AQA GCSE Physics | 8463

SPECIFICATION POINT 4.5.1.2

Contact and non-contact forces

Past-paper questions

Tier	**Foundation**
Question groups	**42**
Available paper years	**2003–2025**

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:** _____

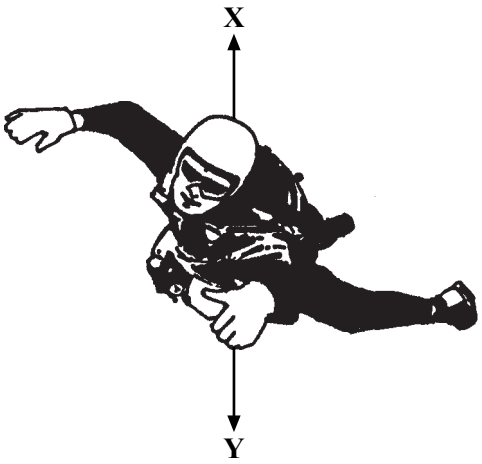
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.5.1.2 Contact and non-contact forces

Question 01

June 2003 | 3451F | Original Q10 | Legacy

10 The diagram shows a sky-diver in free fall. Two forces, **X** and **Y**, act on the sky-diver.



(a) Complete these sentences by crossing out the **two** lines in each box that are wrong.

(i) Force **X** is caused by

friction
gravity
weight

.

(1 mark)

(ii) Force **Y** is caused by

air resistance
friction
gravity

.

(1 mark)

(b) The size of force **X** changes as the sky-diver falls. Describe the motion of the sky-diver when:

(i) force **X** is smaller than force **Y**,

.....

.....

(2 marks)

(ii) force **X** is equal to force **Y**.

.....

.....

(1 mark)

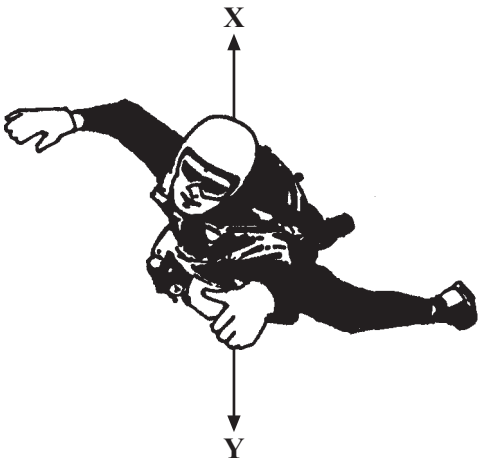
5

4.5.1.2 Contact and non-contact forces

Question 02

June 2003 | 3462F3 | Original Q8 | Legacy

8 The diagram shows a sky-diver in free fall. Two forces, **X** and **Y**, act on the sky-diver.



(a) Complete these sentences by crossing out the **two** lines in each box that are wrong.

(i) Force **X** is caused by

friction
gravity
weight

.

(1 mark)

(ii) Force **Y** is caused by

air resistance
friction
gravity

.

(1 mark)

(b) The size of force **X** changes as the sky-diver falls. Describe the motion of the sky-diver when:

(i) force **X** is smaller than force **Y**,

.....

.....

(2 marks)

(ii) force **X** is equal to force **Y**.

.....

.....

(1 mark)

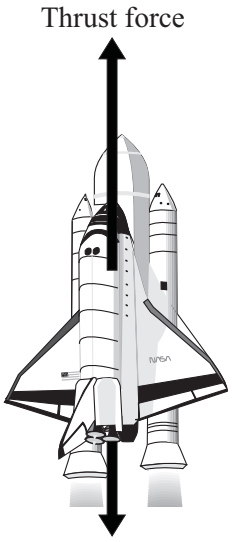
5

4.5.1.2 Contact and non-contact forces

Question 03

June 2004 | 3451F | Original Q12 | Legacy

12 (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 03 · 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 1200°C.

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

.....

.....

(1 mark)

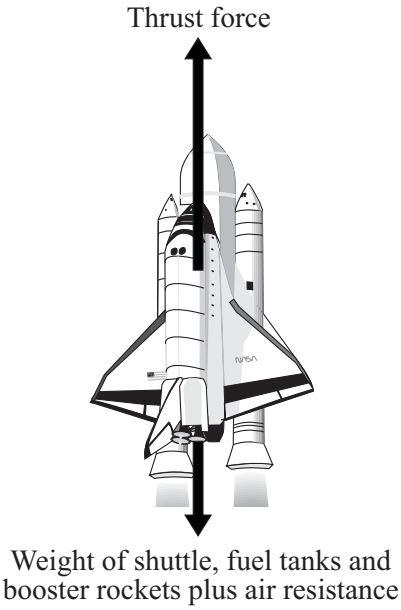
9

4.5.1.2 Contact and non-contact forces

Question 04

June 2004 | 3462F3 | Original Q10 | Legacy

10 (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 04 · continued

1 /

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

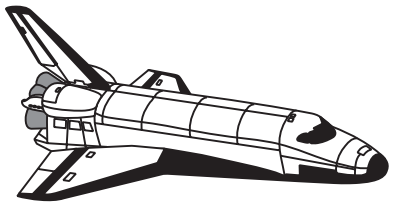
4.5.1.2 Contact and non-contact forces

Question 05

November 2007 | PHY1A | Original Q6 | Legacy

QUESTION SIX

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** . . . .

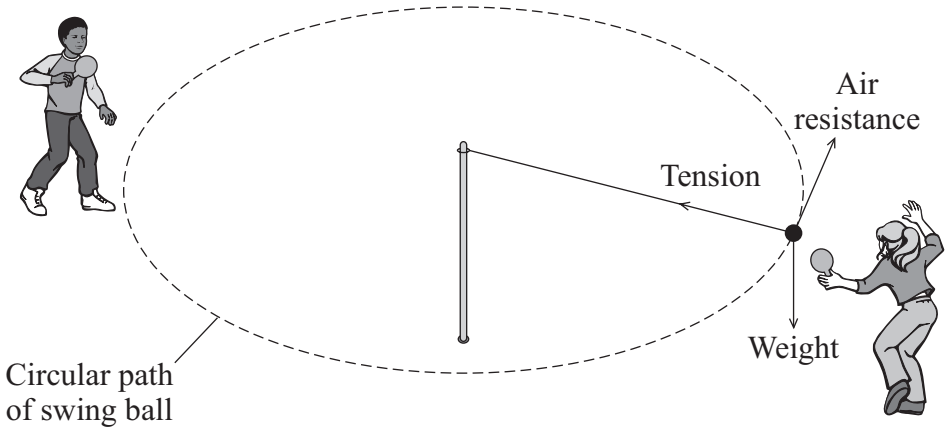
When the shuttle enters the Earth's atmosphere, there is a lot of friction. This makes the tiles covering the shuttle glow red. As a result, the shuttle gives off a lot of . . . **3** . . . and a little . . . **4** . . . .

4.5.1.2 Contact and non-contact forces

Question 06

January 2008 | PHY3F | Original Q3 | Legacy

3 The diagram shows two children playing with a toy called a swing ball. The ball is joined to a pole by a strong string. The children hit the ball so that it goes round in a circular path.



(a) Which force causes the ball to move in a circle?

Draw a ring around your answer.

air resistance **tension** **weight**

(1 mark)

(b) Complete the sentences by ticking (✓) the correct ending.

(i) The force needed to make the ball move in a circular path is larger if

the speed of the ball is increased. ☐

the speed of the ball is decreased. ☐

the string is made longer. ☐

(1 mark)

(ii) The continuous acceleration of a ball moving in a circular path changes

the speed of the ball. ☐

the direction of the ball. ☐

the weight of the ball. ☐

(1 mark)

4.5.1.2 Contact and non-contact forces

Question 06 · continued

BLANK

(c) Which of the following words is used to describe any force that causes an object to move in a circular path?

Draw a ring around your answer.

centripetal **frictional** **gravitational** **universal**

(1 mark)

4

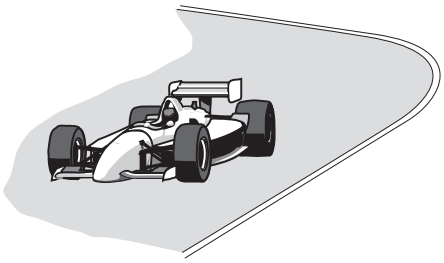
Turn over for the next question

4.5.1.2 Contact and non-contact forces

Question 07

January 2009 | PHY3F | Original Q3 | Legacy

3 (a) Complete the following sentence by drawing a ring around the correct line in the box.



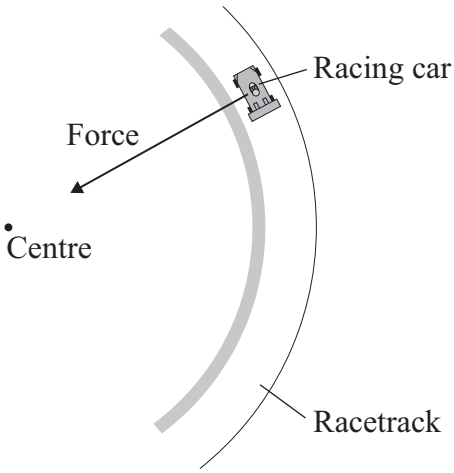
A racing car can accelerate by changing

its direction only
its speed only
either its direction or its speed

.

(1 mark)

3 (b) A racing car moves round a circular part of a racetrack.



A force acts on the racing car. The force is towards the centre of the circular part of the racetrack.

4.5.1.2 Contact and non-contact forces

Question 07 · continued

for mark

Complete the following sentences by drawing a ring around the correct line in each of the boxes.

3 (b) (i) The force is caused by [electrostatics / friction / gravity] .

(1 mark)

3 (b) (ii) The force is a [centripetal force / circular force / perpendicular force] .

(1 mark)

3 (b) (iii) If another racing car has a greater mass and travels at the same speed around the same racetrack, then the force will need to [decrease / stay the same / increase] .

(1 mark)

3 (b) (iv) When the racing car goes faster, the force will need to [decrease / stay the same / increase] .

(1 mark)

Question 3 continues on the next page

Question 07 · continued

for mark

3 (c) This is an item from a newspaper.

No to racetrack plan

At last night's meeting, one local resident said, "The racetrack will be noisy but motor racing leads to safety improvements in all our cars."

"We'll need better brakes. Motor racing encourages speeding and leads to more accidents", said another.

Most of the residents were against the plan to build a racetrack.

Do you agree with most of the residents?

Put a tick (✓) in the box next to your answer and explain.

Yes ☐ No ☐ Not sure ☐

.....

.....

.....

.....

(2 marks)

7

4.5.1.2 Contact and non-contact forces

Question 08

January 2009 | PHY3F | Original Q5 | Legacy

5 (a) Choose the best words from the box to complete the following sentences.

billions	**fission**	**friction**	**fusion**	**gases**
gravity	**liquids**	**millions**	**thousands**	

5 (a) (i) Stars form when enough dust and ..... from space are pulled together by ..... .

(2 marks)

5 (a) (ii) Stars are able to give out energy for millions of years by the process of

..... .

(1 mark)

5 (a) (iii) The Sun is one of many ..... of stars in our galaxy.

(1 mark)

5 (b) What is the name of our galaxy?

.....

(1 mark)

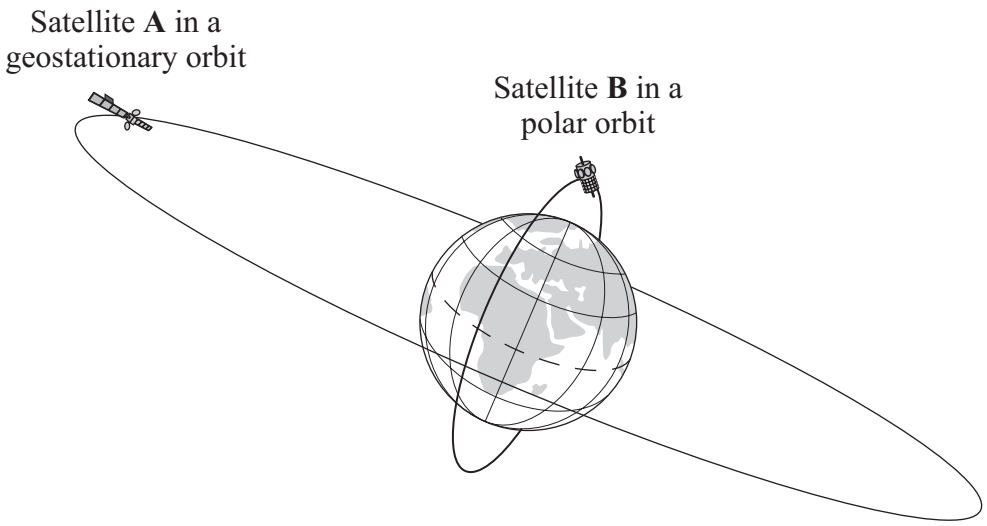
5

4.5.1.2 Contact and non-contact forces

Question 09

3 The diagram shows two satellites orbiting the Earth.

Both satellites have the same mass.



3 (a) Complete the following sentences by drawing a ring around the correct line in each box.

3 (a) (i) The time taken for one orbit by satellite **A** is [less than / the same as / greater than] the time taken for one orbit by satellite **B**.

(1 mark)

3 (a) (ii) The force of attraction between the Earth and satellite **A** is [less than / the same as / greater than] the force of attraction between the Earth and satellite **B**.

(1 mark)

4.5.1.2 Contact and non-contact forces

Question 09 · continued

for mark

3 (a) (iii) The gravitational force of attraction between the Earth and a satellite provides a [centripetal / cosmic / friction] force.

(1 mark)

3 (a) (iv) The time taken for satellite **A** to complete one orbit is [24 hours / 1 week / 1 month / 1 year].

(1 mark)

3 (b) Use phrases from the box to complete the sentences.

geostationary orbit	**high polar orbit**	**low polar orbit**

3 (b) (i) Communications satellites are usually put in a ..... .

(1 mark)

3 (b) (ii) Monitoring satellites are usually put in a ..... .

(1 mark)

6

4.5.1.2 Contact and non-contact forces

Question 10

7 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 °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

7 (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)

7 (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)

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

.....

(1 mark)

4.5.1.2 Contact and non-contact forces

Question 10 · continued

for mark

7 (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)

7 (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)

7 (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

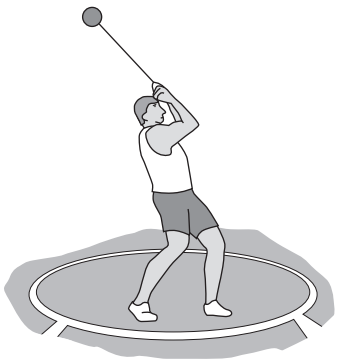
4.5.1.2 Contact and non-contact forces

Question 11

June 2010 | PHY3F | Original Q3 | Legacy

3 The hammer throw is an athletic event.

The athlete throws a heavy metal ball attached by a wire to a handle.



3 (a) The hammer thrower swings the hammer round in a circle before letting go.

He swings the hammer slowly at first and then faster.

Complete the following sentence by drawing a ring around the correct word or line in the box.

As the speed of the swing increases, the centripetal force on the

hammer

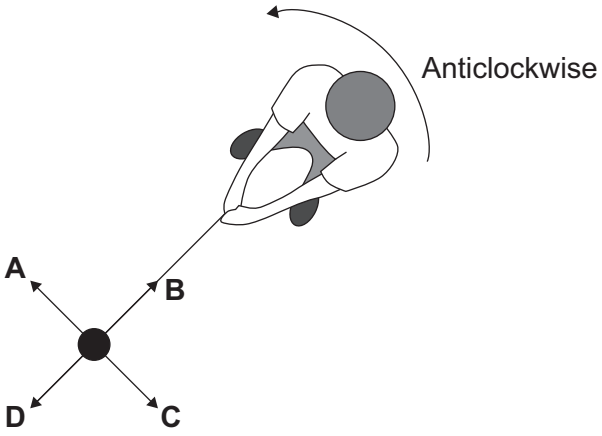
decreases.
does not change.
increases.

(1 mark)

4.5.1.2 Contact and non-contact forces

Question 11 · continued

3 (b) The diagram shows an overhead view of a hammer thrower swinging the hammer anticlockwise in a circle.



3 (b) (i) In which direction, **A**, **B**, **C** or **D**, does the centripetal force act on the hammer?

(1 mark)

3 (b) (ii) Complete the following sentence by drawing a ring around the correct line in the box.

The centripetal force is provided by the

air resistance.
gravitational force.
tension in the wire.

(1 mark)

3 (b) (iii) At the instant shown in the diagram above, the athlete lets go of the handle.

In which direction, **A**, **B**, **C** or **D**, does the hammer move?

(1 mark)

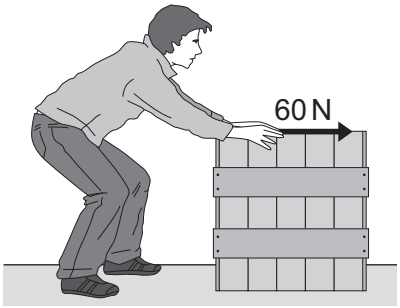
4

4.5.1.2 Contact and non-contact forces

Question 12

June 2012 | PH2FP | Original Q3 | Legacy

3 The diagram shows a worker using a constant force of 60 N to push a crate across the floor.



3 (a) The crate moves at a constant speed in a straight line.

3 (a) (i) Draw an arrow on the diagram to show the direction of the friction force acting on the moving crate.

(1 mark)

3 (a) (ii) State the size of the friction force acting on the moving crate.

..... N

Give the reason for your answer.

.....

.....

(2 marks)

3 (b) Calculate the work done by the worker to push the crate 28 metres.

Use the correct equation from the Physics Equations Sheet.

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

Choose the unit from the list below.

joule **newton** **watt**

.....

.....

Work done = ...

(3 marks)

6

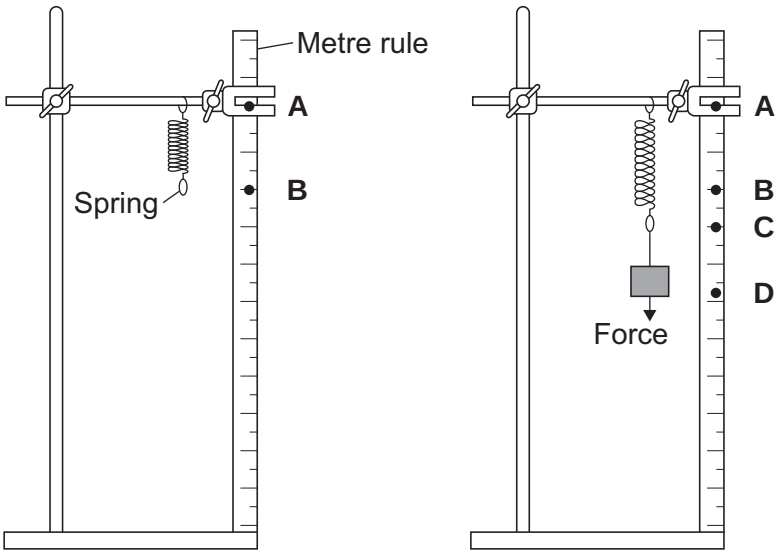
4.5.1.2 Contact and non-contact forces

Question 13

June 2012 | PH2FP | Original Q7 | Legacy

7 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.



7 (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)

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

.....

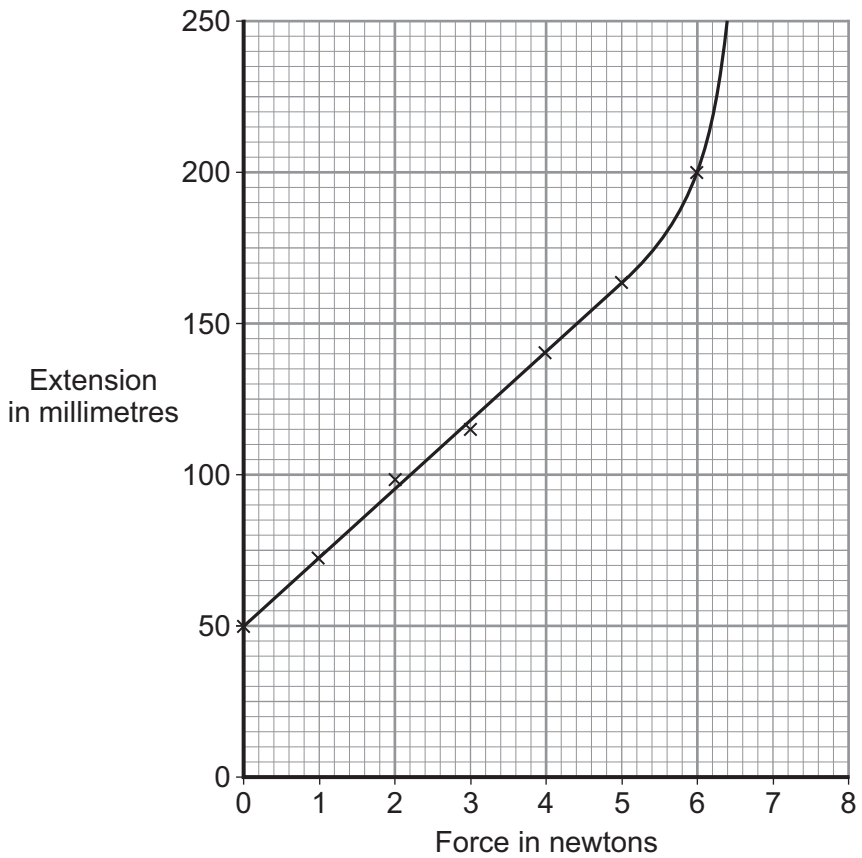
(1 mark)

Question 7 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 13 · continued

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



7 (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 13 · continued

7 (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)

7 (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)

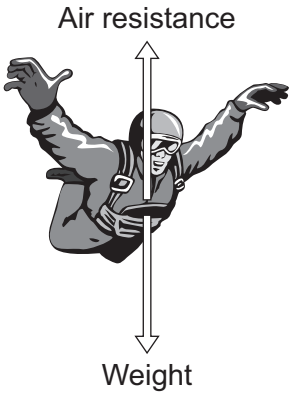
8

4.5.1.2 Contact and non-contact forces

Question 14

June 2012 | PH2FP | Original Q8 | Legacy

8 (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 = ...

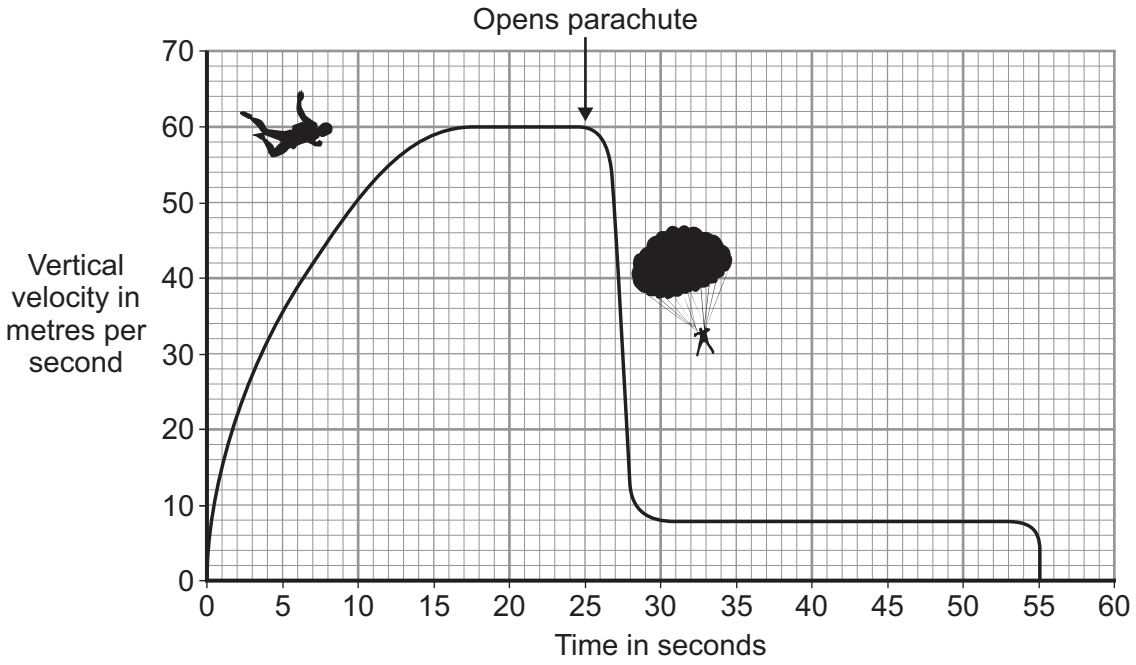
(3 marks)

4.5.1.2 Contact and non-contact forces

Question 14 · continued

8 (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.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

Question 8 continues on the next page

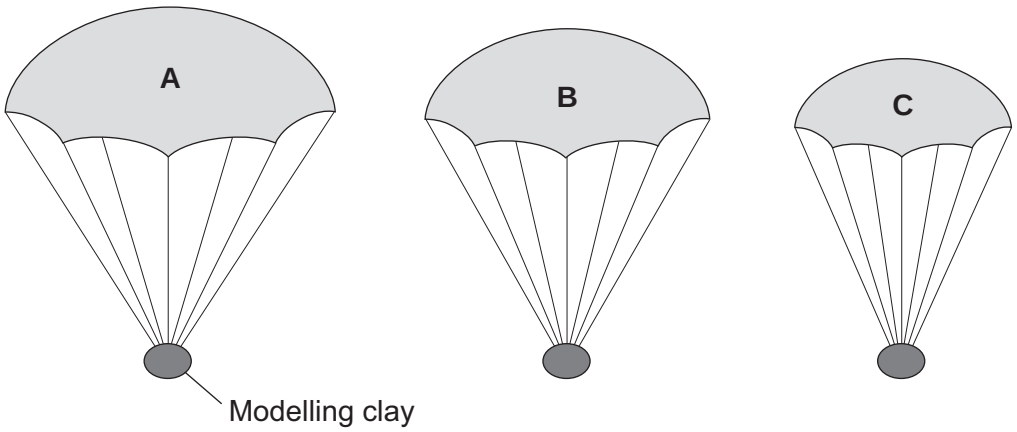
4.5.1.2 Contact and non-contact forces

Question 14 · continued

8 (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.



8 (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)

8 (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

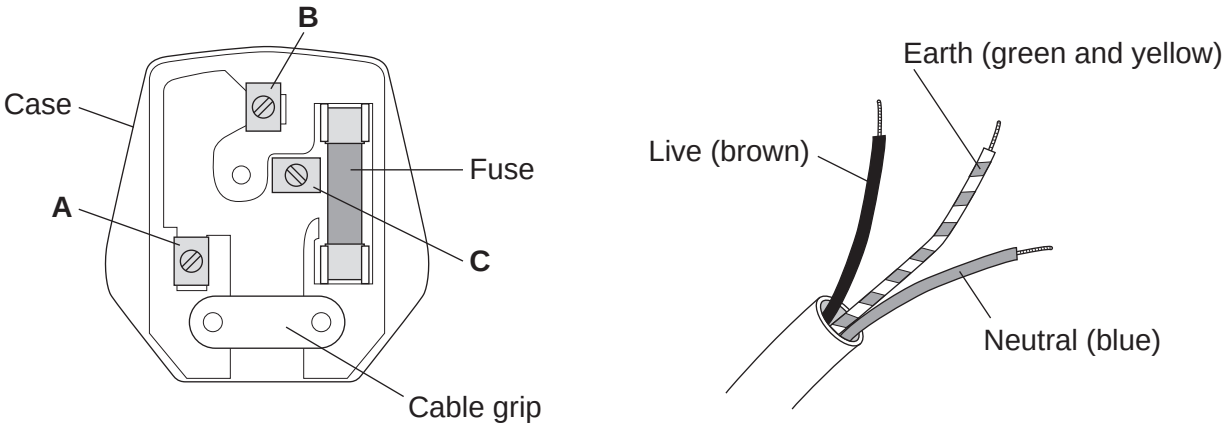
Question 15

June 2014 | PH2FP | Original Q6 | Legacy

6 (a) **Figure 10** shows the inside of a three-pin plug and a length of three-core cable.

The cable is to be connected to the plug.

Figure 10



6 (a) (i) Complete **Table 1** to show which plug terminal, **A**, **B** or **C**, connects to each of the wires inside the cable.

[2 marks]

Table 1

Wire	Plug terminal
Live	
Neutral	
Earth	

6 (a) (ii) Name a material that could be used to make the case of the plug.

[1 mark]

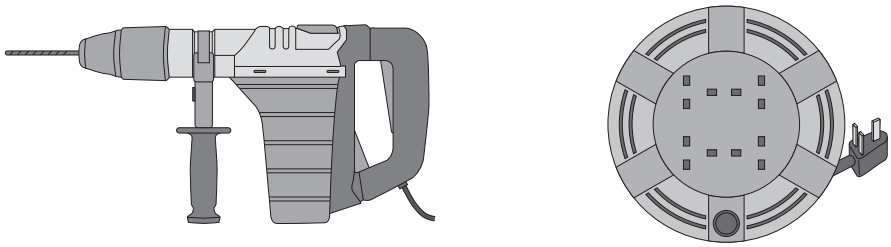
.....

4.5.1.2 Contact and non-contact forces

Question 15 · continued

6 (b) **Figure 11** shows an electric drill and an extension lead. The drill is used with the extension lead.

Figure 11



Electric drill

Extension lead

6 (b) (i) The drill is used for 50 seconds.

In this time, 30 000 joules of energy are transferred from the mains electricity supply to the drill.

Calculate the power of the drill.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Power = ... W

Question 6 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 15 · continued

6 (b) (ii) A second drill is used with the extension lead. The power of this drill is 1200 W.

The instructions for using the extension lead include the following information.

> **When in use the lead may get hot:**
>
> **DO NOT go over the maximum power**
>
> - lead wound inside the case: 820 watts
> - lead fully unwound outside the case: 3100 watts

It would **not** be safe to use this drill with the extension lead if the lead was left wound inside the plastic case.

Explain why.

[3 marks]

.....

.....

.....

.....

.....

.....

4.5.1.2 Contact and non-contact forces

Question 15 · continued

6 (c) **Table 2** gives information about three different electric drills.

Table 2

Drill	Power input in watts	Power output in watts
X	640	500
Y	710	500
Z	800	500

A person is going to buy **one** of the drills, **X**, **Y** or **Z**. The drills cost the same to buy.

Use only the information in the table to decide which **one** of the drills, **X**, **Y** or **Z**, the person should buy.

Write your answer in the box. ☐

Give a reason for your answer.

[1 mark]

.....

.....

.....

9

4.5.1.2 Contact and non-contact forces

Question 16

June 2015 | PH2FP | Original Q3 | Legacy

3 (a) When a force is applied to a spring, the spring extends by 0.12 m. The spring has a spring constant of 25 N/m.

Calculate the force applied to the spring.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

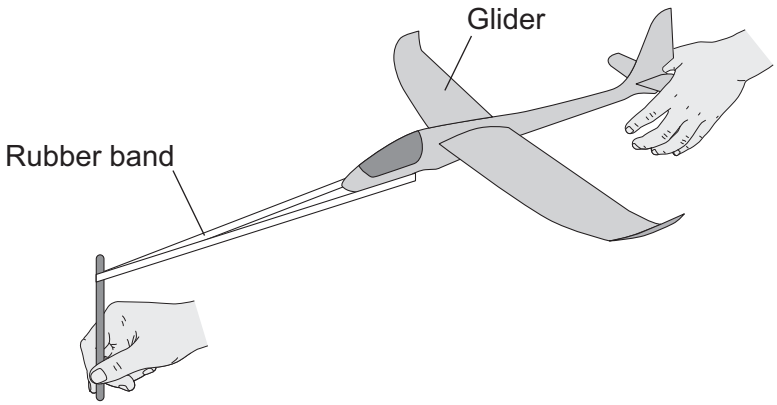
.....

.....

Force = ... N

3 (b) **Figure 2** shows a toy glider. To launch the glider into the air, the rubber band and glider are pulled back and then the glider is released.

Figure 2



3 (b) (i) Use the correct answers from the box to complete the sentence.

[2 marks]

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

When the glider is released, the ..... energy stored in the rubber band decreases and the glider gains ..... energy.

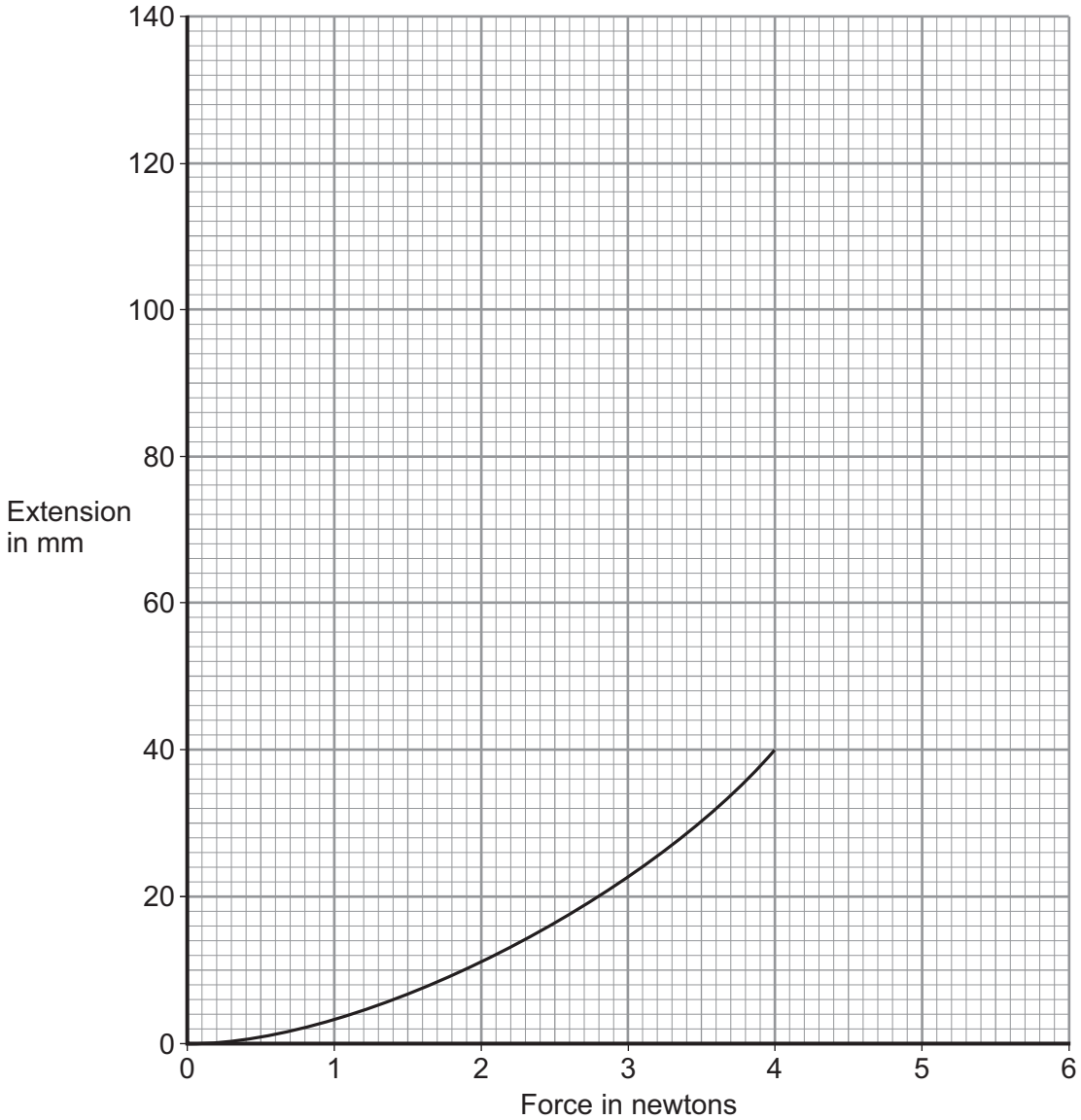
Question 3 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 16 · continued

3 (b) (ii) **Figure 3** shows how the extension of the rubber band varies with the force applied to the rubber band.

Figure 3



What can you conclude, from **Figure 3**, would happen to the extension of the rubber band if the force applied to the rubber band was increased to 6 N?

The rubber band does **not** break.

[2 marks]

.....

.....

.....

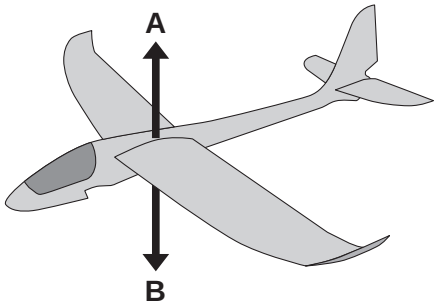
.....

4.5.1.2 Contact and non-contact forces

Question 16 · continued

3 (c) **Figure 4** shows the vertical forces, **A** and **B**, acting on the glider when it is flying.

Figure 4



3 (c) (i) What name is given to the force labelled **B**?

[1 mark]

Draw a ring around the correct answer.

drag **friction** **weight**

3 (c) (ii) Which **one** of the following describes the downward speed of the glider when force **B** is greater than force **A**?

[1 mark]

Tick (✓) **one** box.

Downward speed increases ☐

Downward speed is constant ☐

Downward speed decreases ☐

8

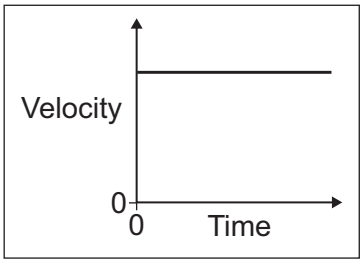
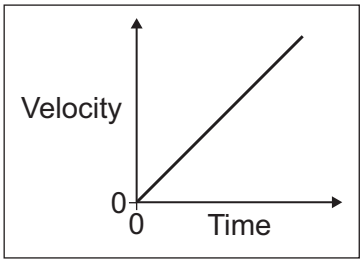
4.5.1.2 Contact and non-contact forces

Question 17

June 2015 | PH2FP | Original Q5 | Legacy

5 (a) Draw **one** line from each velocity–time graph to the statement describing the motion shown by the graph.

[2 marks]

Velocity–time graph	Motion shown by graph
	Constant acceleration
	Not moving
	Constant deceleration
	Constant velocity

5 (b) Use the correct answer from the box to complete the sentence.

[1 mark]

energy	**momentum**	**speed**

The velocity of an object includes both the ..... of the object and the direction the object is moving.

Question 5 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 17 · continued

5 (c) At the start of a race, a horse accelerates from a velocity of 0 m/s to a velocity of 9 m/s in 4 seconds.

5 (c) (i) Calculate the acceleration of the horse.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

Acceleration = ... m/s^2

5 (c) (ii) When the horse accelerates, what, if anything, happens to the air resistance acting against the horse?

[1 mark]

Tick (✓) **one** box.

The air resistance decreases. ☐

The air resistance is constant. ☐

The air resistance increases. ☐

5 (d) A horse and a pony walk across a field at the same constant speed.

The horse has 4000 joules of kinetic energy.

The pony is **half** the mass of the horse.

What is the kinetic energy of the pony?

[2 marks]

Draw a ring around the correct answer.

2000 J **4000 J** **8000 J**

Give a reason for your answer.

.....

.....

8

4.5.1.2 Contact and non-contact forces

Question 18

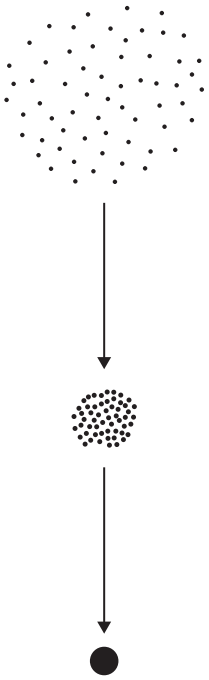
June 2016 | PH2FP | Original Q1 | Legacy

1 (a) **Figure 1** shows how a star is formed.

Use **one** answer from each box to complete the sentences in **Figure 1**.

[3 marks]

Figure 1



gas	**rock**	**water**

A star starts as a huge cloud of dust and _____ particles in space.

friction	**fusion**	**gravity**

The force of _____ pulls the particles in the cloud closer together.

protostar	**red giant**	**white dwarf**

The compressed mass of particles

forms a _____ .

4.5.1.2 Contact and non-contact forces

Question 18 · continued

1 (b) Elements heavier than iron are formed in a supernova.
What is a supernova?

[1 mark]

Tick (✓) **one** box.

the explosion of a massive star ☐

a very bright, hot young star ☐

a very cool super giant star ☐

1 (c) Brown dwarf stars are small stars too cool to give out visible light. They were first discovered in 1995. Scientists think that there are millions of these stars spread throughout the Universe.

Which **one** of the following is the most likely reason why brown dwarf stars were not discovered before 1995?

[1 mark]

Tick (✓) **one** box.

Brown dwarf stars did not exist before 1995. ☐

Scientists were looking in the wrong part of the Universe. ☐

The telescopes and measuring instruments were not sensitive enough. ☐

5

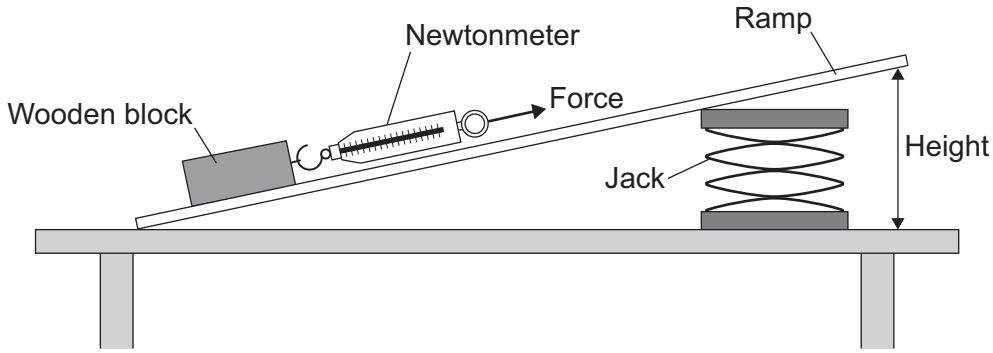
4.5.1.2 Contact and non-contact forces

Question 19

June 2017 | PH2FP | Original Q4 | Legacy

4 A student investigated how the height of a ramp affects the force needed to pull a wooden block up the ramp at a steady speed. **Figure 6** shows the apparatus used by the student.

Figure 6



4 (a) Complete the following sentence.

[1 mark]

To pull the wooden block up the ramp the student must do work against the force of friction and the force of _____ .

4 (b) (i) What was the independent variable in this investigation?

[1 mark]

Tick (✓) **one** box.

The force used to pull the wooden block. ☐

The height of the ramp. ☐

The mass of the wooden block. ☐

4 (b) (ii) What was a control variable in this investigation?

[1 mark]

Tick (✓) **one** box.

The force used to pull the wooden block. ☐

The height of the ramp. ☐

The mass of the wooden block. ☐

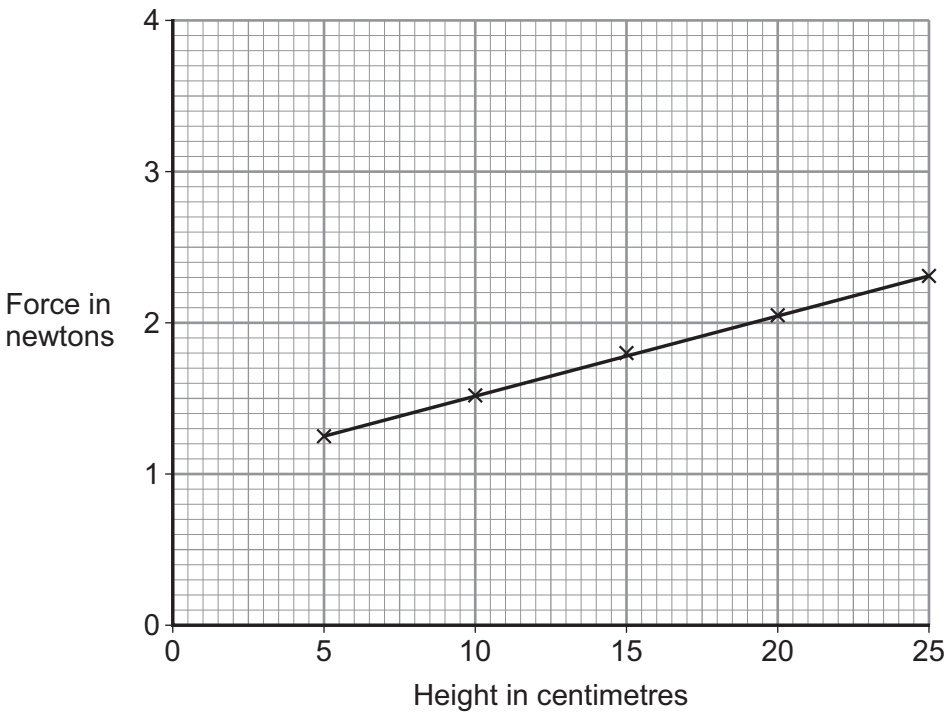
Question 4 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 19 · continued

4 (c) The results from the investigation are plotted in **Figure 7**.

Figure 7



4 (c) (i) How do you know from **Figure 7**, that none of the results were anomalous?

[1 mark]

_____

_____

4 (c) (ii) Use **Figure 7** to estimate the force needed to pull the wooden block along the ramp when the ramp is lying flat on the bench.

[1 mark]

Force = _____ N

4 (c) (iii) What conclusion should be made from the results shown in **Figure 7**?

[2 marks]

_____

_____

_____

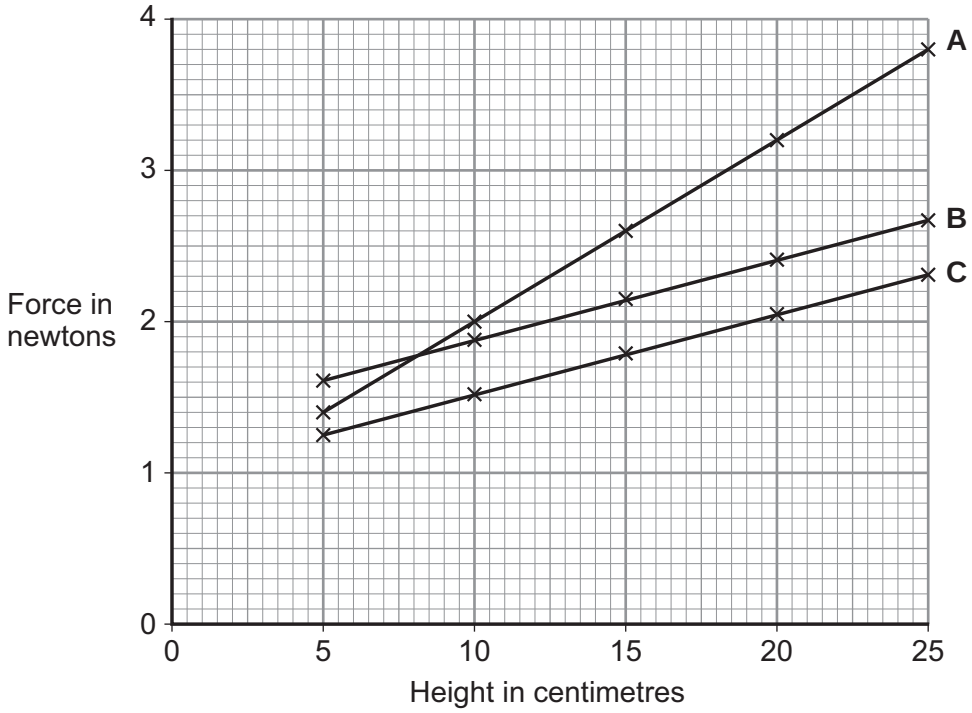
_____

4.5.1.2 Contact and non-contact forces

Question 19 · continued

4 (c) (iv) Another student used the same apparatus to repeat the investigation.
The student increased the force of friction by fixing a rough material to the bottom of the wooden block.

Figure 8



Which of the following, **A**, **B** or **C**, in **Figure 8**, shows the results obtained by this student?

[1 mark]

Tick (✓) **one** box.

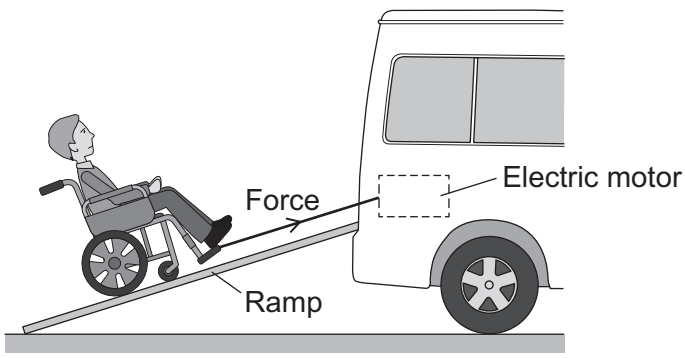
A ☐ **B** ☐ **C** ☐

Question 4 continues on the next page

Question 19 · continued

4 (d) **Figure 9** shows how a ramp is used to help move a child in a wheelchair into a car. The wheelchair is pulled up the ramp by a cable attached to an electric motor.

Figure 9



A force of 260 N is used to pull the child and wheelchair up the ramp.
The ramp is 1.2 m long.

Calculate the work done to pull the child and wheelchair up the ramp.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

Work done = _____ J

10

4.5.1.2 Contact and non-contact forces

Question 20

June 2018 | 8463/1F | Original Q10

1 0 **Figure 15** shows a student walking on a carpet.

Figure 15



1 0 . 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 20 · continued

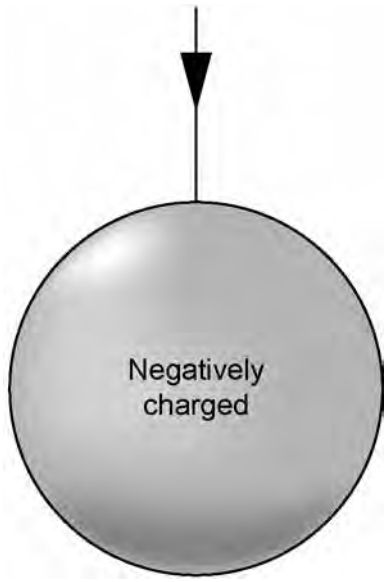
1 0 . 2 The student's head is represented by the sphere in **Figure 16.**

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

Draw **three** more arrows on **Figure 16** to complete the electric field pattern.

[1 mark]

Figure 16



1 0 . 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 20 · continued

June 2018 | 8463/1F | Original Q10

1 0 . 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 21

June 2018 | 8463/2F | Original Q10

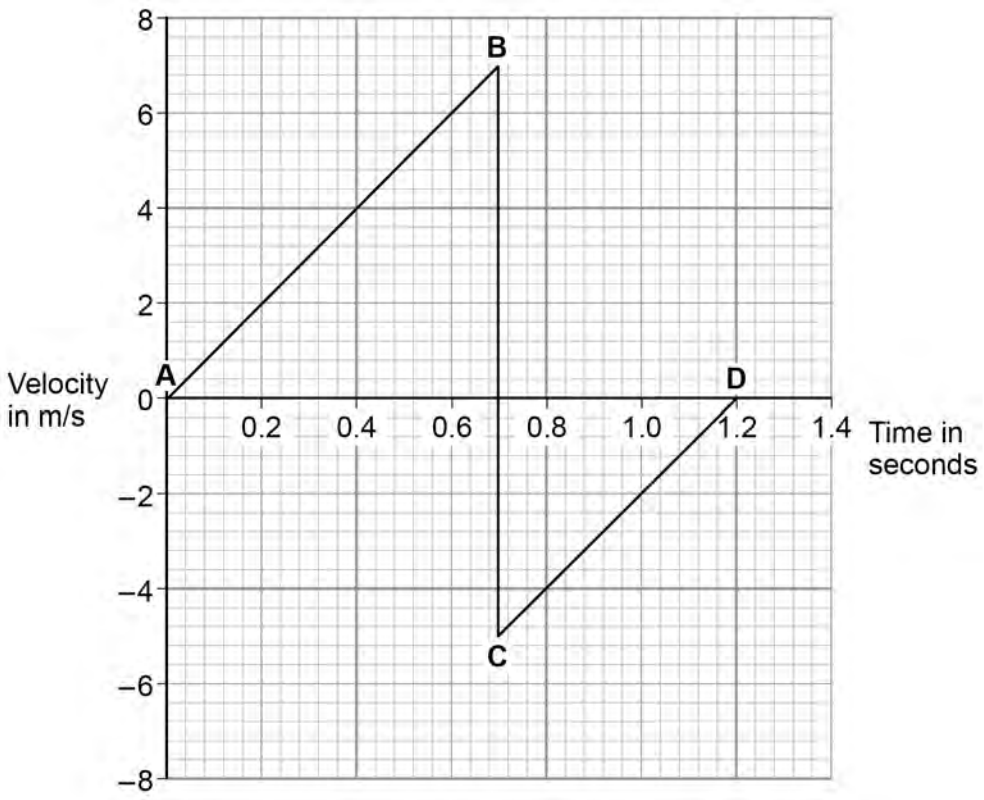
1 0 A child drops a ball.

The ball hits the ground and bounces.

Figure 14 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 14



1 0 . 1 Describe the motion of the ball between points **A** and **B** on **Figure 14**.

[2 marks]

1 0 . 2 What direction is the ball moving between points **C** and **D** on **Figure 14**?

[1 mark]

4.5.1.2 Contact and non-contact forces

Question 21 · continued

June 2018 | 8463/2F | Original Q10

1 0 . 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. ☐

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

Explain how the data in **Figure 14** shows this energy transfer.

[4 marks]

8

4.5.1.2 Contact and non-contact forces

Question 22

June 2018 | 8463/2F | Original Q11

1 1 A student carried out an investigation to determine the spring constant of a spring.

Table 4 gives the data obtained by the student.

Table 4

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

1 1 . 1 Describe a method the student could have used to obtain the data given in **Table 4**.

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 22 · continued

June 2018 | 8463/2F | Original Q11

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

Suggest why.

[1 mark]

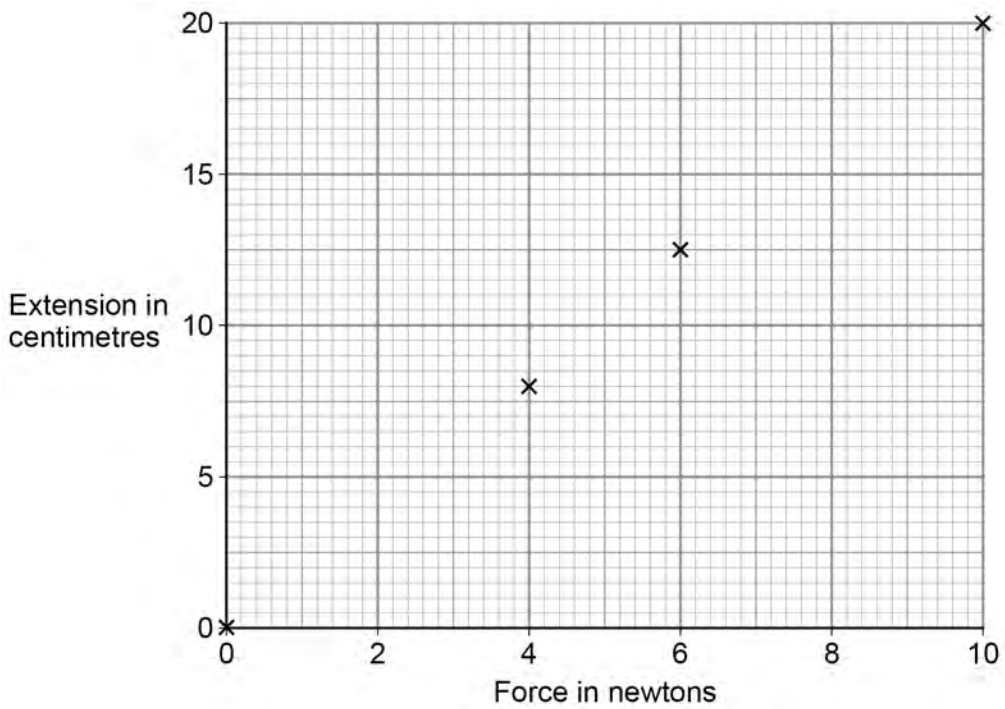
Question 11 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 22 · continued

Figure 15 shows some of the data obtained by the student.

Figure 15



1 1 . 3 Complete **Figure 15** by plotting the missing data from **Table 4.**

Draw the line of best fit.

Table 4 is repeated here to help you answer this question.

[2 marks]

Table 4

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

1 1 . 4 Write down the equation that links extension, force and spring constant.

[1 mark]

4.5.1.2 Contact and non-contact forces

Question 22 · continued

1 1 . 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

1 1 . 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]

1(

4.5.1.2 Contact and non-contact forces

Question 23

0 3 . 1 **Figure 5** shows a bar magnet.

Each circle represents a compass.

Figure 5



Draw an arrow inside each circle to show the direction that each compass would point.

[1 mark]

0 3 . 2 **Figure 6** shows part of a coat.

The coat has two magnets hidden inside the material.

Figure 7 shows how the magnets are used to fasten the coat.

Figure 6

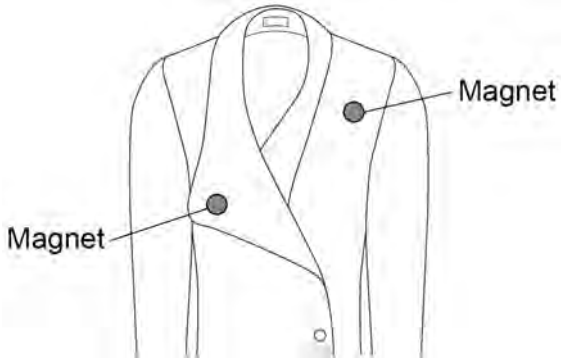


Figure 7



Explain why the magnets inside the coat must **not** have two south poles facing each other.

[2 marks]

4.5.1.2 Contact and non-contact forces

Question 23 · continued

A coil of wire is connected to a battery.

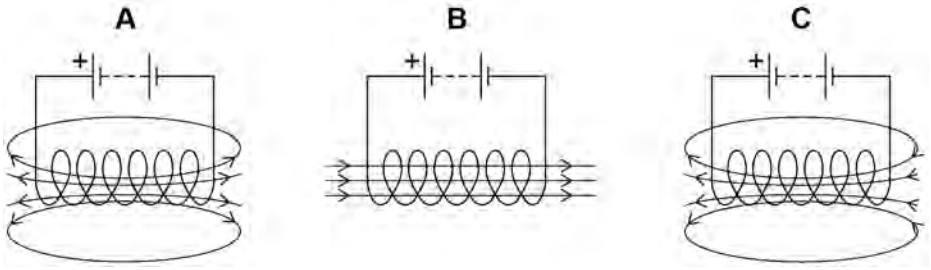
The current in the coil produces a magnetic field.

0 3 . 3 Which diagram in **Figure 8** shows the magnetic field produced by the current in the coil?

[1 mark]

Tick (✓) **one** box.

Figure 8



A ☐ B ☐ C ☐

0 3 . 4 A solid rod is placed inside the coil.

Which type of rod would make the magnetic field of the coil stronger?

[1 mark]

Tick (✓) **one** box.

Glass rod ☐

Plastic rod ☐

Steel rod ☐

Wooden rod ☐

4.5.1.2 Contact and non-contact forces

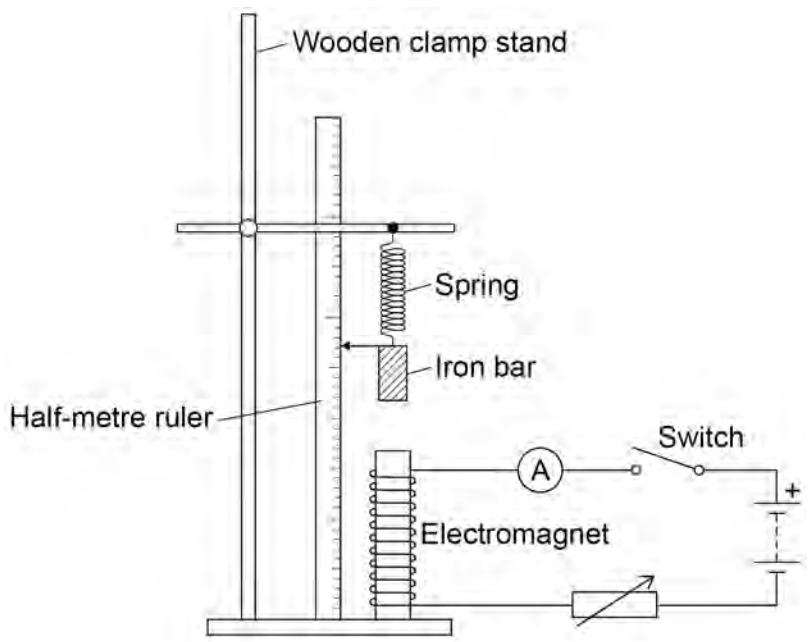
Question 23 · continued

June 2019 | 8463/2F | Original Q3

A student investigated how the strength of an electromagnet varies with the current in the coil of the electromagnet.

Figure 9 shows the equipment the student used.

Figure 9



0 3 . 5 Why does the spring get longer when the electromagnet is switched on?

[1 mark]

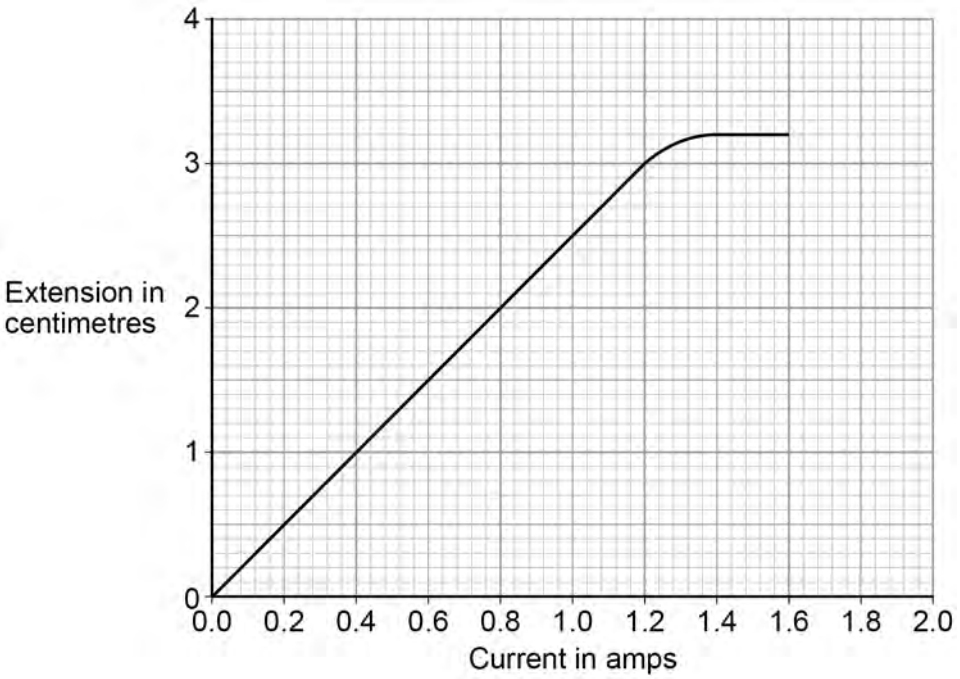
4.5.1.2 Contact and non-contact forces

Question 23 · continued

The student measured how much further the spring extended with different values of current in the coil.

Figure 10 shows the results.

Figure 10



0 3 . 6 The current in the coil is increased from 0.6 A to 1.2 A

Determine the increase in the extension of the spring.

[1 mark]

Increase in the extension = _____ cm

0 3 . 7 Calculate the increase in the force on the spring when the current in the coil increased from 0.6 A to 1.2 A

Spring constant = 0.18 N/cm

Use the equation:

force = spring constant × extension

[2 marks]

Increase in the force = _____ N

4.5.1.2 Contact and non-contact forces

Question 23 · continued

0 3 . 8 Describe what happened to the strength of the electromagnet as the current in the coil increased from 1.2 A to 1.6 A

[2 marks]

11

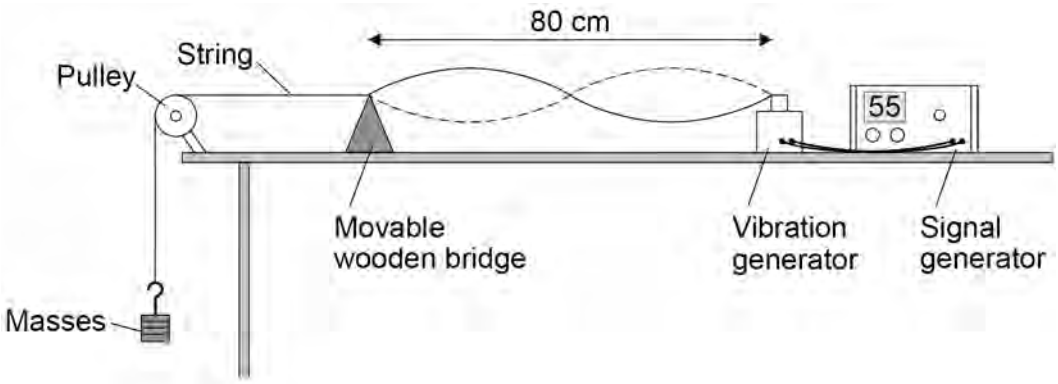
4.5.1.2 Contact and non-contact forces

Question 24

June 2019 | 8463/2F | Original Q9

0 9 **Figure 23** shows the apparatus used to investigate the waves in a stretched string.

Figure 23



The frequency of the signal generator is adjusted so that the wave shown in **Figure 23** is seen.

At this frequency the string vibrates between the two positions shown in **Figure 23**.

0 9 . 1 The wavelength of the wave shown in **Figure 23** was measured as 80 cm

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

[1 mark]

0 9 . 2 Write down the equation which links frequency, wavelength and wave speed.

[1 mark]

0 9 . 3 The string in **Figure 23** vibrates at 55 Hz

Calculate the wave speed of the wave shown in **Figure 23**.

Use data given in **Figure 23**.

[3 marks]

Wave speed = _____ m/s

4.5.1.2 Contact and non-contact forces

Question 24 · continued

0 9 . 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 9 . 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 23**.

Describe a method the student could use for this investigation.

[4 marks]

11

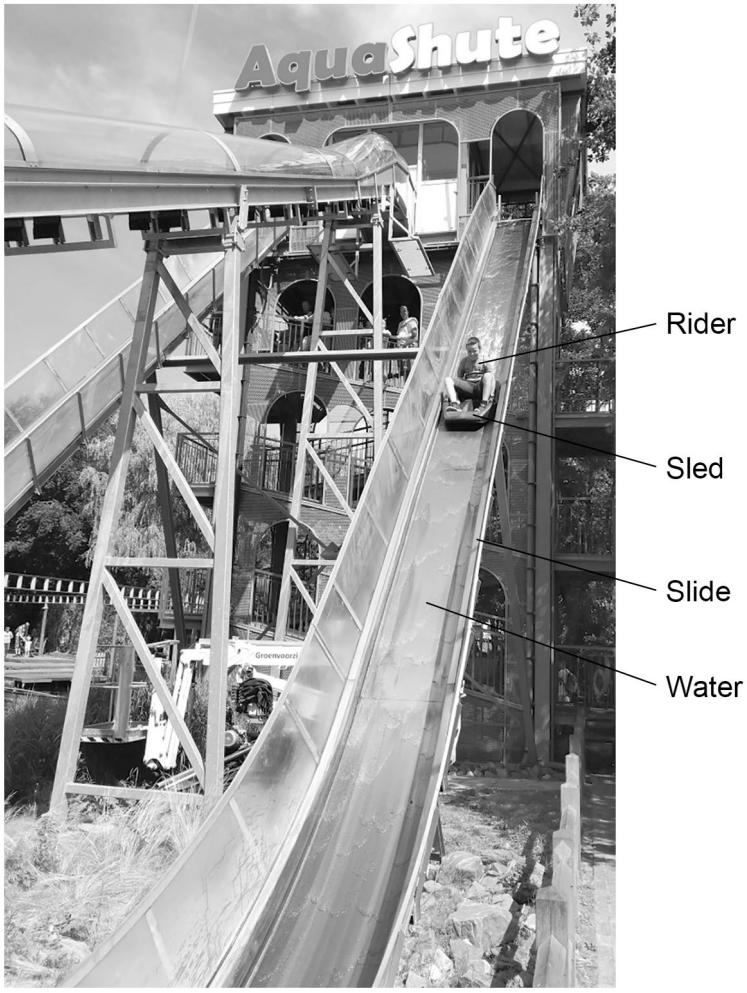
4.5.1.2 Contact and non-contact forces

Question 25

November 2020 | 8463/1F | Original Q2

0 2 **Figure 4** shows a theme park ride called AquaShute.

Figure 4



0 2 . 1 Riders of the AquaShute sit on a sled and move down a slide.

There is a layer of water between the sled and the slide.

How does the layer of water affect the friction between the sled and the slide?

[1 mark]

Tick (✓) **one** box.

The friction is decreased. ☐

The friction is increased. ☐

The friction is not affected. ☐

Question 25 · continued

0 2 . 2 The mass of one rider is 62.5 kg.

The height of the slide is 16.0 m.

gravitational field strength = 9.8 N/kg

Calculate the gravitational potential energy of the rider at the top of the slide.

Use the equation:

gravitational potential energy = mass × gravitational field strength × height

[2 marks]

Gravitational potential energy = _____ J

0 2 . 3 At the bottom of the slide the speed of the rider is 12 m/s.

The mass of the rider is 62.5 kg.

Calculate the kinetic energy of the rider at the bottom of the slide.

Use the equation:

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

[2 marks]

Kinetic energy = _____ J

Question 2 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 25 · continued

0 2 . 4 When a rider reaches the bottom of the slide, the sled decelerates and stops.

Give **two** factors that will affect how far the sled will move before it stops.

[2 marks]

1 _____

_____

2 _____

_____

7

4.5.1.2 Contact and non-contact forces

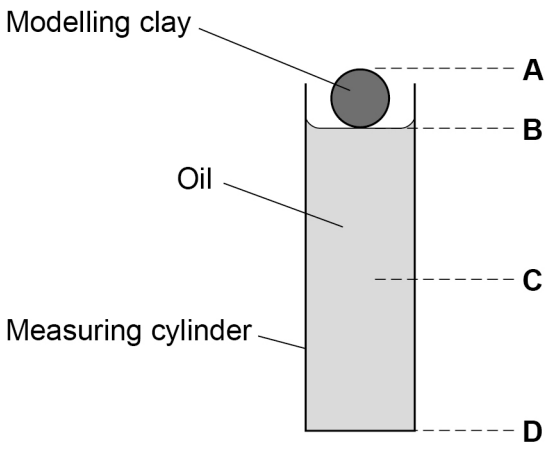
Question 26

November 2020 | 8463/2F | Original Q1

0 1 A student dropped a piece of modelling clay into oil.

Figure 1 shows the modelling clay just before it was dropped into the oil.

Figure 1



0 1 . 1 What was the distance fallen by the modelling clay?

[1 mark]

Tick (✓) **one** box.

from A to C ☐

from A to D ☐

from B to C ☐

from B to D ☐

0 1 . 2 What measuring instrument should be used to measure the distance fallen?

[1 mark]

_____

Question 1 continues on the next page

Question 26 · continued

The student dropped four pieces of modelling clay, each with a different shape.

For each piece the student measured the time taken to fall the same distance through the oil.

0 1 . 3 The student removed each piece of modelling clay from the oil before dropping the next piece.

Suggest **one** reason why.

[1 mark]

The student repeated the measurements and calculated mean values.

Table 1 shows the results.

Table 1

Shape	Time taken in seconds			
	Drop 1	Drop 2	Drop 3	Mean
 Sphere	47	38	41	42
 Cube	68	49	57	58
 Cylinder	34	37	34	**X**
 Cone	29	23	26	26

0 1 . 4 Calculate value **X** in **Table 1**.

[2 marks]

X = _____ s

4.5.1.2 Contact and non-contact forces

Question 26 · continued

0 1 . 5 Each piece of modelling clay had the same mass.

Which shape in **Table 1** had the smallest resistive force acting against it as it fell?

Tick (✓) **one** box.

Give **one** reason for your answer.

[2 marks]

Cone ☐

Cube ☐

Cylinder ☐

Sphere ☐

Reason _____

_____

0 1 . 6 How would the time taken to fall change if the modelling clay was dropped through air instead of through oil?

[1 mark]

Tick (✓) **one** box.

Time through air would be less. ☐

Time through air would be more. ☐

Time through air would be the same. ☐

Question 1 continues on the next page

Question 26 · continued

0 1 . 7 The mass of a piece of modelling clay was 0.050 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the piece of modelling clay.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

0 1 . 8 Weight causes the modelling clay to fall through the oil.

Weight is a non-contact force.

Which of the following are also non-contact forces?

Tick (✓) **two** boxes.

[2 marks]

- Air resistance ☐
- Electrostatic force ☐
- Friction ☐
- Magnetic force ☐
- Tension ☐

12

4.5.1.2 Contact and non-contact forces

Question 27

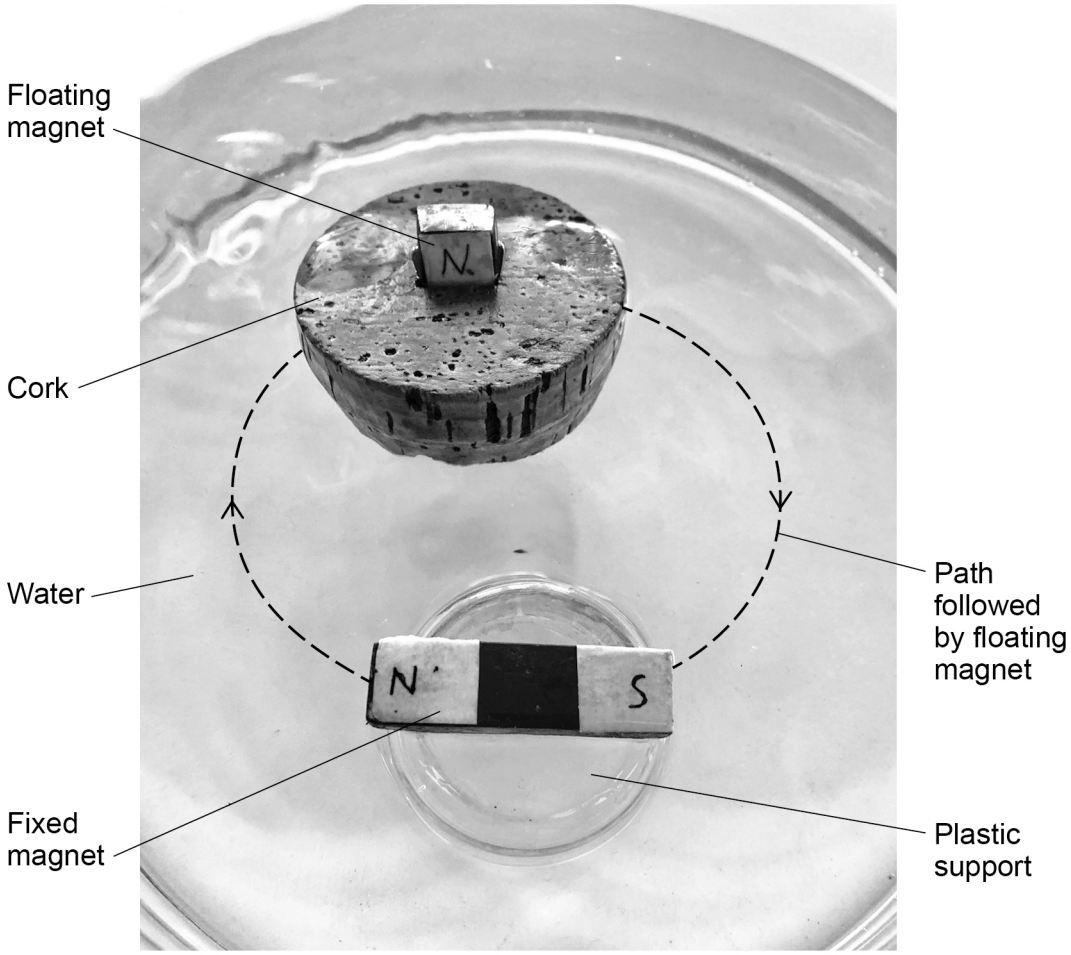
November 2020 | 8463/2F | Original Q5

0 5 A student placed a magnet on top of a plastic support in a bowl of water. This magnet was fixed in position and above the surface of the water.

The student put a second magnet into a piece of cork so that the magnet floated on the water. Only the north pole of the floating magnet was above the surface of the water.

Figure 6 shows the arrangement of the magnets.

Figure 6



0 5 . 1 The floating magnet was placed near to the north pole of the fixed magnet. The floating magnet then moved along the path shown in **Figure 6**.

Explain why.

[2 marks]

Question 27 · continued

0 5 . 2 The student replaced the floating magnet with a piece of iron.

What happened to the piece of iron?

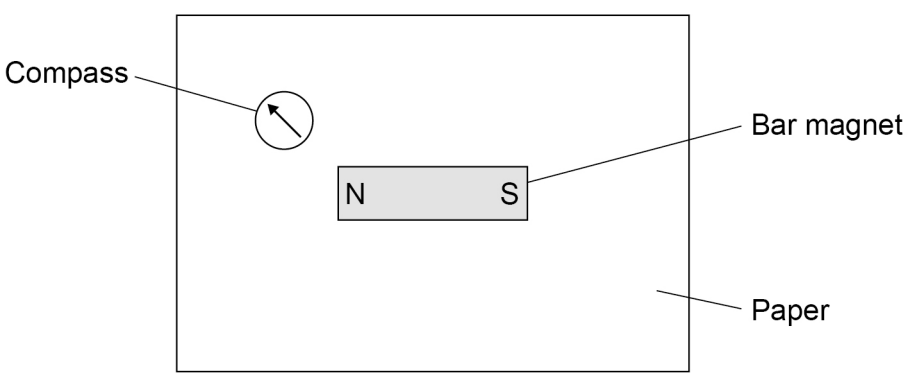
[1 mark]

0 5 . 3 Describe how to use a compass to plot the magnetic field pattern around a bar magnet.

Use **Figure 7** to help you.

[4 marks]

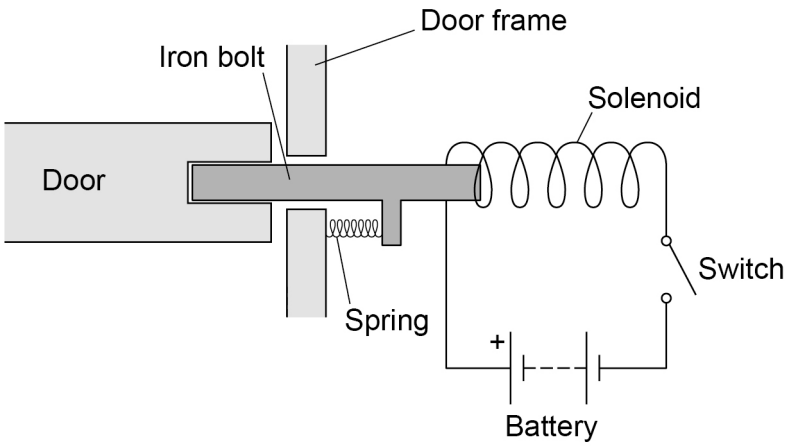
Figure 7



Question 27 · continued

Figure 8 shows a diagram of an electromagnetic lock used to secure a door.

Figure 8



0 5 . 4 **Figure 9** shows an incomplete sequence of how the door unlocks.

Figure 9



Write **one** letter in each box to show the correct sequence.

[2 marks]

A The iron bolt moves.

B A magnetic field is created around the solenoid.

C There is a current in the circuit.

Question 5 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 27 · continued

0 5 . 5 The electromagnetic lock contains a spring.

When the door is unlocked the extension of the spring is 0.040 m.

spring constant = 200 N/m

Calculate the elastic potential energy of the spring when the door is unlocked.

Use the equation:

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

[2 marks]

Elastic potential energy = _____ J

11

4.5.1.2 Contact and non-contact forces

Question 28

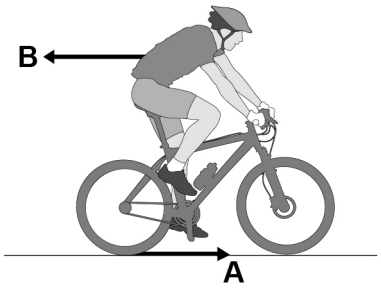
November 2021 | 8463/2F | Original Q2

0 2 **Figure 3** shows a cyclist on a bicycle.

The cyclist is moving at a constant velocity.

Arrows **A** and **B** represent the horizontal forces acting on the bicycle and cyclist.

Figure 3



0 2 . 1 What is force **A**?

[1 mark]

Tick (✓) **one** box.

- Air resistance ☐
- Friction ☐
- Tension ☐
- Upthrust ☐

4.5.1.2 Contact and non-contact forces

Question 28 · continued

0 2 . 2 What is force **B**?

[1 mark]

Tick (✓) **one** box.

- Air resistance ☐
- Magnetic ☐
- Tension ☐
- Upthrust ☐

0 2 . 3 What is the relationship between force **A** and force **B** when the cyclist travels at a constant velocity?

[1 mark]

Tick (✓) **one** box.

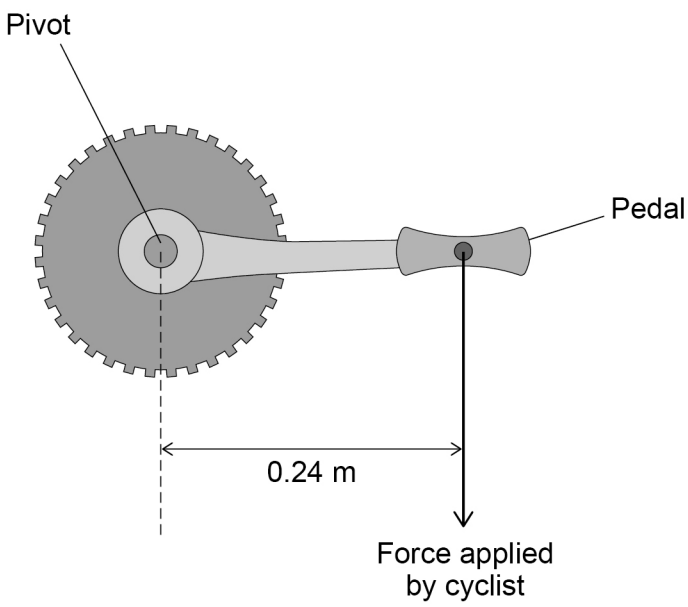
- **A = B** ☐
- **A > B** ☐
- **A < B** ☐

Question 2 continues on the next page

0 2 . 4 The cyclist applies a force of 150 N to one of the bicycle pedals.

Figure 4 shows the distance between the force applied and the pivot.

Figure 4



Calculate the moment about the pivot caused by the force applied to the pedal in **Figure 4**.

Use the equation:

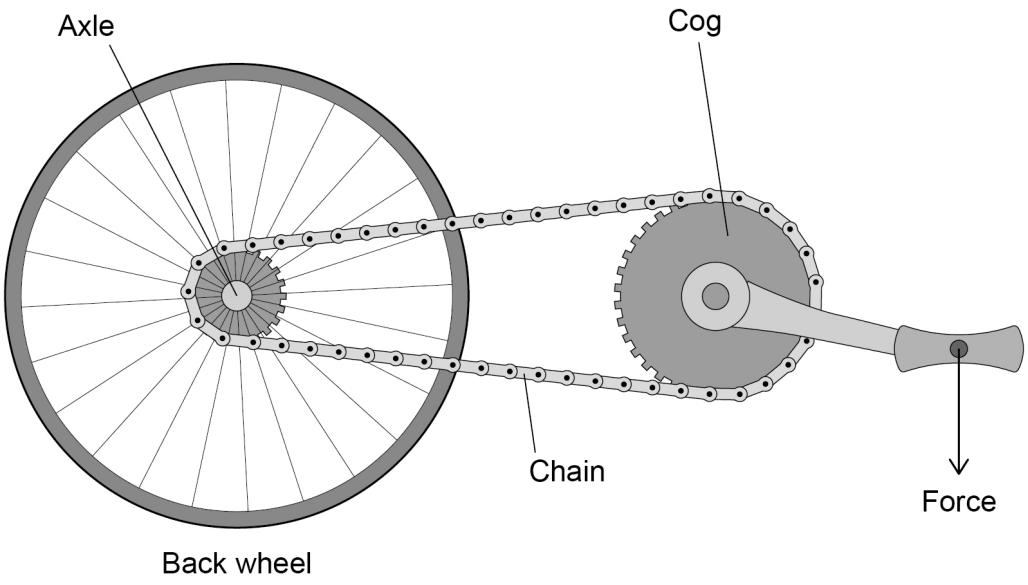
moment of a force = force × distance

[2 marks]

Moment = _____ N m

0 2 . 5 **Figure 5** shows how the pedal is connected to the back wheel of the bicycle.

Figure 5



Complete the sentence.

Choose the answer from the box.

[1 mark]

axle	**chain**	**cog**

The force from the cyclist pushing down on the pedal is transmitted to the back wheel by the _____ .

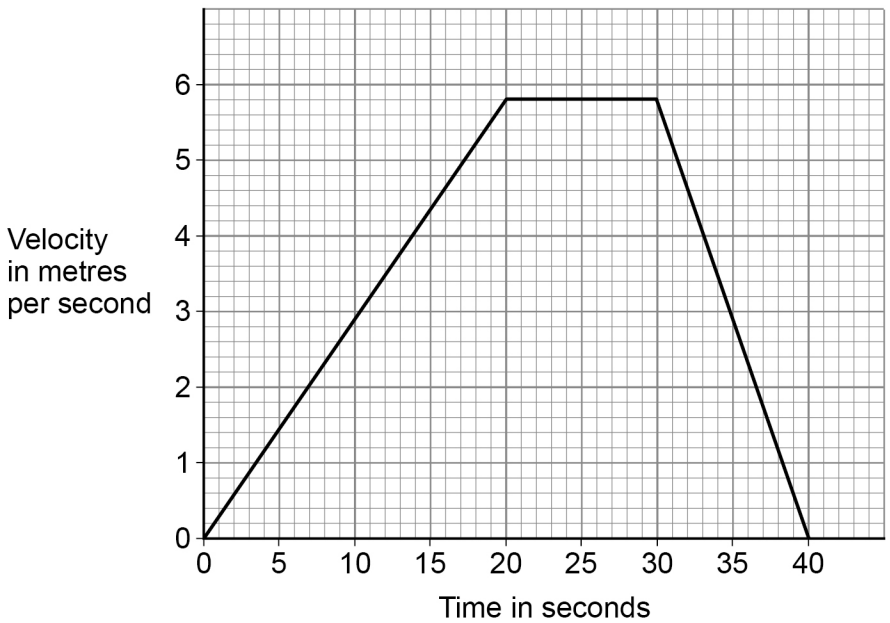
Question 2 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 28 · continued

Figure 6 shows how the velocity of the cyclist changes during a journey.

Figure 6



0 2 . 6 What is the change in velocity of the cyclist in the first 20 seconds of the journey?

[1 mark]

Tick (✓) **one** box.

5.2 m/s ☐

5.4 m/s ☐

5.6 m/s ☐

5.8 m/s ☐

Question 28 · continued

0 2 . 7 Determine the acceleration of the cyclist during the first 20 seconds of the journey.

Use your answer from Question **02.6**

Use the equation:

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

[2 marks]

Acceleration of the cyclist = _____ m/s^2

0 2 . 8 Complete the sentence.

Choose the answer from the box.

[1 mark]

deceleration	**speed**	**velocity**

Between 30 and 40 seconds the cyclist moves with

a constant _____ .

Question 2 continues on the next page

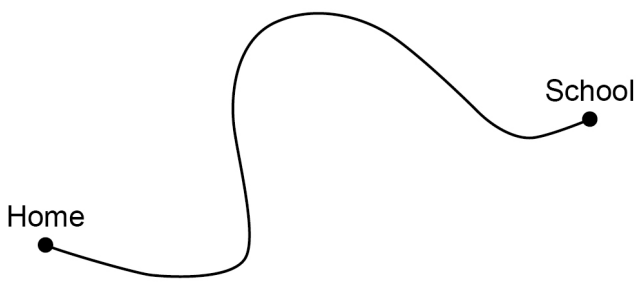
4.5.1.2 Contact and non-contact forces

Question 28 · continued

0 2 . 9 The cyclist travels from home to school.

Figure 7 shows the route the cyclist followed.

Figure 7



Draw an arrow on **Figure 7** to show the displacement of the cyclist.

[1 mark]

11

4.5.1.2 Contact and non-contact forces

Question 29

November 2021 | 8463/2F | Original Q6

0 6 The Sun is the closest star to the Earth.

0 6 . 1 A 2.5 kg mass would have a weight of 750 N at the surface of the Sun.

Calculate the gravitational field strength at the surface of the Sun.

Use the equation:

$$\text{gravitational field strength} = \frac{\text{weight}}{\text{mass}}$$

[2 marks]

Gravitational field strength = _____ N/kg

0 6 . 2 Gravity is a non-contact force.

Which of the following is also a non-contact force?

[1 mark]

Tick (✓) **one** box.

- Air resistance ☐
- Electrostatic ☐
- Friction ☐
- Tension ☐

4.5.1.2 Contact and non-contact forces

Question 29 · continued

0 6 . 3 All stars have a life cycle.

Figure 15 shows part of the life cycle of a star that becomes a black dwarf.

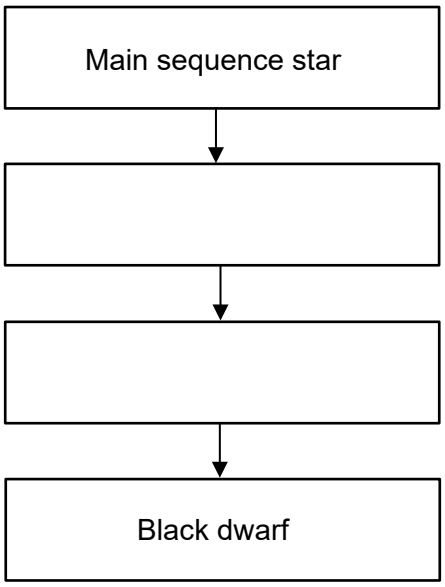
Complete **Figure 15**.

Choose answers from the box.

[2 marks]

Black hole		**Neutron star**
Red giant	**Supernova**	**White dwarf**

Figure 15



Question 6 continues on the next page

Question 29 · continued

Table 3 gives the mass of three stars compared to the mass of the Sun.

Table 3

Star	Mass compared to the mass of the Sun
X	× 25.0
Y	× 15.0
Z	× 0.9

0 6 . 4 Which letter represents the star most likely to become a black dwarf?

Give a reason for your answer.

[2 marks]

Tick (✓) **one** box.

X ☐ **Y** ☐ **Z** ☐

Reason _____

_____

_____

0 6 . 5 In which stage of the life cycle of a star are elements heavier than iron produced?

[1 mark]

Tick (✓) **one** box.

Nebula ☐

Protostar ☐

Supernova ☐

8

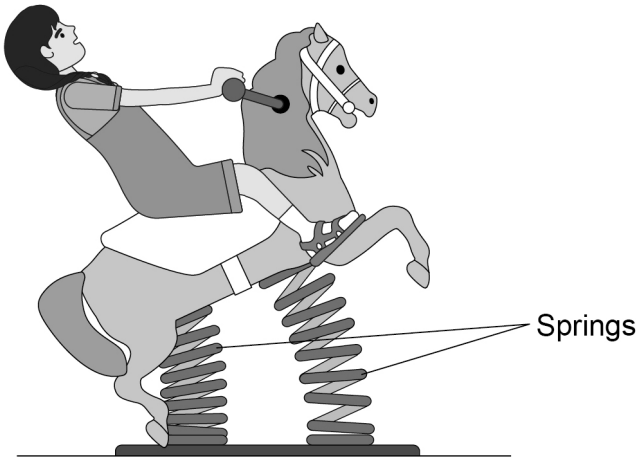
4.5.1.2 Contact and non-contact forces

Question 30

November 2021 | 8463/2F | Original Q9

0 9 **Figure 20** shows a child on a playground toy.

Figure 20



0 9 . 1 The springs have been elastically deformed.

Explain what is meant by 'elastically deformed'.

[2 marks]

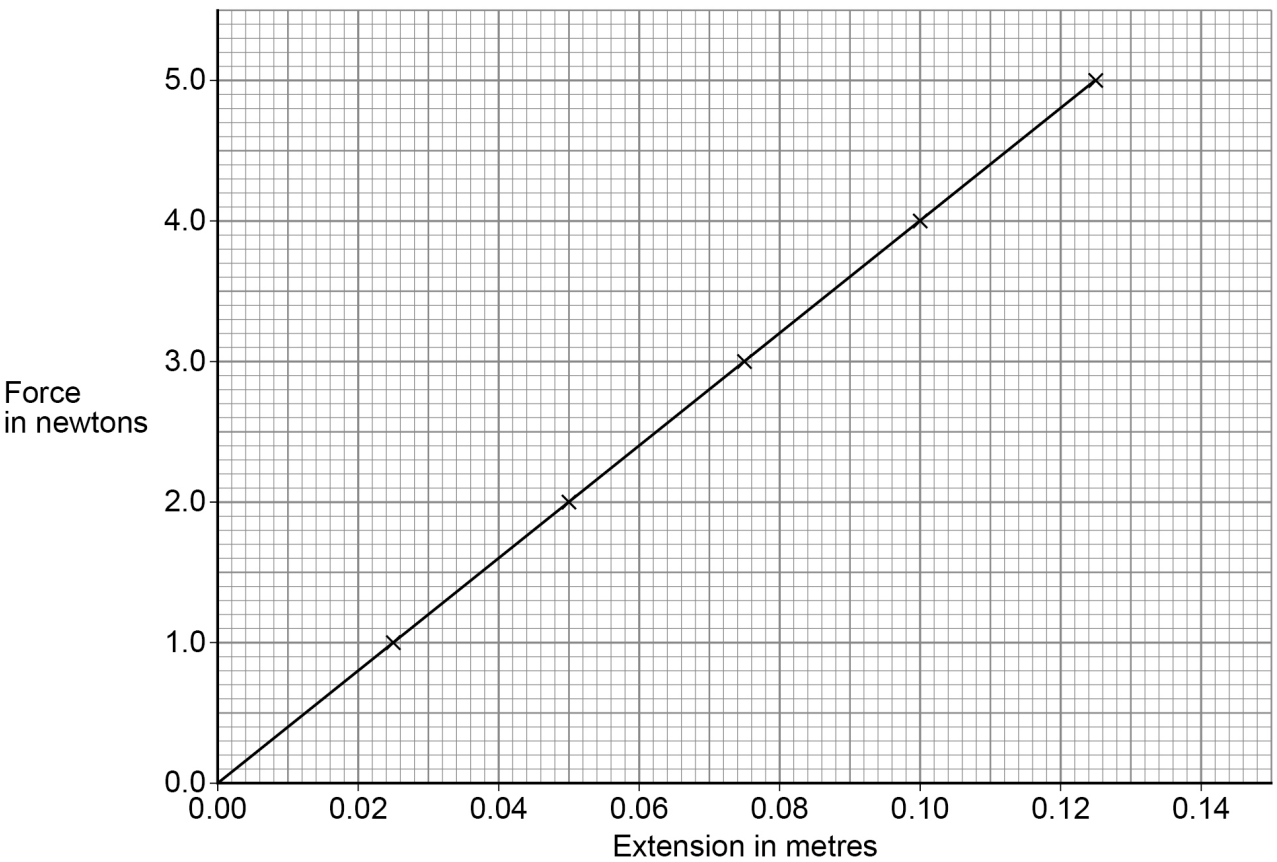
Question 9 continues on the next page

Question 30 · continued

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

Figure 21 shows the results.

Figure 21



4.5.1.2 Contact and non-contact forces

Question 30 · continued

0 9 . 2 Describe a method the student could use to obtain the results given in **Figure 21**.

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

Your answer may include a diagram.

[6 marks]

Question 9 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 30 · continued

0 9 . 3 Which equation links extension (*e*), force (*F*) and spring constant (*k*).

[1 mark]

Tick (✓) **one** box.

force = spring constant × (extension)^2 ☐

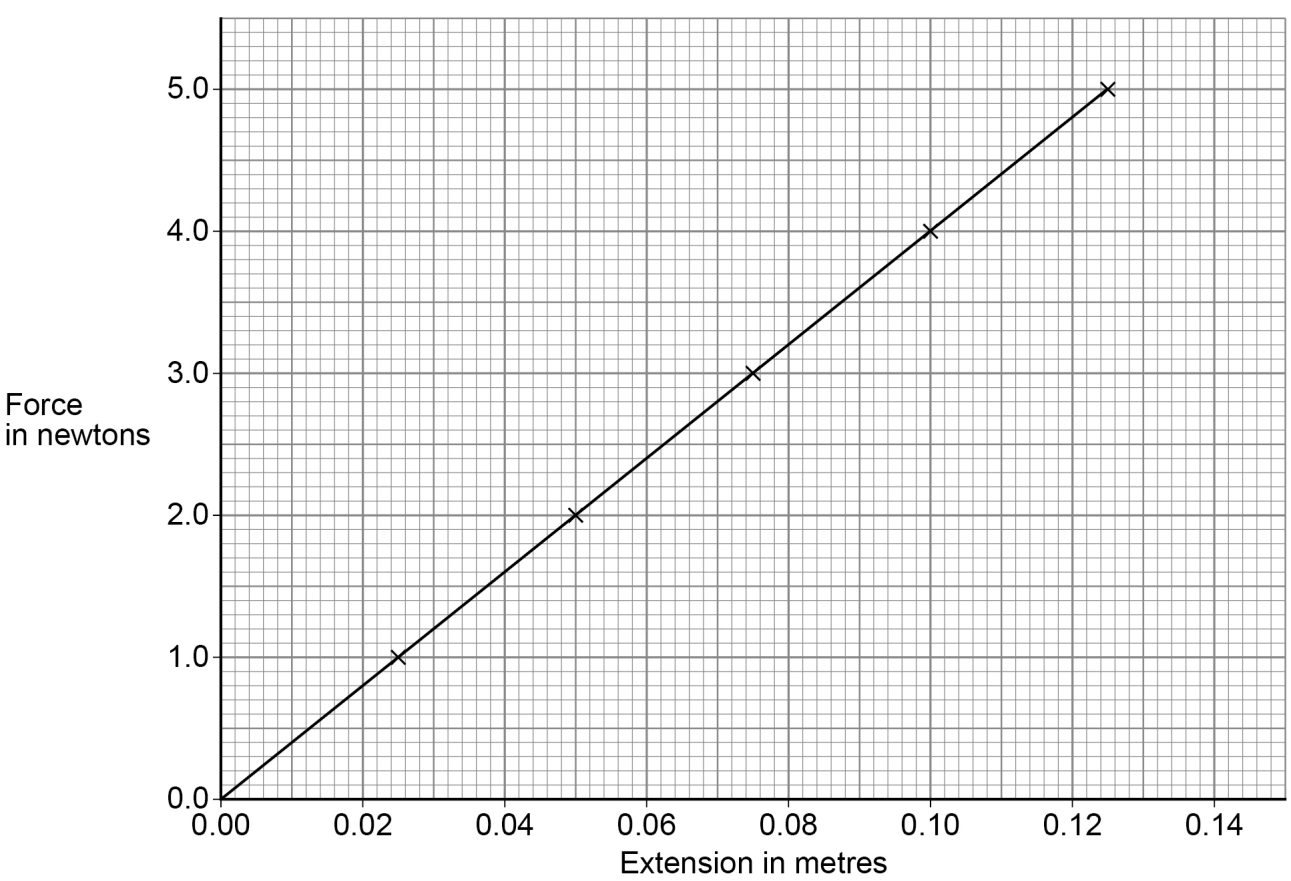
force = spring constant × extension ☐

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

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

Figure 21 is repeated below.

Figure 21



4.5.1.2 Contact and non-contact forces

Question 30 · continued

0 9 . 4 Determine the spring constant of the spring.

Use **Figure 21**.

[3 marks]

Spring constant = _____ N/m

0 9 . 5 The student concluded:

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

Describe how **Figure 21** supports the student's conclusion.

[2 marks]

Question 9 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 30 · continued

0 9 . 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

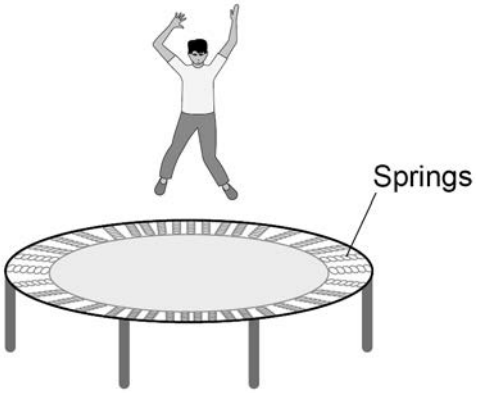
4.5.1.2 Contact and non-contact forces

Question 31

June 2022 | 8463/1F | Original Q1

0 1 **Figure 1** shows a boy bouncing on a trampoline.

Figure 1



0 1 . 1 The boy falls from the position in **Figure 1** towards the trampoline.

Complete the sentences.

Choose answers from the box.

[2 marks]

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

As the boy falls, there is a decrease in his _____ energy.

As the boy falls, there is an increase in his _____ energy.

Question 31 · continued

0 1 . 2 As the boy lands on the trampoline, each spring stretches 0.015 m.

spring constant of each spring = 120 000 N/m

Calculate the energy stored by each spring.

Use the equation:

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

[2 marks]

Elastic potential energy = _____ J

0 1 . 3 There are 40 springs on the trampoline.

Calculate the total energy stored by the 40 springs when each spring is stretched by 0.015 m.

Use your answer from Question **01.2**

[1 mark]

Total energy stored = _____ J

Question 1 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 31 · continued

0 1 . 4 The kinetic energy of the boy as he lands on the trampoline is 600 J.

The maximum kinetic energy of the boy after he bounces is 45% of his kinetic energy as he lands.

Calculate the maximum kinetic energy of the boy after he bounces.

[2 marks]

Maximum kinetic energy = _____ J

0 1 . 5 Why is the kinetic energy of the boy after he bounces less than his kinetic energy as he lands?

[1 mark]

Tick (✓) **one** box.

- Energy is not conserved. ☐
- Energy is transferred to the surroundings. ☐
- The springs transfer energy to the boy. ☐

8

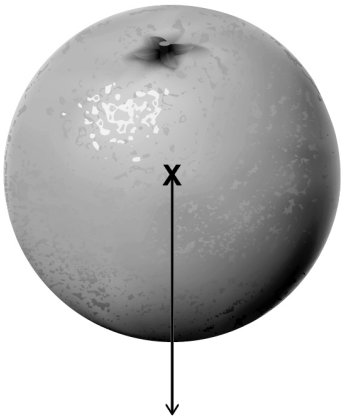
4.5.1.2 Contact and non-contact forces

Question 32

June 2022 | 8463/2F | Original Q4

0 4 **Figure 6** shows the weight of an orange acting from a point labelled **X**.

Figure 6



0 4 . 1 What name is given to point **X** in **Figure 6**?

[1 mark]

Tick (✓) **one** box.

Centre of force ☐

Centre of mass ☐

Centre of balance ☐

Centre of weight ☐

0 4 . 2 Weight and mass are not the same.

The relationship between weight and mass for an object can be written as:

$$\text{weight} \propto \text{mass}$$

Which sentence describes the relationship between weight and mass?

[1 mark]

Tick (✓) **one** box.

Weight is approximately equal to mass. ☐

Weight is directly proportional to mass. ☐

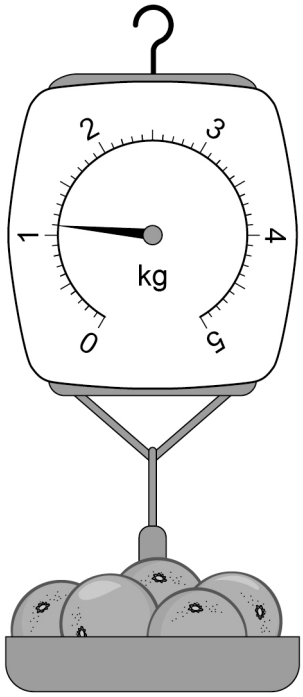
Weight is less than mass. ☐

4.5.1.2 Contact and non-contact forces

Question 32 · continued

Figure 7 shows a balance used to measure the mass of 5 oranges.

Figure 7



0 4 . 3 All 5 of the oranges have the same mass.

Determine the mass of 1 orange.

[2 marks]

Mass = _____ kg

0 4 . 4 Calculate the weight of 1 orange.

gravitational field strength = 9.8 N/kg

Use the equation:

weight = mass × gravitational field strength

[2 marks]

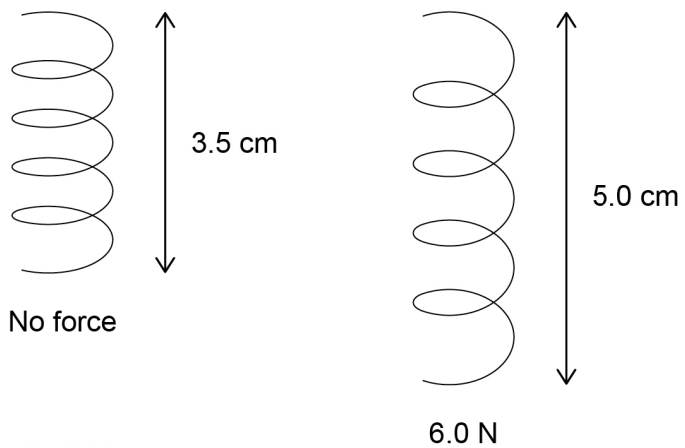
Weight = _____ N

Question 32 · continued

The balance shown in **Figure 7** contains a spring.

Figure 8 shows the spring with no force acting on it and with a force of 6.0 N acting on it.

Figure 8



0 4 . 5 What is the extension of the spring when a force of 6.0 N acts on it?

[1 mark]

Tick (✓) **one** box.

0.015 m ☐

0.035 m ☐

0.050 m ☐

0.085 m ☐

0 4 . 6 Calculate the spring constant of the spring.

Use the equation:

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

[2 marks]

Spring constant = _____ N/m

4.5.1.2 Contact and non-contact forces

Question 32 · continued

0 4 . 7 What will happen to the spring when the force is removed?

[1 mark]

10

Turn over for the next question

4.5.1.2 Contact and non-contact forces

Question 33

June 2022 | 8463/2F | Original Q8

0 8 **Figure 15** shows an electric super-car.

Figure 15



0 8 . 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 _____

Question 33 · continued

Use the Physics Equations Sheet to answer questions **08.2** and **08.3**.

0 8 . 2 Write down the equation which links acceleration (a), change in velocity (Δv) and time taken (t).

[1 mark]

0 8 . 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 8 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 33 · continued

0 8 . 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 33 · continued

June 2022 | 8463/2F | Original Q8

Use the Physics Equations Sheet to answer questions **08.5** and **08.6**.

0 8 . 5 Write down the equation which links distance (*s*), force (*F*) and work done (*W*).

[1 mark]

0 8 . 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

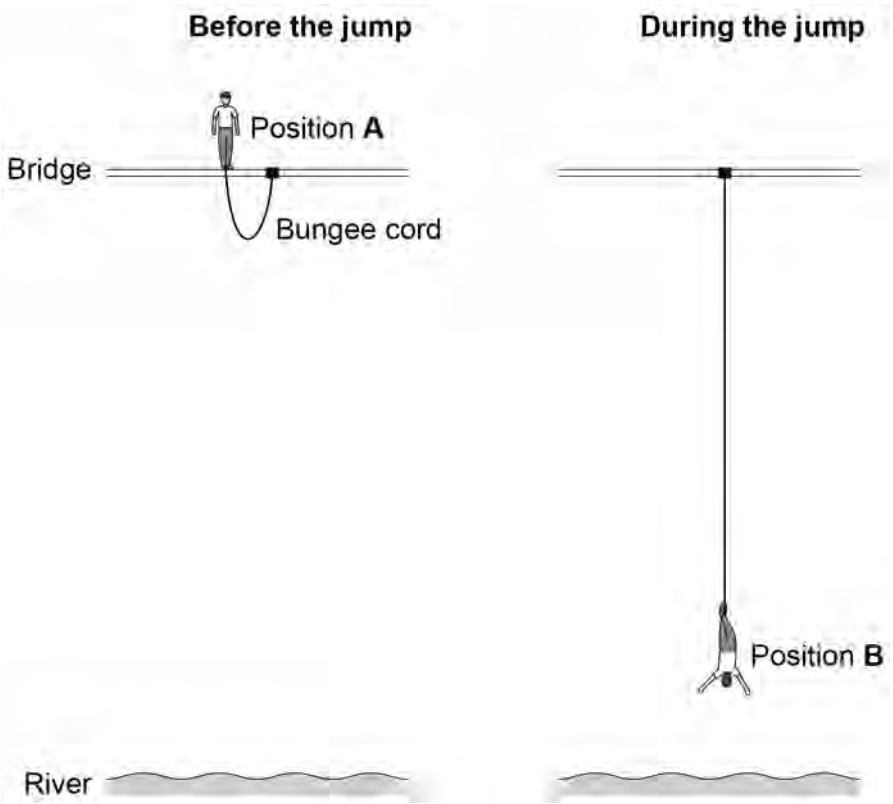
Question 34

June 2023 | 8463/1F | Original Q6

0 6 **Figure 8** shows a student before and during a bungee jump.

The diagram is not to scale.

Figure 8



0 6 . 1 In position **B**, the student is moving towards the river and the bungee cord is stretching.

How do the energy stores in position **B** compare with the energy stores in position **A**?

[3 marks]

Tick (✓) **one** box in **each** row.

Energy store	Less than at A	The same as at A	More than at A
The student's gravitational potential energy			
The student's kinetic energy			
The bungee cord's elastic potential energy			

4.5.1.2 Contact and non-contact forces

Question 34 · continued

0 6 . 2 The bungee cord behaves like a spring with a spring constant of 78.4 N/m.

At one point in the bungee jump, the extension of the bungee cord is 25 m.

Calculate the elastic potential energy stored by the bungee cord.

Use the equation:

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

[2 marks]

Elastic potential energy = _____ J

4.5.1.2 Contact and non-contact forces

Question 34 · continued

Table 5 shows information about different bungee cords.

Table 5

Bungee cord	Spring constant in N/m	Maximum extension before snapping in metres
A	78.4	36
B	82.0	24
C	84.5	12

0 6 . 3 Bungee cord **C** will have a smaller extension than **A** or **B** for any bungee jumper.

Give the reason why.

[1 mark]

0 6 . 4 Which bungee cord would be safest to use for a person with a large weight?

Give a reason for your answer.

[2 marks]

Bungee cord _____

Reason _____

8

4.5.1.2 Contact and non-contact forces

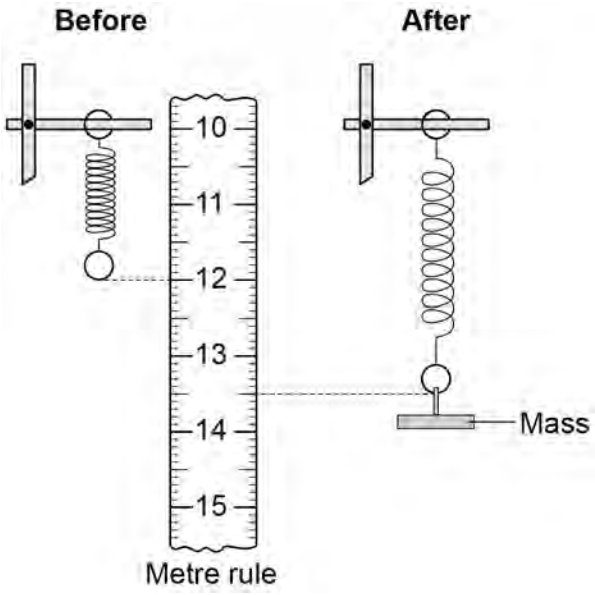
Question 35

June 2023 | 8463/2F | Original Q1

0 1 A student carried out an investigation to determine the spring constant of a spring.

Figure 1 shows the spring before and after a mass was hung from the end of the spring.

Figure 1



0 1 . 1 What is the extension of the spring in **Figure 1**?

[1 mark]

Tick (✓) **one** box.

1.5 cm ☐

3.5 cm ☐

13.5 cm ☐

Question 35 · continued

0 1 . 2 Give **one** safety precaution the student should have taken during this investigation.

[1 mark]

0 1 . 3 The student hung a mass of 0.050 kg from the spring.

gravitational field strength = 9.8 N/kg

Calculate the weight of the 0.050 kg mass.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

0 1 . 4 The weight of the mass applies a force to the spring.

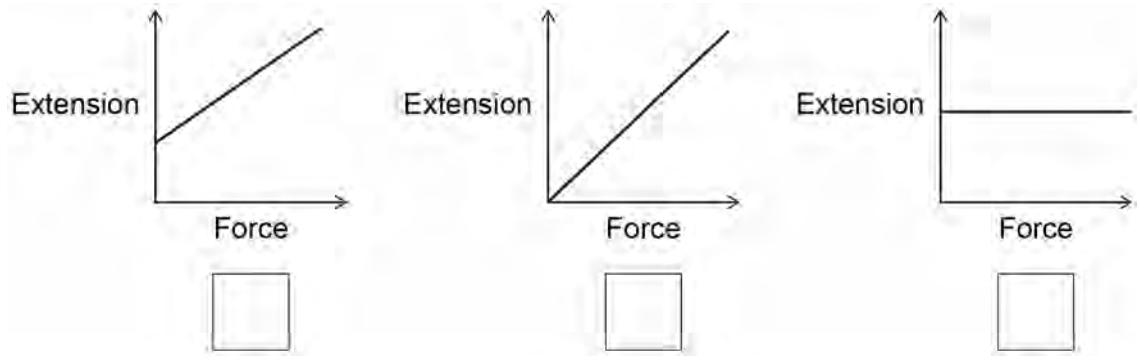
The student added more masses and recorded the extension of the spring.

Which graph in **Figure 2** shows the relationship between the force applied to the spring and the extension of the spring?

[1 mark]

Tick (✓) **one** box.

Figure 2



4.5.1.2 Contact and non-contact forces

Question 35 · continued

0 1 . 5 A force of 2.0 N was applied to a different spring.

The extension of the spring was 0.080 m.

Calculate the spring constant of the spring.

Use the equation:

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

[2 marks]

Spring constant = _____ N/m

7

4.5.1.2 Contact and non-contact forces

Question 36

June 2023 | 8463/2F | Original Q2

0 2 The stopping distance of a car is the braking distance added to the thinking distance.

0 2 . 1 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**electrostatic**	**kinetic**
nuclear		**thermal**

A driver applies the brakes to a moving car.

As the car slows down, there is a decrease in the _____ energy of the car.

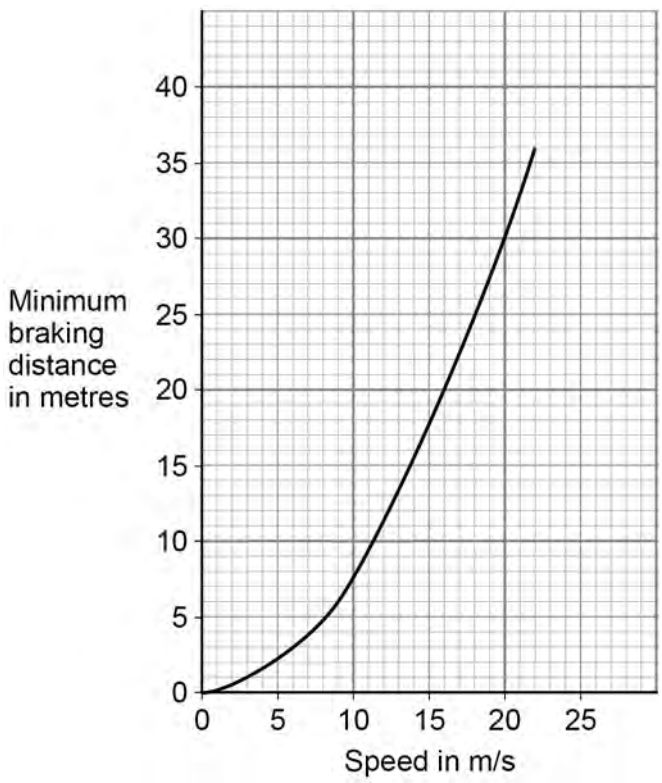
The work done by friction causes an increase in the _____ energy store of the brakes.

Question 2 continues on the next page

Question 36 · continued

0 2 . 2 **Figure 3** shows how the speed of the car affects the minimum braking distance of the car.

Figure 3



Describe the relationship between the speed of the car and the minimum braking distance of the car.

[1 mark]

0 2 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

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

When the road becomes icy, the braking distance _____ .

Question 36 · continued

A car driver applies the brakes to decelerate the car as it approaches a road junction.

The car decelerates at 0.25 m/s^2.

mass of the car = 1600 kg

0 2 . 4 Calculate the time taken for the velocity of the car to decrease from 12.5 m/s to 5.0 m/s.

Use the equation:

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

[3 marks]

Time taken = _____ s

0 2 . 5 Calculate the resultant force causing the car to decelerate.

Use the equation:

$$\text{resultant force} = \text{mass} \times \text{deceleration}$$

[2 marks]

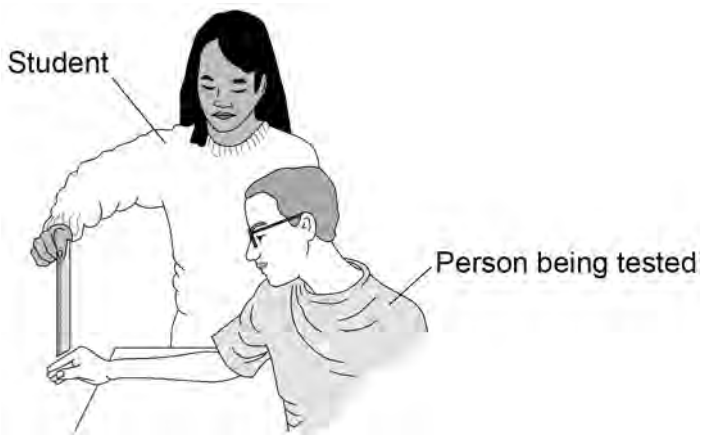
Resultant force = _____ N

Question 36 · continued

Thinking distance is affected by the reaction time of the driver.

Figure 4 shows how a student tested a person's reaction time.

Figure 4



The student held a ruler and then released it.

The person being tested closed his hand to catch the ruler as quickly as possible.

The further the ruler fell the greater the person's reaction time.

0 2 . 6 The student wanted to test the reaction time of the people in her class.

Which of the following could have been a control variable in this investigation?

[1 mark]

Tick (✓) **one** box.

Distance fallen by the ruler before being caught ☐

Initial height of the ruler above the person's hand ☐

Reaction time of the person being tested ☐

4.5.1.2 Contact and non-contact forces

Question 36 · continued

0 2 . 7 The student tested three people in her class.

The mean distance that the ruler fell before being caught was 18.2 cm.

If all of the people in her class were tested, the mean distance may not be 18.2 cm.

Suggest why.

[1 mark]

0 2 . 8 Describe how this investigation could be changed to find out how listening to music affects reaction time.

[2 marks]

13

4.5.1.2 Contact and non-contact forces

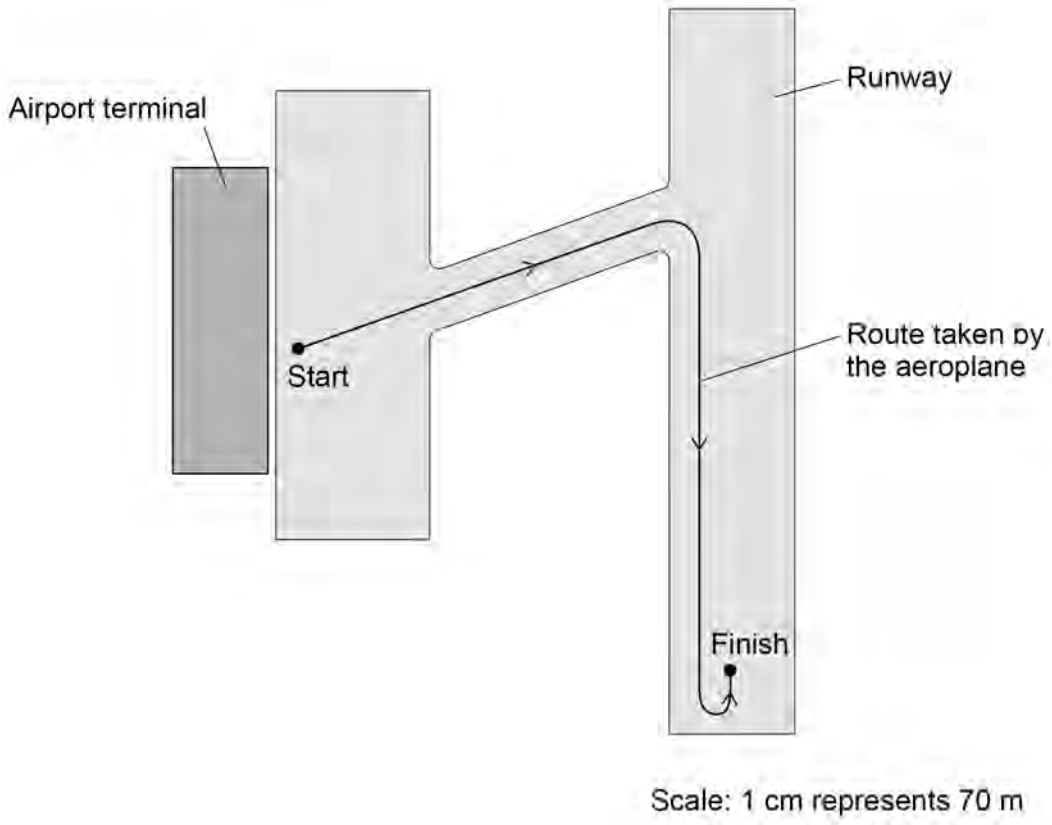
Question 37

June 2023 | 8463/2F | Original Q10

1 0 **Figure 25** shows the route an aeroplane takes as it travels from an airport terminal to the runway.

Figure 25 has been drawn to scale.

Figure 25



1 0 . 1 Determine the magnitude of the aeroplane's displacement from the start point to the finish point on **Figure 25**.

[2 marks]

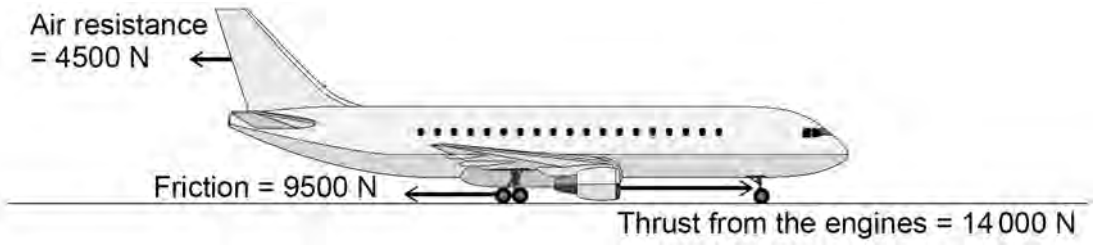
Displacement = _____ m

4.5.1.2 Contact and non-contact forces

Question 37 · continued

Figure 26 shows the direction of the horizontal forces acting on the aeroplane as it moves in a straight line towards the runway.

Figure 26



1 0 . 2 Determine the magnitude of the resultant horizontal force on the aeroplane.

[1 mark]

Resultant horizontal force = _____ N

1 0 . 3 Describe the motion of the aeroplane as it moves towards the runway.

[1 mark]

1 0 . 4 Air resistance and friction are contact forces.

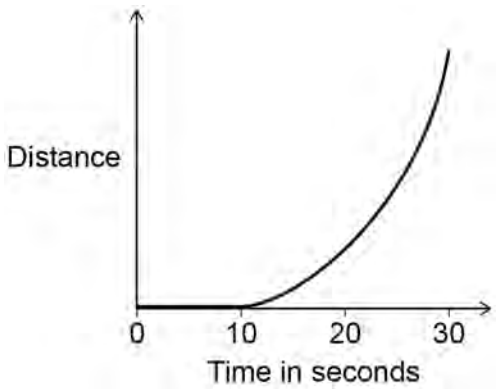
Give **one** other example of a contact force.

[1 mark]

1 0 . 5 The aeroplane stops for a short time and then accelerates along the runway.

Figure 27 shows a distance–time sketch-graph for this stage of the journey.

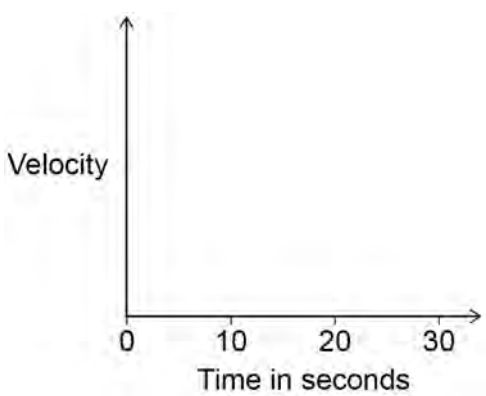
Figure 27



Draw the velocity–time sketch-graph for this stage of the journey on **Figure 28**.

[2 marks]

Figure 28

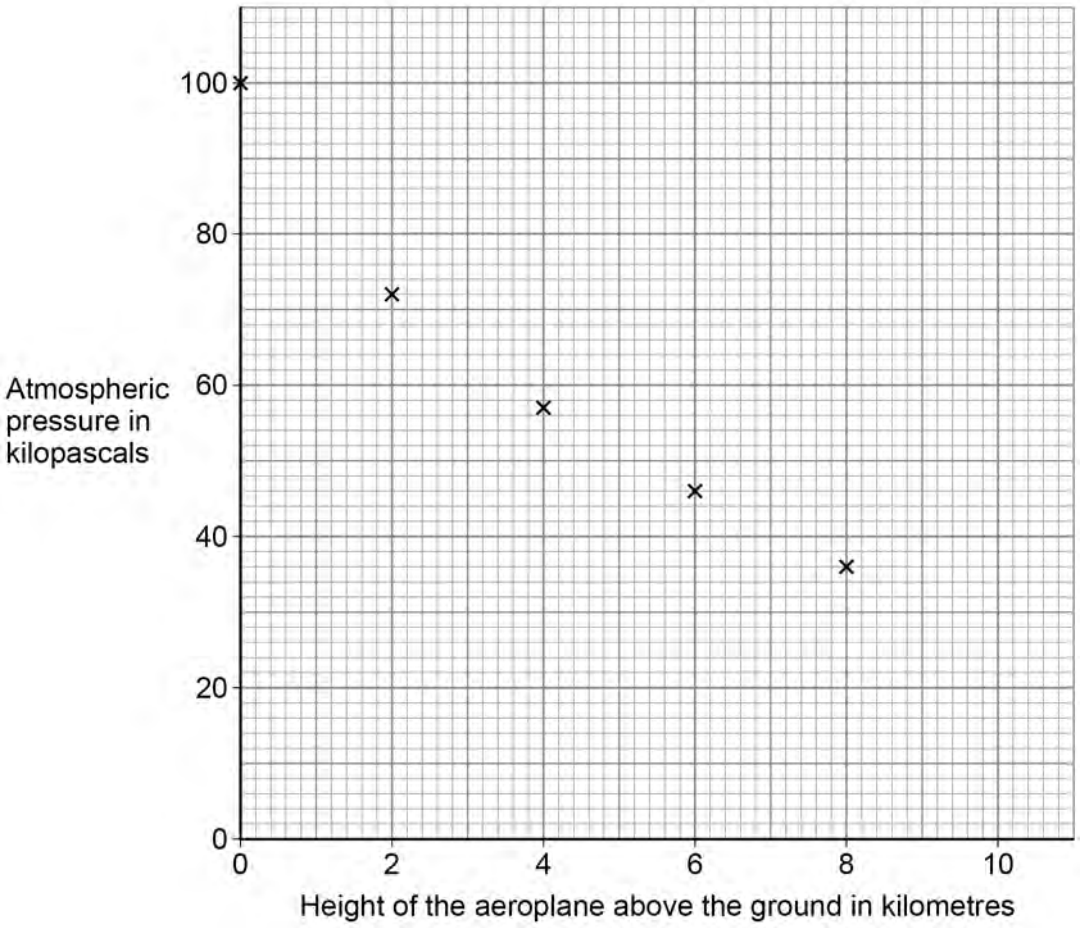


Question 37 · continued

1 0 . 6 The aeroplane takes off from the runway, so its height above the ground increases.

Figure 29 shows how atmospheric pressure varies with the height of the aeroplane above the ground.

Figure 29



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

[2 marks]

Atmospheric pressure = _____ kPa

Question 10 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 37 · continued

1 0 . 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 38

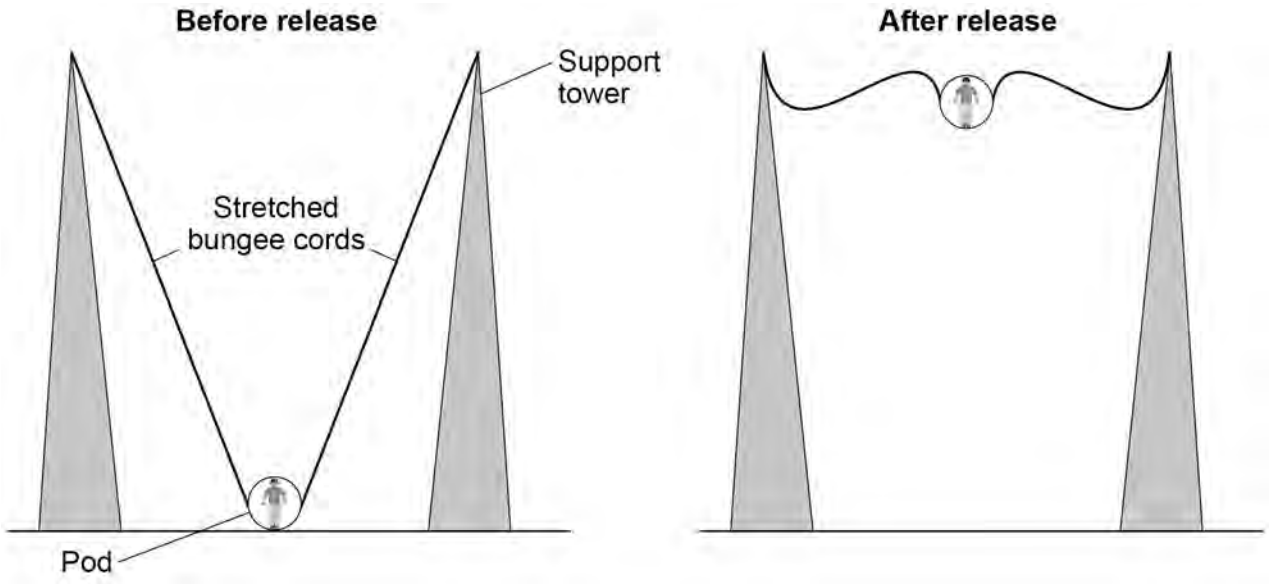
June 2024 | 8463/1F | Original Q3

0 3 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 7 shows a person using the ride.

Figure 7



0 3 . 1 How is the extension of each bungee cord calculated?

[1 mark]

Tick (✓) **one** box.

stretched length + original length ☐

stretched length – original length ☐

stretched length × original length ☐

stretched length ÷ original length ☐

4.5.1.2 Contact and non-contact forces

Question 38 · continued

0 3 . 2 Before the pod is released, the extension of each bungee cord is 7.5 m.

spring constant of the bungee cord = 800 N/m

Calculate the elastic potential energy stored in each stretched bungee cord.

Use the equation:

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

[2 marks]

Elastic potential energy = _____ J

0 3 . 3 The maximum speed of the pod is 15 m/s.

The mass of the pod is 240 kg.

Calculate the maximum kinetic energy of the pod.

Use the equation:

kinetic energy = 0.5 × mass × (speed)^2

[2 marks]

Maximum kinetic energy = _____ J

Question 38 · continued

Use the Physics Equations Sheet to answer questions **03.4** and **03.5**.

0 3 . 4 Which equation links gravitational field strength (g), gravitational potential energy (E_p), height (h) and mass (m)?

[1 mark]

Tick (✓) **one** box.

$E_p = \frac{m \times g}{h}$ ☐

$E_p = \frac{m}{g \times h}$ ☐

$E_p = m \times g \times h$ ☐

0 3 . 5 The pod has 24 000 J of gravitational potential energy when at its maximum height.

The mass of the pod is 240 kg.

gravitational field strength = 9.8 N/kg

Calculate the maximum height reached by the pod.

[3 marks]

Maximum height = _____ m

Question 3 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 38 · continued

0 3 . 6 Why is the maximum gravitational potential energy of the pod less than the initial elastic potential energy of the bungee cords?

[2 marks]

Tick (✓) **two** boxes.

- Energy is created. ☐
- Energy is destroyed. ☐
- Energy is transferred to the surroundings. ☐
- Work is done against air resistance. ☐
- Work is done by the force of gravity. ☐
- Work is done by the person in the pod. ☐

11

4.5.1.2 Contact and non-contact forces

Question 39

June 2024 | 8463/2F | Original Q7

0 7 A swimming pool is being filled with water.

0 7 . 1 Calculate the weight of the water in the swimming pool when the mass of the water is 25 000 kg.

gravitational field strength = 9.8 N/kg

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

Question 39 · continued

0 7 . 2 When the swimming pool is full, the weight of the water is 1 960 000 N.

The bottom of the swimming pool has an area of 49 m^2.

Calculate the pressure at the bottom of the swimming pool when it is full.

Use the equation:

$$\text{pressure} = \frac{\text{weight}}{\text{area}}$$

Choose the unit from the box.

[3 marks]

m^2	**m^3**	**N**	**Pa**

Pressure = _____ Unit _____

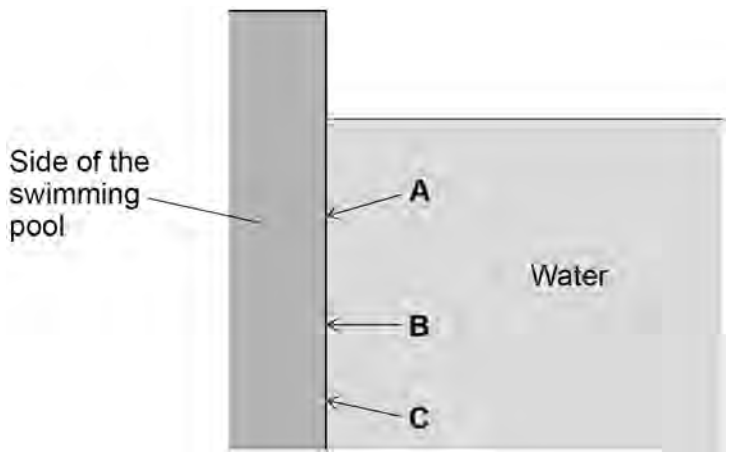
Question 7 continues on the next page

Question 39 · continued

0 7 . 3 There is a force acting on the side of the swimming pool because of the water pressure.

Figure 11 shows the side of the swimming pool.

Figure 11



Which arrow shows the direction of the force acting on the side of the swimming pool?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

0 7 . 4 A child is swimming in the pool. The velocity of the child is 0.70 m/s.

The child then accelerates for 5.0 s, reaching a final velocity of 1.3 m/s.

Calculate the acceleration of the child.

Use the equation:

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

[2 marks]

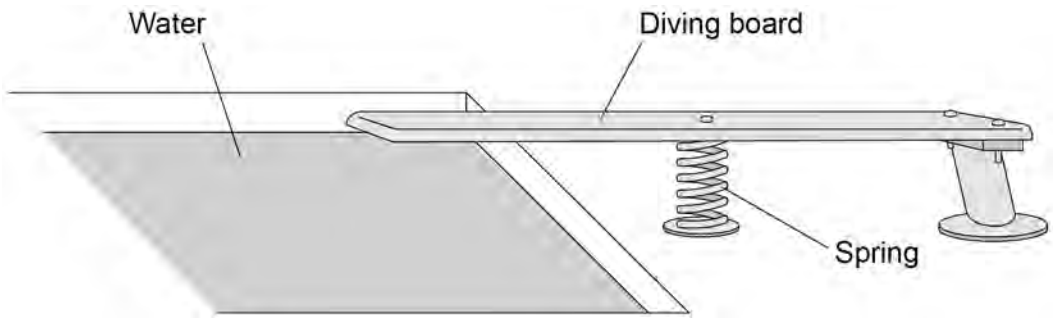
Acceleration = _____ m/s^2

4.5.1.2 Contact and non-contact forces

Question 39 · continued

Figure 12 shows a diving board at the side of the swimming pool.

Figure 12



0 7 . 5 The original length of the spring is 0.84 m.

When the child stands on the diving board, the length of the spring decreases by 0.21 m.

Calculate the percentage change in the length of the spring.

[2 marks]

Percentage change in length = _____ %

Question 7 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 39 · continued

Use the Physics Equations Sheet to answer questions **07.6** and **07.7**.

0 7 . 6 Write down the equation which links extension (*e*), force applied to a spring (*F*) and spring constant (*k*).

[1 mark]

0 7 . 7 The force applied to the spring by the weight of the child is 336 N.

The change in length of the spring is 0.21 m.

Calculate the spring constant of the spring.

[3 marks]

Spring constant = _____ N/m

4.5.1.2 Contact and non-contact forces

Question 39 · continued

0 7 . 8 The child steps off the diving board and falls into the swimming pool.

The initial velocity of the child is 0 m/s.

acceleration due to gravity = 9.8 m/s^2

Calculate the final velocity when the child has fallen a distance of 0.95 m through the air.

Give your answer to 2 significant figures.

Use the Physics Equations Sheet.

[4 marks]

Final velocity of child (2 significant figures) = _____ m/s

18

4.5.1.2 Contact and non-contact forces

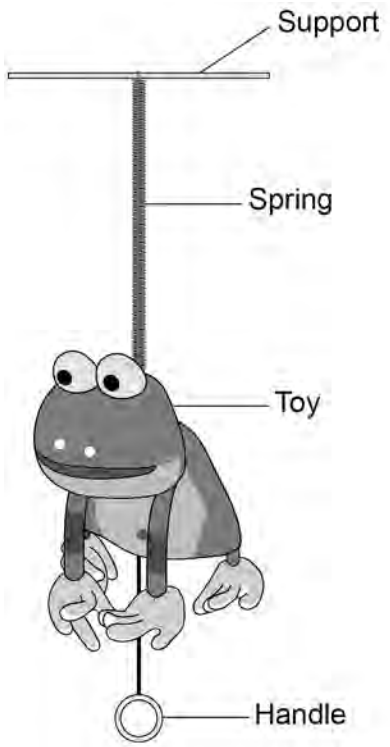
Question 40

June 2025 | 8463/1F | Original Q6

0 6 **Figure 10** shows a toy which is hung from a support.

When the handle is pulled down and then released, the toy bounces up and down.

Figure 10



0 6 . 1 When the handle is pulled down, the spring extends.

The extension of the spring is 0.35 m.

The spring constant of the spring is 5.6 N/m.

Calculate the elastic potential energy stored by the stretched spring.

Use the equation:

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

[2 marks]

Elastic potential energy = _____ J

Question 40 · continued

Use the Physics Equations Sheet to answer questions **06.2** and **06.3**.

0 6 . 2 Which equation links gravitational field strength (g), gravitational potential energy (E_p), height (h) and mass (m)?

[1 mark]

Tick (✓) **one** box.

$E_p = \frac{mg}{h}$ ☐

$E_p = \frac{m}{gh}$ ☐

$E_p = mgh$ ☐

0 6 . 3 When the handle is released, the toy moves upwards through a height of 0.60 m.

The toy has 0.294 J of gravitational potential energy in its highest position.

gravitational field strength = 9.8 N/kg

Calculate the mass of the toy.

[3 marks]

Mass of the toy = _____ kg

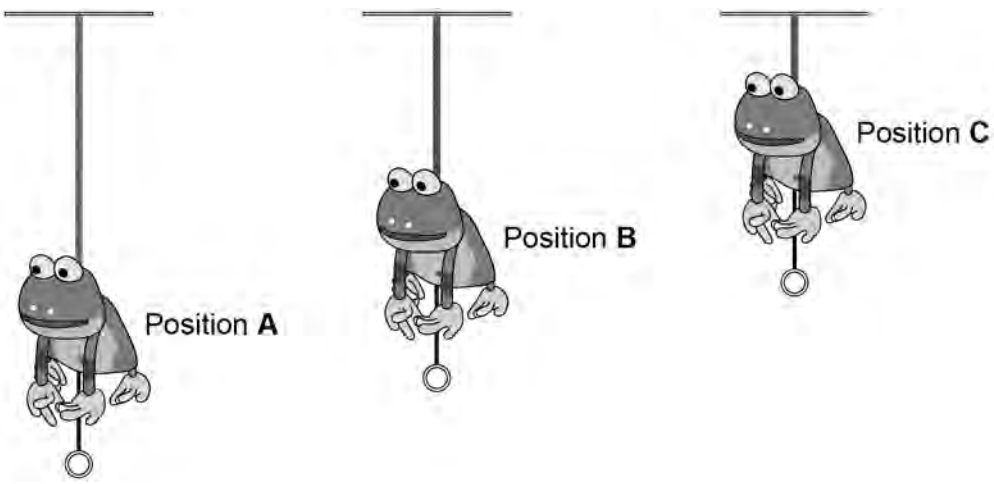
Question 6 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 40 · continued

Figure 11 shows the toy in three different positions.

Figure 11



The toy is released from position **A** and moves upwards.

The toy is moving upwards in position **B**.

The toy is at maximum height in position **C**.

0 6 . 4 Between position **A** and position **B**, the extension of the spring decreases.

How does the elastic potential energy stored by the spring change as the extension decreases?

[1 mark]

Tick (✓) **one** box.

Elastic potential energy decreases. ☐

Elastic potential energy stays the same. ☐

Elastic potential energy increases. ☐

4.5.1.2 Contact and non-contact forces

Question 40 · continued

0 6 . 5 Between position **B** and position **C**, the toy slows down.

How does the kinetic energy of the toy change as the toy slows down?

[1 mark]

Tick (✓) **one** box.

Kinetic energy decreases. ☐

Kinetic energy stays the same. ☐

Kinetic energy increases. ☐

0 6 . 6 How does the gravitational potential energy of the toy change as the toy moves from position **B** to position **C**?

[1 mark]

Tick (✓) **one** box.

Gravitational potential energy decreases. ☐

Gravitational potential energy stays the same. ☐

Gravitational potential energy increases. ☐

Question 6 continues on the next page

4.5.1.2 Contact and non-contact forces

Question 40 · continued

0 6 . 7 The toy moves up and down many times before eventually stopping.

Which **two** of the following are reasons why the toy eventually stops?

[2 marks]

Tick (✓) **two** boxes.

- Air resistance opposes the motion of the toy. ☐
- Energy is destroyed. ☐
- Energy is transferred to the surroundings. ☐
- The gravitational field strength decreases. ☐
- The spring loses its elasticity. ☐

11

4.5.1.2 Contact and non-contact forces

Question 41

June 2025 | 8463/2F | Original Q2

0 2 Very long trains can be pulled by more than one engine.

A train is made up of four engines pulling trucks filled with coal.

0 2 . 1 The coal in one truck has a mass of 75 000 kg.

gravitational field strength = 9.8 N/kg

Calculate the weight of the coal in **one** truck.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

0 2 . 2 **One** engine exerts a forward force of 850 000 N.

Calculate the work done by **one** engine when the train moves a distance of 80 m.

Use the equation:

work done = force × distance moved

[2 marks]

Work done = _____ J

4.5.1.2 Contact and non-contact forces

Question 41 · continued

0 2 . 3 Each of the four engines exerts a forward force of 850 000 N on the trucks.

Calculate the total forward force on the trucks.

[2 marks]

Total forward force = _____ N

0 2 . 4 The force exerted by the engines on the trucks is a contact force.

Which of the following is also a contact force?

[1 mark]

Tick (✓) **one** box.

- Electrostatic force ☐
- Frictional force ☐
- Gravitational force ☐

Question 2 continues on the next page

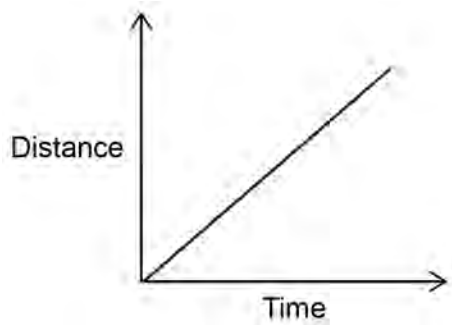
4.5.1.2 Contact and non-contact forces

Question 41 · continued

0 2 . 5 Which sketch graph represents the train moving at a constant speed?

[1 mark]

Tick (✓) **one** box.



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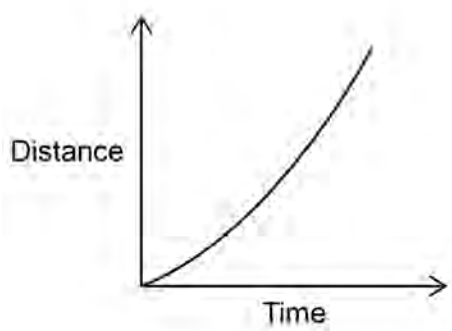

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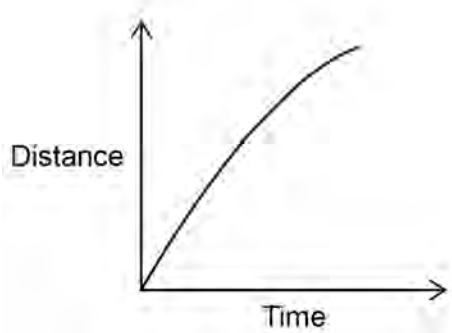


☐

4.5.1.2 Contact and non-contact forces

Question 41 · continued

0 2 . 6 The train accelerates for 150 s.

The velocity of the train changes from 16 m/s to 25 m/s.

Calculate the acceleration of the train.

Use the equation:

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

[3 marks]

Acceleration = _____ m/s^2

11

Turn over for the next question

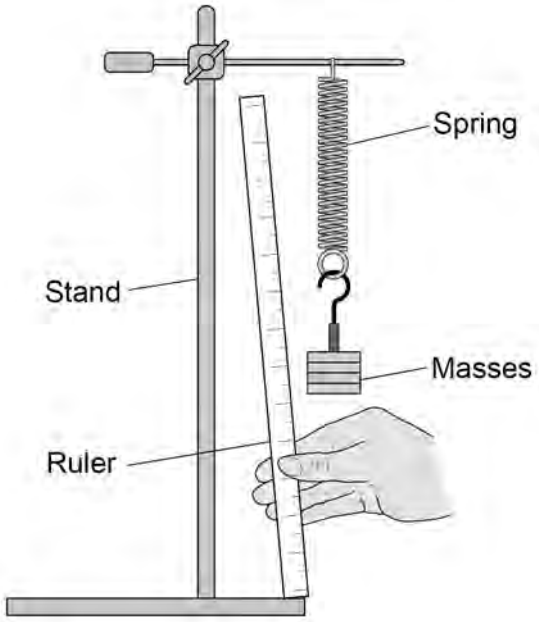
4.5.1.2 Contact and non-contact forces

Question 42

0 9 A student investigated how the force applied to a spring affects the length of the spring.

Figure 13 shows the apparatus used.

Figure 13



0 9 . 1 What is the independent variable in this investigation?

[1 mark]

_____

0 9 . 2 Describe **one** risk of harm in this investigation and a safety precaution to reduce the risk.

[2 marks]

Risk of harm _____

_____

Safety precaution _____

_____

Question 42 · continued

0 9 . 3 The student measured the length of the spring using the arrangement shown in **Figure 13**.

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

[2 marks]

1 _____

_____

2 _____

_____

Question 9 continues on the next page

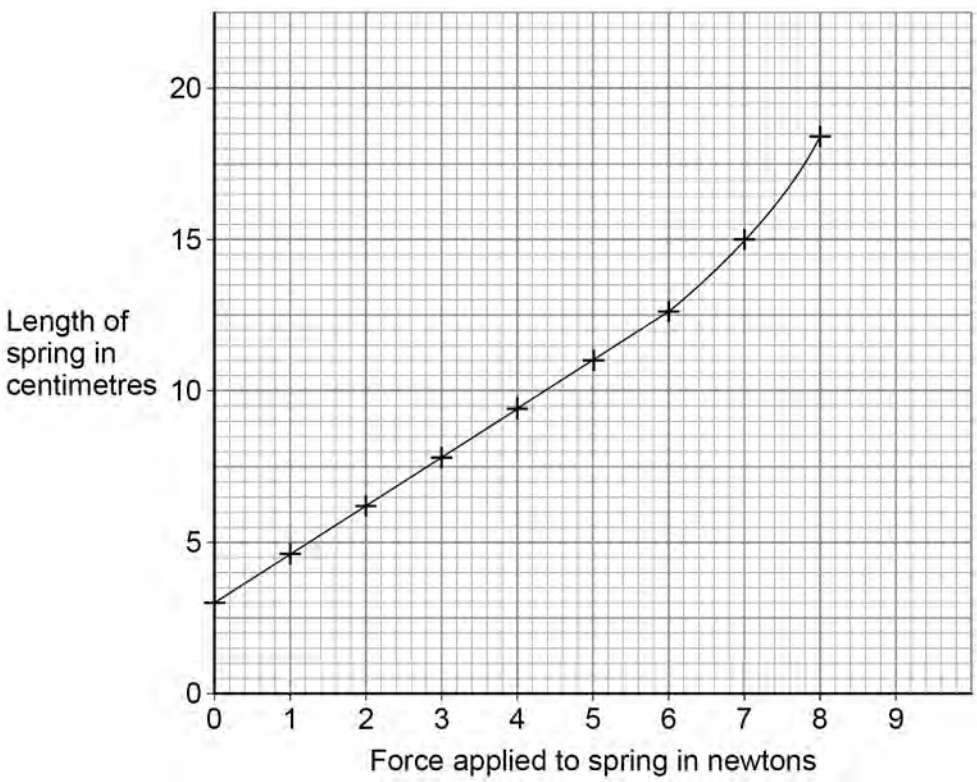
Question 42 · continued

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 14 shows the results.

Figure 14



0 9 . 4 Why does the line on the graph **not** pass through the origin?

[1 mark]

Question 42 · continued

0 9 . 5 Above 6.0 N the line on **Figure 14** curves upwards.

Explain why.

[2 marks]

Use the Physics Equations Sheet to answer questions **09.6** and **09.7**.

0 9 . 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 9 . 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