AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.1.2

Contact and non-contact forces

Past-paper questions

Tier	**Higher**
Question groups	**22**
Available paper years	**2004–2025**

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:** _____

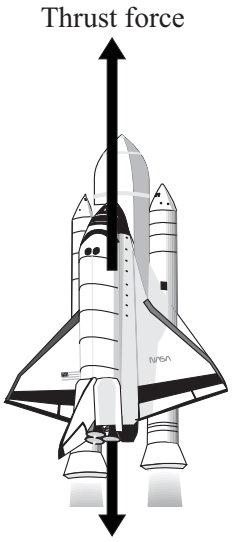
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.1.2 Contact and non-contact forces

Question 01

June 2004 | 3451H | Original Q5 | Legacy

5 (a) The arrows in the diagram represent the size and direction of the forces on a space shuttle, fuel tank and booster rockets one second after launch. The longer the arrow the bigger the force.



(i) Describe the upward motion of the space shuttle one second after launch.

.....

(1 mark)

(ii) By the time it moves out of the Earth's atmosphere, the total weight of the space shuttle, fuel tank and booster rockets has decreased and so has the air resistance.

How does this change the motion of the space shuttle? (Assume the thrust force does not change).

.....

(1 mark)

(b) The space shuttle takes 9 minutes to reach its orbital velocity of 8100 m/s.

(i) Write down the equation that links acceleration, change in velocity and time taken.

.....

(1 mark)

(ii) Calculate, in m/s^2, the average acceleration of the space shuttle during the first 9 minutes of its flight. Show clearly how you work out your answer.

.....

.....

average acceleration =.....m/s^2

(2 marks)

4.5.1.2 Contact and non-contact forces

Question 01 · continued

MARGIN BLANK

(iii) How is the velocity of an object different from the speed of an object?

.....

.....

(1 mark)

(c) The space shuttle can stay in orbit around the Earth for several weeks.



Not to scale

Explain why the space shuttle stays in orbit and does not fall to the Earth.

.....

.....

.....

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(2 marks)

(d) As the shuttle returns to Earth, friction causes its outside temperature to go as high as 1200°C.

Why is the underneath of the shuttle covered with black tiles?

.....

.....

(1 mark)

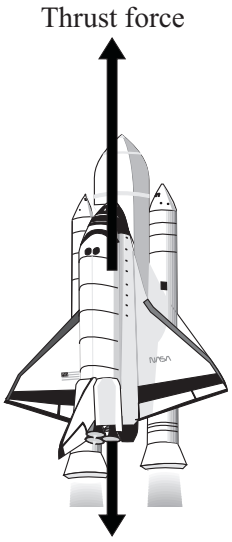
9

4.5.1.2 Contact and non-contact forces

Question 02

June 2004 | 3462H3 | Original Q5 | Legacy

5 (a) The arrows in the diagram represent the size and direction of the forces on a space shuttle, fuel tank and booster rockets one second after launch. The longer the arrow the bigger the force.



(i) Describe the upward motion of the space shuttle one second after launch.

.....

(1 mark)

(ii) By the time it moves out of the Earth's atmosphere, the total weight of the space shuttle, fuel tank and booster rockets has decreased and so has the air resistance.

How does this change the motion of the space shuttle? (Assume the thrust force does not change).

.....

(1 mark)

(b) The space shuttle takes 9 minutes to reach its orbital velocity of 8100 m/s.

(i) Write down the equation that links acceleration, change in velocity and time taken.

.....

(1 mark)

(ii) Calculate, in m/s^2, the average acceleration of the space shuttle during the first 9 minutes of its flight. Show clearly how you work out your answer.

.....

.....

average acceleration =.....m/s^2

(2 marks)

4.5.1.2 Contact and non-contact forces

Question 02 · continued

MARGIN BLANK

(iii) How is the velocity of an object different from the speed of an object?

.....

.....

(1 mark)

(c) The space shuttle can stay in orbit around the Earth for several weeks.



Not to scale

Explain why the space shuttle stays in orbit and does not fall to the Earth.

.....

.....

.....

.....

(2 marks)

(d) As the shuttle returns to Earth, friction causes its outside temperature to go as high as 1200ºC.

Why is the underneath of the shuttle covered with black tiles?

.....

.....

(1 mark)

9

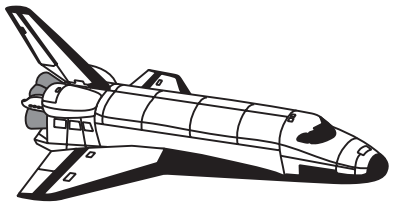
4.5.1.2 Contact and non-contact forces

Question 03

November 2007 | PHY1A | Original Q1 | Legacy

QUESTION ONE

The diagram shows the space shuttle returning to Earth. As it moves towards Earth, it moves faster.



Match forms of energy, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A gravitational potential energy

B kinetic energy

C light energy

D thermal energy

As the shuttle moves towards Earth, it loses . . . **1** . . . .

When the shuttle moves faster, it gains . . . **2** . . . .

When the shuttle enters the Earth's atmosphere, there is a lot of friction. This makes the tiles covering the shuttle glow red. As a result, the shuttle gives off a lot of . . . **3** . . . and a little . . . **4** . . . .

4.5.1.2 Contact and non-contact forces

Question 04

1 A student collects data from the Internet about planets in the solar system.
She arranges the data into a table.

Name of the planet	Distance from the Sun in millions of kilometres	Time taken for one orbit of the Sun in years	Time taken to spin on its axis in hours	Average temperature on the side facing the Sun in ^{o}C
Mercury	60	0.24	1400	+430
Venus	110	0.60	5800	+470
Earth	150	1	24	+20
Mars	230	2	25	–20
Jupiter	780	12	10	–150
Saturn	1400	30	10	–180
Uranus	2900	84	17	–220
Neptune	4500	160	16	–230

1 (a) Name the **two** variables in the student's table which **always** have the relationship:

As one increases, so does the other.

..... and .....

(1 mark)

1 (b) (i) Give an example of **two** variables in the student's table which **generally** have the relationship:

As one increases, the other decreases.

..... and .....

(1 mark)

4.5.1.2 Contact and non-contact forces

Question 04 · continued

for mark

1 (b) (ii) Which piece of data does not seem to fit the relationship in (b)(i)?

.....

(1 mark)

1 (c) Scientists plan to launch a satellite which will orbit Mars above its equator.
It will be a geostationary satellite.

How many hours will it take to orbit Mars?

..... hours

(1 mark)

1 (d) Mars has two moons.

Neither of them is in a geostationary orbit and they both take different times to orbit the planet.

Which **one** of these statements is correct.
Put a tick (✓) in the box next to your answer.

The two moons will always be above the same point on the surface of Mars. ☐

The two moons will be in different positions at different times. ☐

You can never see both moons at the same time. ☐

(1 mark)

1 (e) Use words from the box to complete the **three** spaces in the passage.

circular	**direction**	**friction**	**gravitational**	**speed**	**universal**

The moons of the planet Neptune move in circular paths around the planet.

They continuously accelerate towards the centre of Neptune.

The acceleration changes the ..... of each moon but does not change its ..... . The force causing the acceleration is a ..... force.

(2 marks)

7

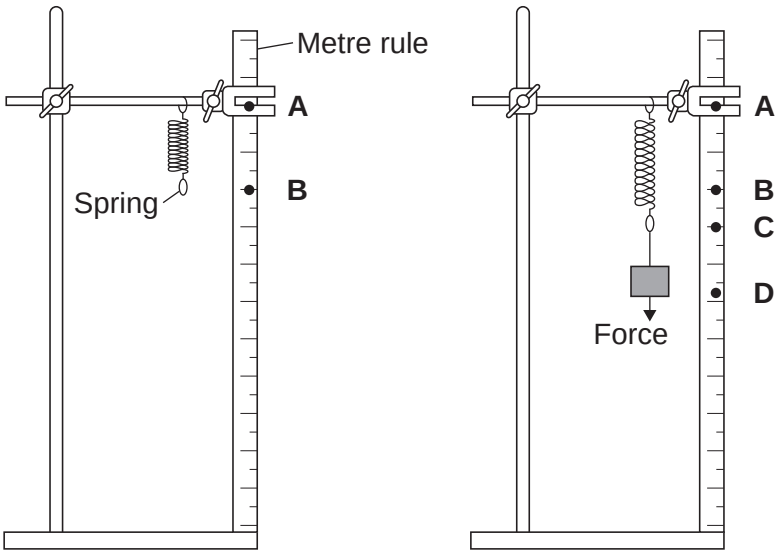
4.5.1.2 Contact and non-contact forces

Question 05

June 2012 | PH2HP | Original Q1 | Legacy

1 A student investigated how the extension of a spring depends on the force applied to the spring.

The diagram shows the spring before and after a force had been applied.



1 (a) (i) Complete the following sentence using letters, **A**, **B**, **C** or **D**, from the diagram.

The extension of the spring is the distance between the positions labelled .....

and ..... on the metre rule.

(1 mark)

1 (a) (ii) What form of energy is stored in the stretched spring?

.....

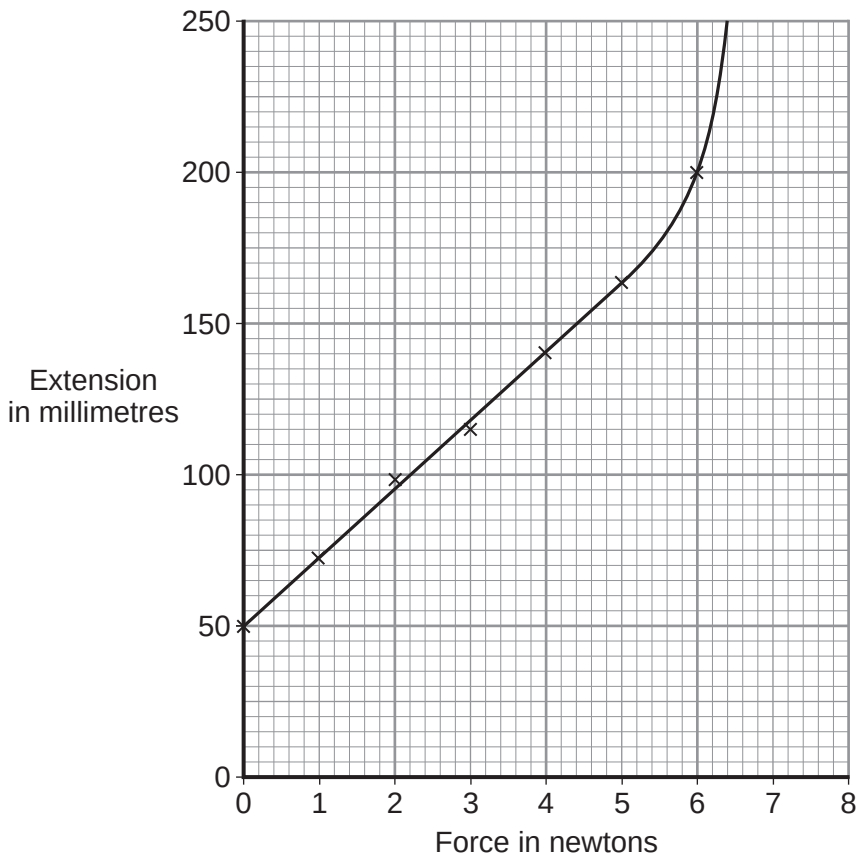
(1 mark)

Question 1 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 05 · continued

1 (b) The results from the investigation are plotted on the following graph.



1 (b) (i) The graph shows that the student has made an error throughout the investigation.

What error has the student made?

.....

.....

Give the reason for your answer.

.....

.....

(2 marks)

4.5.1.2 Contact and non-contact forces

Question 05 · continued

1 (b) (ii) The student has loaded the spring beyond its *limit of proportionality*.

Mark on the graph line the *limit of proportionality* of the spring. Label the point **P**.

Give the reason for choosing your point **P**.

.....

.....

.....

(2 marks)

1 (c) The student uses a different spring as a spring balance. When the student hangs a stone from this spring, its extension is 72 mm.

The spring does not go past the limit of proportionality.

Calculate the force exerted by the stone on the spring.

spring constant = 25 N/m

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Force = ... N

(2 marks)

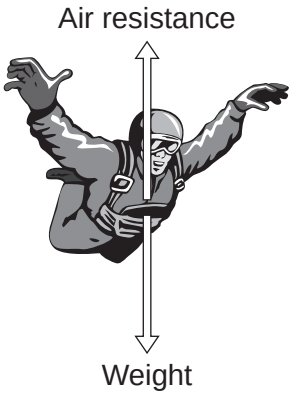
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4.5.1.2 Contact and non-contact forces

Question 06

June 2012 | PH2HP | Original Q3 | Legacy

3 (a) The diagram shows the forces acting on a parachutist in free fall.



The parachutist has a mass of 75 kg.

Calculate the weight of the parachutist.

gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer and give the unit.

.....

.....

Weight = ...

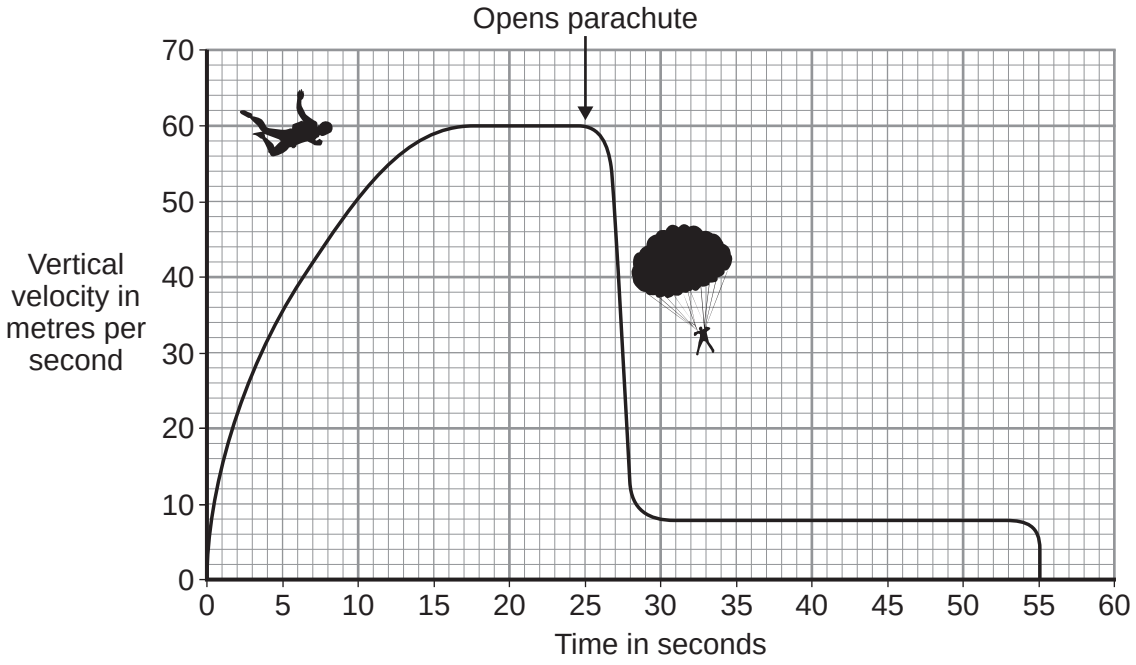
(3 marks)

4.5.1.2 Contact and non-contact forces

Question 06 · continued

3 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The graph shows how the vertical velocity of a parachutist changes from the moment the parachutist jumps from the aircraft until landing on the ground.



Using the idea of forces, explain why the parachutist reaches a terminal velocity and why opening the parachute reduces the terminal velocity.

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(6 marks)

Question 3 continues on the next page

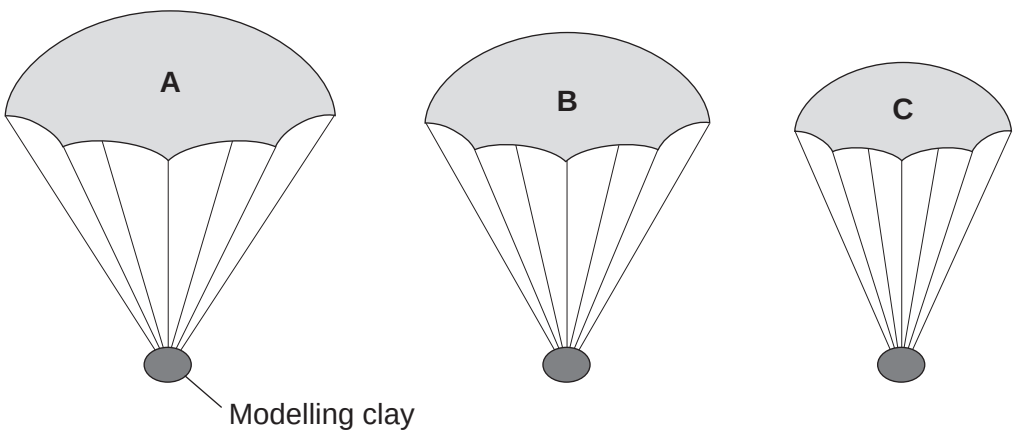
4.5.1.2 Contact and non-contact forces

Question 06 · continued

3 (c) A student wrote the following hypothesis.

'The larger the area of a parachute, the slower a parachutist falls.'

To test this hypothesis the student made three model parachutes, **A**, **B** and **C**, from one large plastic bag. The student dropped each parachute from the same height and timed how long each parachute took to fall to the ground.



3 (c) (i) The height that the student dropped the parachute from was a control variable.

Name **one** other control variable in this experiment.

.....

(1 mark)

3 (c) (ii) Use the student's hypothesis to predict which parachute, **A**, **B** or **C**, will hit the ground first.

Write your answer in the box. ☐

Give a reason for your answer.

.....

.....

.....

(2 marks)

12

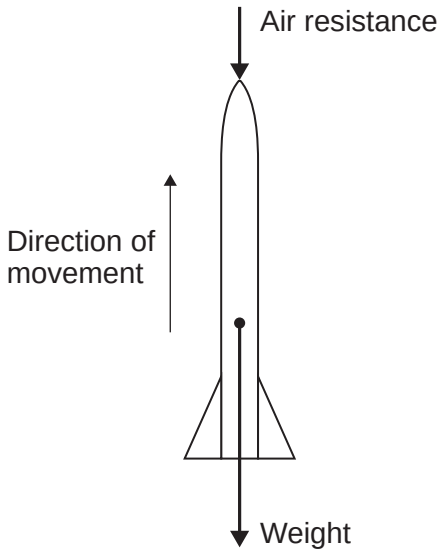
4.5.1.2 Contact and non-contact forces

Question 07

June 2015 | PH2HP | Original Q6 | Legacy

6 (a) **Figure 7** shows the forces acting on a model air-powered rocket just after it has been launched vertically upwards.

Figure 7



6 (a) (i) How does the velocity of the rocket change as the rocket moves **upwards**?

[2 marks]

.....

Give a reason for your answer.

.....

.....

6 (a) (ii) The velocity of the rocket is not the same as the speed of the rocket.

What is the difference between the velocity of an object and the speed of an object?

[1 mark]

.....

.....

.....

4.5.1.2 Contact and non-contact forces

Question 07 · continued

6 (b) The speed of the rocket just after being launched is 12 m/s.
The mass of the rocket is 0.05 kg.

6 (b) (i) Calculate the kinetic energy of the rocket just after being launched.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Kinetic energy = ... J

6 (b) (ii) As the rocket moves upwards, it gains gravitational potential energy.

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

[1 mark]

Maximum gravitational potential energy = ... J

6 (b) (iii) Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N/kg.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Maximum height = ... m

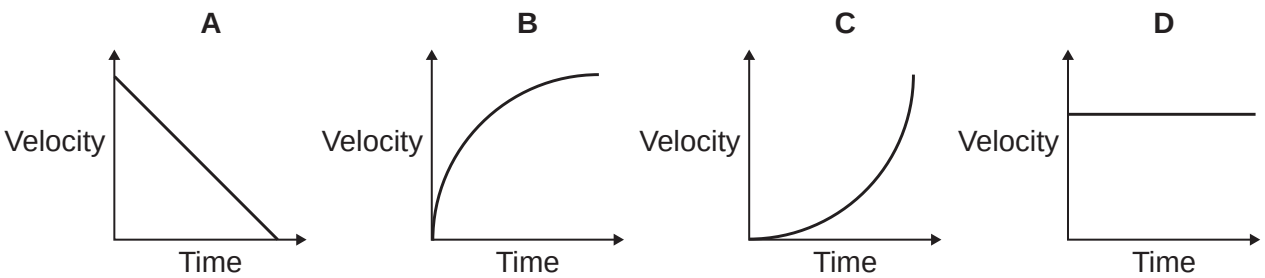
Question 6 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 07 · continued

6 (b) (iv) **Figure 8** shows four velocity–time graphs.

Figure 8



Taking air resistance into account, which graph, **A**, **B**, **C** or **D**, shows how the velocity of the rocket changes as it **falls** from the maximum height it reached until it just hits the ground?

[1 mark]

Write the correct answer in the box.

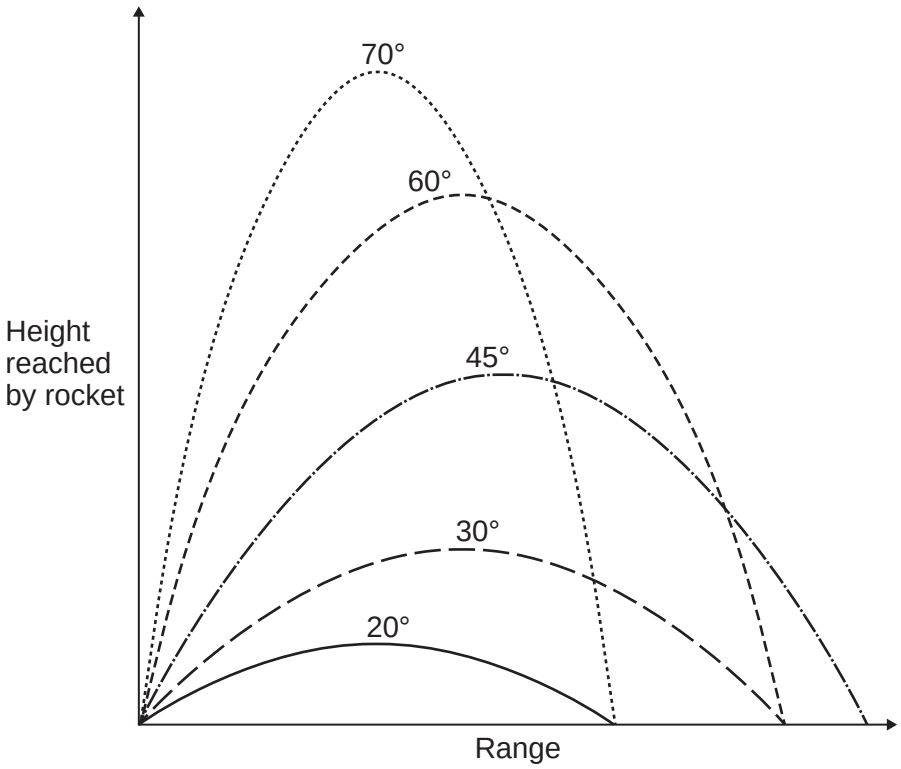
4.5.1.2 Contact and non-contact forces

Question 07 · continued

6 (c) The rocket can be launched at different angles to the horizontal.
The horizontal distance the rocket travels is called the range.

Figure 9 shows the paths taken by the rocket when launched at different angles.
Air resistance has been ignored.

Figure 9



What pattern links the angle at which the rocket is launched and the range of the rocket?

[2 marks]

.....

.....

.....

.....

11

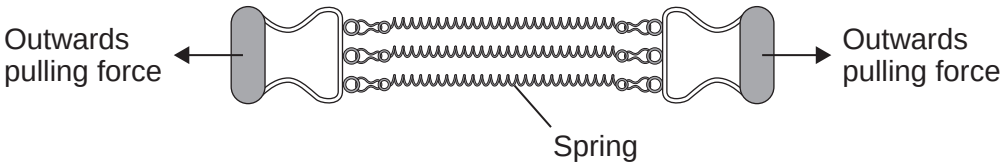
4.5.1.2 Contact and non-contact forces

Question 08

June 2016 | PH2HP | Original Q5 | Legacy

5 **Figure 11** shows an exercise device called a chest expander. The three springs are identical.

Figure 11



A person pulls outwards on the handles and does work to stretch the springs.

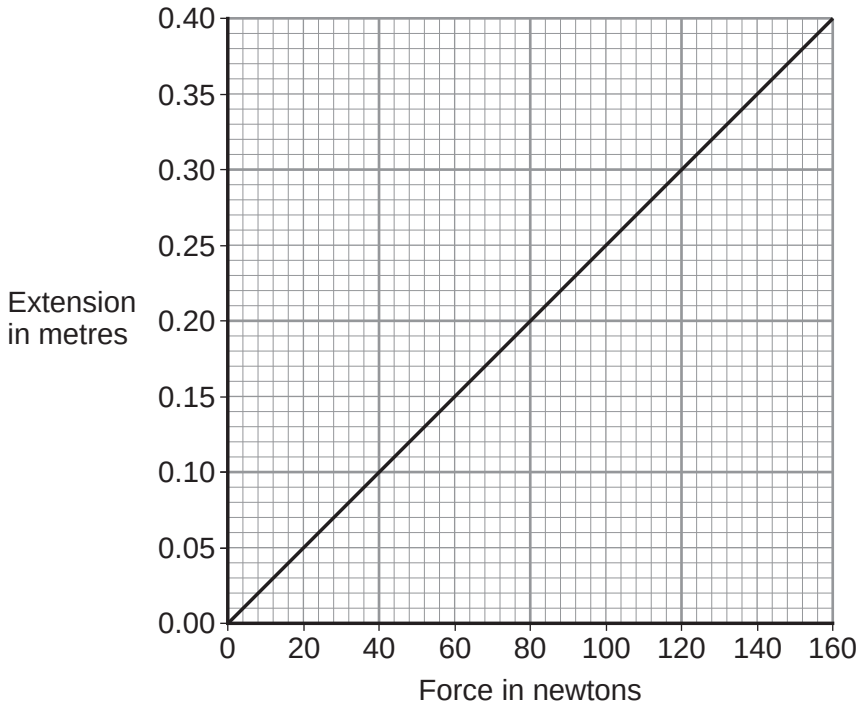
5 (a) Complete the following sentence.

[1 mark]

When the springs are stretched _____ _____ energy is stored in the springs.

5 (b) **Figure 12** shows how the extension of a single spring from the chest expander depends on the force acting on the spring.

Figure 12



4.5.1.2 Contact and non-contact forces

Question 08 · continued

5 (b) (i) How can you tell, from **Figure 12**, that the limit of proportionality of the spring has not been exceeded?

[1 mark]

_____

_____

5 (b) (ii) Use data from **Figure 12** to calculate the spring constant of the spring.
Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

_____

_____

_____

Spring constant = _____ Unit _____

5 (b) (iii) Three identical resistors joined in parallel in an electrical circuit share the total current in the circuit.

In a similar way, the three springs in the chest expander share the total force exerted.

By considering this similarity, use **Figure 12** to determine the total force exerted on the chest expander when each spring is stretched by 0.25 m.

[2 marks]

_____

_____

Total force = _____ N

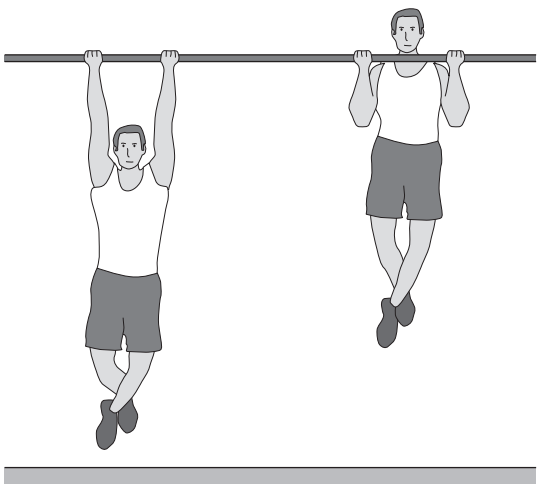
Question 5 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 08 · continued

5 (c) The student in **Figure 13** is doing an exercise called a chin-up.

Figure 13



Each time the student does one chin-up he lifts his body 0.40 m vertically upwards.
The mass of the student is 65 kg.
The student is able to do 12 chin-ups in 60 seconds.

Calculate the power developed by the student.

Gravitational field strength = 10 N/kg

Use the correct equations from the Physics Equations Sheet.

[3 marks]

Power = _____ W

10

4.5.1.2 Contact and non-contact forces

Question 09

June 2018 | 8463/1H | Original Q1

0 1 **Figure 1** shows a student walking on a carpet.

Figure 1



0 1 . 1 The student becomes negatively charged because of the friction between his socks and the carpet.

Explain why the friction causes the student to become charged.

[2 marks]

4.5.1.2 Contact and non-contact forces

Question 09 · continued

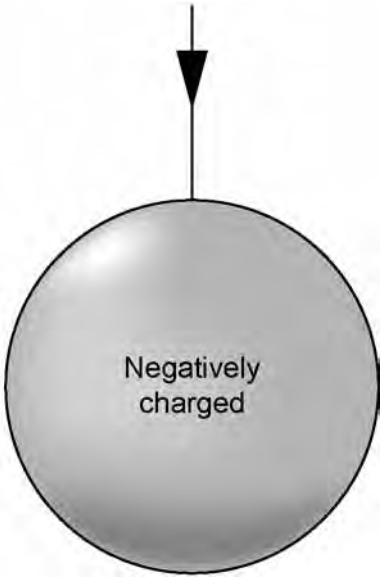
0 1 . 2 The student's head is represented by the sphere in **Figure 2.**

The student is negatively charged. The arrow shows part of the electric field around the student's head.

Draw **three** more arrows on **Figure 2** to complete the electric field pattern.

[1 mark]

Figure 2



0 1 . 3 The negatively charged student touches a metal tap and receives an electric shock.

Explain why.

[3 marks]

4.5.1.2 Contact and non-contact forces

Question 09 · continued

0 1 . 4 Some carpets have thin copper wires running through them. The student is less likely to receive an electric shock after walking on this type of carpet.

Suggest why.

[2 marks]

8

4.5.1.2 Contact and non-contact forces

Question 10

June 2018 | 8463/1H | Original Q4

0 4 **Figure 5** shows a cyclist riding along a straight, level road at a constant speed.

Figure 5



0 4 . 1 Complete the sentences.

[2 marks]

As the cyclist rides along the road, the _____ energy store in the cyclist's body decreases.

The speed of the cyclist is constant when the work done by the cyclist is _____ the work done against air resistance.

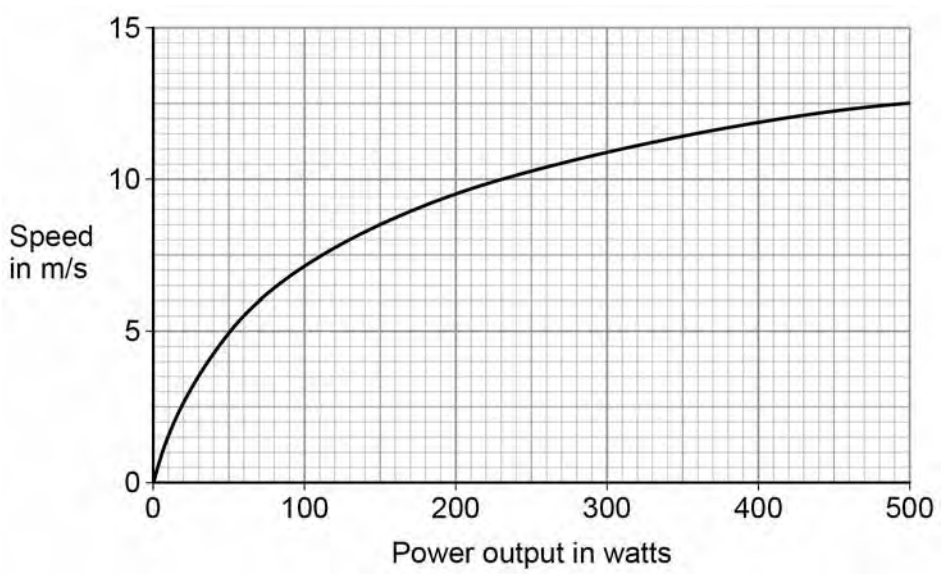
Question 4 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 10 · continued

Figure 6 shows how the speed changes as the power output of the cyclist changes.

Figure 6



0 4 . 2 Write down the equation that links power, time and work done.

[1 mark]

0 4 . 3 Calculate the work done by the cyclist when his power output is 200 W for 1800 seconds.

[3 marks]

Work done = _____ J

4.5.1.2 Contact and non-contact forces

Question 10 · continued

June 2018 | 8463/1H | Original Q4

0 4 . 4 Calculate the percentage increase in speed of the cyclist when the power output changes from 200 W to 300 W.

[2 marks]

Percentage increase in speed = _____

0 4 . 5 The maximum speed this cyclist can travel on a level road is 14 m/s.

How does cycling uphill affect the maximum speed of this cyclist?

Explain your answer.

[3 marks]

11

4.5.1.2 Contact and non-contact forces

Question 11

June 2018 | 8463/2H | Original Q1

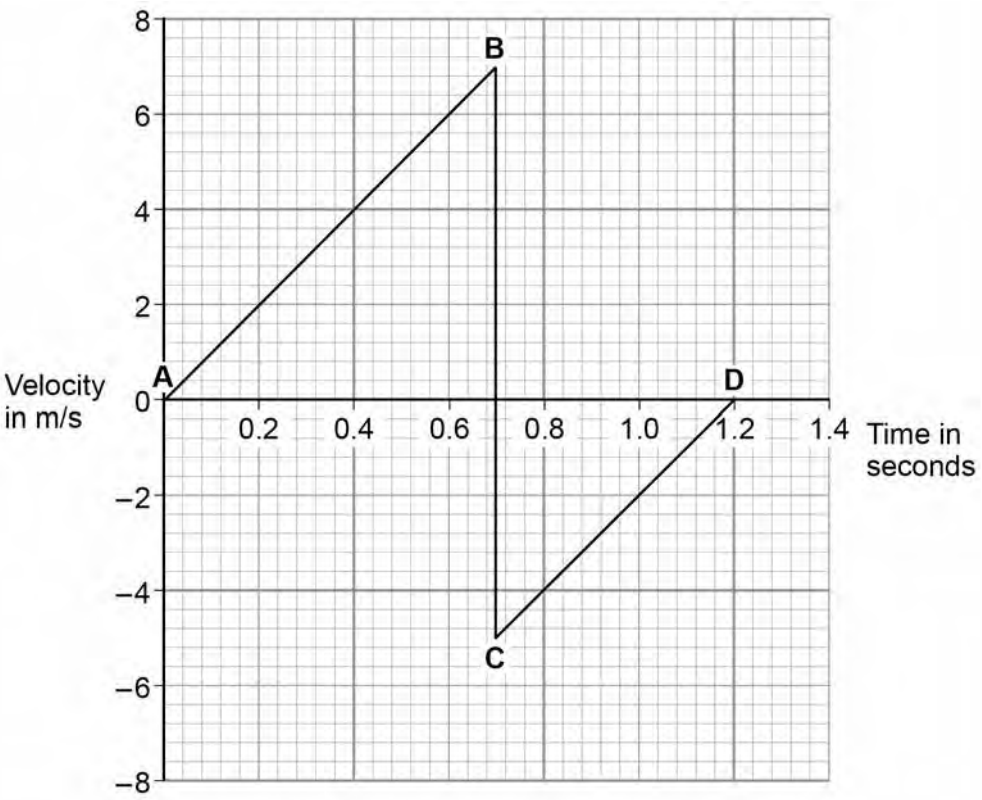
0 1 A child drops a ball.

The ball hits the ground and bounces.

Figure 1 shows the velocity-time graph for the ball from when the ball is dropped until when the ball reaches the top of its first bounce.

Air resistance has been ignored.

Figure 1



0 1 . 1 Describe the motion of the ball between points **A** and **B** on **Figure 1**.

[2 marks]

0 1 . 2 What direction is the ball moving between points **C** and **D** on **Figure 1**?

[1 mark]

4.5.1.2 Contact and non-contact forces

Question 11 · continued

0 1 . 3 The ball and the Earth form a system.

What is meant by 'a system'?

Tick **one** box.

[1 mark]

A group of objects that interact. ☐

Objects with big differences in mass. ☐

Objects with gravitational potential energy. ☐

0 1 . 4 When the ball hits the ground, energy is transferred from the ball to the Earth.

Explain how the data in **Figure 1** shows this energy transfer.

[4 marks]

8

4.5.1.2 Contact and non-contact forces

Question 12

June 2018 | 8463/2H | Original Q2

0 2 A student carried out an investigation to determine the spring constant of a spring.

Table 1 gives the data obtained by the student.

Table 1

Force in N	Extension in cm
0	0.0
2	3.5
4	8.0
6	12.5
8	16.0
10	20.0

0 2 . 1 Describe a method the student could have used to obtain the data given in **Table 1**.

Your answer should include any cause of inaccuracy in the data.

Your answer may include a labelled diagram.

[6 marks]

4.5.1.2 Contact and non-contact forces

Question 12 · continued

0 2 . 2 The student measured the extension for five different forces rather than just measuring the extension for one force.

Suggest why.

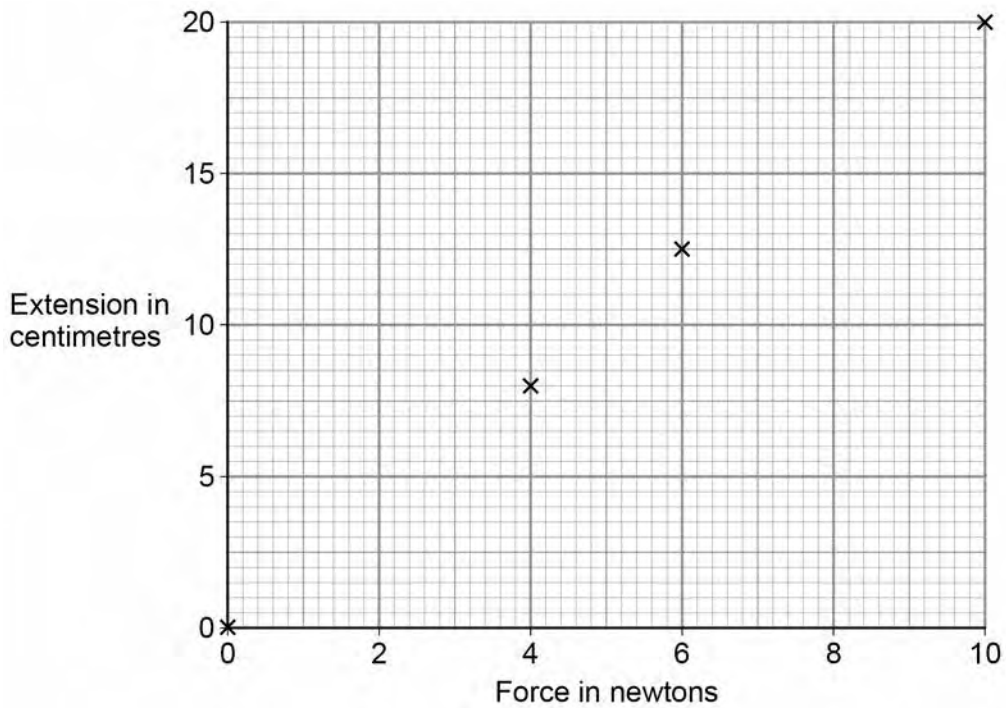
[1 mark]

Question 2 continues on the next page

Question 12 · continued

Figure 2 shows some of the data obtained by the student.

Figure 2



0 2 . 3 Complete **Figure 2** by plotting the missing data from **Table 1.**

Draw the line of best fit.

Table 1 is repeated here to help you answer this question.

[2 marks]

Table 1

Force in N	Extension in cm
0	0.0
2	3.5
4	8.0
6	12.5
8	16.0
10	20.0

0 2 . 4 Write down the equation that links extension, force and spring constant.

[1 mark]

4.5.1.2 Contact and non-contact forces

Question 12 · continued

0 2 . 5 Calculate the spring constant of the spring that the student used.

Give your answer in newtons per metre.

[4 marks]

Spring constant = _____ N/m

0 2 . 6 Hooke's Law states that:
'The extension of an elastic object is directly proportional to the force applied, provided the limit of proportionality is not exceeded.'

The student concluded that over the range of force used, the spring obeyed Hooke's Law.

Explain how the data supports the student's conclusion.

[2 marks]

16

4.5.1.2 Contact and non-contact forces

Question 13

June 2018 | 8463/2H | Original Q6

0 6 **Figure 8** shows a boat floating on the sea. The boat is stationary.

Figure 8



0 6 . 1 **Figure 9** shows part of the free body diagram for the boat.

Complete the free body diagram for the boat.

[2 marks]

Figure 9



4.5.1.2 Contact and non-contact forces

Question 13 · continued

0 6 . 2 Calculate the mass of the boat.

Use the information given in **Figure 9**.

gravitational field strength = 9.8 N/kg

Give your answer to **two** significant figures.

[4 marks]

Mass = _____ kg

0 6 . 3 When the boat propeller pushes water backwards, the boat moves forwards.
The force on the water causes an equal and opposite force to act on the boat.

Which law is this an example of?

[1 mark]

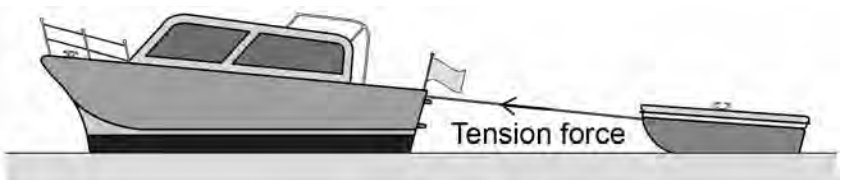
Question 6 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 13 · continued

0 6 . 4 **Figure 10** shows the boat towing a small dinghy.

Figure 10



The tension force in the tow rope causes a horizontal force forwards and a vertical force upwards on the dinghy.

horizontal force forwards = 150 N
vertical force upwards = 50 N

4.5.1.2 Contact and non-contact forces

Question 13 · continued

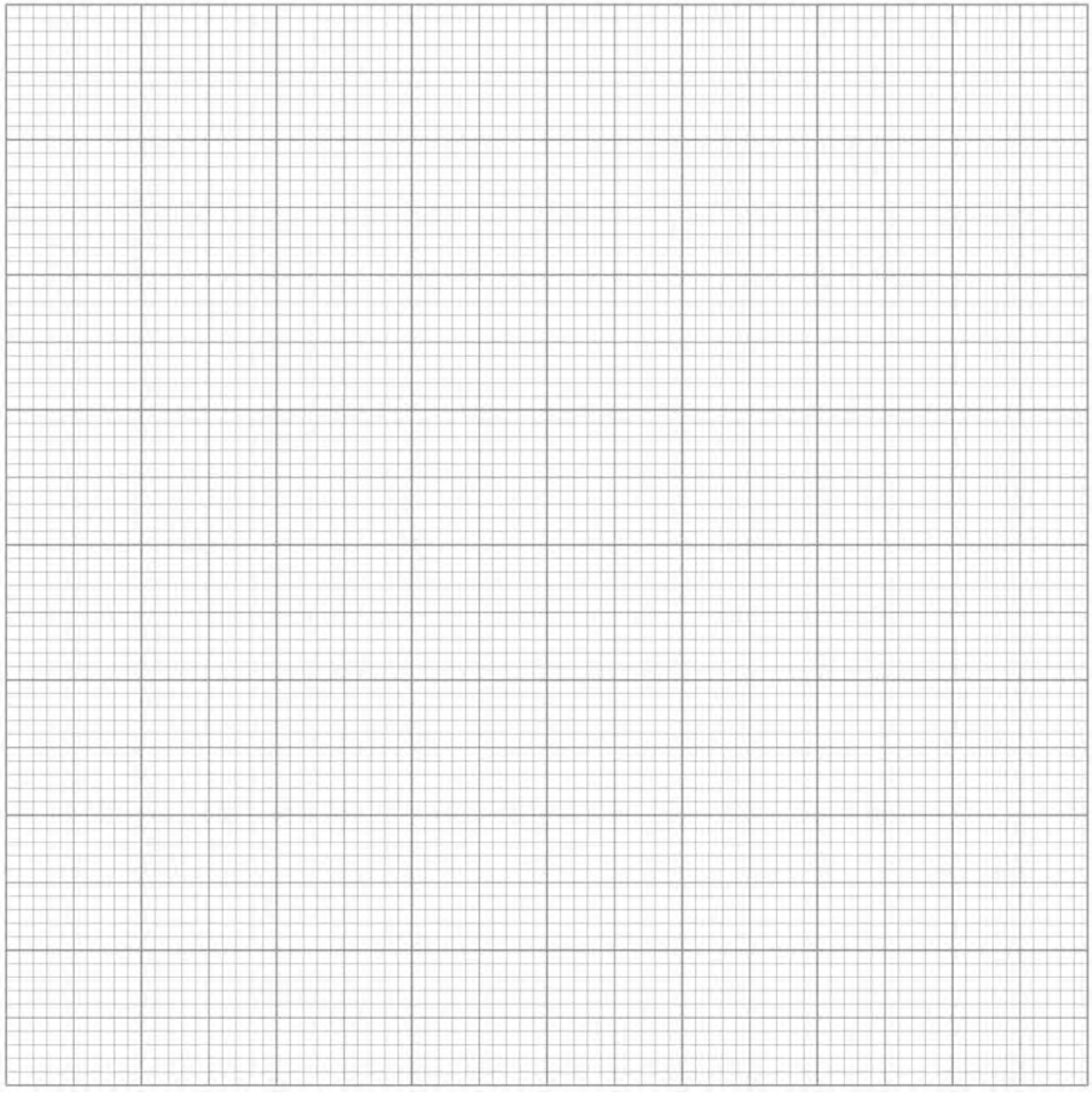
June 2018 | 8463/2H | Original Q6

Figure 11 shows a grid.

Draw a vector diagram to determine the magnitude of the tension force in the tow rope and the direction of the force this causes on the dinghy.

[4 marks]

Figure 11



Magnitude of the tension force in the tow rope = _____ N

Direction of the force on the dinghy caused by the tension force in the tow rope = _____

11

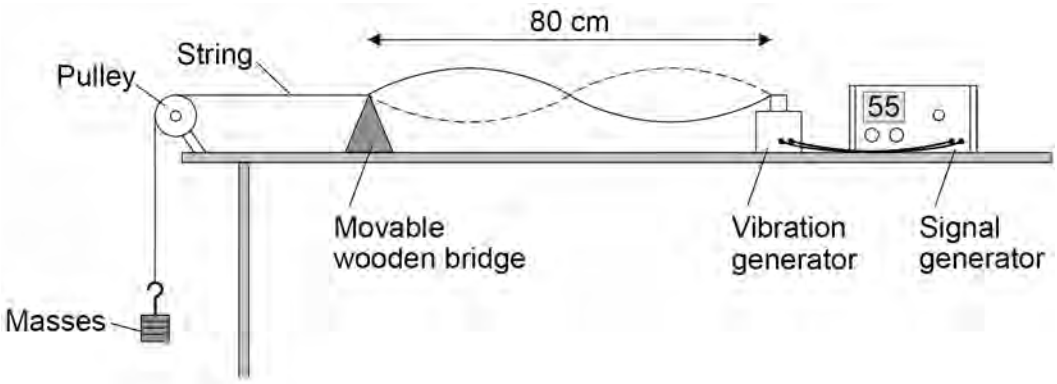
4.5.1.2 Contact and non-contact forces

Question 14

June 2019 | 8463/2H | Original Q2

0 2 **Figure 4** shows the apparatus used to investigate the waves in a stretched string.

Figure 4



The frequency of the signal generator is adjusted so that the wave shown in **Figure 4** is seen.

At this frequency the string vibrates between the two positions shown in **Figure 4**.

0 2 . 1 The wavelength of the wave shown in **Figure 4** was measured as 80 cm

What piece of apparatus would have been suitable for measuring this wavelength?

[1 mark]

0 2 . 2 Write down the equation which links frequency, wavelength and wave speed.

[1 mark]

0 2 . 3 The string in **Figure 4** vibrates at 55 Hz

Calculate the wave speed of the wave shown in **Figure 4**.

Use data given in **Figure 4**.

[3 marks]

Wave speed = _____ m/s

4.5.1.2 Contact and non-contact forces

Question 14 · continued

0 2 . 4 The frequency of the signal generator is increased.

This makes the wavelength of the wave change.

The wave speed stays the same.

Describe how the apparatus could be adjusted to show one complete wave without reducing the frequency.

[2 marks]

0 2 . 5 A student wants to investigate how the speed of a wave on a stretched string depends on the tension in the string.

The student uses the apparatus in **Figure 4**.

Describe a method the student could use for this investigation.

[4 marks]

11

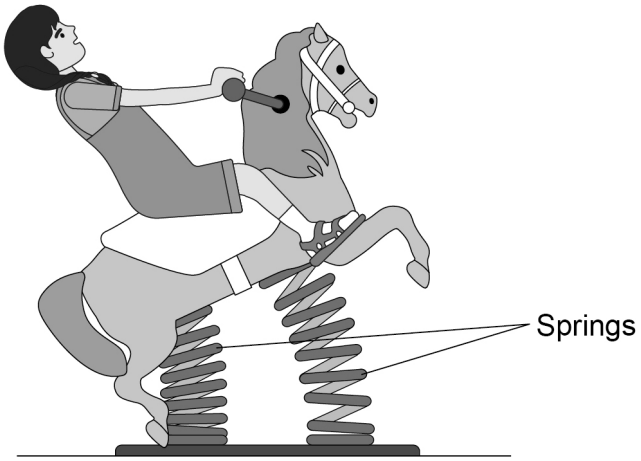
4.5.1.2 Contact and non-contact forces

Question 15

November 2021 | 8463/2H | Original Q2

0 2 **Figure 3** shows a child on a playground toy.

Figure 3



0 2 . 1 The springs have been elastically deformed.

Explain what is meant by 'elastically deformed'.

[2 marks]

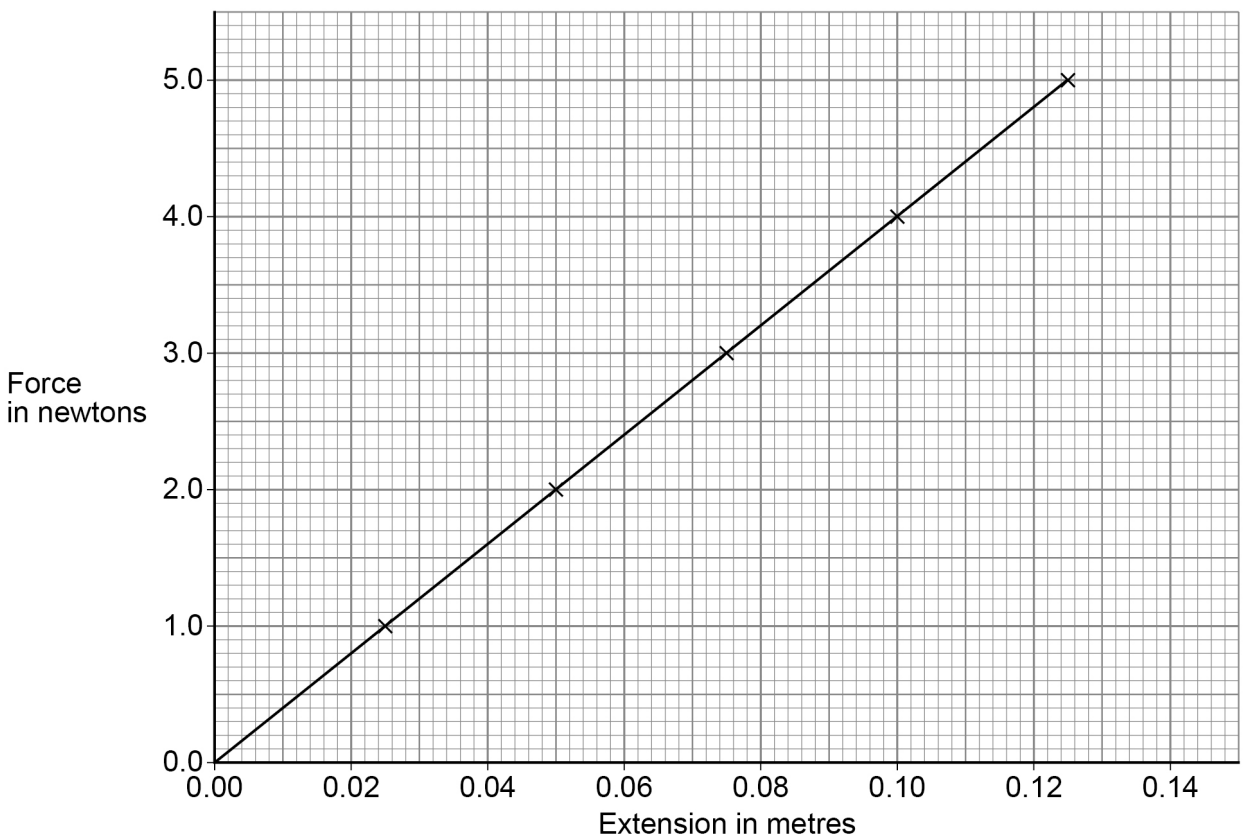
Question 2 continues on the next page

Question 15 · continued

A student investigated the relationship between the force applied to a spring and the extension of the spring.

Figure 4 shows the results.

Figure 4



4.5.1.2 Contact and non-contact forces

Question 15 · continued

0 2 . 2 Describe a method the student could use to obtain the results given in **Figure 4**.

You should include a risk assessment for **one** hazard in the investigation.

Your answer may include a diagram.

[6 marks]

Question 2 continues on the next page

Question 15 · continued

0 2 . 3 Which equation links extension (e), force (F) and spring constant (k).

[1 mark]

Tick (✓) **one** box.

force = spring constant × (extension)^2 ☐

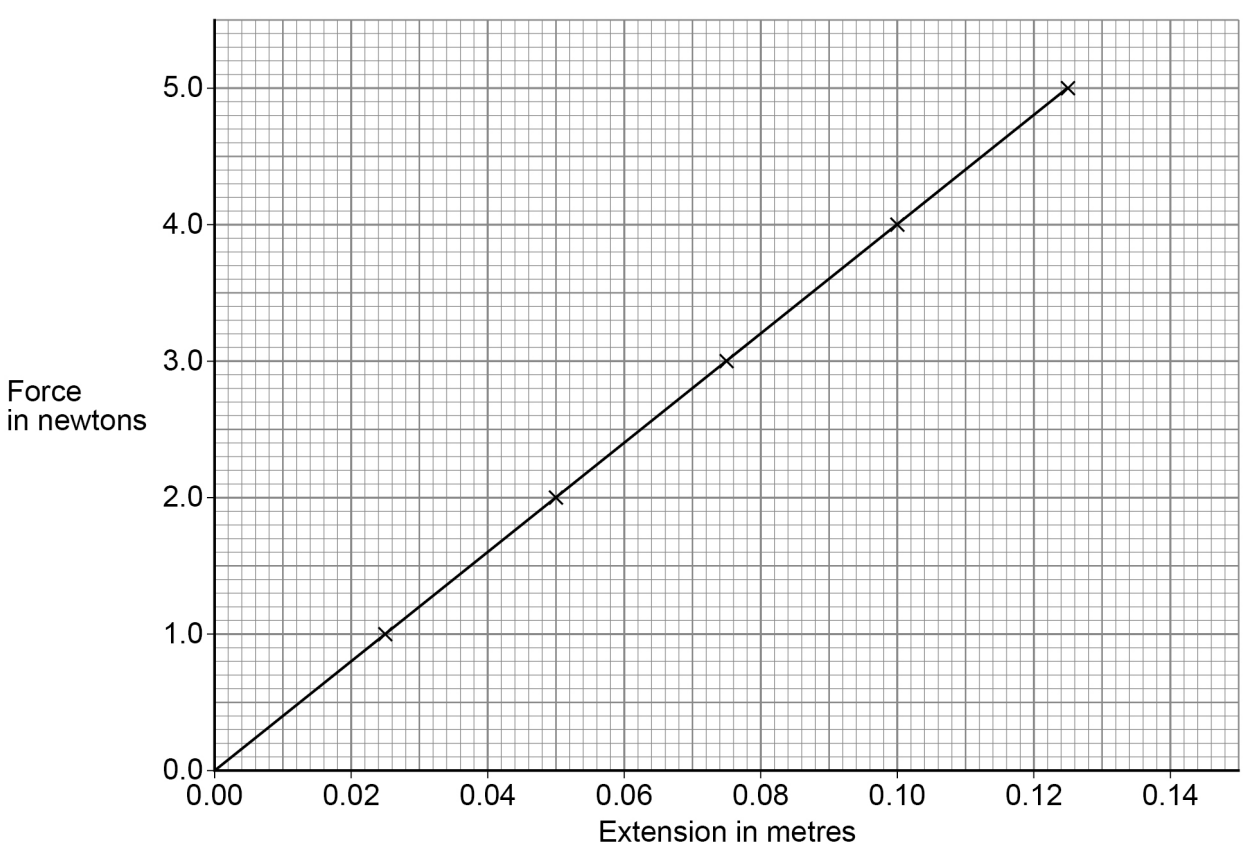
force = spring constant × extension ☐

force = $\frac{\text{extension}}{\text{spring constant}}$ ☐

force = $\frac{\text{spring constant}}{\text{extension}}$ ☐

Figure 4 is repeated below.

Figure 4



4.5.1.2 Contact and non-contact forces

Question 15 · continued

0 2 . 4 Determine the spring constant of the spring.

Use **Figure 4**.

[3 marks]

Spring constant = _____ N/m

0 2 . 5 The student concluded:

'The extension of the spring is directly proportional to the force applied to the spring.'

Describe how **Figure 4** supports the student's conclusion.

[2 marks]

Question 2 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 15 · continued

0 2 . 6 The student repeated the investigation using a different spring with a spring constant of 13 N/m.

Calculate the elastic potential energy of the spring when the extension of the spring was 20 cm.

Use the Physics Equations Sheet.

[3 marks]

Elastic potential energy = _____ J

17

4.5.1.2 Contact and non-contact forces

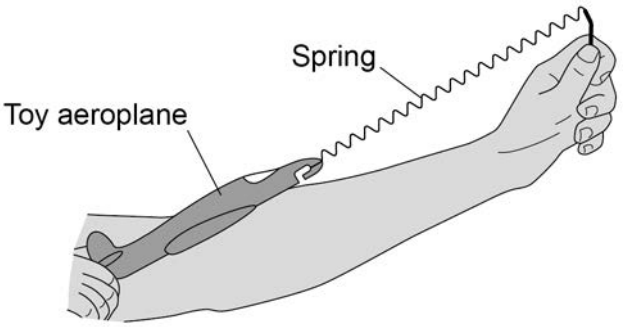
Question 16

June 2022 | 8463/1H | Original Q10

1 0 **Figure 11** shows a student launching a toy aeroplane.

To launch the aeroplane, the student pulls on it to stretch the spring and then releases it.

Figure 11



1 0 . 1 Just before the toy aeroplane is released, the spring has an extension of 0.12 m.

mass of aeroplane = 0.020 kg

spring constant of the spring = 50 N/m

Calculate the maximum speed of the toy aeroplane just after it is launched.

Use the Physics Equations Sheet.

Give the unit.

[6 marks]

Speed = _____ Unit _____

4.5.1.2 Contact and non-contact forces

Question 16 · continued

1 0 . 2 Complete the sentence.

[1 mark]

As the aeroplane moves upwards through the air there is a decrease

in the _____ energy of the aeroplane.

1 0 . 3 Give **one** factor which would increase the distance the toy aeroplane travels horizontally before hitting the ground.

[1 mark]

_____

_____

8

Turn over for the next question

4.5.1.2 Contact and non-contact forces

Question 17

June 2022 | 8463/2HR | Original Q1

0 1 **Figure 1** shows an electric super-car.

Figure 1



0 1 . 1 The battery in an electric car needs to be recharged.

Suggest **two** factors that affect the distance an electric car can travel before the battery needs to be recharged.

[2 marks]

1 _____

2 _____

4.5.1.2 Contact and non-contact forces

Question 17 · continued

Use the Physics Equations Sheet to answer questions **01.2** and **01.3**.

0 1 . 2 Write down the equation which links acceleration (a), change in velocity (Δv) and time taken (t).

[1 mark]

0 1 . 3 The maximum acceleration of the car is 20 m/s^2.

Calculate the time taken for the speed of the car to change from 0 m/s to 28 m/s at its maximum acceleration.

[3 marks]

Time taken = _____ s

Question 1 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 17 · continued

0 1 . 4 In a trial run, the car accelerates at 10 m/s^2 until it reaches its final velocity.

distance travelled by the car = 605 m

initial velocity of the car = 0 m/s

Calculate the final velocity of the car.

Use the Physics Equations Sheet.

[3 marks]

Final velocity = _____ m/s

4.5.1.2 Contact and non-contact forces

Question 17 · continued

Use the Physics Equations Sheet to answer questions **01.5** and **01.6**.

0 1 . 5 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 1 . 6 When travelling at its maximum speed the air resistance acting on the car is 4000 N.

Calculate the work done against air resistance when the car travels a distance of 7.5 km at its maximum speed.

[3 marks]

Work done = _____ J

13

4.5.1.2 Contact and non-contact forces

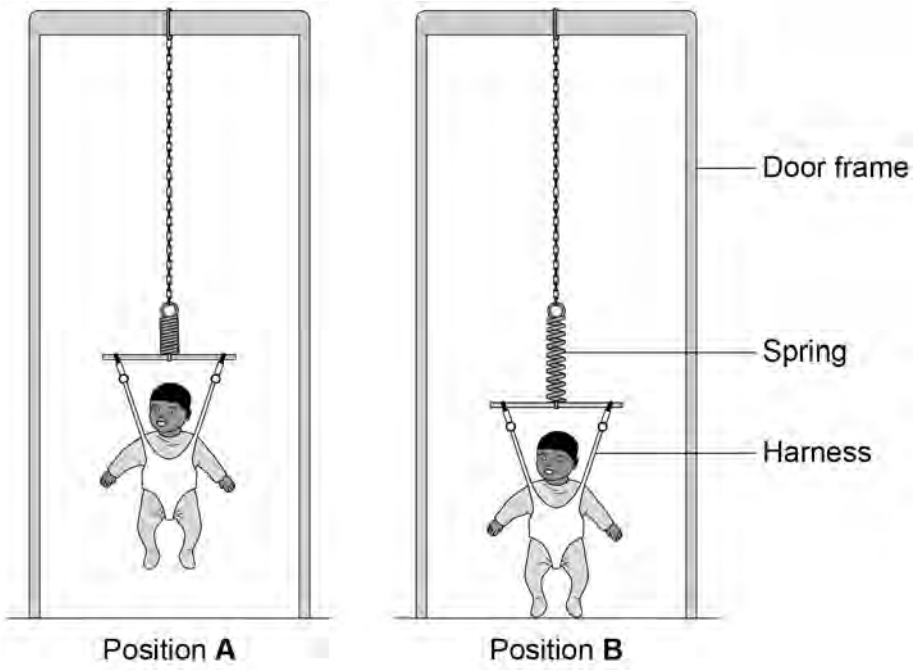
Question 18

June 2023 | 8463/1H | Original Q7

0 7 A baby bouncer is a harness attached to a spring that hangs from a door frame.

Figure 7 shows a baby in a baby bouncer in two positions.

Figure 7



0 7 . 1 The baby bouncer should not be used with babies that have a mass greater than 12 kg.

Suggest **one** reason why.

[1 mark]

4.5.1.2 Contact and non-contact forces

Question 18 · continued

0 7 . 2 In positions **A** and **B** the baby is stationary.

Describe the energy transfers as the baby moves from position **A** to position **B**.

[3 marks]

0 7 . 3 In one position the extension of the spring is 8.0 cm.

The elastic potential energy stored by the spring is 4.0 J.

Calculate the spring constant of the spring.

Use the Physics Equations Sheet.

[4 marks]

Spring constant = _____ N/m

8

4.5.1.2 Contact and non-contact forces

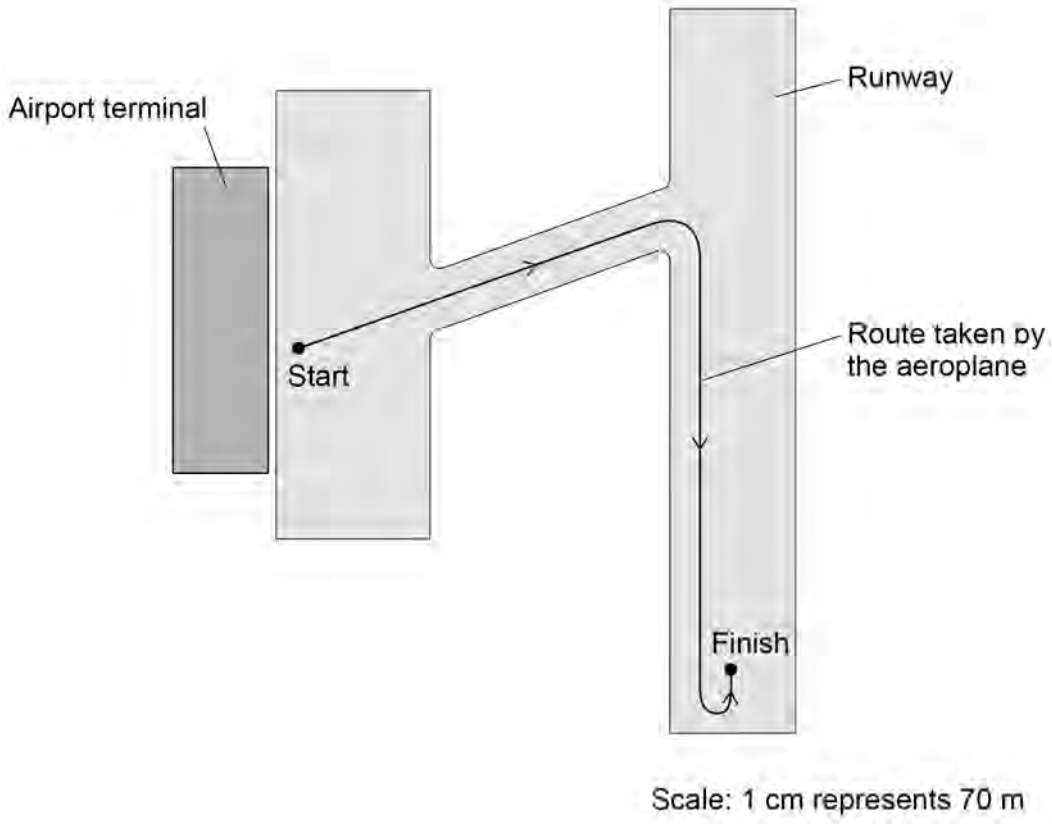
Question 19

June 2023 | 8463/2H | Original Q2

0 2 **Figure 3** shows the route an aeroplane takes as it travels from an airport terminal to the runway.

Figure 3 has been drawn to scale.

Figure 3



0 2 . 1 Determine the magnitude of the aeroplane's displacement from the start point to the finish point on **Figure 3**.

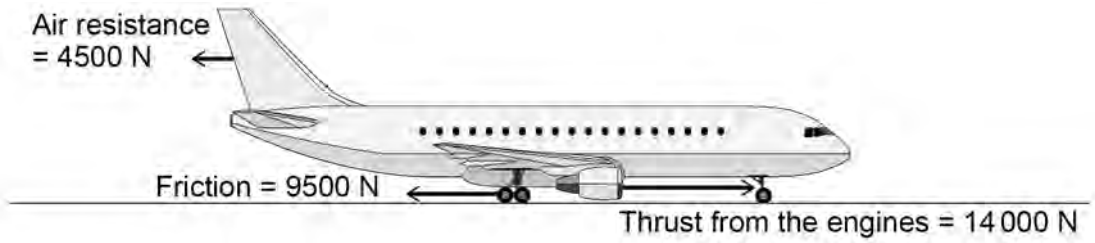
[2 marks]

Displacement = _____ m

Question 19 · continued

Figure 4 shows the direction of the horizontal forces acting on the aeroplane as it moves in a straight line towards the runway.

Figure 4



0 2 . 2 Determine the magnitude of the resultant horizontal force on the aeroplane.

[1 mark]

Resultant horizontal force = _____ N

0 2 . 3 Describe the motion of the aeroplane as it moves towards the runway.

[1 mark]

0 2 . 4 Air resistance and friction are contact forces.

Give **one** other example of a contact force.

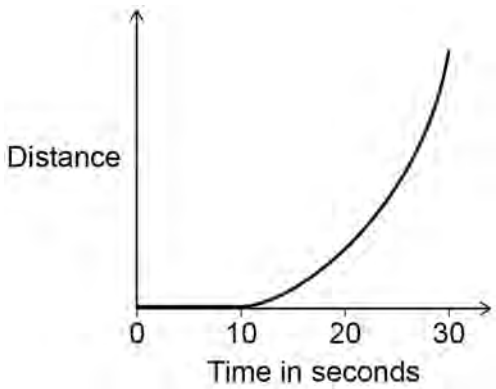
[1 mark]

Question 19 · continued

0 2 . 5 The aeroplane stops for a short time and then accelerates along the runway.

Figure 5 shows a distance–time sketch-graph for this stage of the journey.

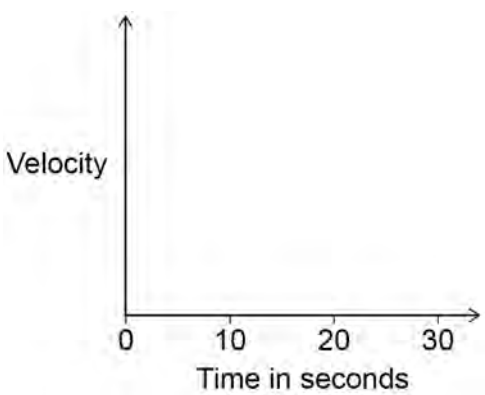
Figure 5



Draw the velocity–time sketch-graph for this stage of the journey on **Figure 6**.

[2 marks]

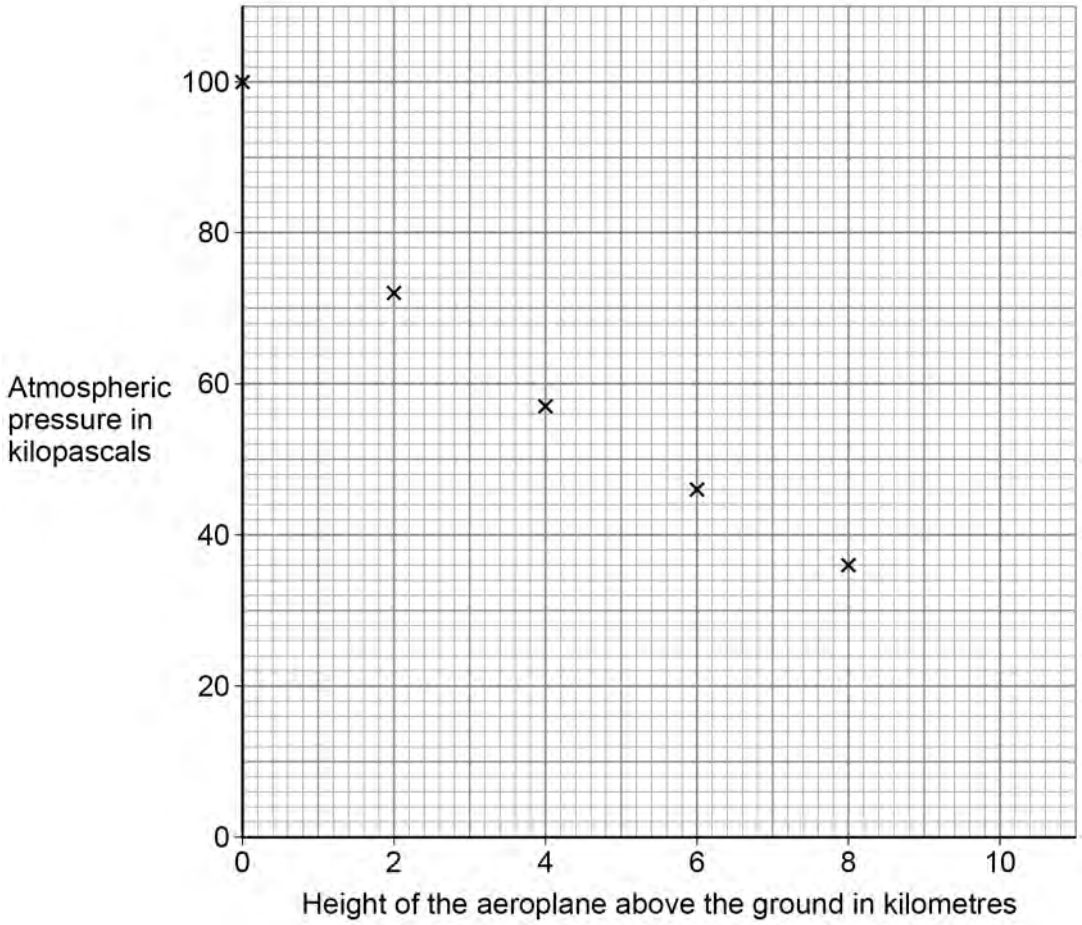
Figure 6



0 2 . 6 The aeroplane takes off from the runway, so its height above the ground increases.

Figure 7 shows how atmospheric pressure varies with the height of the aeroplane above the ground.

Figure 7



Estimate the atmospheric pressure when the height of the aeroplane above the ground is 10 km.

[2 marks]

Atmospheric pressure = _____ kPa

Question 2 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 19 · continued

0 2 . 7 What happens to the air surrounding the aeroplane as the height of the aeroplane above the ground increases?

[1 mark]

Tick (✓) **one** box.

- The average density of the air above the aeroplane decreases. ☐
- The mass of air above the aeroplane increases. ☐
- The temperature of the air increases. ☐
- The volume of air below the aeroplane decreases. ☐

10

4.5.1.2 Contact and non-contact forces

Question 20

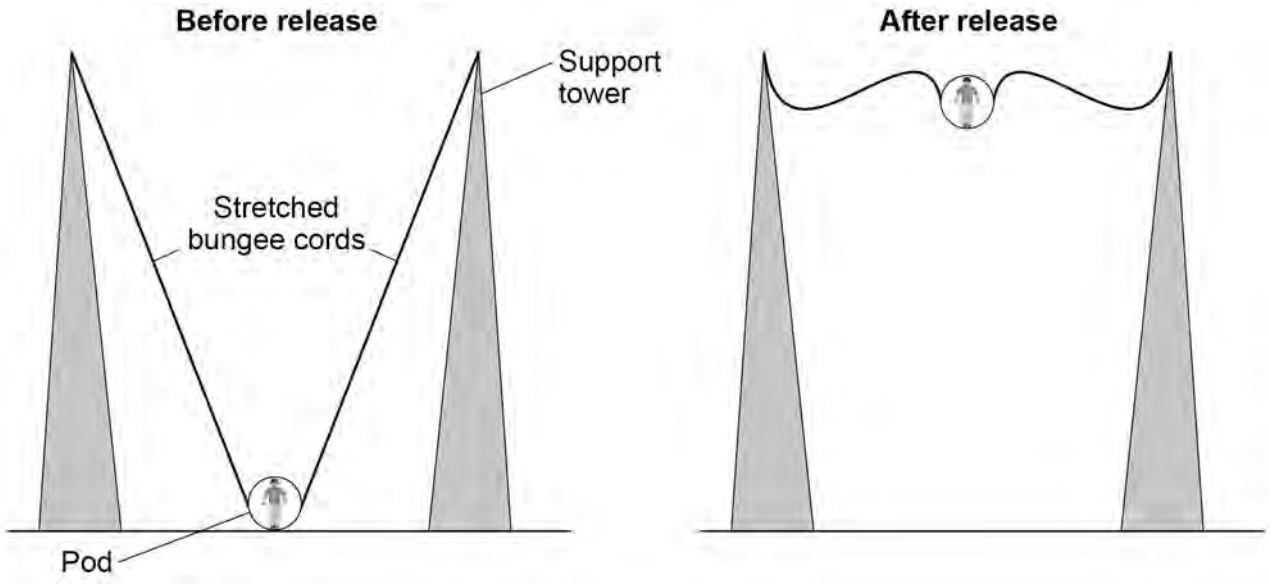
June 2024 | 8463/1H | Original Q6

0 6 In a ride at a theme park, a person is strapped into a pod that is attached to two stretched bungee cords.

The bungee cords behave like springs.

Figure 10 shows a person using the ride.

Figure 10



0 6 . 1 Which energy store increases as the bungee cords are stretched?

[1 mark]

4.5.1.2 Contact and non-contact forces

Question 20 · continued

0 6 . 2 When the pod is released, the pod accelerates upwards.

Before the pod is released the extension of **each** of the two bungee cords is 8.0 m.

The spring constant of each bungee cord is 735 N/m.

The mass of the pod is 240 kg.

gravitational field strength = 9.8 N/kg

Calculate the maximum height reached by the pod.

Use the Physics Equations Sheet.

[6 marks]

Maximum height = _____ m

0 6 . 3 The actual maximum height reached by the pod will be lower than the correct answer to Question **06.2**

Explain why.

[2 marks]

9

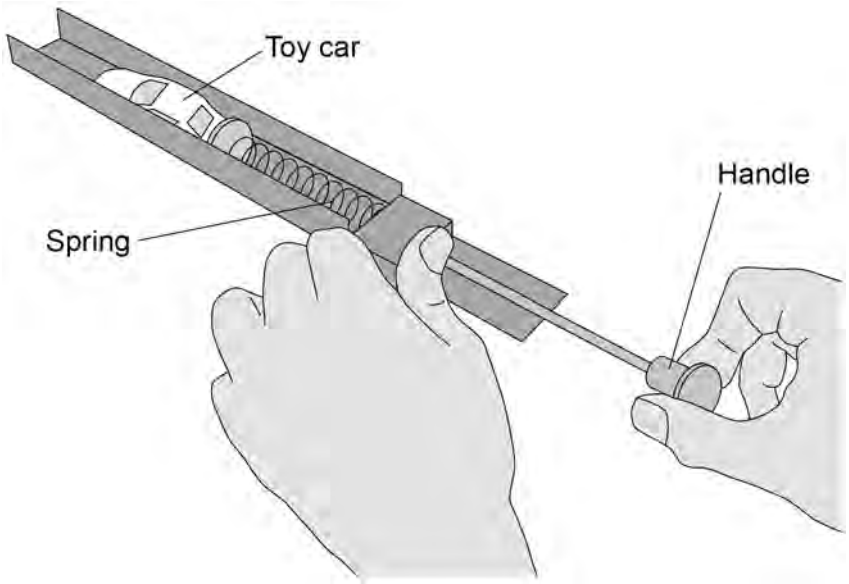
4.5.1.2 Contact and non-contact forces

Question 21

June 2025 | 8463/1H | Original Q10

1 0 **Figure 12** shows a device that accelerates a toy car at the start of a race track.

Figure 12



4.5.1.2 Contact and non-contact forces

Question 21 · continued

1 0 . 1 Pulling the handle compresses the spring in the device by 0.075 m.

When the handle is released, the energy stored in the compressed spring is transferred to the toy car.

spring constant = 64 N/m

mass of toy car = 0.052 kg

Calculate the maximum possible speed of the toy car just after the car starts to move.

Use the Physics Equations Sheet.

Give your answer to **2** significant figures.

[6 marks]

Maximum possible speed (2 significant figures) = _____ m/s

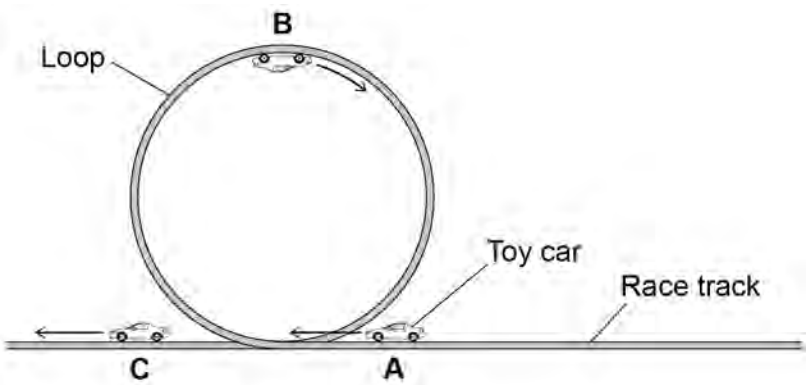
Question 10 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 21 · continued

1 0 . 2 **Figure 13** shows the path of the toy car along a loop section of the race track.

Figure 13



The car moves along the track from position **A** to position **B** and then to position **C**.

Describe how the energy stores of the car change as the car moves along the track from position **A** to position **C**.

Ignore the effects of friction and air resistance.

[3 marks]

4.5.1.2 Contact and non-contact forces

Question 21 · continued

1 0 . 3 At the end of the race track, the toy car passes through a light gate that measures the speed of the car.

Which **two** measurements are needed to determine the speed of the car?

[2 marks]

Tick (✓) **two** boxes.

- Length of the toy car ☐
- Mass of the toy car ☐
- Temperature of the room ☐
- Time for the toy car to pass the light gate ☐
- Total length of the race track ☐

11

4.5.1.2 Contact and non-contact forces

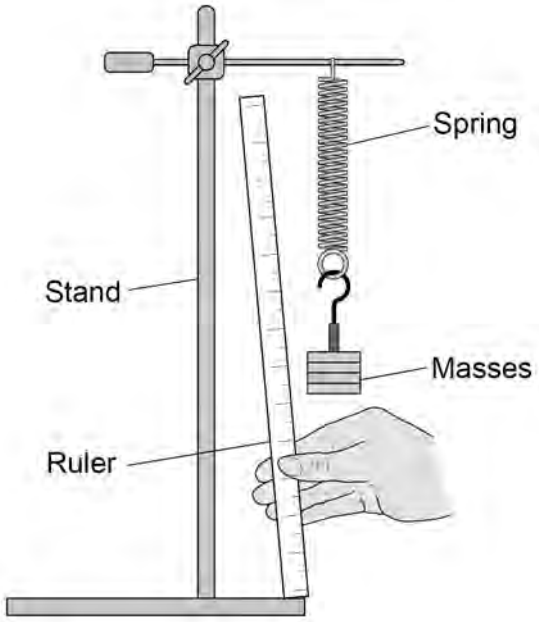
Question 22

June 2025 | 8463/2H | Original Q2

0 2 A student investigated how the force applied to a spring affects the length of the spring.

Figure 1 shows the apparatus used.

Figure 1



0 2 . 1 What is the independent variable in this investigation?

[1 mark]

0 2 . 2 Describe **one** risk of harm in this investigation and a safety precaution to reduce the risk.

[2 marks]

Risk of harm

Safety precaution

4.5.1.2 Contact and non-contact forces

Question 22 · continued

0 2 . 3 The student measured the length of the spring using the arrangement shown in **Figure 1**.

Give **two** ways the student could have changed the arrangement to improve the accuracy of the measurement.

[2 marks]

1 _____

_____

2 _____

_____

Question 2 continues on the next page

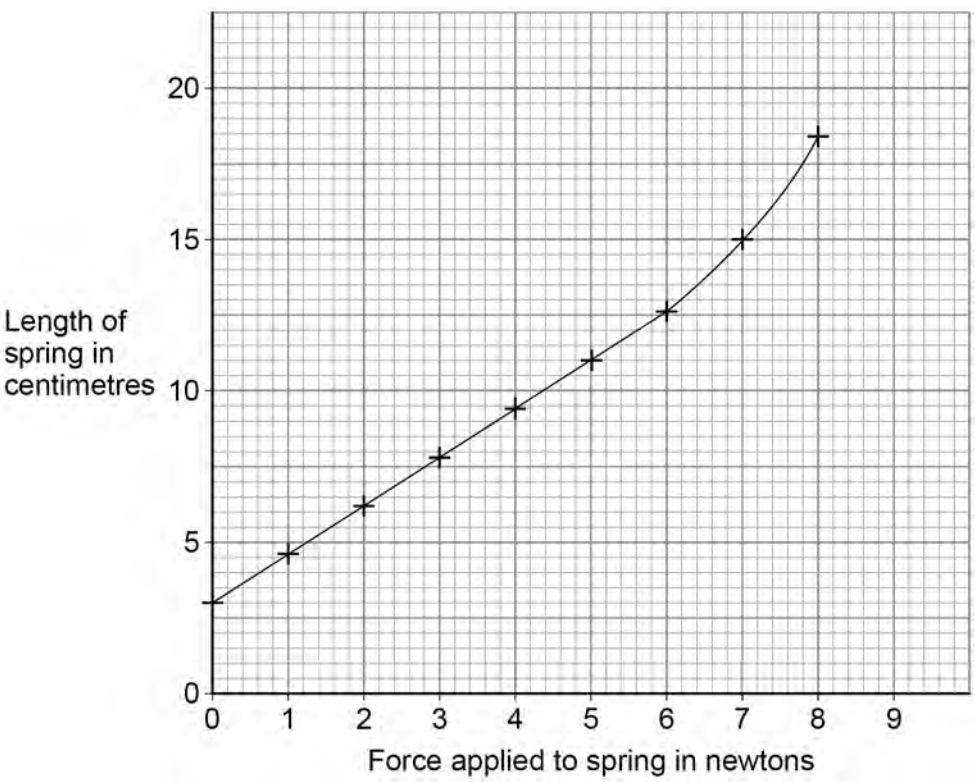
Question 22 · continued

The student recorded accurate values for the length of the spring as the mass on the spring increased.

The student calculated the force applied to the spring by each mass.

Figure 2 shows the results.

Figure 2



0 2 . 4 Why does the line on the graph **not** pass through the origin?

[1 mark]

Question 22 · continued

0 2 . 5 Above 6.0 N the line on **Figure 2** curves upwards.

Explain why.

[2 marks]

Use the Physics Equations Sheet to answer questions **02.6** and **02.7**.

0 2 . 6 Which equation links extension (*e*), force (*F*) and spring constant (*k*)?

[1 mark]

Tick (✓) **one** box.

force = spring constant × extension ☐

force = $\frac{\text{spring constant}}{\text{extension}}$ ☐

force = $\frac{\text{extension}}{\text{spring constant}}$ ☐

0 2 . 7 When the force on the spring is 4.0 N, the extension of the spring is 0.064 m.

Calculate the spring constant of the spring.

[3 marks]

Spring constant = _____ N/m

12