TUTOR ZONE

Name

Percentage	
Grade	

GCSE Physics

Forces

Duration: 1 hour

Total Marks: 62

Information for Candidates:

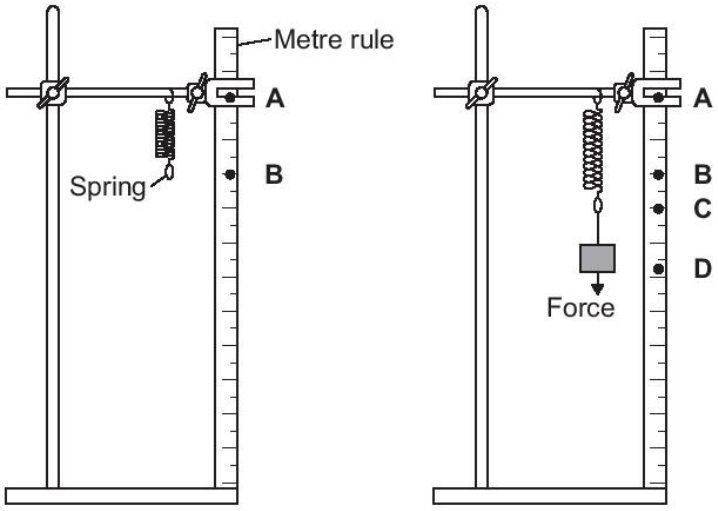
- Use black or blue ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional paper is used, the question number(s) must be clearly shown
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

Do not write in this table	
Question	Mark
TOTAL	

Answer **all** questions in the spaces provided.

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)

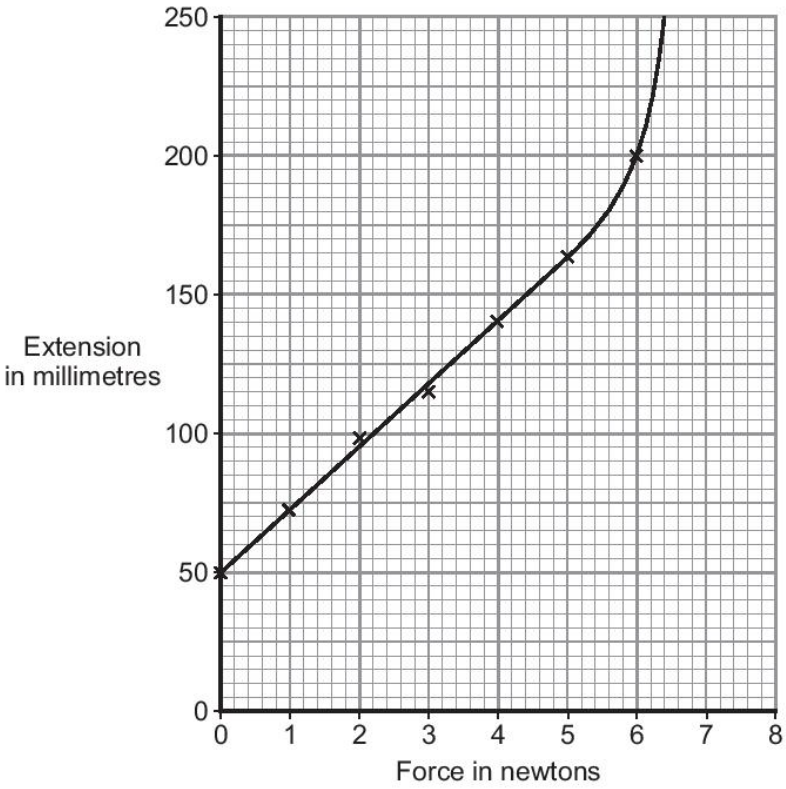
1 (a) (ii) What form of energy is stored in the stretched spring?

.....

(1 mark)

Question 1 continues on the next page

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)

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

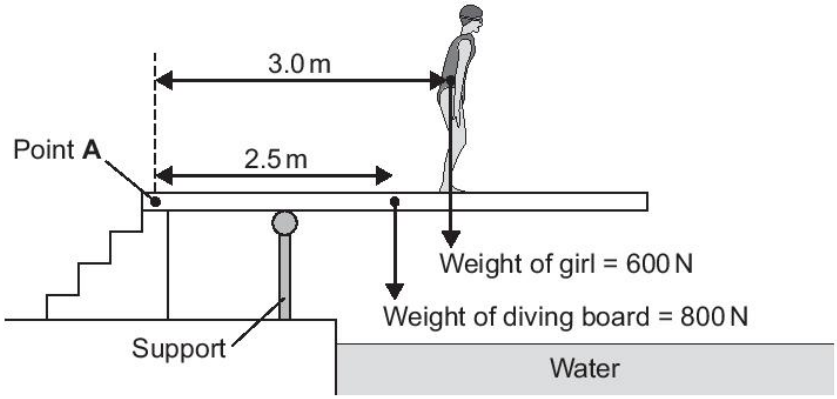
(2 marks)

8

Turn over for the next question

4 (a) **Figure 5** shows a girl standing on a diving board.

Figure 5



Calculate the total clockwise moment of the weight of the diving board and the weight of the girl about Point **A**. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[4 marks]

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.....

.....

Total clockwise moment about Point **A** = ...

Question 4 continues on the next page

4 (b) **Figure 6** shows the girl standing at a different place on the diving board.

The support provides an upward force **F** to keep the diving board balanced.

Figure 6

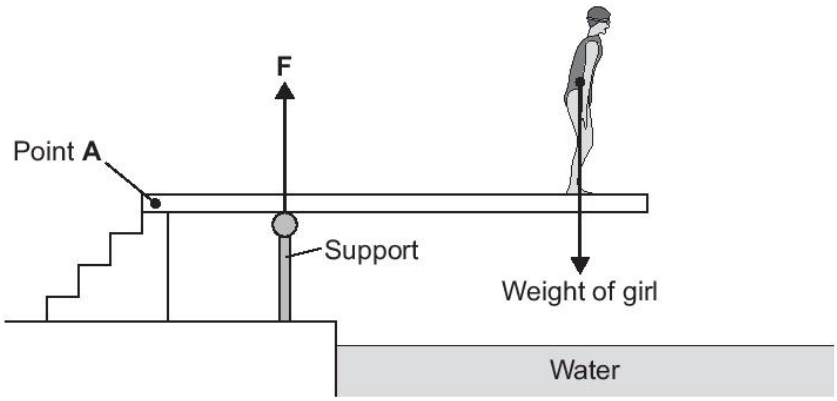
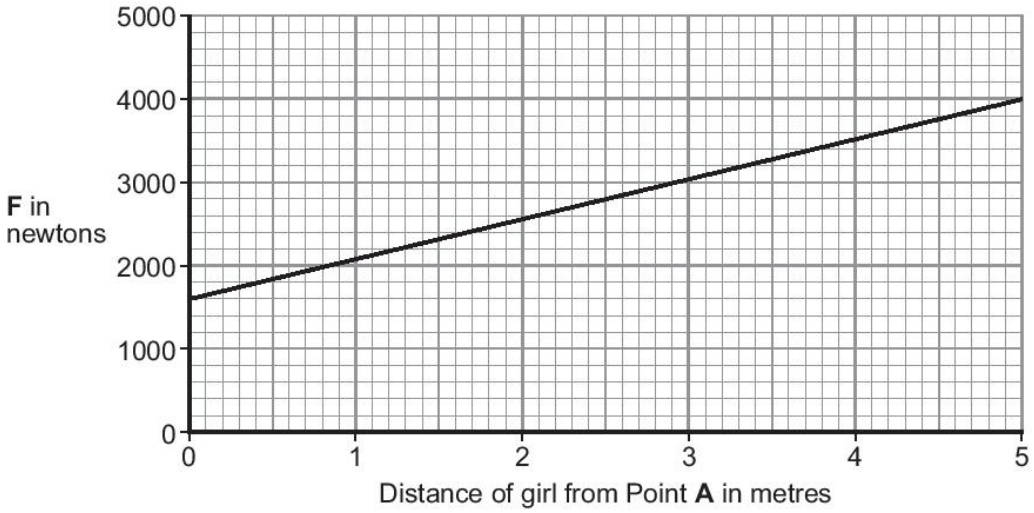


Figure 7 shows how the upward force **F** varies with the distance of the girl from Point **A**.

Figure 7



Explain, in terms of clockwise and anticlockwise moments, why the upward force **F** increases as shown in **Figure 7**.

[3 marks]

.....

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.....

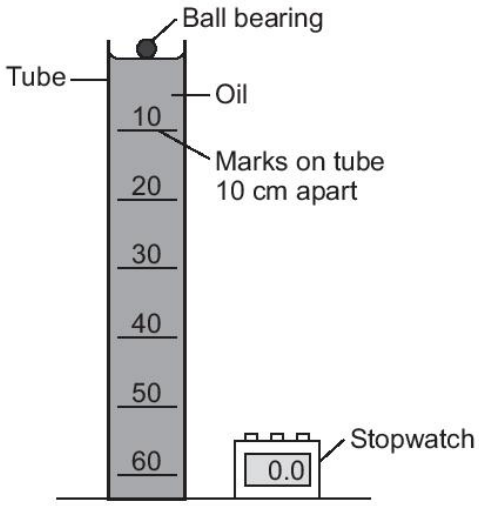
7

Turn over for the next question

Answer **all** questions in the spaces provided.

1 A student investigated how the speed of a ball bearing changes as the ball bearing falls through a tube of oil.
Figure 1 shows the equipment the student used.

Figure 1



The student measured the time taken for the ball bearing to fall different distances.
Each distance was measured from the top of the oil.

1 (a) What is likely to have been the main source of error in this investigation?

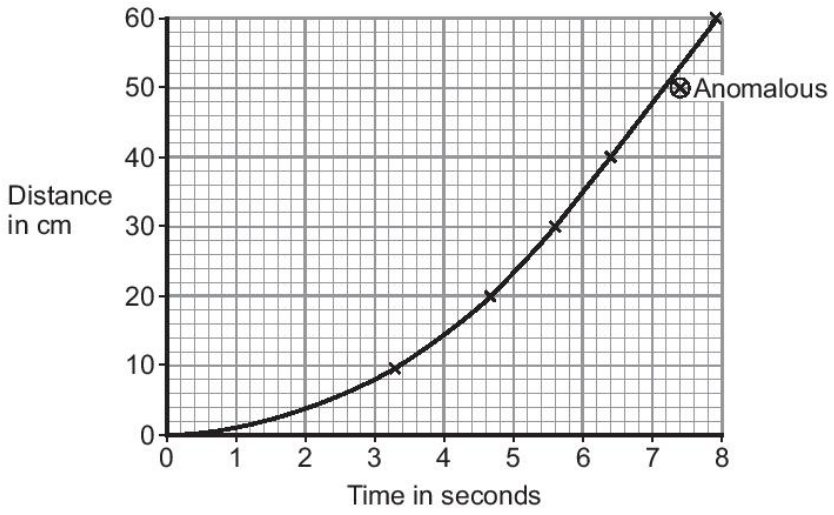
[1 mark]

_____

_____

1 (b) **Figure 2** shows the student's results plotted as a graph.

Figure 2



1 (b) (i) The student has identified one of the results as being anomalous.

Use the correct answer from the box to complete the sentence.

[1 mark]

after	as	before

The anomalous result was caused by the stopwatch being started _____ the ball bearing was released.

1 (b) (ii) What can you conclude from the graph about the speed of the ball bearing during the first four seconds?

[1 mark]

_____

_____

1 (b) (iii) The graph shows that the ball bearing reached its terminal velocity.

Describe how the graph would be used to calculate the terminal velocity of the ball bearing.

[1 mark]

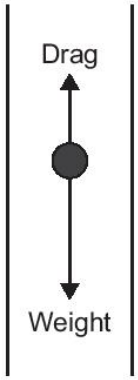
_____

_____

Question 1 continues on the next page

1 (b) (iv) The directions of the two forces acting on the ball bearing as it falls through the oil are shown in **Figure 3**.

Figure 3



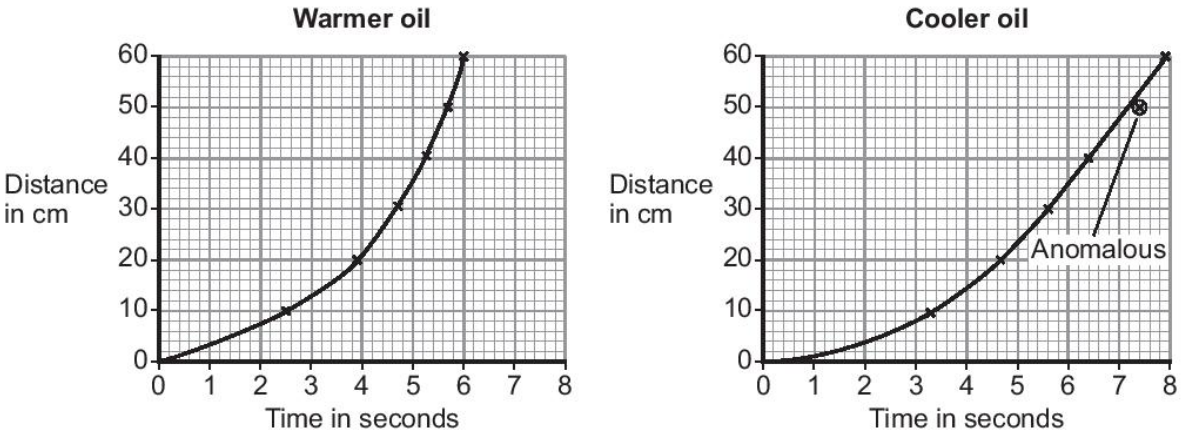
Explain, in terms of the forces shown in **Figure 3**, why the ball bearing reaches its terminal velocity.

[2 marks]

1 (c) The student repeated the investigation using warmer oil.

Figure 4 shows the set of results using the warmer oil **and** the set of results using the cooler oil.

Figure 4



Compare the two graphs in **Figure 4**.

Use the correct phrase from the box to complete the sentence.

[3 marks]

less than	**equal to**	**greater than**

After falling 40 cm, the drag force on the ball bearing in the warmer oil is

_____ the drag force on the ball bearing in the cooler oil.

Explain the reason for your answer.

_____

_____

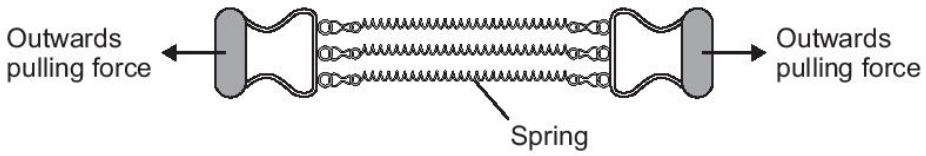
_____

_____

9

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.

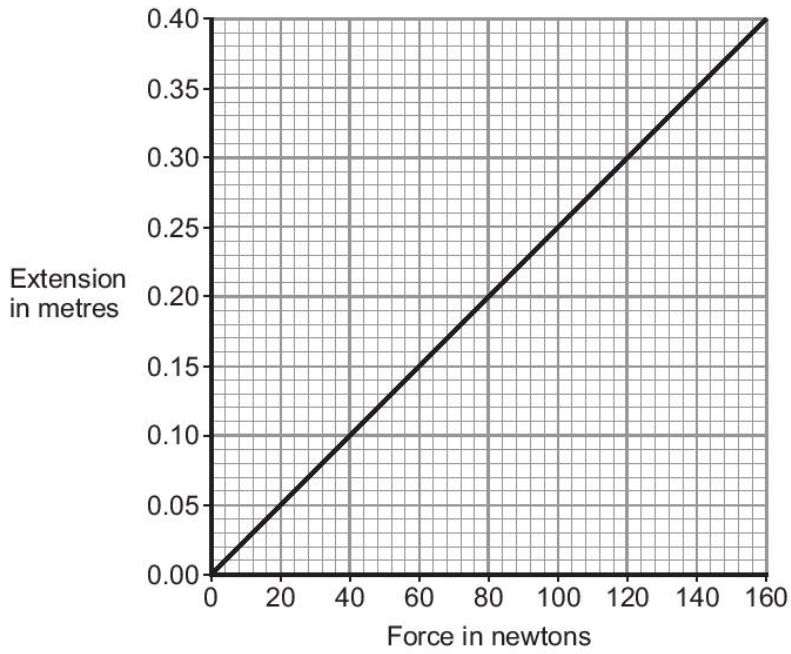
5 (a) Complete the following sentence.

[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



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]

_____

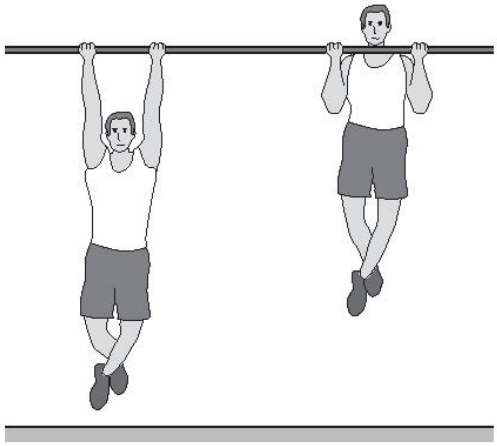
_____

Total force = _____ N

Question 5 continues on the next page

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.

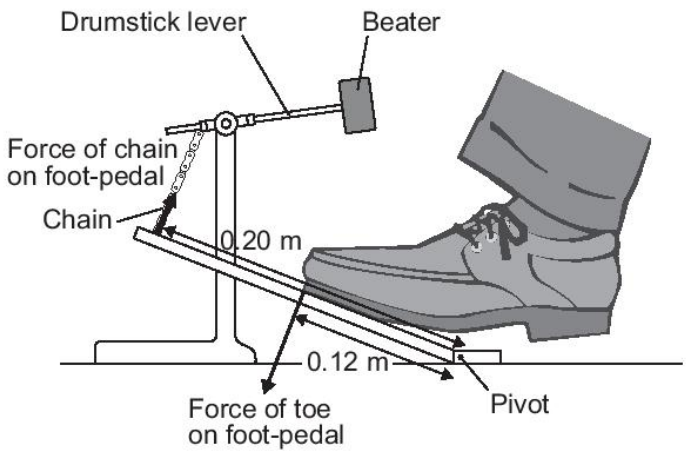
[3 marks]

Power = _____ W

10

5 A drum is hit by a beater attached to a drumstick lever. The drumstick lever is attached to a foot-pedal by a chain, as shown in **Figure 9**.

Figure 9



5 (a) When the toe is pushed down the force creates a moment on the foot-pedal.

5 (a) (i) State what is meant by the moment of a force.

[1 mark]

_____

_____

5 (a) (ii) The foot-pedal is pushed halfway down and held stationary. The toe and the chain both exert a force on the foot-pedal.

Compare the sizes and directions of the moments caused by the force of the toe and the force of the chain on the foot-pedal.

[1 mark]

_____

_____

5 (a) (iii) The drummer's toe pushes with a 1.5 N force on the foot-pedal.
The perpendicular distance from the pivot to the force is 0.12 m.
The perpendicular distance from the pivot to the chain is 0.20 m.

Calculate the force of the chain acting on the foot-pedal.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Force = _____ N

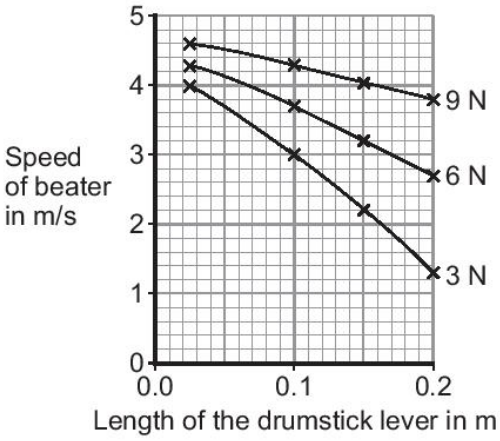
Question 5 continues on the next page

5 (b) The foot-pedal is pushed with different forces to make the beater move at different speeds.

The higher the speed at which the beater hits the drum, the louder the sound the drum makes.

Figure 10 shows how the length of the drumstick lever affects the speed of the beater for three different forces.

Figure 10



The drummer needs to be able to sometimes play the drum quietly and sometimes loudly.

How does the **length** of the drumstick lever affect the variation in loudness of the sound from the drum when applying:

[2 marks]

a force of 3 N? _____

_____

a range of forces from 3 N to 9 N? _____

_____

7

4 A lorry driver sees the traffic lights at a road junction change to red.
The driver applies the brakes to stop the lorry.

The stopping distance is the thinking distance plus the braking distance.

4 (a) (i) Which statement describes the thinking distance?

[1 mark]

Tick (✓) **one** box.

The time it takes for the lorry to stop after the brakes are applied. ☐

The time it takes the driver to react and apply the brakes. ☐

The distance the lorry travels once the brakes are applied. ☐

The distance the lorry travels during the driver's reaction time. ☐

4 (a) (ii) How does thinking distance depend on the speed of the lorry?

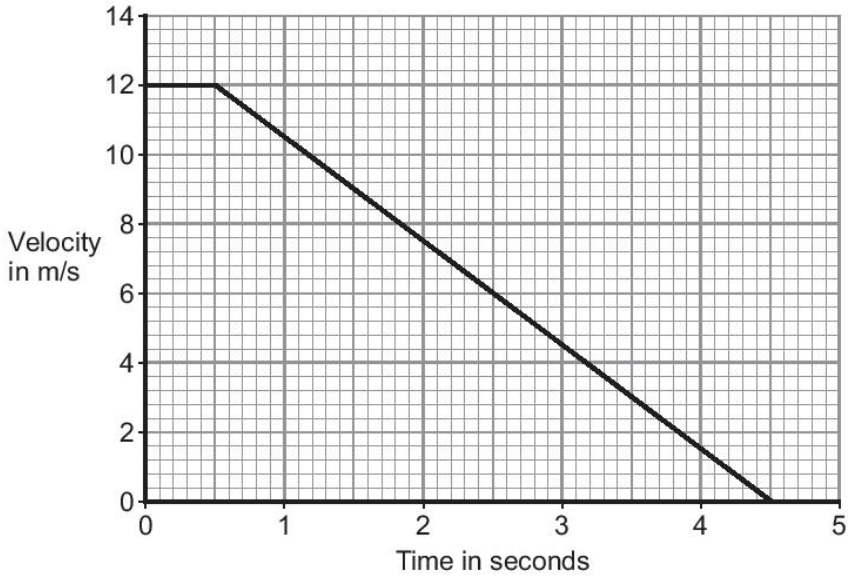
[1 mark]

_____

_____

4 (b) **Figure 3** shows how the velocity of the lorry changes from just after the driver sees the traffic lights change to red.

Figure 3



4 (b) (i) Calculate the braking distance of the lorry.

Show how you used **Figure 3** to obtain your answer.

[2 marks]

_____

_____

_____

Distance = _____ m

4 (b) (ii) The work done to stop the lorry is 360 kJ

Calculate the braking force used to stop the lorry.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

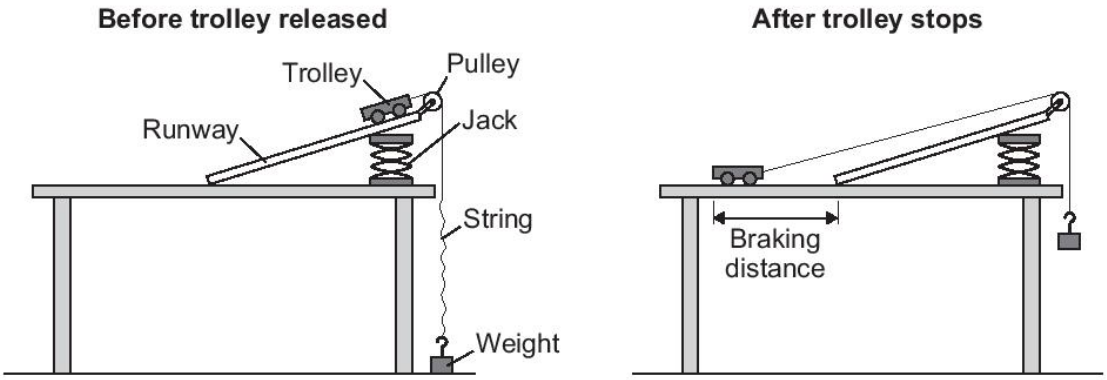
_____

Braking force = _____ N

Question 4 continues on the next page

4 (c) A student investigated how braking distance depends on braking force. The student used the apparatus shown in **Figure 4**.

Figure 4



The student released the trolley from the top of the runway. When the trolley reached the bottom of the runway the string became taut and the trolley started to lift a weight from the floor. The weight being lifted was equal to the braking force on the trolley.

The student changed the weight being lifted and measured the new braking distance.

4 (c) (i) State **one** control variable in this investigation.

[1 mark]

_____

_____

4 (c) (ii) **Figure 4** shows the braking distance measured by the student.

What else could the student have measured that would also have given the braking distance?

[1 mark]

_____

_____

_____

4 (c) (iii) Measuring each braking distance at least twice would improve the investigation. Suggest why.

[2 marks]

_____

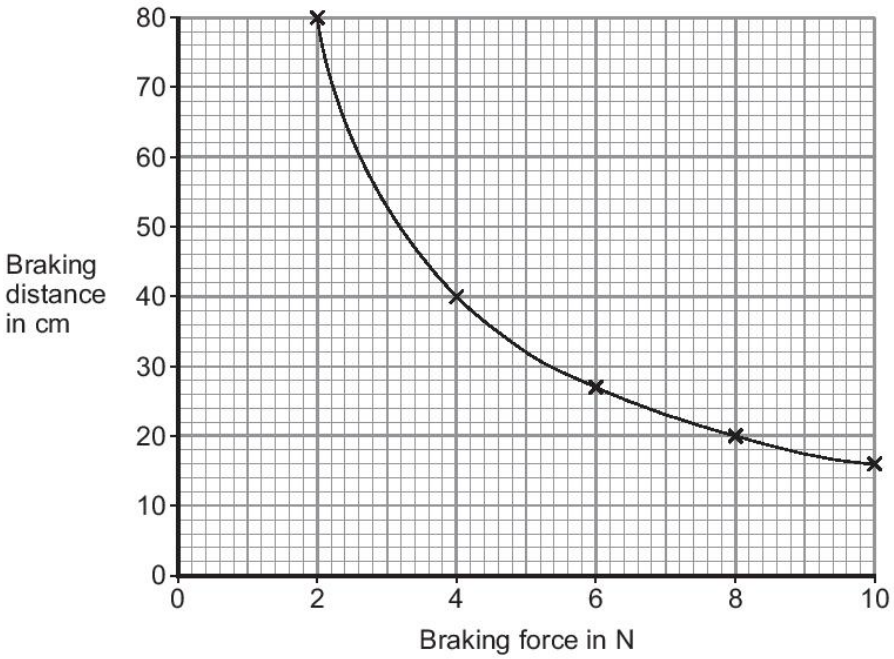
_____

_____

_____

4 (c) (iv) The results of the investigation are plotted as a graph in **Figure 5**.

Figure 5



What conclusions should be made from this investigation about the relationship between braking distance and braking force?

Use data from **Figure 5** to justify your conclusion.

[2 marks]

_____

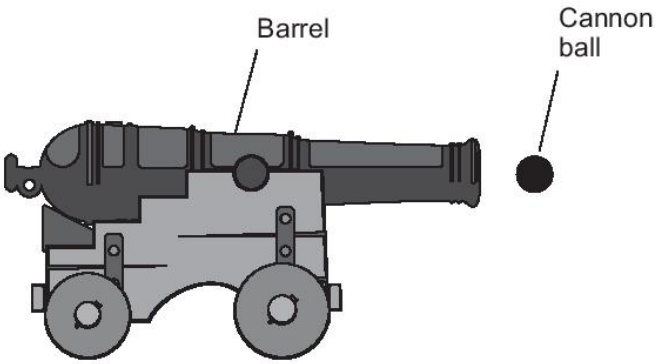
_____

_____

_____

7 **Figure 9** shows one type of cannon.

Figure 9



7 (a) When the cannon is fired, there is an explosion inside the barrel. The explosion causes the cannon ball to move forwards and the cannon to move backwards.

Explain, using the idea of momentum, why the cannon moves backwards after firing.

[3 marks]

Question 7 continues on the next page

7 (b) When the cannon is fired, the cannon ball accelerates at 2500 m/s^2 for 0.05 seconds. The cannon ball has a mass of 8 kg

Calculate the momentum of the cannon ball 0.05 seconds after the cannon is fired.

Use the correct **equations** from the Physics Equations Sheet.

[3 marks]

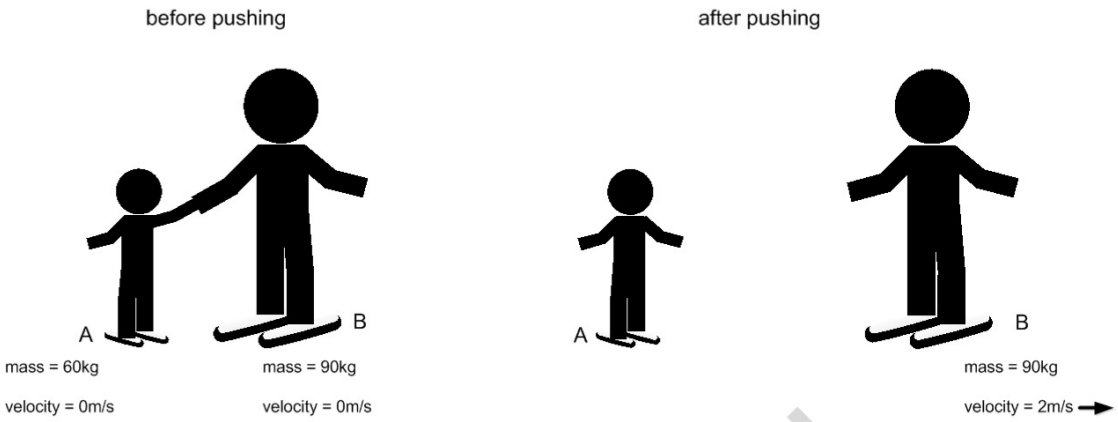
Momentum = _____ kg m/s

6

END OF QUESTIONS

22 Two ice skaters A and B, at rest, start together on the ice.

The ice skaters push apart and they move off in opposite directions.



(a) State the law of conservation of momentum.

……

…… **[1]**

(b) Use the data and your knowledge of momentum to calculate the velocity of skater **A** after pushing.

……

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……

…… **[2]**