AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



EXAM QUESTION PACK

4.5.3 FORCES AND ELASTICITY (PACK 1)

SCORE	PERCENTAGE
/90	%

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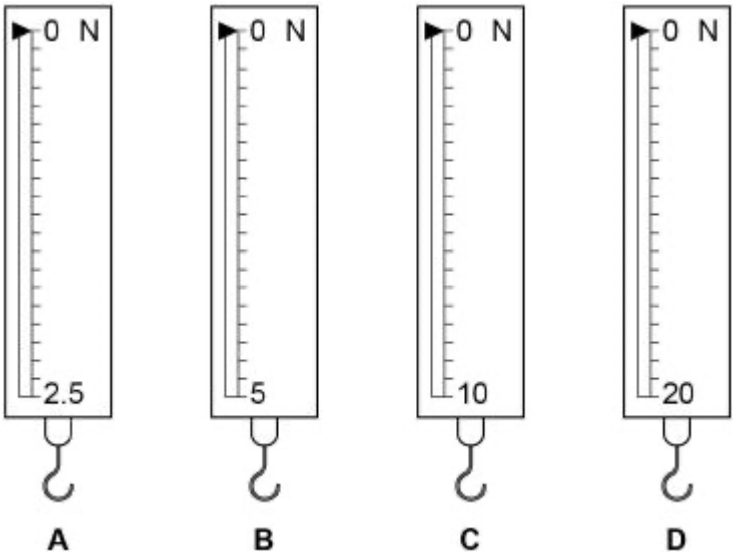
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Q1.

(a) **Figure 1** shows four newtonmeters.

Each newtonmeter contains a spring.

Figure 1



Which newtonmeter has the spring with the greatest spring constant?

Give a reason for your answer.

Newtonmeter _____

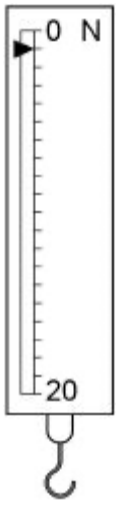
Reason _____

_____

(2)

(b) The newtonmeter in **Figure 2** will give an error when used to make a measurement.

Figure 2



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Name the type of error.

Describe how this error can be corrected.

Type of error _____

Correction _____

_____

(2)

(c) A student hangs a weight on a newtonmeter.

The energy now stored in the spring in the newtonmeter is 4.5×10^{-2} J

The student then increases the weight on the newtonmeter by 2.0 N

Calculate the total extension of the spring.

Spring constant = 400 N/m

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Total extension = _____ m

(6)

(Total 10 marks)

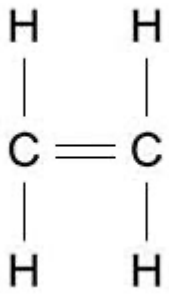
Q2.

Supermarket carrier bags can be made from poly(ethene).

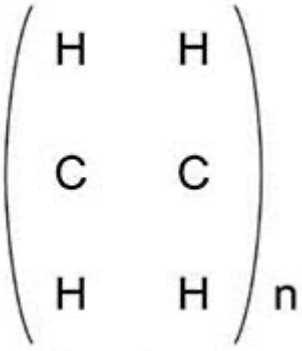
(a) Poly(ethene) is produced from ethene.

The structure of ethene is:

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Complete the structure of poly(ethene).

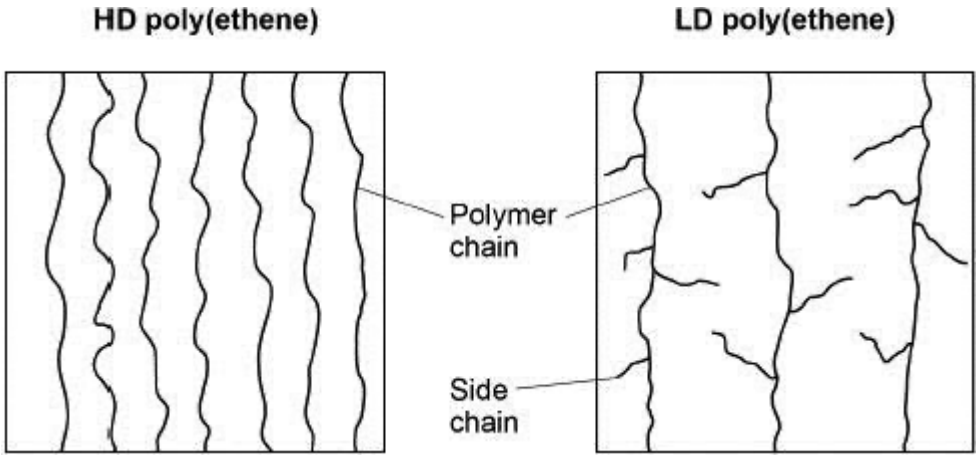


(2)

There are two types of poly(ethene): HD poly(ethene) and LD poly(ethene).

(b) **Figure 1** shows the polymer chains in HD poly(ethene) and LD poly(ethene).

Figure 1



Describe the differences in the structure and arrangement of the polymer chains in the two types of poly(ethene).

_____

_____

_____

_____

(2)

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A student investigated how poly(ethene) extends when a force is applied.

(c) Describe a method to investigate how the extension of poly(ethene) changes with the force applied.

_____

_____

_____

_____

_____

_____

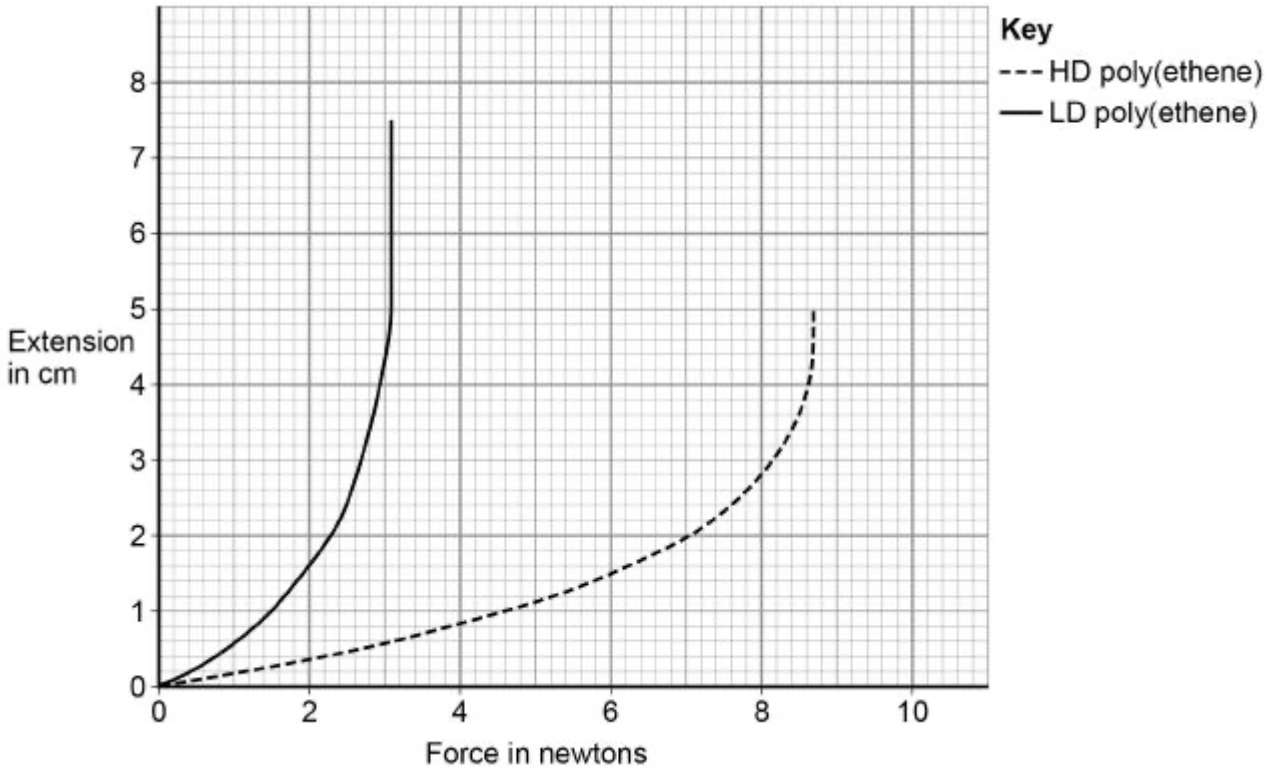
_____

_____

(4)

Figure 2 shows the results for HD poly(ethene) and LD poly(ethene).

Figure 2



(d) Give **two** comparisons between the results for HD poly(ethene) and for LD poly(ethene).

Use **Figure 2**.

1. _____

_____

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2. _____

_____

(2)

(e) Carrier bags in supermarkets used to be provided free. Supermarkets now make customers pay for carrier bags.

When they were free, 8.0 billion new carrier bags were used each year.

After supermarkets started making customers pay for carrier bags, the use of new bags dropped by 85%.

Calculate how many carrier bags are now used each year.

_____

_____

_____

Number of bags = _____

(2)

(f) There are two types of carrier bag in common use:

- disposable bags
- bags for life.

Bags for life can be returned to the supermarket when no longer usable.

The supermarket replaces the bag for life free of charge and arranges for the bag to be recycled.

The table below shows data from a life cycle assessment (LCA) for the two types of carrier bag.

	Disposable bag	**Bag for life**
Type of polymer	HD poly(ethene)	LD poly(ethene)
Raw material from which polymer is made	Crude oil	Crude oil
Mass of waste material per bag from production in grams	0.42	0.17
Mass of carbon dioxide emitted per bag during production and transport in grams	1.6	6.9
Mean number of times used	1	6
Possible disposal methods	Landfill Incineration	Landfill Incineration

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	Recycling	Recycling

Evaluate the use of each type of carrier bag.

Use data from the table above and your own knowledge.

(6)

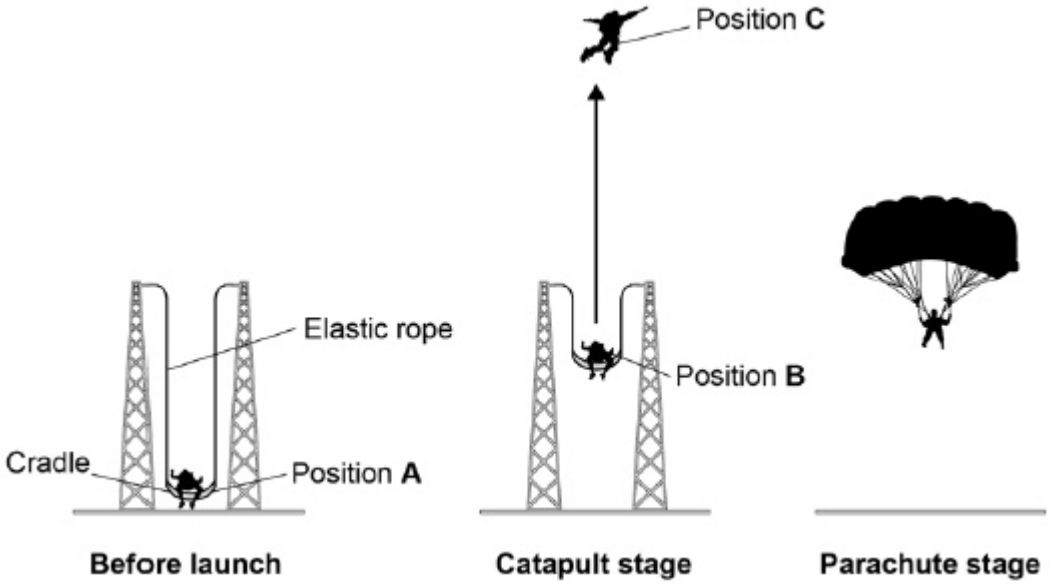
(Total 18 marks)

Q3.

The diagram shows the stages of an extreme sport called 'human catapult'.

- A person lies in a cradle which is held to the ground.
- The cradle is released.
- The person is launched vertically into the air by an elastic rope.
- The person then parachutes back to the ground.

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(a) In position **A** there is a store of elastic energy.

Position **C** is the person's maximum height.

Describe the energy transfers from position **A**, through position **B**, to position **C**.

(3)

(b) In the last few metres of his descent during the parachute stage, the person travels at a terminal velocity.

Explain why.

(2)

(c) When stretched in position **A**, the elastic rope stores 25 000 joules.

The elastic rope behaves like a spring, with a spring constant of 125 N/m

Calculate the extension of the elastic rope.

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Use the Physics Equations Sheet.

Extension of elastic rope = _____ m

(4)

(d) The vertical velocity of the person at position **B** in the diagram is 26 m/s

The vertical velocity at position **C** is 0 m/s

Calculate the distance between position **B** and position **C**. Ignore the effect of air resistance.

Use the Physics Equations Sheet.

Distance = _____ m

(4)

(Total 13 marks)

Q4.

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

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This is the method used.

1. Hang a spring from a rod.

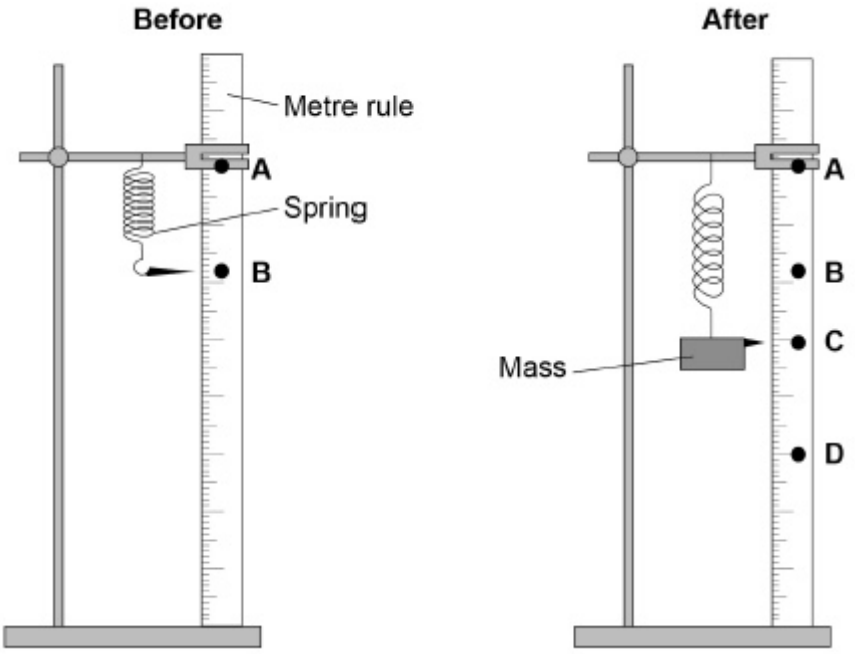
2. Hang a mass from the spring.

3. Measure the extension of the spring.

4. Repeat steps 2 and 3 using different masses.

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

Figure 1



(a) Give **two** ways in which the appearance of the spring has changed.

1. _____

_____

2. _____

_____

(2)

(b) The extension of the spring is the distance between which **two** points on the metre rule?

Use letters from the diagram in **Figure 1**.

_____ and _____

(1)

(c) The force applied to the spring is the weight of the mass hanging from the spring.

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

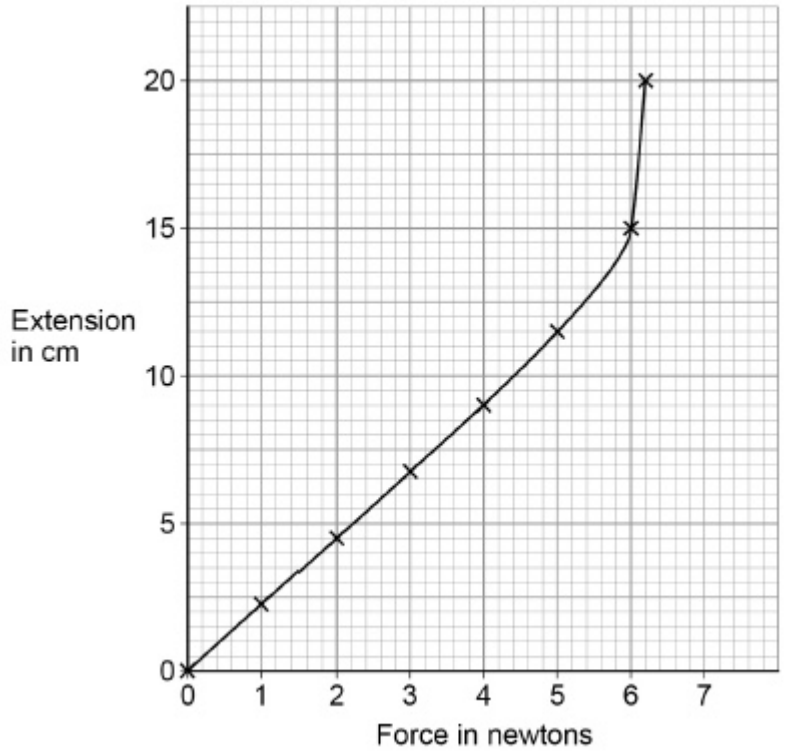
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_____

(1)

Figure 2 shows the student's results.

Figure 2



(d) During the investigation the limit of proportionality of the spring was exceeded.

What is the value of force at which this happened?

Give a reason for your choice.

Force = _____ N

Reason _____

_____

(2)

(e) Suggest how the student could obtain a more accurate answer for the limit of proportionality of the spring.

You should include the additional readings the student should take.

_____

_____

_____

_____

(2)

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(f) Write the equation that links extension, force and the spring constant.

_____

(1)

(g) A different spring has a spring constant of 18 N/m

When an apple is hung from the spring, the spring extends 6.4 cm

The spring does not go past the limit of proportionality.

Calculate the force exerted by the apple on the spring.

_____

_____

_____

_____

Force = _____ N

(3)

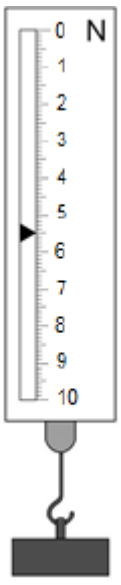
(Total 12 marks)

Q5.

A newtonmeter measures the weight of objects.

Look at **Figure 1**.

Figure 1



(a) What is the weight of the object in **Figure 1**?

Weight = _____ N

(1)

(b) The spring inside the newtonmeter behaves elastically.

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What happens to the length of the spring when the object is removed from the newtonmeter?

Tick **one** box.

The spring gets longer	☐
The spring gets shorter	☐
The spring stays the same length	☐

(1)

(c) A student carried out a practical to investigate the extension of a spring.

Write a method the student could have used.

(4)

(d) What could be done to improve the accuracy in this investigation?

Tick **two** boxes.

Use a pointer from the spring to measure the length.	☐
Use a stronger spring in the practical.	☐
Use a new spring between each reading.	☐
Make sure the spring is stationary before measuring length.	☐

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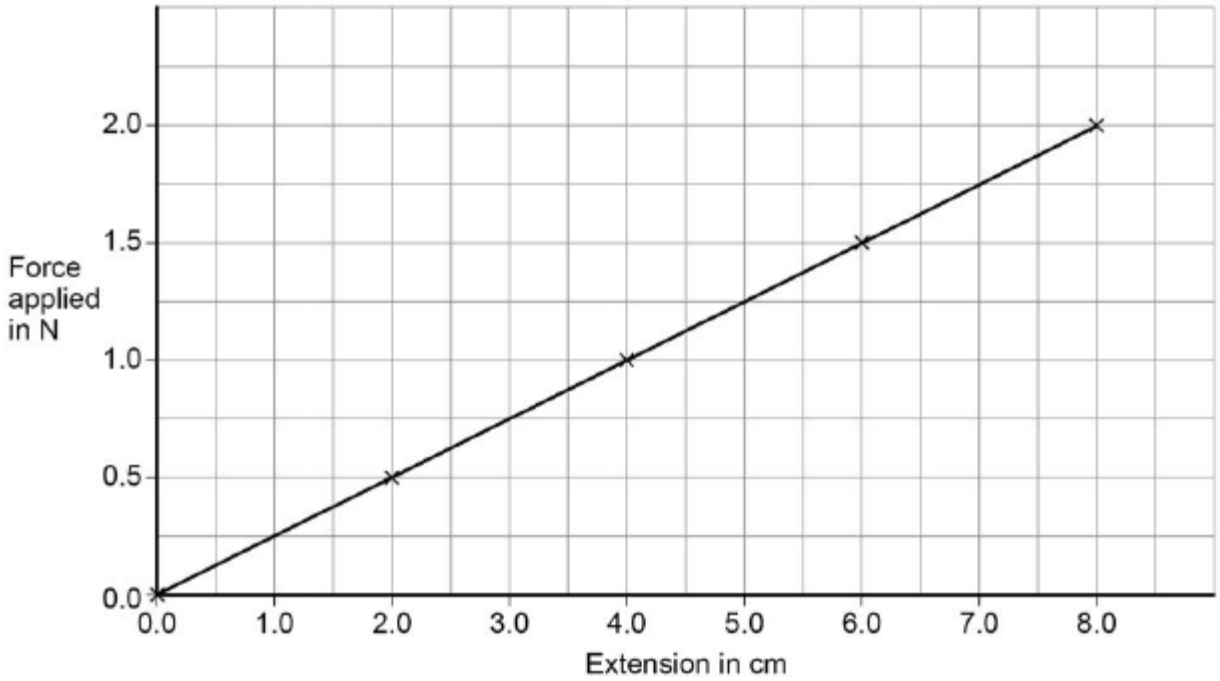
Use a longer rule when measuring length. ☐

(2)

(e) The student added weights to a spring and measured the extension of the spring.

Figure 2 shows his results.

Figure 2



What is the relationship between force applied and extension?

Tick **one** box.

Extension is inversely proportional to force ☐

Extension increases by smaller values as force increases ☐

Extension is directly proportional to force ☐

(1)

(f) Use **Figure 2** to determine the additional force needed to increase the extension in the spring from 5.0 cm to 7.0 cm.

Force needed = _____ N

(1)

(g) The table below shows some results with a different spring.

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Force applied in N	Extension in m
0.0	0.000
0.5	0.025
1.0	0.050
1.5	0.075

What would the extension be with a force of 2.0 N?

Tick **one** box.

0.080 m ☐

0.080 m ☐

0.095 m ☐

0.100 m ☐

(1)

(h) The spring constant for the spring in above **Table** is 20 N / m.

Calculate the work done in stretching the spring until the extension of the spring is 0.050m

Use the correct equation from the Physics Equation Sheet.

_____

_____

Work done = _____ J

(2)

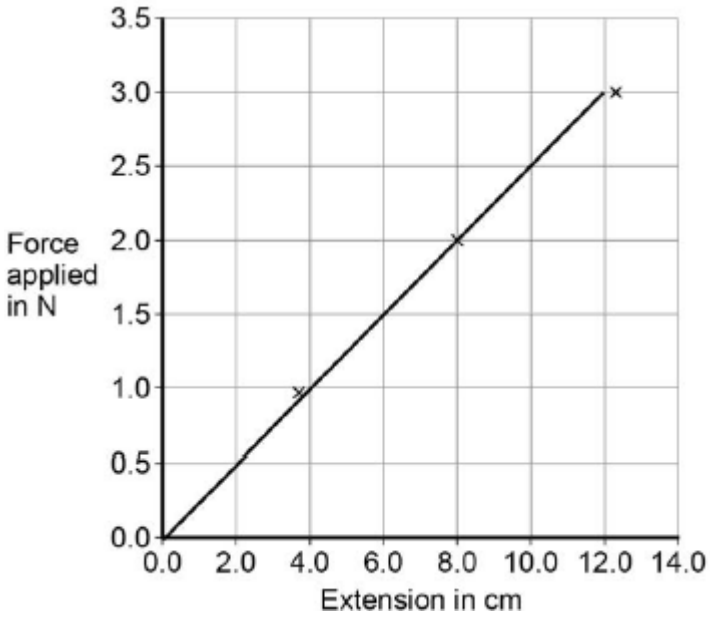
(Total 13 marks)

Q6.

A student changed the force applied to a spring by adding weights.

The figure below shows a graph of her results.

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(a) Write down the equation that links the force applied and extension for a spring.

_____

(1)

(b) Identify the pattern shown in the figure above.

Explain your answer.

_____

_____

_____

_____

(2)

(c) Give **one** way the student could improve her investigation.

_____

(1)

(d) Describe the relationship between work done and elastic potential energy in stretching a spring.

_____

_____

_____

_____

(2)

(e) Draw a line on the figure above to show the results for a stiffer spring.

Explain the reason for the line you have drawn.

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(3)

(f) Explain what would happen to the spring if the student kept adding weights?

(2)

(Total 11 marks)

Q7.

Forces can be classed as contact or non-contact forces.

(a) Look at the table below.

Tick **one** box for each type of force to say whether it is a contact force or a non-contact force.

Type of force	Contact force	Non-contact force
Electrostatic		
Friction		
Gravity		

(3)

(b) Force is a vector quantity.

What are two other vector quantities?

Tick **two** boxes.

Mass ☐

Time ☐

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Velocity ☐

Speed ☐

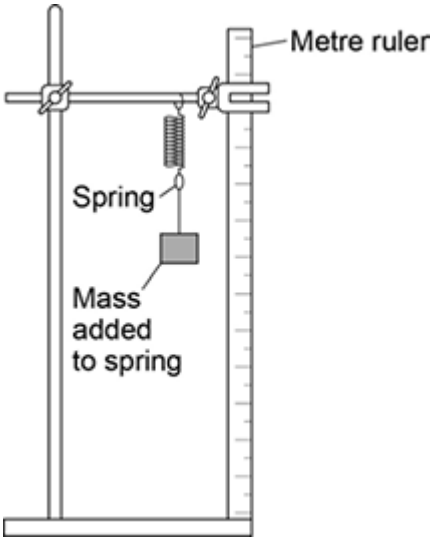
Displacement ☐

(2)

(c) A student does a practical to investigate the relationship between force and extension for a spring.

Figure 1 shows how he set up his experiment.

Figure 1



What could the student do to improve the accuracy of his investigation?

Tick **one** box.

Use a longer ruler to measure the length ☐

Use a pointer from the spring to measure the length ☐

Use a new spring between each reading ☐

Use a stronger spring in the investigation ☐

(1)

(d) The weight on the spring is the force applied to the spring.

The student puts a mass of 25 g on the spring.

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Gravitational field strength = 9.8 N / kg

Calculate the weight on the spring.

Use the equation:

weight = mass × gravitational field strength

_____

_____

_____

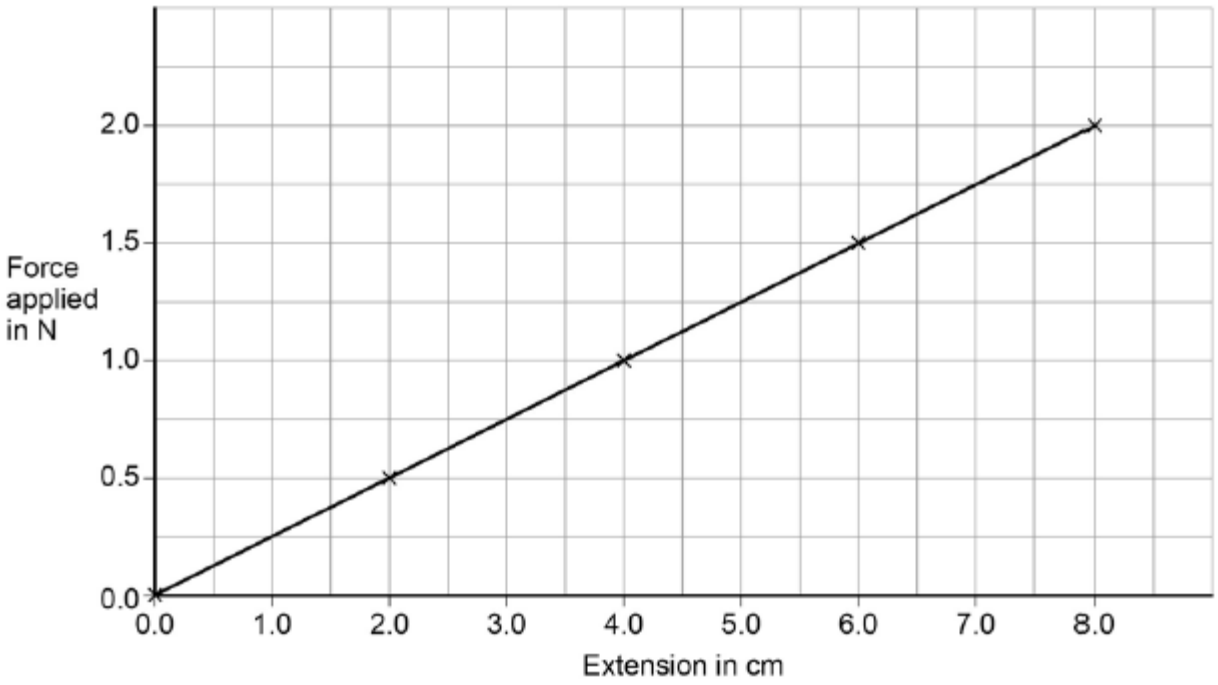
Weight on spring = _____ N

(3)

(e) The student plotted a graph of force applied and extension of the spring.

Figure 2 shows his graph.

Figure 2



What is the relationship between force applied and extension?

Tick **one** box.

Extension is directly proportional to force ☐

Extension increases by smaller values as force increases ☐

Extension is inversely proportional to force ☐

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(1)

(f) Use **Figure 2** to determine the force needed to give an extension of 4.5 cm.

Force needed = _____ N

(1)

(g) A different spring has a spring constant of 13.5 N / m.

Calculate the elastic potential energy stored in the spring when its extension is 12 cm.

Use the correct equation from the Physics equation sheet.

_____

_____

_____

Elastic potential energy = _____ J

(2)

(Total 13 marks)

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