12

6.1.1.2 Changes in energy

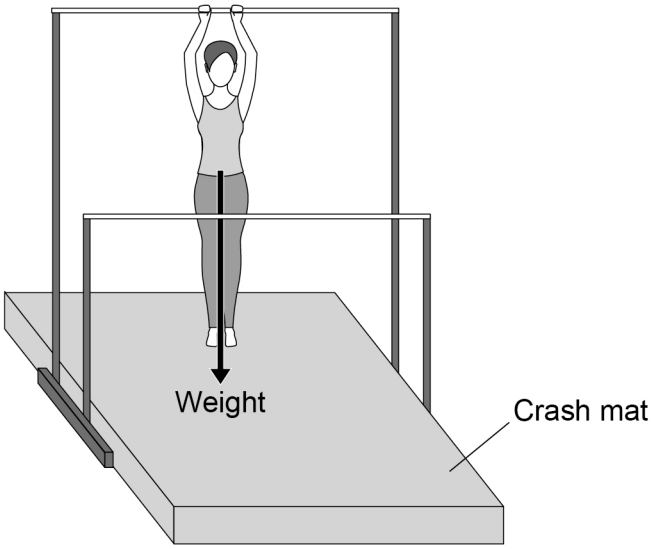
Question 04

June 2019 | 8464/P/2F | Original Q2

0 2 **Figure 3** shows a gymnast on a piece of gymnastic equipment.

The equipment consists of two bars at different heights.

Figure 3



0 2 . 1 The gymnast exerts a downward force on the bar.

What is the size of the upward force acting on the gymnast from the bar?

[1 mark]

Tick (✓) **one** box.

It is greater than the downward force. ☐

It is less than the downward force. ☐

It is the same size as the downward force. ☐

6.1.1.2 Changes in energy

Question 04 · continued

0 2 . 2 Why is the weight of the gymnast represented by an arrow?

[1 mark]

Tick (✓) **one** box.

- Weight is a constant. ☐
- Weight is a scalar. ☐
- Weight is a unit. ☐
- Weight is a vector. ☐

0 2 . 3 **Figure 3** shows the weight of the gymnast acting from a point.

What name is given to this point?

[1 mark]

Tick (✓) **one** box.

- Centre of force ☐
- Centre of mass ☐
- Centre of tension ☐
- Centre of weight ☐

Question 2 continues on the next page

6.1.1.2 Changes in energy

Question 04 · continued

0 2 . 4 The gymnast has a mass of 45 kg

gravitational field strength = 9.8 N/kg

Calculate the weight of the gymnast.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

0 2 . 5 The gymnast swings from one bar to the other bar several times.

Describe how the gravitational potential energy store and the kinetic energy store of the gymnast change as she moves between the bars.

[4 marks]

6.1.1.2 Changes in energy

Question 04 · continued

0 2 . 6 Falling on the crash mat reduces the average deceleration of the gymnast compared with falling on a hard surface.

Explain why reducing the deceleration is important to the gymnast.

[2 marks]

11

Turn over for the next question

6.1.1.2 Changes in energy

Question 05

November 2020 | 8464/P/1F | Original Q4

0 4 A scientist had a balloon which was filled with air.

0 4 . 1 Which statement describes how air particles move?

[1 mark]

Tick (✓) **one** box.

- At random speeds in random directions ☐
- At random speeds in the same direction ☐
- At the same speed in random directions ☐
- At the same speed in the same direction ☐

The temperature of the air was 19 °C

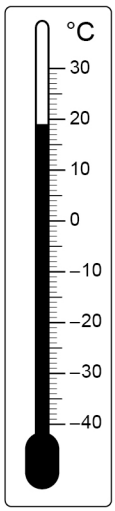
The scientist dipped the balloon into liquid nitrogen.

The temperature of the liquid nitrogen was −196 °C

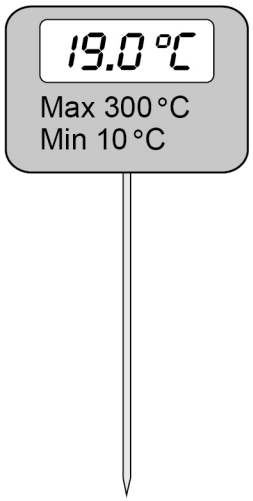
0 4 . 2 Which thermometer could be used to measure the temperature of the liquid nitrogen?

[1 mark]

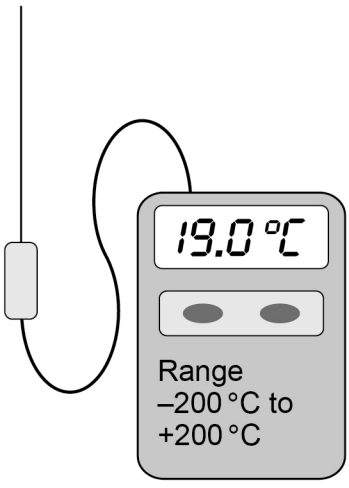
Tick (✓) **one** box.



☐



☐



☐

0 4 . 3 The scientist wore special insulating gloves when putting the balloon into the liquid nitrogen.

Suggest why.

[1 mark]

0 4 . 4 When the balloon was put into liquid nitrogen the temperature of the air in the balloon decreased.

Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[2 marks]

decreased	**stayed the same**	**increased**

As the air in the balloon cooled down, the speed of the particles

_____ . This is because the kinetic energy of the

particles _____ .

Question 4 continues on the next page

Question 05 · continued

0 4 . 5 The air in the balloon had a mass of 0.00320 kg

The temperature of the air in the balloon decreased by 215 °C

The change in thermal energy of the air in the balloon was 860 J

Calculate the specific heat capacity of the air in the balloon.

Use the Physics Equations Sheet.

[3 marks]

Specific heat capacity = _____ J/kg°C

0 4 . 6 The liquid nitrogen boiled.

What happens to the temperature of nitrogen as it boils?

[1 mark]

Tick (✓) **one** box.

- Temperature decreases ☐
- Temperature increases ☐
- Temperature stays the same ☐

Question 05 · continued

The scientist recorded measurements to calculate the specific latent heat of vaporisation of nitrogen.

0 4 . 7 What is meant by vaporisation?

[1 mark]

Tick (✓) **one** box.

A change of state from liquid to gas ☐

A change of state from solid to gas ☐

A change of state from solid to liquid ☐

0 4 . 8 The mass of nitrogen that vaporised was 0.0072 kg

1440 J of energy was transferred to the nitrogen as it vaporised.

Calculate the specific latent heat of vaporisation of nitrogen.

Use the Physics Equations Sheet.

[3 marks]

Specific latent heat of vaporisation = _____ J/kg

13

6.1.1.2 Changes in energy

Question 06

November 2020 | 8464/P/2F | Original Q1

0 1 **Figure 1** shows a girl bowling a ball along a ten-pin bowling lane.

Figure 1



The girl is trying to knock down the ten pins at the end of the bowling lane.

As the ball travels along the lane the velocity of the ball decreases.

0 1 . 1 Velocity is a vector.

Which statement describes a vector?

[1 mark]

Tick (✓) **one** box.

Vectors have direction only. ☐

Vectors have magnitude and direction. ☐

Vectors have magnitude only. ☐

6.1.1.2 Changes in energy

Question 06 · continued

0 1 . 2 Why does the velocity of the ball decrease as the ball travels along the lane?

[1 mark]

Tick (✓) **one** box.

The force of gravity slows the ball down. ☐

There are no forces acting on the ball. ☐

There is a resultant force acting on the ball. ☐

0 1 . 3 The ball travels along the lane at an average speed of 4.5 m/s

It takes the ball 4.0 seconds to travel the length of the lane.

Calculate the length of the lane.

Use the equation:

distance travelled = speed × time

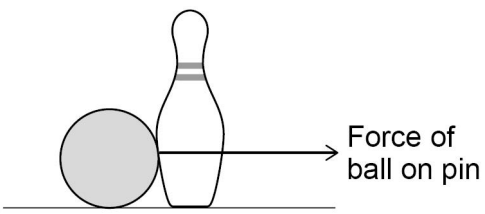
[2 marks]

Length of the lane = _____ m

Question 1 continues on the next page

Figure 2 shows the ball hitting one of the pins.

Figure 2



0 1 . 4 Draw an arrow on **Figure 2** to show the force of the pin on the ball.

[2 marks]

0 1 . 5 The velocity of the pin changes from 0 to 12 m/s

It takes 0.15 seconds for the velocity to change.

Calculate the acceleration of the pin.

Use the equation:

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

[2 marks]

Acceleration = _____ m/s^2

6.1.1.2 Changes in energy

Question 06 · continued

0 1 . 6 When the pin is struck it accelerates.

Complete the sentences.

Choose answers from the box.

Each answer can be used once, more than once, or not at all.

[3 marks]

decreases	**increases**	**stays the same**

The displacement of the pin from the girl _____ .

The mass of the pin _____ .

The kinetic energy of the pin _____ .

11

Turn over for the next question

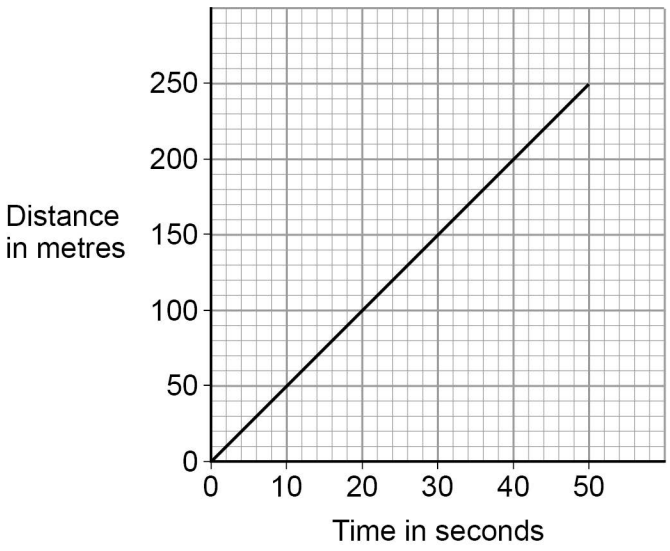
6.1.1.2 Changes in energy

Question 07

November 2020 | 8464/P/2F | Original Q4

0 4 **Figure 5** shows a distance-time graph for 50 seconds of a bicycle ride.

Figure 5



0 4 . 1 The gradient of the distance-time graph gives the speed of the bicycle.

Determine the speed of the bicycle.

[2 marks]

Speed = _____ m/s

0 4 . 2 Which force acting on the moving bicycle is a non-contact force?

[1 mark]

Tick (✓) **one** box.

Air resistance ☐

Friction ☐

Gravitational force ☐

Normal contact force ☐

0 4 . 3 The bicycle travels a distance of 250 m

The bicycle exerts a constant horizontal force of 30 N on the ground.

Calculate the work done.

Use the equation:

work done = force × distance

Choose the unit from the box.

[3 marks]

J	**kg**	**m**

Work done = _____ Unit _____

6.1.1.2 Changes in energy

Question 07 · continued

0 4 . 4 The bicycle travels at a constant speed.

Complete the sentences.

Choose answers from the box.

[3 marks]

chemical	**frictional**	**kinetic**
magnetic		**tension**

As the bicycle moves, work is done against _____ forces.

There is no change in the cyclist's _____ store of energy.

There is a decrease in the cyclist's _____ store of energy.

9

6.1.1.2 Changes in energy

Question 08

November 2021 | 8464/P/1F | Original Q2

0 2 In a sport called far-leaping, an athlete uses a long pole to cross a river.

Figure 4 shows an athlete far-leaping.

Figure 4

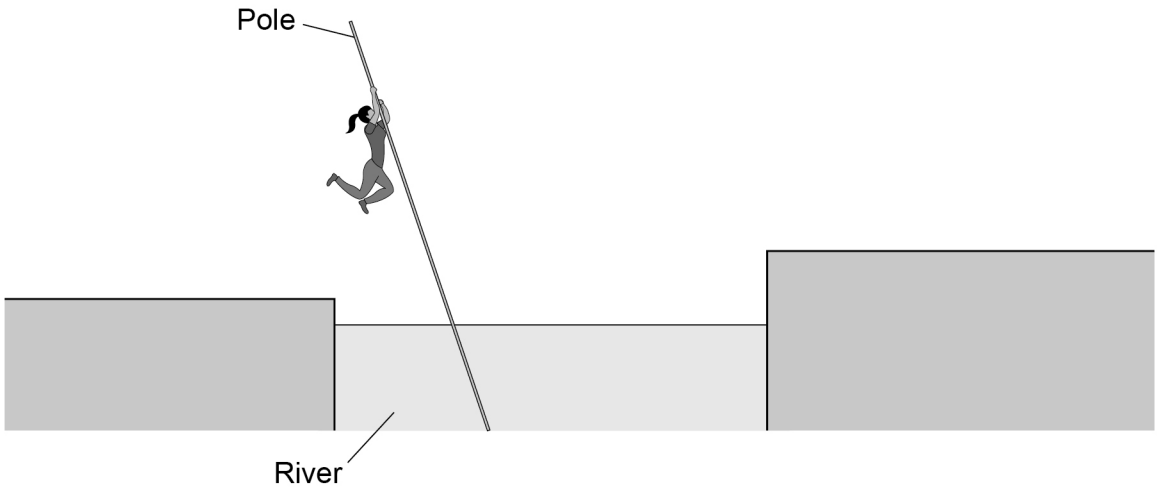
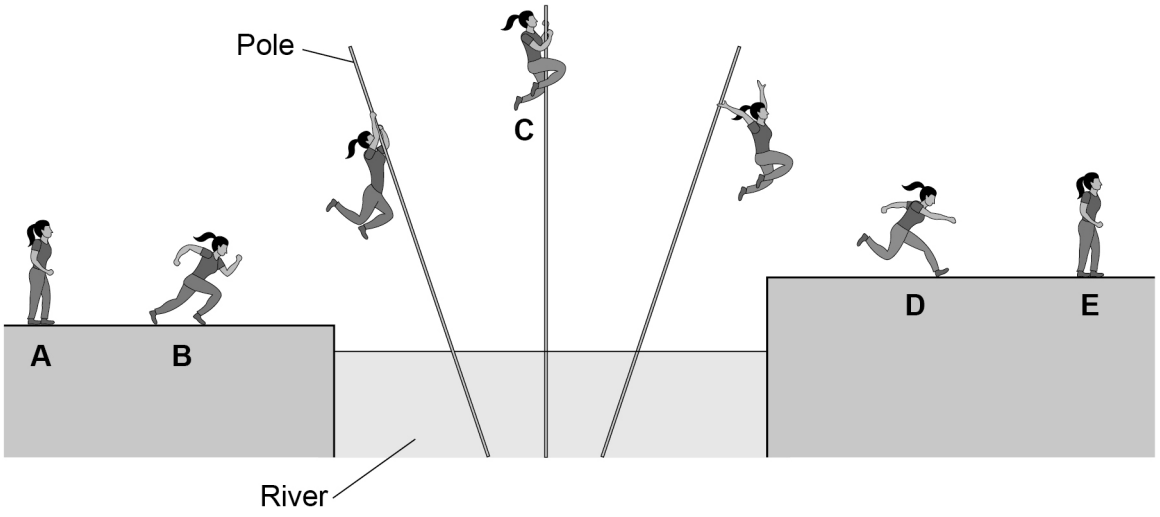


Figure 5 shows the athlete in different stages of far-leaping.

Figure 5



Question 08 · continued

0 2 . 1 Complete the sentence.

Choose answers from the box.

[2 marks]

chemical	**nuclear**	**kinetic**
elastic potential		**gravitational potential**

Between positions **A** and **B** the athlete speeds up. There is

an increase in the athlete's _____ energy and

a decrease in the athlete's _____ store of energy.

0 2 . 2 Between positions **B** and **C** the athlete jumps to the pole and climbs up it.

Which statement describes a change in the athlete's energy between positions **B** and **C**?

[1 mark]

Tick (✓) **one** box.

- Elastic potential energy decreases. ☐
- Elastic potential energy increases. ☐
- Gravitational potential energy decreases. ☐
- Gravitational potential energy increases. ☐

Question 2 continues on the next page

Question 08 · continued

0 2 . 3 The pole falls over from position **C**. The athlete lets go of the pole and lands at position **D**.

The change in height of the athlete between positions **C** and **D** is 3.0 m.

mass of athlete = 50 kg

gravitational field strength = 9.8 N/kg

Calculate the change in gravitational potential energy of the athlete between positions **C** and **D**.

Use the equation:

change in gravitational potential energy = mass × gravitational field strength × change in height

[2 marks]

Change in gravitational potential energy = _____ J

Question 08 · continued

0 2 . 4 The kinetic energy of the athlete at position **D** is 1600 J.

mass of athlete = 50 kg

Calculate the speed of the athlete at position **D**.

Use the equation:

$$\text{speed} = \sqrt{\frac{2 \times \text{kinetic energy}}{\text{mass}}}$$

Choose the unit from the box.

[3 marks]

m/s	J/kg	J/s

Speed = _____ Unit _____

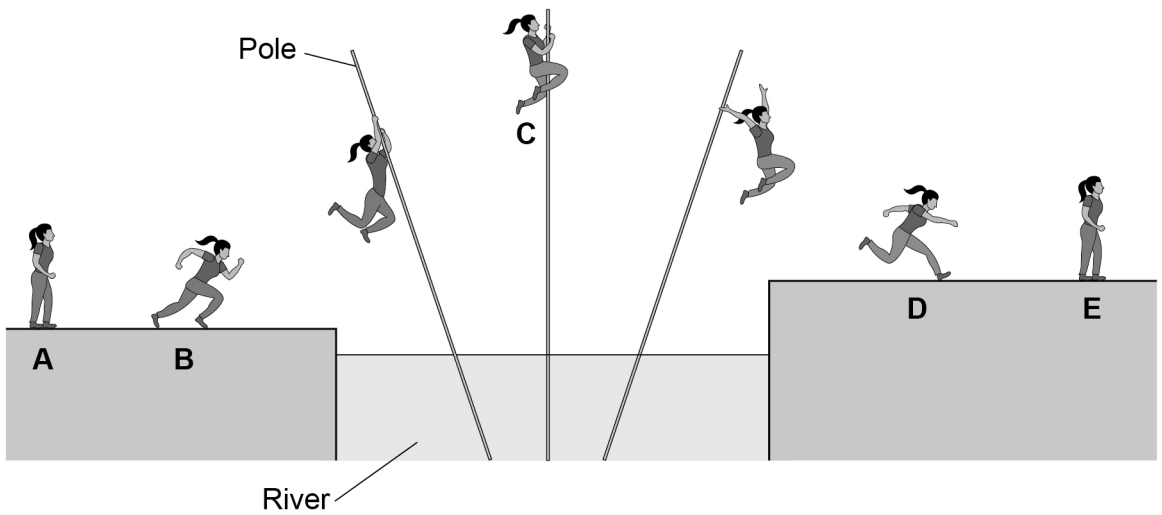
Question 2 continues on the next page

6.1.1.2 Changes in energy

Question 08 · continued

Figure 5 is repeated below.

Figure 5



0 2 . 5 At positions **A** and **E**, the athlete is standing still.

Why does the athlete have less energy in position **E** than in position **A**?

[1 mark]

Tick (✓) **one** box.

Energy has been transferred from the athlete to the air. ☐

The air temperature has decreased. ☐

The height of the athlete above the water has increased. ☐

Question 08 · continued

0 2 . 6 Athletes have a large power output when they are far-leaping.

What is meant by the power of an athlete?

[1 mark]

Tick (✓) **one** box.

The rate at which the athlete transfers energy. ☐

The size of the maximum force exerted by the athlete. ☐

The total energy transferred by the athlete. ☐

0 2 . 7 A second athlete crossed the same river by far-leaping.

The second athlete had less power than the first athlete when running between position **A** and position **B**.

Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[2 marks]

less than	**the same as**	**more than**

Two factors that could explain why the second athlete had less power than the first athlete are:

1. The time taken by the second athlete to run between position **A** and position **B** was _____ the first athlete.

2. The work done by the second athlete was _____ the first athlete.

12

6.1.1.2 Changes in energy

Question 09

November 2021 | 8464/P/2F | Original Q3

0 3 The stopping distance of a car is the sum of the thinking distance and the braking distance.

0 3 . 1 The thinking distance is affected by the reaction time of the driver.

Which **two** of the following can affect the reaction time of the driver?

[2 marks]

Tick (✓) **two** boxes.

- Damaged brakes ☐
- Taking drugs ☐
- Tiredness ☐
- Wet roads ☐
- Worn tyres ☐

Question 09 · continued

Scientists measured the reaction time for drivers of different ages.

Figure 6 shows the results.

Figure 6



0 3 . 2 At what age did the drivers have the lowest mean reaction time?

[1 mark]

Age = _____ years

0 3 . 3 What was the lowest mean reaction time?

[1 mark]

Time = _____ seconds

Question 3 continues on the next page

6.1.1.2 Changes in energy

Question 09 · continued

The braking distance of a car is the distance travelled between the driver applying the brakes and the car stopping.

0 3 . 4 Complete the sentences.

Choose answers from the box.

Each answer may be used once, more than once or not at all.

[2 marks]

decreases	**stays the same**	**increases**

When the brakes are applied, the kinetic energy of the

car _____ .

The temperature of the brakes _____ .

6.1.1.2 Changes in energy

Question 09 · continued

0 3 . 5 A car is travelling at a speed of 12 m/s.

The driver applies the brakes and the car decelerates at a constant 3.0 m/s^2.

Calculate the braking distance of the car.

Use the equation:

$$\text{braking distance} = \frac{(\text{speed})^2}{2 \times \text{deceleration}}$$

Choose the unit from the box.

[3 marks]

m	kg	s

Braking distance = _____ Unit _____

0 3 . 6 To pass the UK driving test, people must know the typical stopping distance of a car at certain speeds.

Suggest **one** reason why.

[1 mark]

10

6.1.1.2 Changes in energy

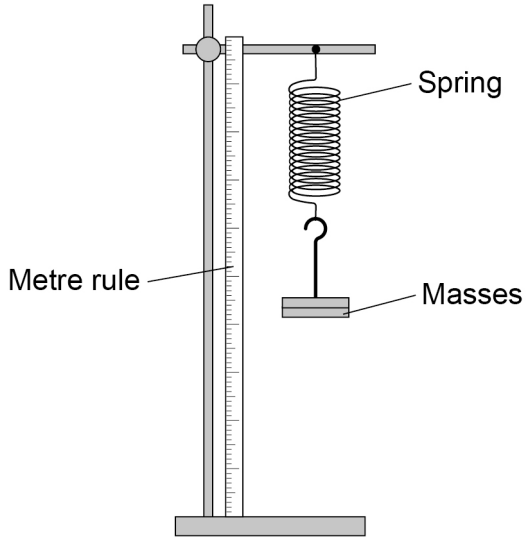
Question 10

November 2021 | 8464/P/2F | Original Q6

0 6 **Figure 8** shows a stretched spring.

The spring is elastically deformed.

Figure 8



0 6 . 1 What is meant by 'elastically deformed'?

[1 mark]

Tick (✓) **one** box.

As the force on the spring increases the length of the spring increases. ☐

Only a very small force is needed to stretch the spring. ☐

The force on the spring causes it to change shape. ☐

The spring will return to its original length when the force is removed. ☐

6.1.1.2 Changes in energy

Question 10 · continued

0 6 . 2 Describe a method to determine the extension of the spring.

[2 marks]

0 6 . 3 The extension of the spring is 80 mm.

spring constant = 40 N/m

Calculate the elastic potential energy of the spring.

Use the Physics Equations Sheet.

[3 marks]

Elastic potential energy = _____ J

Question 6 continues on the next page

6.1.1.2 Changes in energy

Question 10 · continued

0 6 . 4 Write down the equation which links extension (*e*), force (*F*) and spring constant (*k*).

[1 mark]

0 6 . 5 A force of 300 N acts on a different spring.

The force causes the spring to extend by 0.40 m.

Calculate the spring constant of the spring.

[3 marks]

Spring constant = _____ N/m

10

6.1.1.2 Changes in energy

Question 11

June 2022 | 8464/P/1F | Original Q2

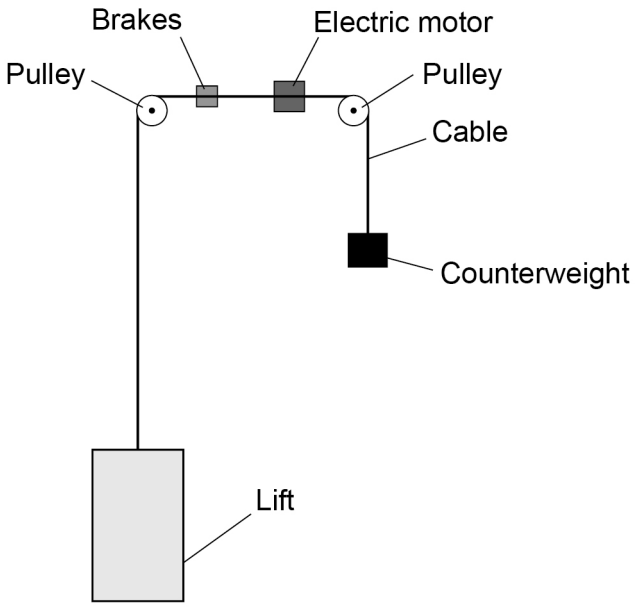
0 2 **Figure 3** shows a lift near the bottom of a building.

The lift is attached by a cable to a counterweight.

An electric motor moves the lift.

The lift is moving up.

Figure 3



0 2 . 1 As the lift moves up, how far does the counterweight move down?

[1 mark]

Tick (✓) **one** box.

A shorter distance than the lift. ☐

The same distance as the lift. ☐

A longer distance than the lift. ☐

6.1.1.2 Changes in energy

Question 11 · continued

0 2 . 2 What happens to the gravitational potential energy of the counterweight as it moves down?

[1 mark]

Tick (✓) **one** box.

It decreases ☐

It stays the same ☐

It increases ☐

0 2 . 3 Calculate the change in gravitational potential energy of the lift when it moves up 4.0 m

The mass of the lift is 1300 kg

gravitational field strength = 9.8 N/kg

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Change in gravitational potential energy = _____ J

Question 2 continues on the next page

6.1.1.2 Changes in energy

Question 11 · continued

0 2 . 4 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**gravitational potential**
internal		**kinetic**

Friction between the brakes and the cable causes the speed of the lift to decrease.

As the speed decreases, there is a decrease in the _____ energy of the lift.

As the speed decreases, there is an increase in the _____ energy of the brakes.

0 2 . 5 The motor transfers different amounts of energy each time people use the lift.

Which factors affect the amount of energy transferred by the motor as the lift moves?

[2 marks]

Tick (✓) **two** boxes.

- The distance moved by the lift ☐
- The height of the building ☐
- The length of the steel cable ☐
- The maximum power of the motor ☐
- The weight of the people in the lift ☐

6.1.1.2 Changes in energy

Question 11 · continued

0 2 . 6 The weight of the lift and the counterweight stretch the cable by 0.015 m

The cable acts like a spring with a spring constant of 880 000 N/m

Calculate the elastic potential energy of the stretched cable.

Use the equation:

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

[2 marks]

Elastic potential energy = _____ J

0 2 . 7 A lift system using a counterweight is more efficient than a lift system that does not use a counterweight.

How does having a more efficient system affect the energy transferred by the motor?

[1 mark]

Tick (✓) **one** box.

- Less energy is transferred. ☐
- The same amount of energy is transferred. ☐
- More energy is transferred. ☐

11

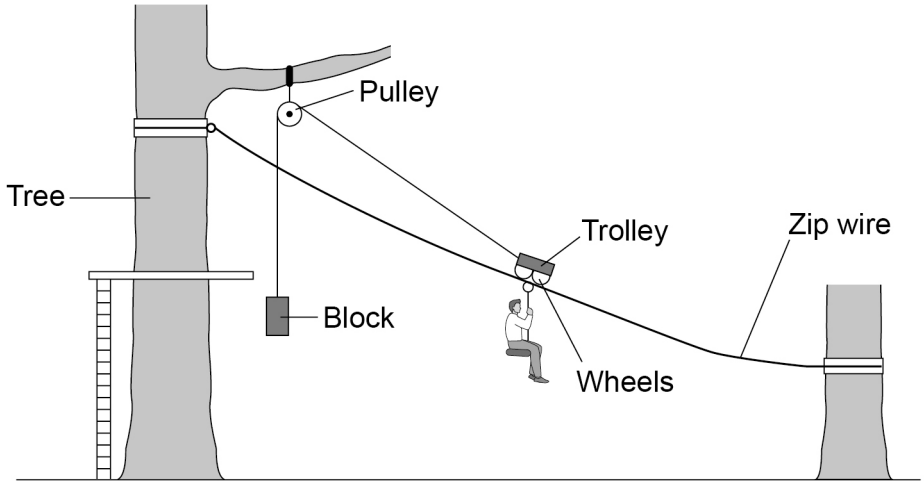
6.1.1.2 Changes in energy

Question 12

June 2023 | 8464/P/1F | Original Q2

0 2 **Figure 3** shows a person using a zip wire to move from a tree to the ground.

Figure 3



As the person moves down the zip wire, the block moves upwards.

0 2 . 1 What happens to the gravitational potential energy of the person as the person accelerates down the zip wire?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Stays the same ☐

Increases ☐

6.1.1.2 Changes in energy

Question 12 · continued

0 2 . 2 What happens to the kinetic energy of the person as the person accelerates down the zip wire?

[1 mark]

Tick (✓) **one** box.

Decreases ☐

Stays the same ☐

Increases ☐

0 2 . 3 The block is 3.4 m above the ground when the person is at the bottom of the zip wire.

mass of block = 2.5 kg

gravitational field strength = 9.8 N/kg

Calculate the gravitational potential energy of the block.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Gravitational potential energy = _____ J

Question 2 continues on the next page

Question 12 · continued

The trolley is a seat suspended from wheels which can roll along the zip wire.

0 2 . 4 When the person reaches the end of the zip wire, the person gets off the trolley.

The block falls downwards pulling the trolley back to the top of the zip wire.

maximum speed of block = 4.8 m/s

mass of block = 2.5 kg

Calculate the maximum kinetic energy of the block.

Use the equation:

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

[2 marks]

Maximum kinetic energy = _____ J

0 2 . 5 As the trolley moves, work is done against friction.

What is the effect of this?

[1 mark]

Tick (✓) **one** box.

- Some energy is destroyed. ☐
- Some energy is transferred to the surroundings. ☐
- The total energy of the block and trolley increases. ☐

6.1.1.2 Changes in energy

Question 12 · continued

0 2 . 6 The person oils the wheels on the trolley.

Explain how this will affect the speed of the person down the zip wire.

[2 marks]

9

Turn over for the next question

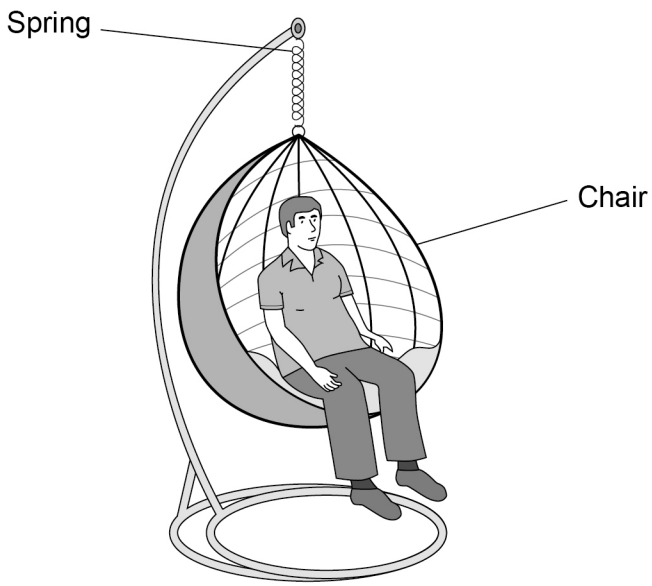
6.1.1.2 Changes in energy

Question 13

June 2023 | 8464/P/2F | Original Q1

0 1 **Figure 1** shows a garden chair hanging from a spring.

Figure 1



The weight of the person causes the spring to extend.

0 1 . 1 Why does the weight of the person cause the spring to extend?

[1 mark]

Tick (✓) **one** box.

- Weight acts downwards ☐
- Weight acts in all directions ☐
- Weight acts upwards ☐

6.1.1.2 Changes in energy

Question 13 · continued

0 1 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

a gravitational	**a frictional**	**an electrostatic**

The weight of the person in **Figure 1** is _____ force.

Question 1 continues on the next page

6.1.1.2 Changes in energy

Question 13 · continued

The weight of the person causes an extension in the spring of 0.070 m.

The spring constant of the spring is 12 000 N/m.

0 1 . 3 Calculate the weight of the person.

Use the equation:

weight = spring constant × extension

[2 marks]

Weight = _____ N

0 1 . 4 Calculate the elastic potential energy stored in the extended spring.

Use the equation:

elastic potential energy = 0.5 × spring constant × (extension)^2

[2 marks]

Elastic potential energy = _____ J

6.1.1.2 Changes in energy

Question 13 · continued

0 1 . 5 If there is more than one person on the chair, the spring could become inelastically deformed.

What is meant by 'inelastically deformed'?

[1 mark]

Tick (✓) **one** box.

- The spring extends more when two or more forces act on it. ☐
- The spring will not go back to its original length when the force is removed. ☐
- The spring extends so that it is twice as long as its original length. ☐

Question 1 continues on the next page

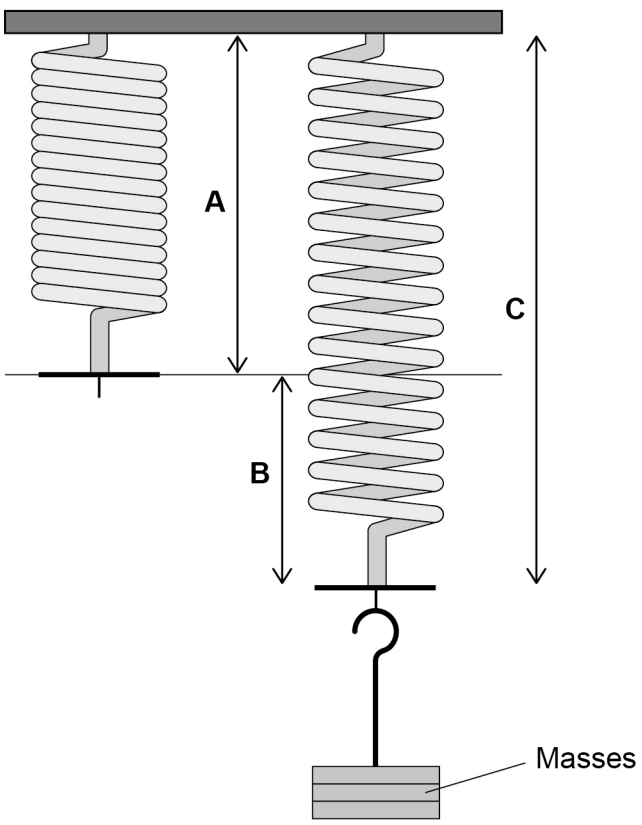
Question 13 · continued

The manufacturer of the chair investigated the extension of a new spring.

0 1 . 6 **Figure 2** shows slotted masses hanging from the spring.

The weight of the masses extends the spring.

Figure 2



Which length in **Figure 2** represents the extension of the spring?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

6.1.1.2 Changes in energy

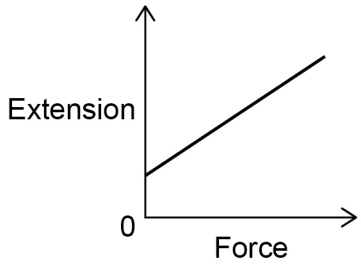
Question 13 · continued

0 1 . 7 Which graph shows that the extension of the spring is directly proportional to the force applied to the spring?

[1 mark]

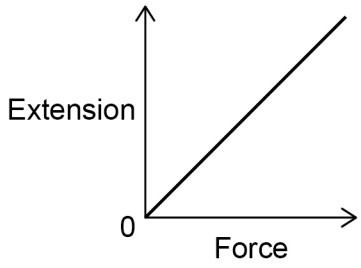
Tick (✓) **one** box.

A



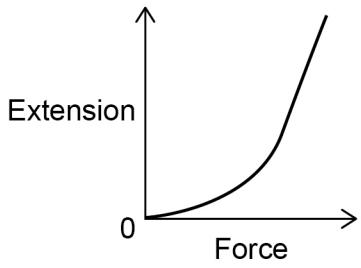
☐

B



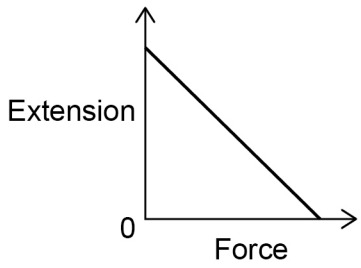
☐

C



☐

D



☐

Question 1 continues on the next page

6.1.1.2 Changes in energy

Question 13 · continued

0 1 . 8 **Table 1** shows the results of the manufacturer's investigation.

Table 1

Force in newtons	Extension in metres
100	0.008
200	0.016

Suggest **two** improvements to the investigation.

[2 marks]

1 _____

_____

2 _____

_____

11

6.1.1.2 Changes in energy

Question 14

June 2024 | 8464/P/1F | Original Q2

0 2 **Figure 2** shows an outdoor swimming pool.

The water in the swimming pool comes from the sea.

Figure 2



The water in the pool is heated using a geothermal energy resource.

0 2 . 1 Which of the following describes a geothermal energy resource?

[1 mark]

Tick (✓) **one** box.

A non-renewable energy resource with high carbon emissions. ☐

A non-renewable energy resource with low running costs. ☐

A renewable energy resource that uses hot rocks underground. ☐

A renewable energy resource that uses the tides. ☐

Question 14 · continued

0 2 . 2 15 kg of seawater is heated before it is added to the pool.

specific heat capacity of seawater = 3800 J/kg °C

Calculate the change in thermal energy of 15 kg of seawater when its temperature is increased by 9.0 °C.

Use the equation:

change in thermal energy = mass × specific heat capacity × temperature change

[2 marks]

Change in thermal energy = _____ J

0 2 . 3 The energy transferred from 1.0 m^2 of the surface of the pool to the air is 80 J each second.

The surface area of the pool is 120 m^2.

Calculate the energy transferred from the whole surface of the pool to the air each second.

[1 mark]

Energy transferred each second = _____ J

Question 2 continues on the next page

6.1.1.2 Changes in energy

Question 14 · continued

0 2 . 4 Which of the following units is the same as 1 J/s?

[1 mark]

Tick (✓) **one** box.

1 N ☐

1 Pa ☐

1 W ☐

0 2 . 5 The pool is above sea level.

5.0 kg of water is pumped from sea level into the pool.

The water gains 196 J of gravitational potential energy.

gravitational field strength = 9.8 N/kg

Calculate the height of the pool above sea level.

Use the equation:

$$\text{height} = \frac{\text{gravitational potential energy}}{\text{mass} \times \text{gravitational field strength}}$$

[2 marks]

Height = _____ m

6.1.1.2 Changes in energy

Question 14 · continued

0 2 . 6 The water in some swimming pools is heated by burning fossil fuels.

Explain **one** environmental **disadvantage** of burning fossil fuels.

[2 marks]

9

Turn over for the next question

6.1.1.2 Changes in energy

Question 15

June 2024 | 8464/P/2F | Original Q7

0 7 **Figure 12** shows an Olympic gymnast performing a floor routine.

Figure 12



The floor contains springs.

When the gymnast lands on the floor, a force compresses the springs in the floor.

0 7 . 1 When a spring is compressed, the elastic potential energy of the spring increases.

Explain why compressing the springs in the floor helps the gymnast to jump higher.

Use ideas about energy in your answer.

[2 marks]

Question 7 continues on the next page

6.1.1.2 Changes in energy

Question 15 · continued

0 7 . 2 When the gymnast lands on the floor, one of the springs compresses by 1.2 cm.

spring constant = 8500 N/m

Calculate the elastic potential energy stored in the spring.

Use the Physics Equations Sheet.

Give the unit.

[4 marks]

Elastic potential energy = _____ Unit _____

6.1.1.2 Changes in energy

Question 15 · continued

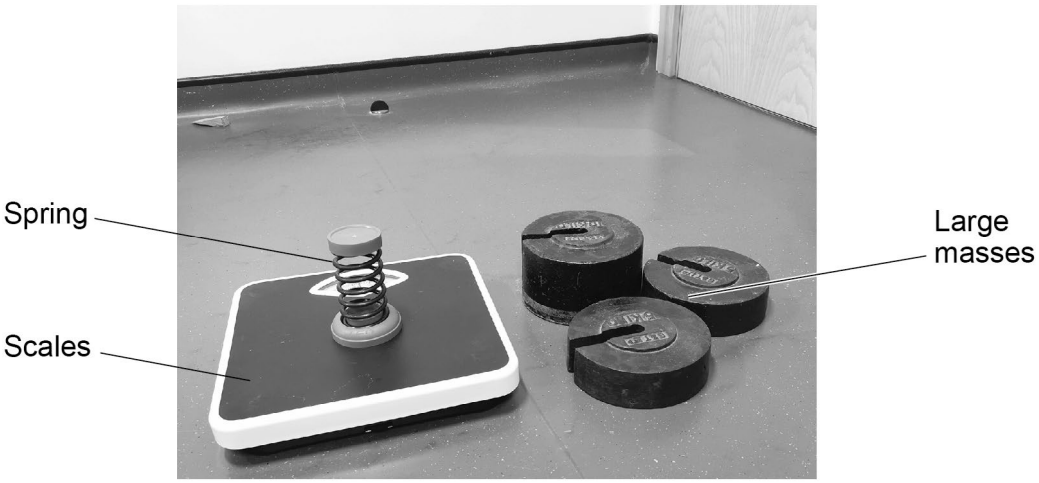
A student investigated a spring with a different spring constant.

When masses are placed on the spring it compresses.

The student measured the compression of the spring for different masses.

Figure 13 shows some of the equipment used.

Figure 13



0 7 . 3 Describe how the compression of the spring could be determined.

[2 marks]

0 7 . 4 Explain why the investigation should be done on the laboratory floor rather than on a table.

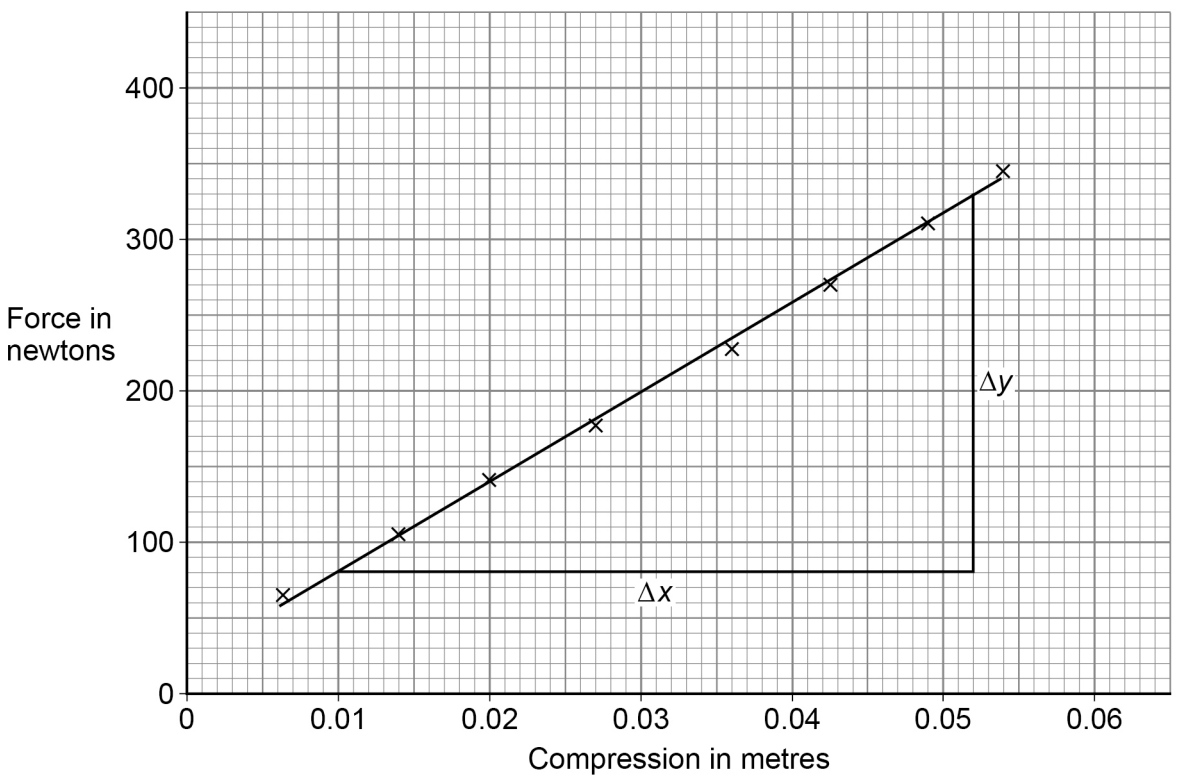
[2 marks]

6.1.1.2 Changes in energy

Question 15 · continued

Figure 14 shows the results.

Figure 14



6.1.1.2 Changes in energy

Question 15 · continued

The spring constant is the gradient of the line of best fit shown on **Figure 14**.

0 7 . 5 Determine the value Δy on **Figure 14**.

[1 mark]

$\Delta y =$ _____ N

0 7 . 6 Determine the value Δx on **Figure 14**.

[1 mark]

$\Delta x =$ _____ m

0 7 . 7 Determine the spring constant of the spring.

Use your answers to Question **07.5** and Question **07.6**.

Give your answer to 3 significant figures.

[2 marks]

Spring constant (3 significant figures) = _____ N/m

14

6.1.1.2 Changes in energy

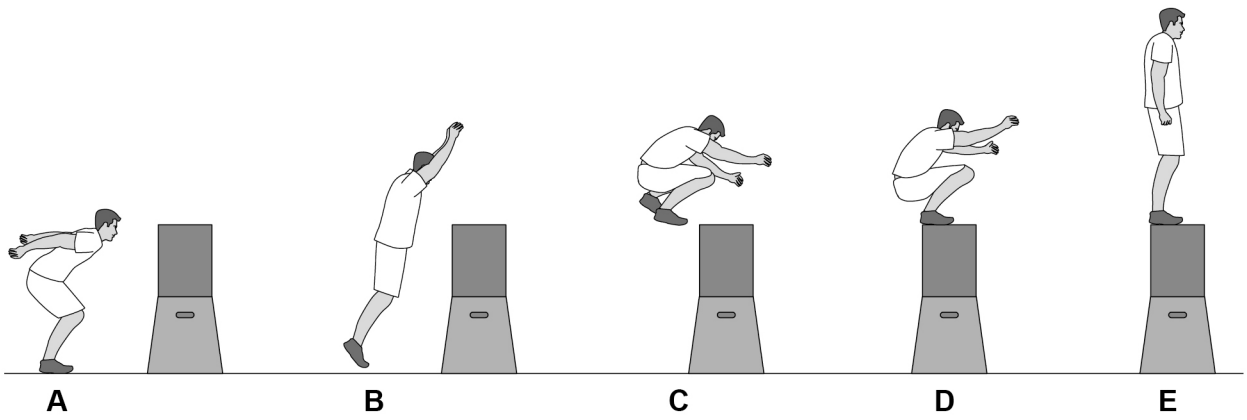
Question 16

June 2025 | 8464/P/1F | Original Q3

0 3 A person performs a 'vertical box jump'.

Figure 4 shows five different stages, **A**, **B**, **C**, **D** and **E**, of the jump.

Figure 4



0 3 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

A	**B**	**C**	**D**	**E**

The person has the least gravitational potential energy at stage _____.

The person has the greatest kinetic energy at stage _____.

Question 16 · continued

0 3 . 2 The person in **Figure 4** has a mass of 60 kg.

The person leaves the ground with a speed of 5.5 m/s.

Calculate the kinetic energy of the person.

Use the equation:

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

[2 marks]

Kinetic energy = _____ J

0 3 . 3 The person has a mass of 60 kg.

The height of the jump is 1.5 m.

gravitational field strength = 9.8 N/kg

Calculate the gravitational potential energy of the person at a height of 1.5 m.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Gravitational potential energy = _____ J

Question 3 continues on the next page

6.1.1.2 Changes in energy

Question 16 · continued

0 3 . 4 The person jumps onto a box higher than the one in **Figure 4**, on page 12.

To jump onto a higher box, the person's speed when leaving the ground is different.

Explain how the speed is different when jumping onto a higher box.

You should answer in terms of gravitational potential energy and kinetic energy.

[3 marks]

0 3 . 5 Suggest **one** reason why a person is more likely to be injured when falling off a higher box.

[1 mark]

10