AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 6.5.3

Forces and elasticity

Past-paper questions

Tier	**Foundation**
Question groups	**10**
Available paper years	**2018–2024**

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.

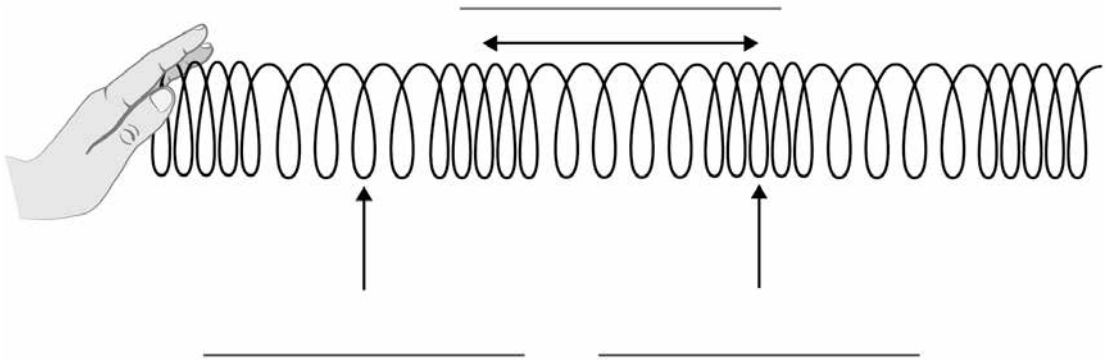
6.5.3 Forces and elasticity

Question 01

June 2018 | 8464/P/2F | Original Q2

0 2 **Figure 2** shows a slinky spring used to model a sound wave.

Figure 2



0 2 . 1 Label the arrows on **Figure 2**

Choose the answers from the box.

[3 marks]

amplitude	**compression**	**frequency**
rarefaction		**wavelength**

0 2 . 2 What type of wave is a sound wave?

[1 mark]

Tick **one** box.

- electromagnetic ☐
- longitudinal ☐
- transverse ☐

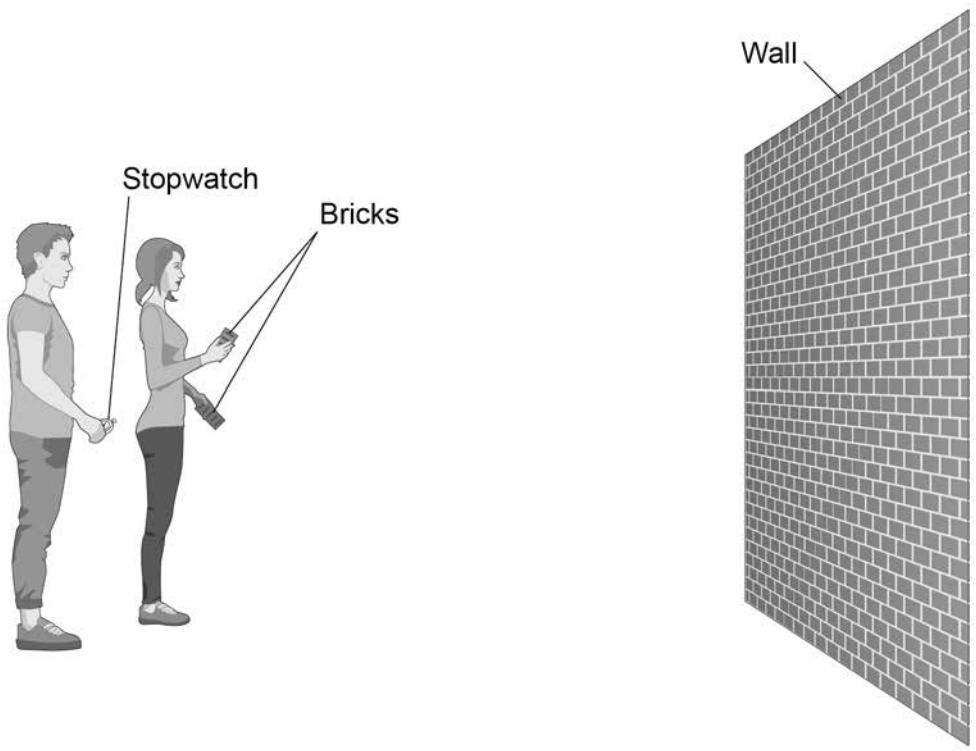
Question 2 continues on the next page

6.5.3 Forces and elasticity

Question 01 · continued

0 2 . 3 **Figure 3** shows two students measuring the speed of sound in air.

Figure 3



One student bangs two bricks together.

The sound wave produced is reflected from the wall and travels back to the students.

Describe how they can determine the speed of sound.

[4 marks]

8

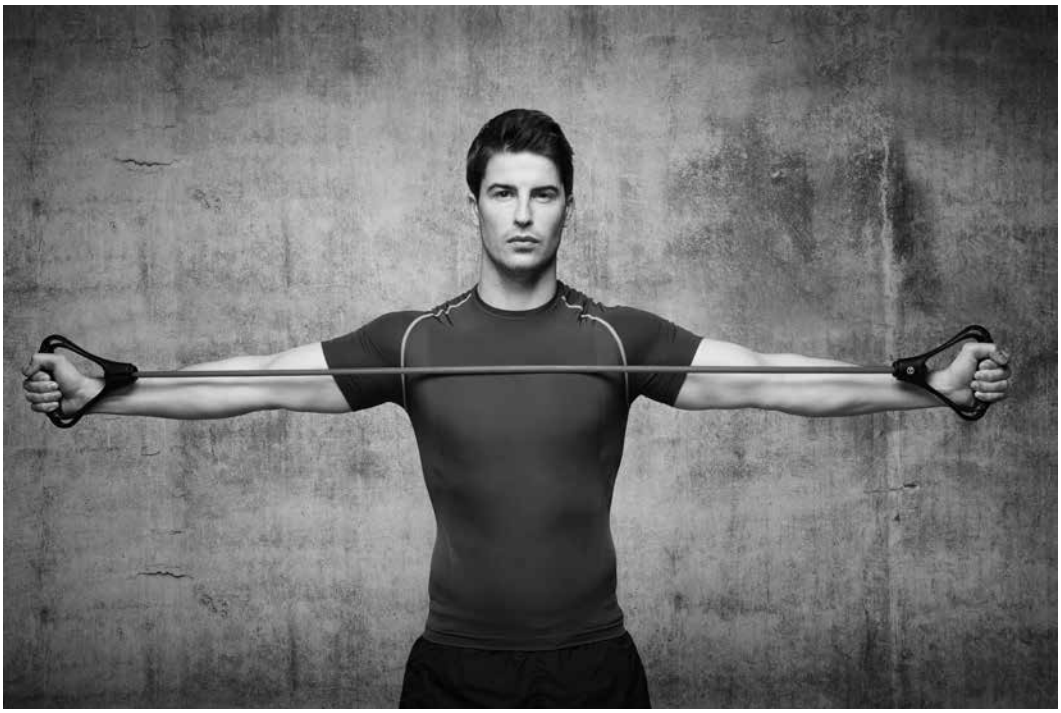
6.5.3 Forces and elasticity

Question 02

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]

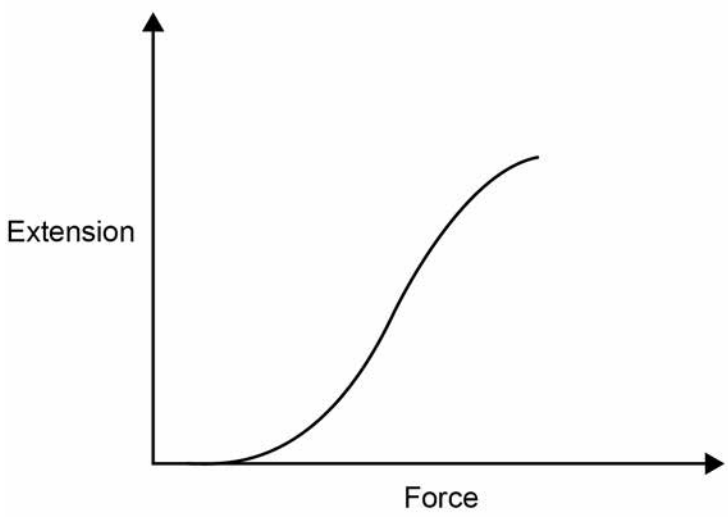
6.5.3 Forces and elasticity

Question 02 · continued

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

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

6.5.3 Forces and elasticity

Question 02 · continued

Figure 8 shows a chest expander.

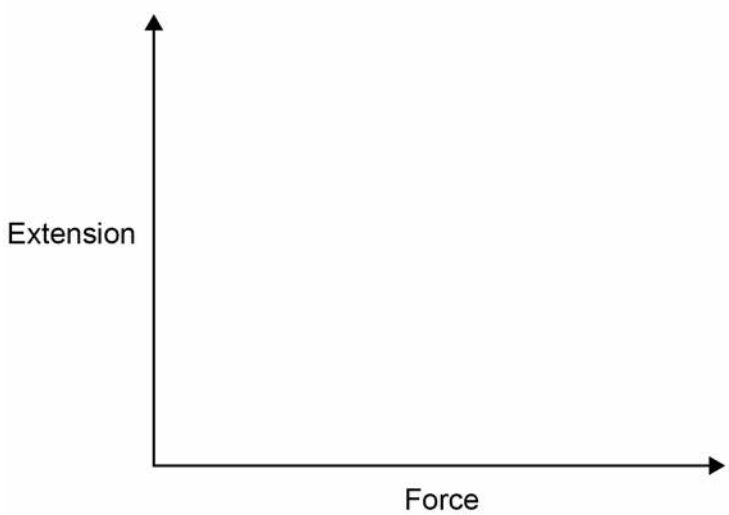
Figure 8



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



6.5.3 Forces and elasticity

Question 02 · continued

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

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

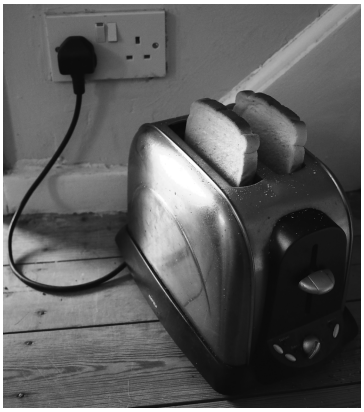
6.5.3 Forces and elasticity

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 _____ .

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.

6.5.3 Forces and elasticity

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

6.5.3 Forces and elasticity

Question 04

November 2020 | 8464/P/2F | Original Q2

0 2 **Figure 3** shows a computer keyboard.

There is a spring under each key.

Figure 3



0 2 . 1 Why do the keys have springs under them?

[1 mark]

Tick (✓) **one** box.

Springs make the keys easier to press. ☐

Springs make the keys lighter. ☐

Springs push the keys back to their original position. ☐

0 2 . 2 Why does every spring used in the keyboard have the same spring constant?

[1 mark]

Tick (✓) **one** box.

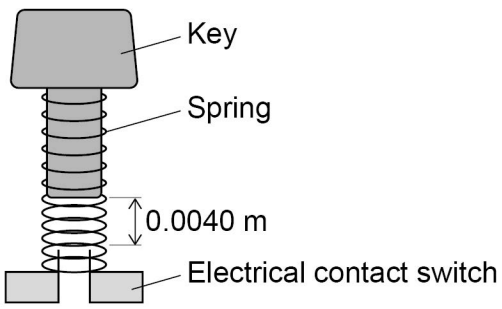
So that more than one key can be pressed at the same time. ☐

So that the same force is needed to press each key. ☐

So that the springs are all the same length. ☐

Figure 4 shows one of the keys and its spring.

Figure 4



0 2 . 3 What happens to the length of the spring when the key is pressed?

[1 mark]

0 2 . 4 How far must the key move before it touches the switch?

[1 mark]

Tick (✓) **one** box.

4.0 mm ☐ 4.0 cm ☐ 4.0 μm ☐

0 2 . 5 If a key is not pressed with enough force, no signal is sent to the computer.

Explain why.

[2 marks]

Question 04 · continued

0 2 . 6 The spring in **Figure 4** has a spring constant of 200 N/m

Calculate the force on the spring when the key moves a distance of 0.0040 m

Use the equation:

force = spring constant × compression

[2 marks]

Force = _____ N

0 2 . 7 Suggest **two** ways the spring in the key in **Figure 4** could be changed so that the switch can be closed more quickly.

[2 marks]

1 _____

2 _____

10

6.5.3 Forces and elasticity

Question 05

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

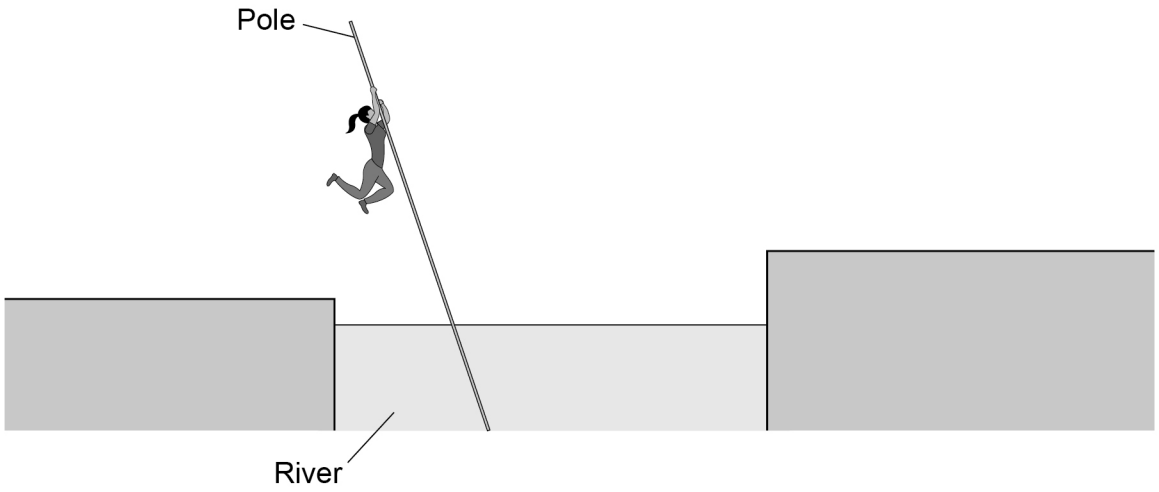
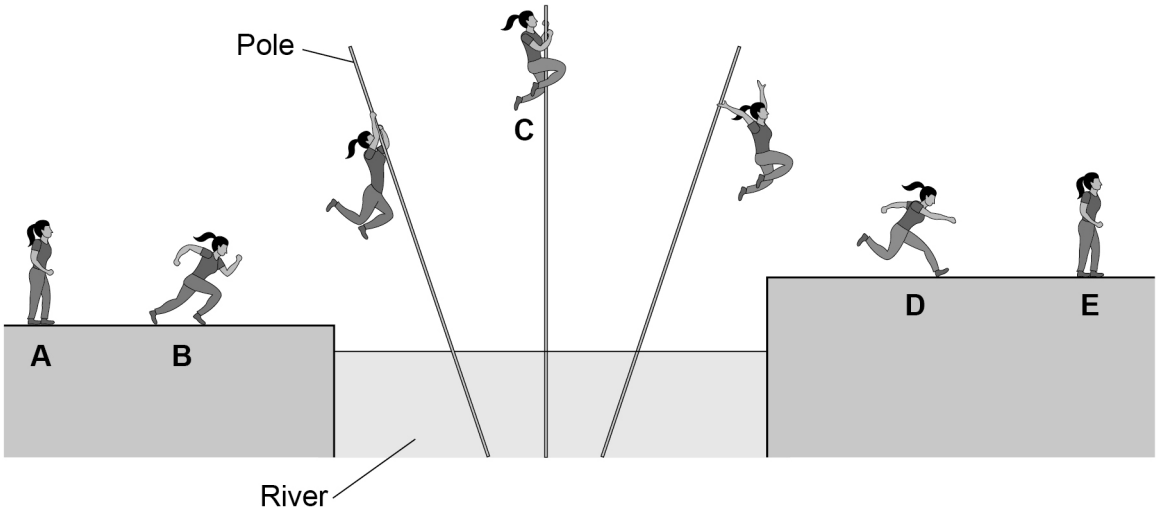


Figure 5 shows the athlete in different stages of far-leaping.

Figure 5



Question 05 · 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

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 05 · 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]

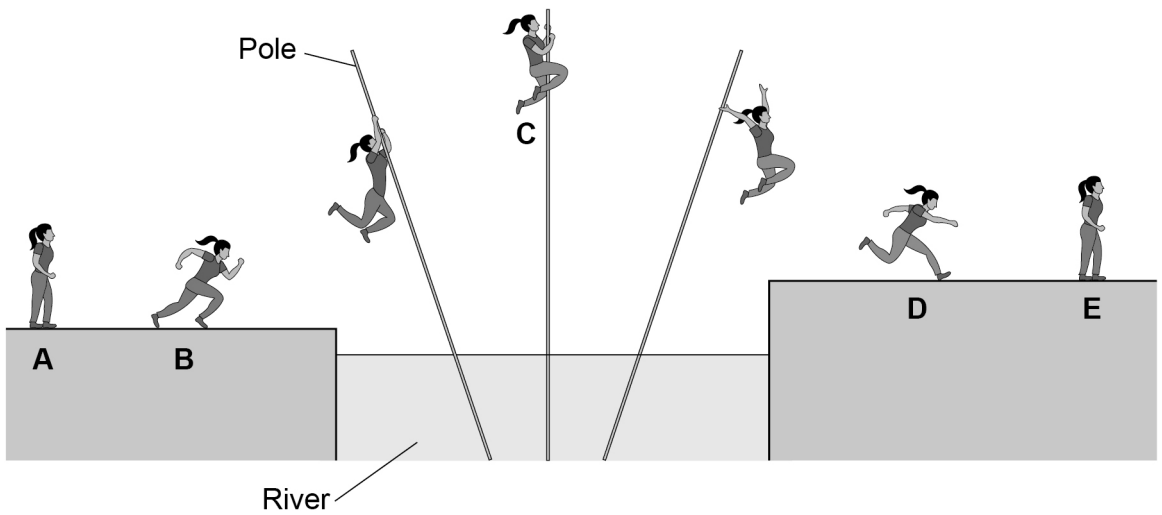
m/s	J/kg	J/s

Speed = _____ Unit _____

Question 2 continues on the next page

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 05 · 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

6.5.3 Forces and elasticity

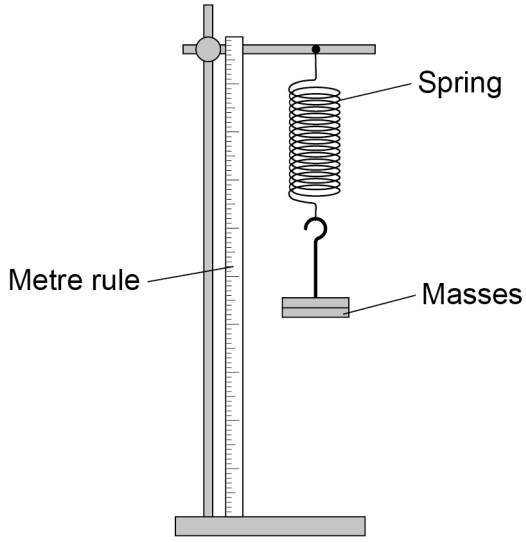
Question 06

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. ☐

Question 06 · 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

Question 06 · 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

6.5.3 Forces and elasticity

Question 07

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

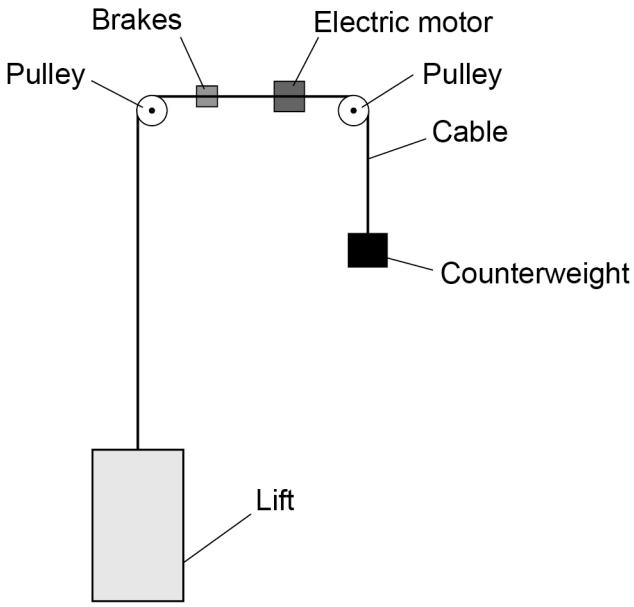
0 2 **Figure 3** shows a lift near the bottom of a building.

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. ☐

Question 07 · 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

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 ☐

Question 07 · 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

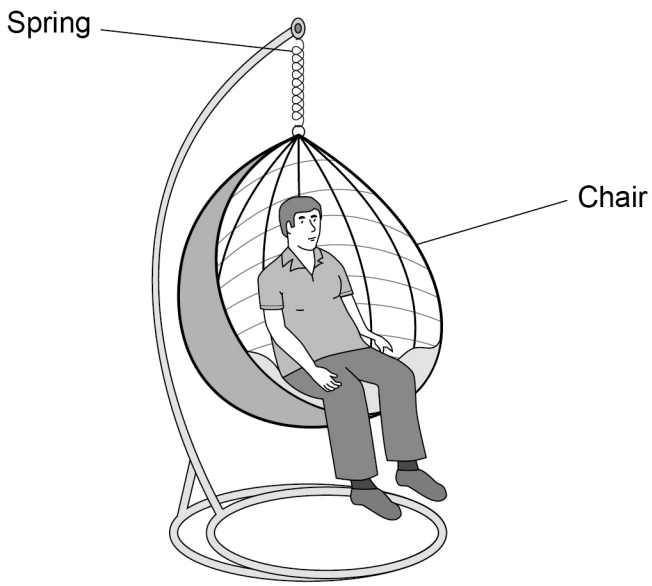
6.5.3 Forces and elasticity

Question 08

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 ☐

Question 08 · 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

Question 08 · continued June 2023 | 8464/P/2F | Original Q1

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

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. ☐

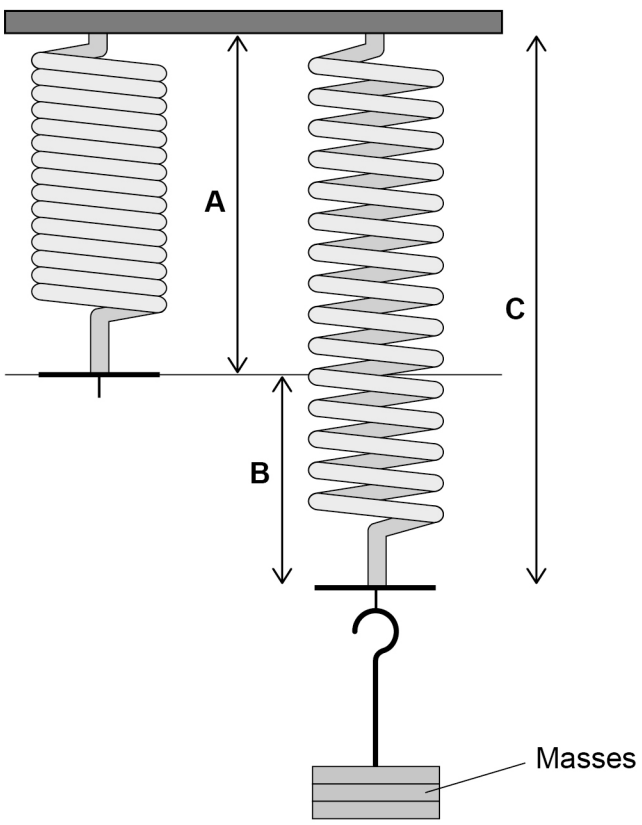
Question 1 continues on the next page

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** ☐

6.5.3 Forces and elasticity

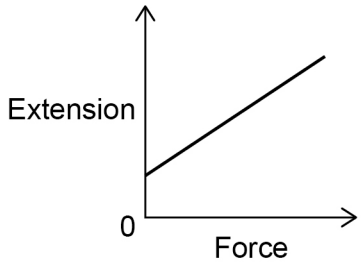
Question 08 · continued

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

[1 mark]

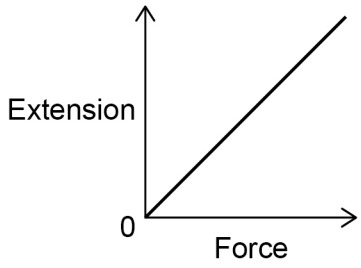
Tick (✓) **one** box.

A



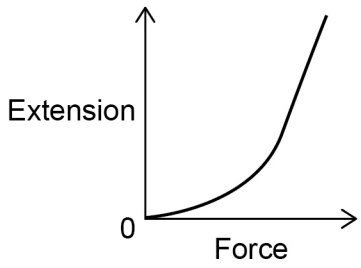
☐

B



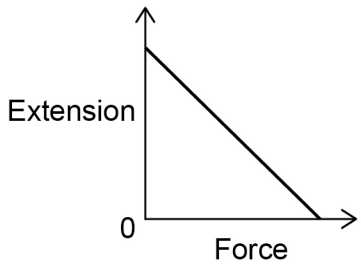
☐

C



☐

D



☐

Question 1 continues on the next page

Question 08 · 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

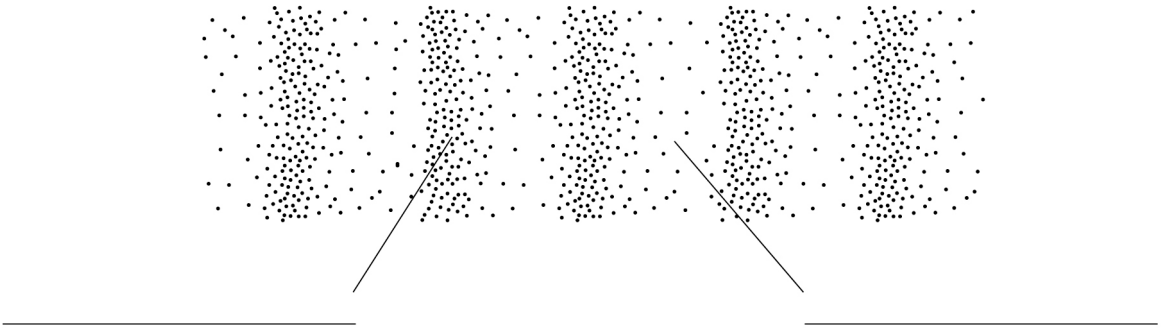
6.5.3 Forces and elasticity

Question 09

0 4 Sound waves are longitudinal waves.

0 4 . 1 **Figure 9** shows a sound wave.

Figure 9



Complete the labels on **Figure 9**.

Choose answers from the box.

[2 marks]

compression	**extension**	**rarefaction**
reflection		**resistance**

6.5.3 Forces and elasticity

Question 09 · continued

0 4 . 2 Which of the following is true for longitudinal waves?

[1 mark]

Tick (✓) **one** box.

Longitudinal waves transfer charge. ☐

Longitudinal waves transfer energy. ☐

Longitudinal waves transfer matter. ☐

Question 4 continues on the next page

Question 09 · continued

Figure 10 shows a device a farmer uses to scare away birds.

Figure 10



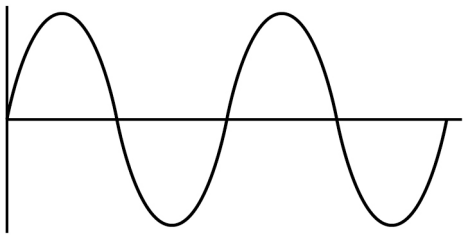
The device emits a very loud sound.

The farmer measures the sound emitted by the device at different distances from the device.

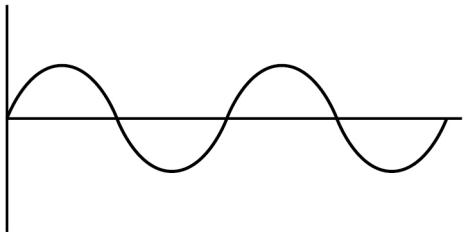
0 4 . 3 **Figure 11** shows a visual display of the sound waves at different distances from the device.

Both waves are drawn to the same scale.

Figure 11



At a distance of 80 m



At a distance of 200 m

Which property of the wave changes between 80 m and 200 m?

[1 mark]

Tick (✓) **one** box.

Amplitude ☐

Frequency ☐

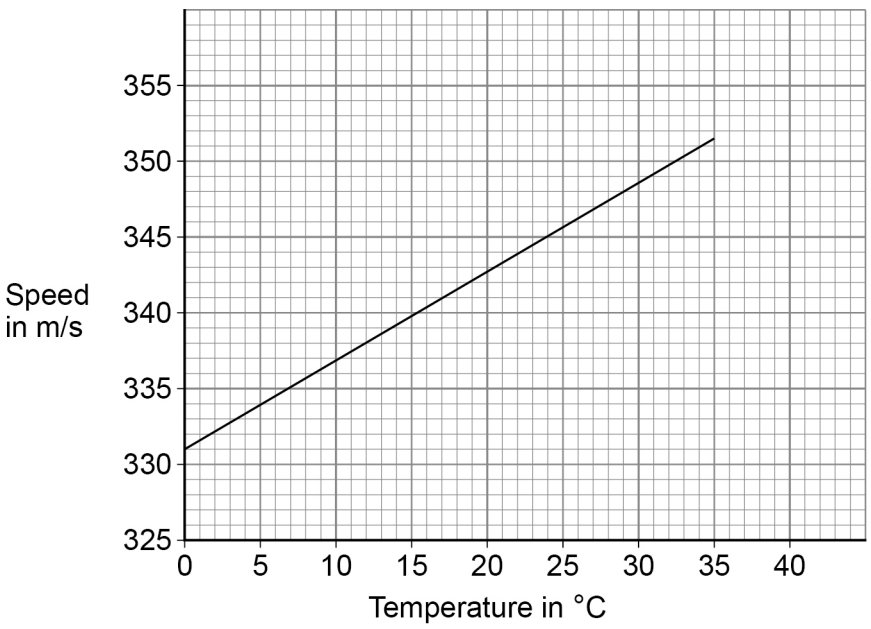
Period ☐

Wavelength ☐

Question 4 continues on the next page

Figure 12 shows how the speed of the sound emitted by the device is affected by the temperature of the air.

Figure 12



0 4 . 4 The farmer tests the device on a day when the temperature of the air is 15 °C.

What is the speed of the sound emitted by the device when the temperature of the air is 15 °C?

[1 mark]

Speed = _____ m/s

Question 09 · continued

0 4 . 5 The farmer stands a safe distance from the device.

It takes a time of 0.20 s for the sound to travel from the device to the farmer.

Calculate the distance between the device and the farmer.

Use your answer to Question **04.4** and the equation:

distance = speed × time

[2 marks]

Distance = _____ m

0 4 . 6 Explain how the time taken for the sound to reach the farmer is affected by the temperature of the air.

Use **Figure 12**.

[2 marks]

9

6.5.3 Forces and elasticity

Question 10

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

6.5.3 Forces and elasticity

Question 10 · 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 _____

Question 10 · continued

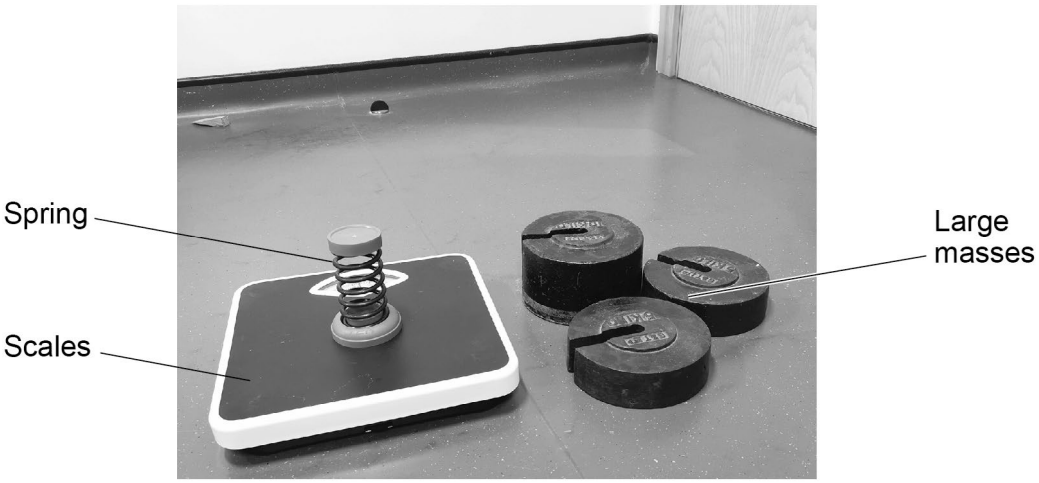
A student investigated a spring with a different spring constant.

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.

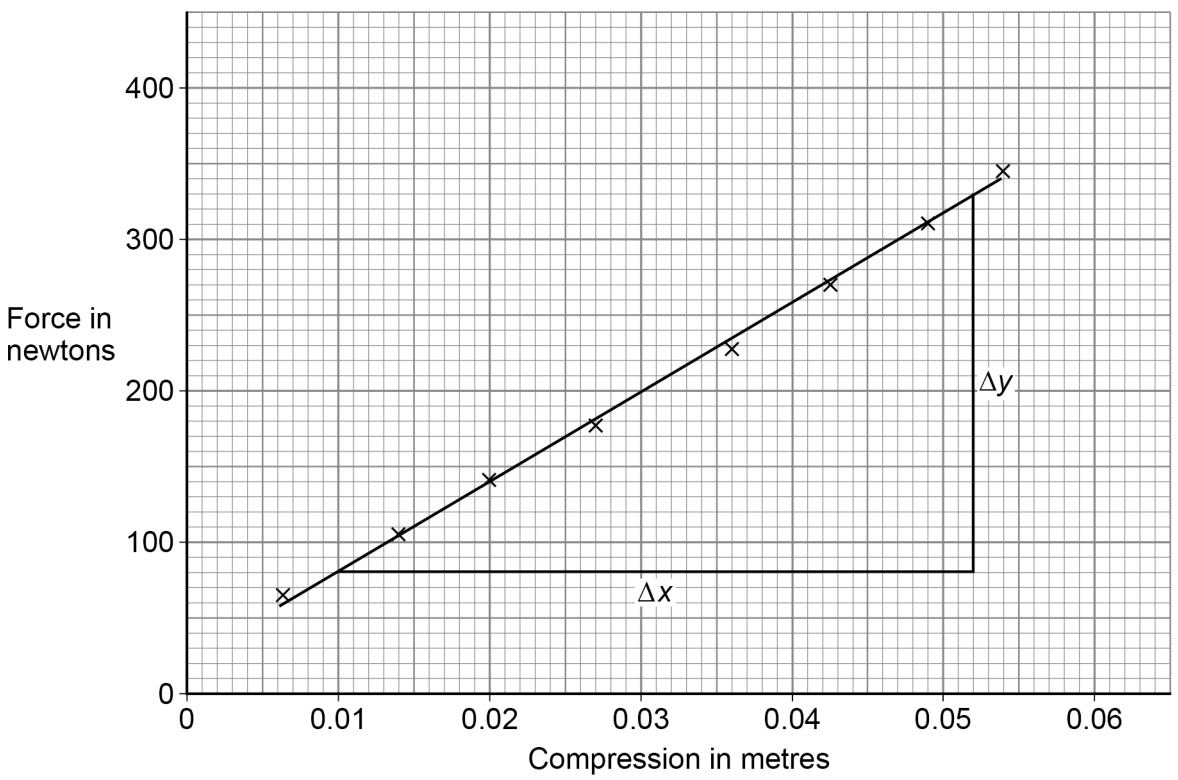
[2 marks]

6.5.3 Forces and elasticity

Question 10 · continued

Figure 14 shows the results.

Figure 14



6.5.3 Forces and elasticity

Question 10 · 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

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