Name:

Date:

P5 - Test 5
FORCES
Intermediate

GCSE
PHYSICS
AQA - Triple Science

Mark | Grade

Materials

For this paper you must have:

- Ruler
- Pencil and Rubber
- Scientific calculator, which you are expected to use when appropriate

Instructions

- Answer all questions
- Answer questions in the space provided
- All working must be shown

Information

- The marks for the questions are shown in brackets

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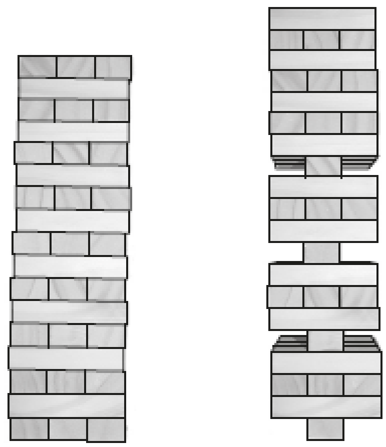
1. In a balancing game, wooden blocks are used to build a tower. The shape of the tower at the start of the game is shown in **Figure 1**. During the game, some of the blocks are taken out and put on top of the tower as shown in **Figure 2**. This causes the centre of mass of the tower to change.

Figure 1 **Figure 2**



(a) (i) State what is meant by the term 'centre of mass'.

____

____

____

(1)

(ii) Give **two** reasons why the tower in **Figure 2** is less stable than the tower in **Figure 1**.

1. ____

____

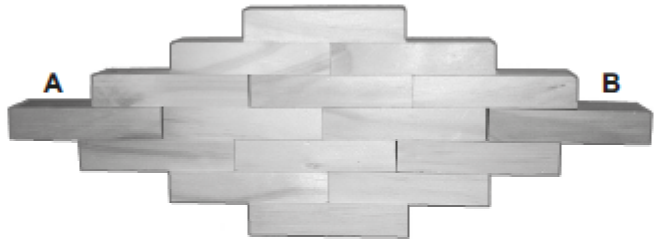
2. ____

____

(2)

(b) **Figure 3** shows a different arrangement for the wooden blocks.

Figure 3



A block was placed in position **A** and an identical block was placed in position **B** at the same time.

Explain why the tower did not fall over. You should include reference to moments in your answer.

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____

____

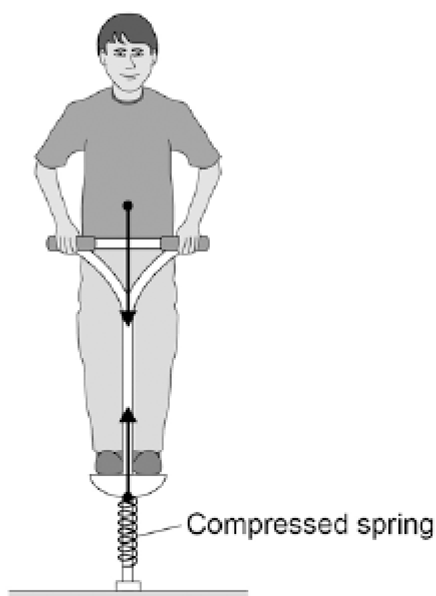
____

(2)

(Total 5 marks)

2. The figure below shows the forces acting on a child who is balancing on a pogo stick.

The child and pogo stick are not moving.



(a) The downward force of the child on the spring is equal to the upward force of the spring on the child.

This is an example of which one of Newton's Laws of motion?

Tick **one** box.

First Law ☐

Second Law ☐

Third Law ☐

(1)

(b) Complete the sentence.

Use an answer from the box.

elastic potential	**gravitational potential**	**kinetic**

The compressed spring stores ____________________ energy.

(1)

(c) The child has a weight of 343 N.

Gravitational field strength = 9.8 N / kg

Write down the equation which links gravitational field strength, mass and weight.

____

(1)

(d) Calculate the mass of the child.

____

____

____

Mass = ____________________ kg

(3)

(e) The weight of the child causes the spring to compress elastically from a length of 30cm to a new length of 23cm.

Write down the equation which links compression, force and spring constant.

____

(1)

(f) Calculate the spring constant of the spring.

Give your answer in newtons per metre.

____

____

____

Spring constant = ___________________________ N / m

(4)

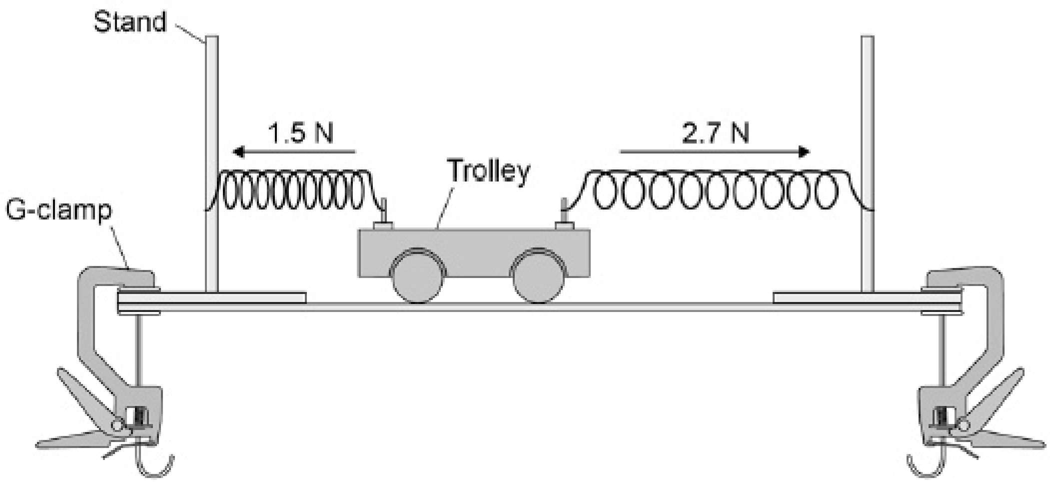
(Total 11 marks)

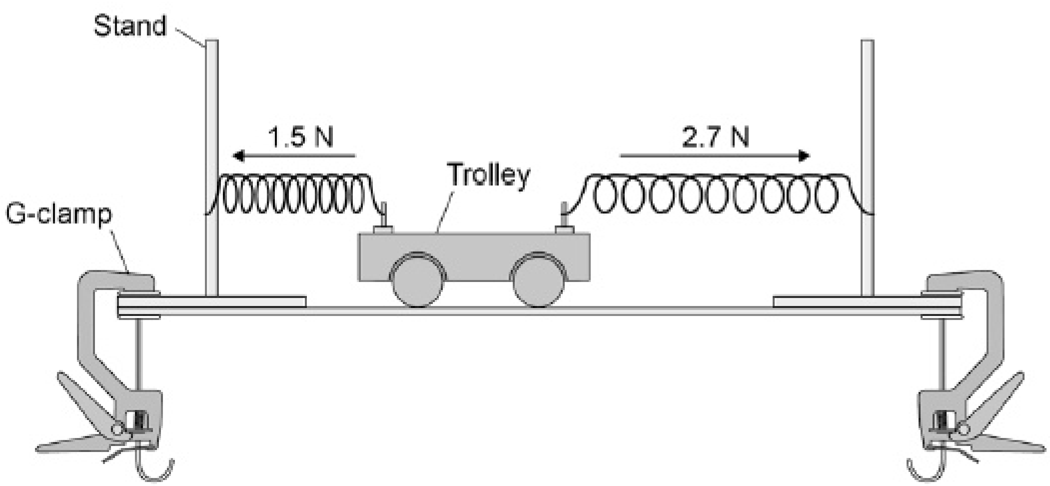
3. A trolley is attached to two identical springs.

The trolley is pushed to the left and then released.

Figure 1 shows the horizontal forces acting on the trolley just after it is released.

Figure 1





(a) Write the equation which links acceleration, mass and resultant force.

____

(1)

(b) The trolley has a mass of 0.75 kg

Calculate the acceleration of the trolley just after it is released.

Give the unit.

____

____

____

____

____

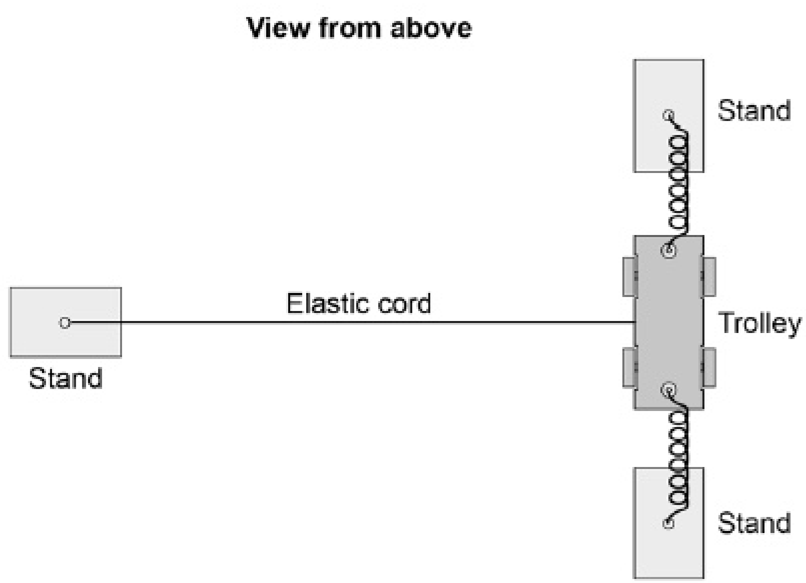
Acceleration = ____________________ Unit ____________________

(4)

An elastic cord is fixed to the trolley.

Figure 2 shows the arrangement viewed from above.

Figure 2



When the trolley is pushed and released a wave travels along the cord.

(c) What type of wave travels along the cord?

____

Give the reason for your answer.

____

____

(2)

(d) Suggest one change that could be made to the apparatus shown in **Figure 2** to produce a wave with a lower frequency.

____

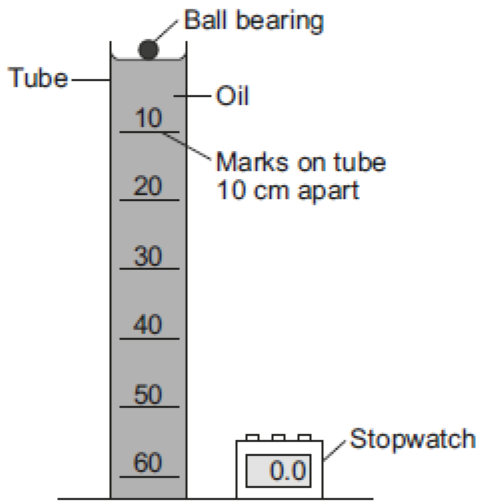
____

(1)

(Total 8 marks)

4. 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.

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

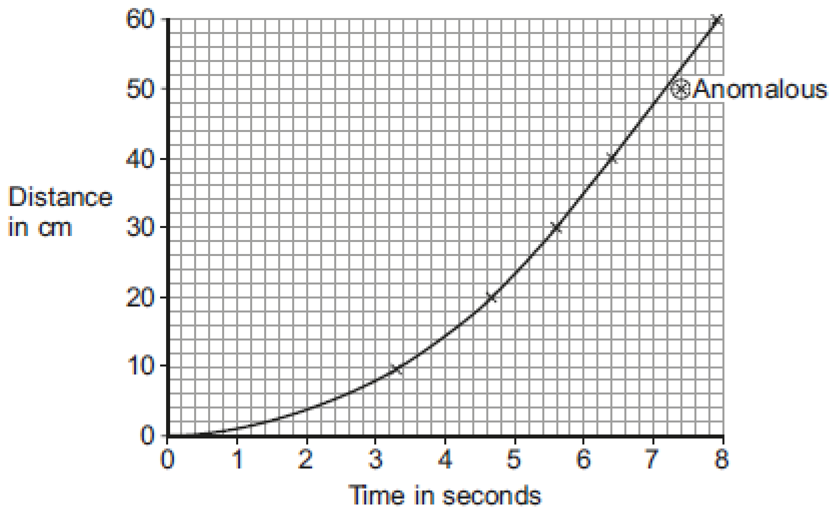
____

____

(1)

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

Figure 2



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

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

after	**as**	**before**

The anomalous result was caused by the stopwatch being started

____________ the ball bearing was released.

(1)

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

____

____

(1)

(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.

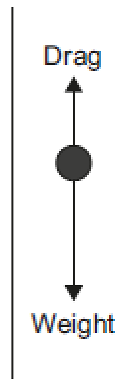
____

____

(1)

(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.

____

____

____

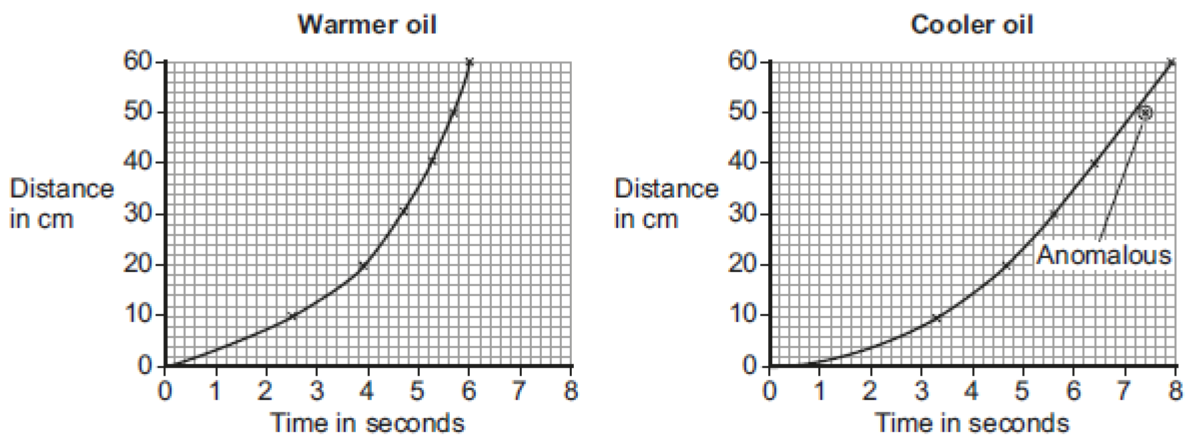
____

(2)

(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 answer from the box to complete the sentence.

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.

____

____

____

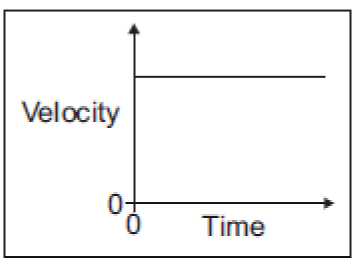
____

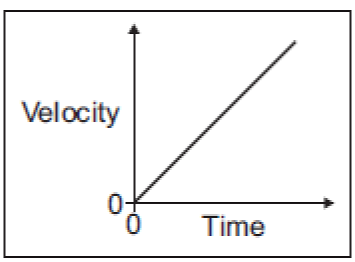
(3)

(Total 9 marks)

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

Velocity–time graph





Motion shown by graph

Constant acceleration

Not moving

Constant deceleration

Constant velocity

(2)

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

energy	**momentum**	**speed**

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

(1)

(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.

(i) Calculate the acceleration of the horse.

____

____

Acceleration = ______________________ m/s^2

(2)

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

Tick (✓) **one** box.

The air resistance decreases ☐

The air resistance is constant ☐

The air resistance increases ☐

(1)

(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?

Draw a ring around the correct answer

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

Give a reason for your answer.

____

____

(2)
(Total 8 marks)

6. An investigation was carried out to show how thinking distance, braking distance and stopping distance are affected by the speed of a car.

The results are shown in the table.

Speed in metres per second	Thinking distance in metres	Braking distance in metres	Stopping distance in metres
10	6	6	12
15	9	14	43
20	12	24	36
25	15	38	53
30	18	55	73

(a) Draw a ring around the correct answer to complete each sentence.

As speed increases, thinking distance

decreases.
increases.
stays the same.

As speed increases, braking distance

decreases.
increases.
stays the same.

(2)

(b) One of the values of stopping distance is incorrect.

Draw a ring around the incorrect value in the table.

Calculate the correct value of this stopping distance.

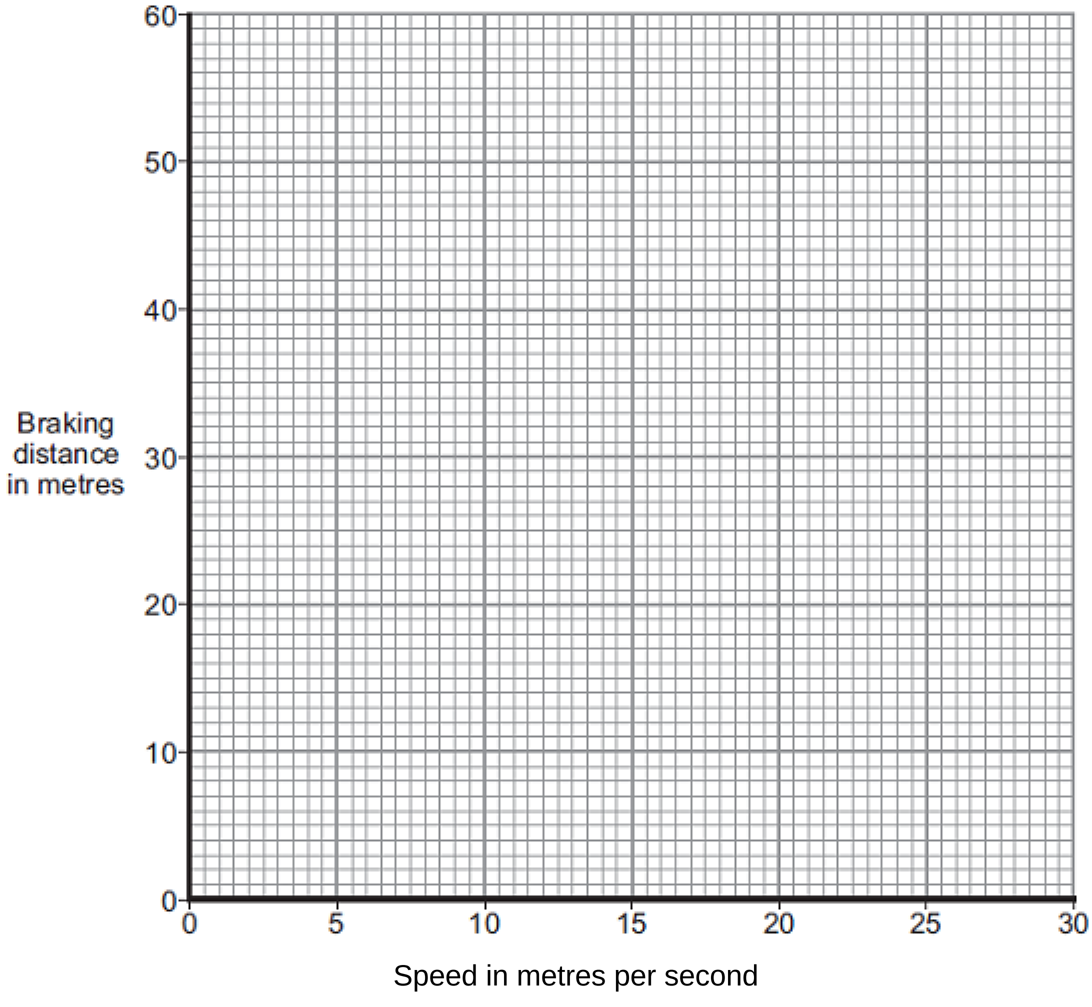
____

Stopping distance = ________________ m

(2)

(c) (i) Using the results from the table, plot a graph of braking distance against speed.

Draw a line of best fit through your points.



(3)

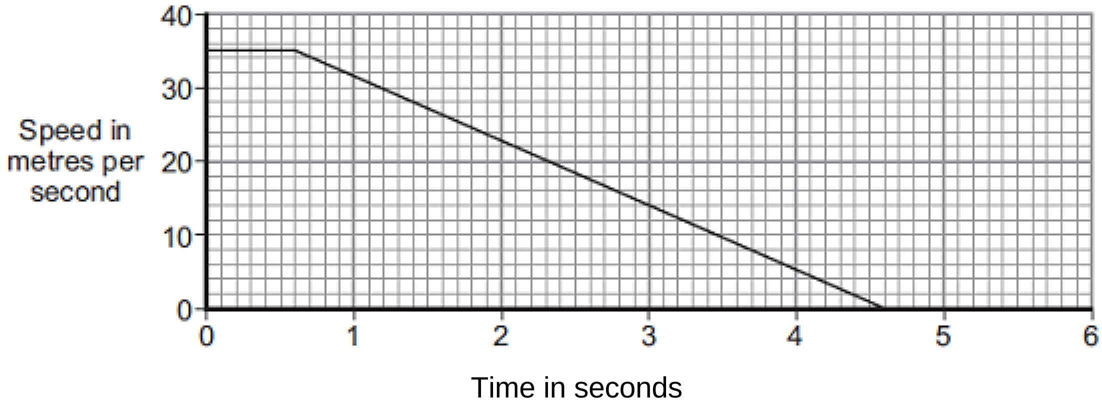
(ii) Use your graph to determine the braking distance, in metres, at a speed of 22 m / s.

Braking distance = ________________ m

(1)

(d) The speed–time graph for a car is shown below.

While travelling at a speed of 35 m / s, the driver sees an obstacle in the road at time *t* = 0.
The driver reacts and brakes to a stop.



(i) Determine the braking distance.

____

____

____

____

Braking distance = ________________ m

(3)

(ii) If the driver was driving at 35 m / s on an icy road, the speed–time graph would be different.

Add another line to the speed–time graph above to show the effect of travelling at 35 m / s on an icy road and reacting to an obstacle in the road at time *t* = 0.

(3)

(e) A car of mass 1200 kg is travelling with a velocity of 35 m / s.

(i) Calculate the momentum of the car.

Give the unit.

____

____

____

Momentum = ______________________

(3)

(ii) The car stops in 4 seconds.

Calculate the average braking force acting on the car during the 4 seconds.

____

____

Force = ________________ N

(2)

(Total 19 marks)

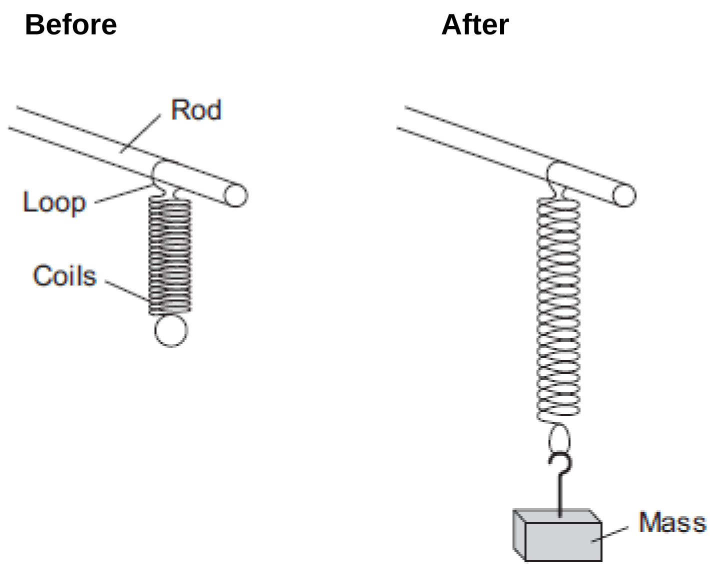
7. A student investigated the behaviour of springs. She had a box of identical springs.

(a) When a force acts on a spring, the shape of the spring changes.

The student suspended a spring from a rod by one of its loops. A force was applied to the spring by suspending a mass from it.

Figure 1 shows a spring before and after a mass had been suspended from it.

Figure 1



(i) State **two** ways in which the shape of the spring has changed.

1. ____

2. ____

(2)

(ii) No other masses were provided.

Explain how the student could test if the spring was behaving elastically.

____

____

____

____

(2)

(b) In a second investigation, a student took a set of measurements of force and extension.

Her results are shown in **Table 1** .

Table 1

Force in newtons	0.0	1.0	2.0	3.0	4.0	5.0	6.0
Extension in cm	0.0	4.0		12.0	16.0	22.0	31.0

(i) Add the missing value to **Table 1**.

Explain why you chose this value.

____

____

____

____

(3)

(ii) During this investigation the spring exceeded its limit of proportionality.

Suggest a value of force at which this happened.

Give a reason for your answer.

Force = ____________________ N

Reason ____

____

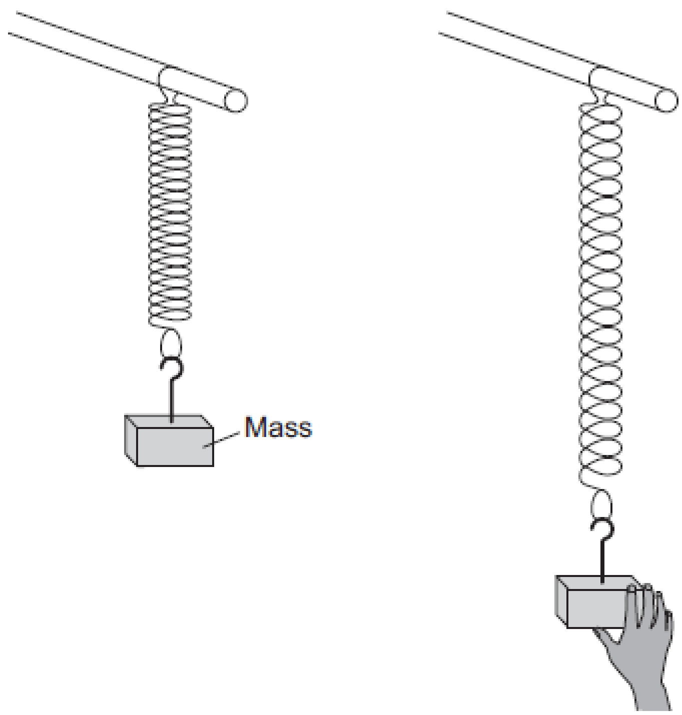
____

(2)

(c) In a third investigation the student:

- suspended a 100 g mass from a spring
- pulled the mass down as shown in **Figure 2**
- released the mass so that it oscillated up and down
- measured the time for 10 complete oscillations of the mass
- repeated for masses of 200 g, 300 g and 400 g.

Figure 2



Her results are shown in **Table 2**.

Table 2

	Time for 10 complete oscillations in seconds			
Mass in g	**Test 1**	**Test 2**	**Test 3**	**Mean**
100	4.34	5.20	4.32	4.6
200	5.93	5.99	5.86	5.9
300	7.01	7.12	7.08	7.1
400	8.23	8.22	8.25	8.2

(i) Before the mass is released, the spring stores energy.

What type of energy does the spring store?

Tick (✓) **one** box.

	Tick (✓)
Elastic potential energy	
Gravitational potential energy	
Kinetic energy	

(1)

(ii) The value of time for the 100 g mass in **Test 2** is anomalous.

Suggest **two** likely causes of this anomalous result.

Tick (✓) **two** boxes.

	Tick (✓)
Misread stopwatch	
Pulled the mass down too far	
Timed half oscillations, not complete oscillations	
Timed too few complete oscillations	
Timed too many complete oscillations	

(2)

(iii) Calculate the correct mean value of time for the 100 g mass in **Table 2**.

____

____

Mean value = ____________________ s

(1)

(iv) Although the raw data in **Table 2** is given to 3 significant figures, the mean values are correctly given to 2 significant figures.

Suggest why.

____

____

____

____

(2)

(v) The student wanted to plot her results on a graph. She thought that four sets of results were not enough.

What extra equipment would she need to get more results?

____

____

____

____

(2)
(Total 17 marks)