Forces And Elasticity

These practice questions can be used by students and teachers and is

Suitable for GCSE AQA Physics Topic Question 8463

Level: GSCE AQA 8463

Subject: Physics

Exam Board: GCSE AQA

Topic: Forces And Elasticity

Q1.

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

The table below gives the data obtained by the student.

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

(a) Describe a method the student could have used to obtain the data given in the table above.

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

Your answer may include a labelled diagram.

.....

(6)

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

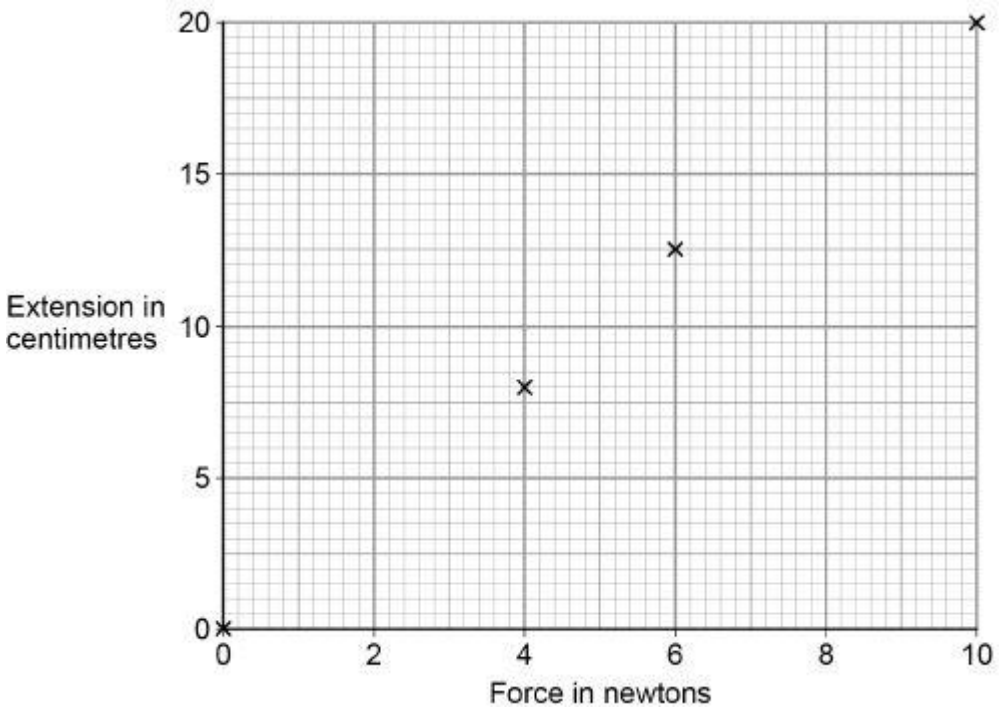
Suggest why.

_____

_____

(1)

The diagram below shows some of the data obtained by the student.



(c) Complete the diagram above by plotting the missing data from the table above.

Draw the line of best fit.

The table above is repeated here to help you answer this question.

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

(2)

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

_____

(1)

(e) Calculate the spring constant of the spring that the student used.

Give your answer in newtons per metre.

_____

_____

_____

_____

Spring constant = _____ N/m

(4)

(f) 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)

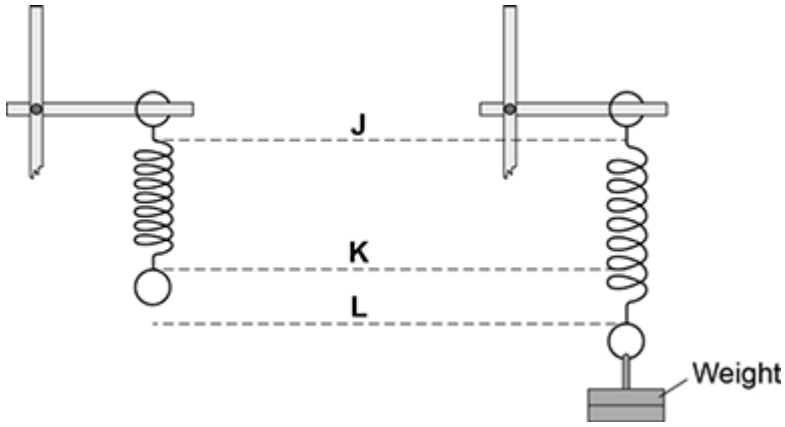
(Total 16 marks)

Q2.

A student suspended a spring from a laboratory stand and then hung a weight from the spring.

Figure 1 shows the spring before and after the weight is added.

Figure 1



(a) Which distance gives the extension of the spring?

Tick **one** box.

from **J** to **K** ☐

from **K** to **L** ☐

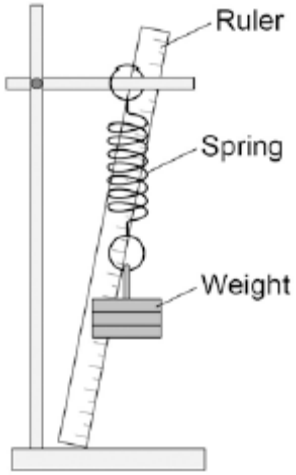
from **J** to **L** ☐

(1)

(b) The student used the spring, a set of weights and a ruler to investigate how the extension of the spring depended on the weight hanging from the spring.

Figure 2 shows that the ruler is in a tilted position and not upright as it should be.

Figure 2



How would leaving the ruler tilted affect the weight and extension data to be recorded by the student?

Use answers from the box to complete each sentence.

Each answer may be used once, more than once or not at all.

greater than	**the same as**	**smaller than**

The weight recorded by the student would be _____ the actual weight.

The extension recorded by the student would be _____ the actual extension of the spring.

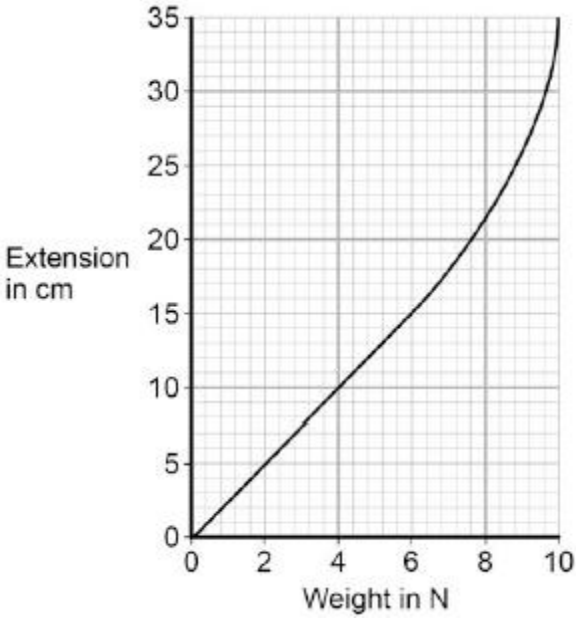
(2)

(c) The student moves the ruler so that it is upright and not tilted.

The student then completed the investigation and plotted the data taken in a graph.

The student's graph is shown in **Figure 3**.

Figure 3



Use **Figure 3** to determine the additional force needed to increase the extension of the spring from 5cm to 15cm.

Additional force = _____ N

(1)

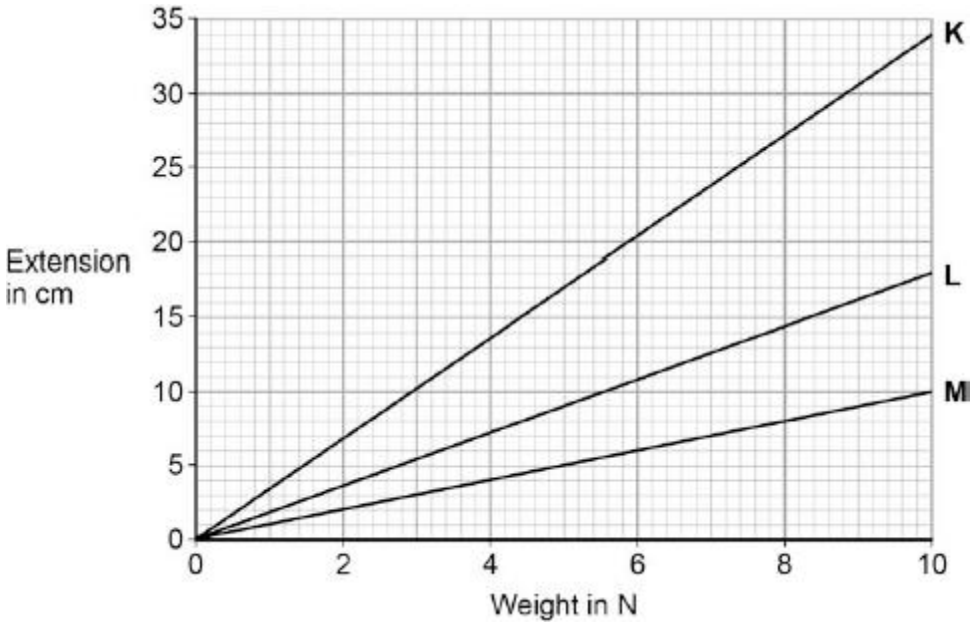
(d) What can you conclude from **Figure 3** about the limit of proportionality of the spring?

(1)

(e) The student repeated the investigation with three more springs, **K**, **L** and **M**.

The results for these springs are given in **Figure 4**.

Figure 4



All three springs show the same relationship between the weight and extension.

What is that relationship?

Tick **one** box.

The extension increases non-linearly with the increasing weight.	☐
The extension is inversely proportional to the weight.	☐
The extension is directly proportional to the weight.	☐

(1)

(f) Which statement, **A**, **B** or **C**, should be used to complete the sentence?

Write the correct letter, **A**, **B** or **C**, in the box below.

A a lower spring constant than

B the same spring constant as

C a greater spring constant than

From **Figure 4** it can be concluded that spring **M** has ☐ the other two springs.

(1)

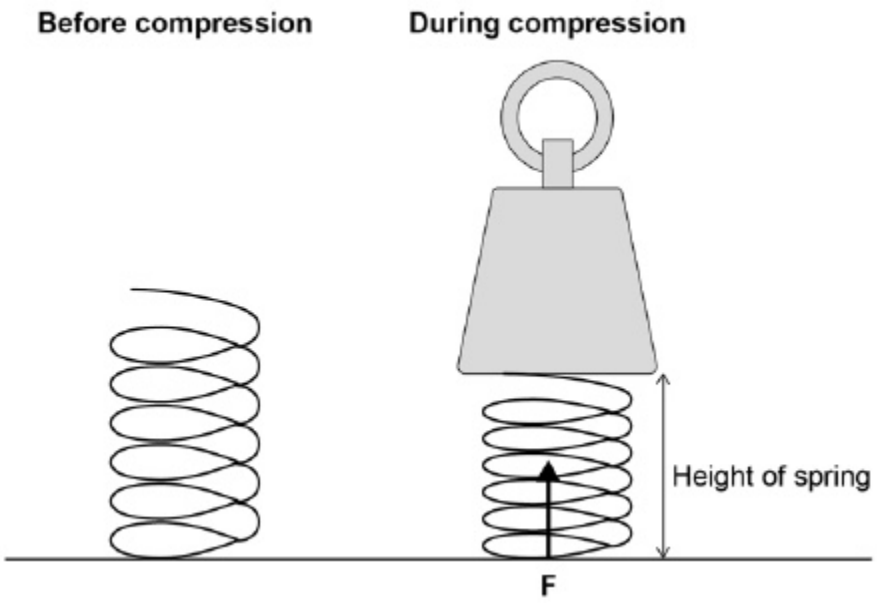
(Total 7 marks)

Q3.

Figure 1 shows a spring before and during compression.

The arrow F represents one of the two forces involved in compressing the spring.

Figure 1



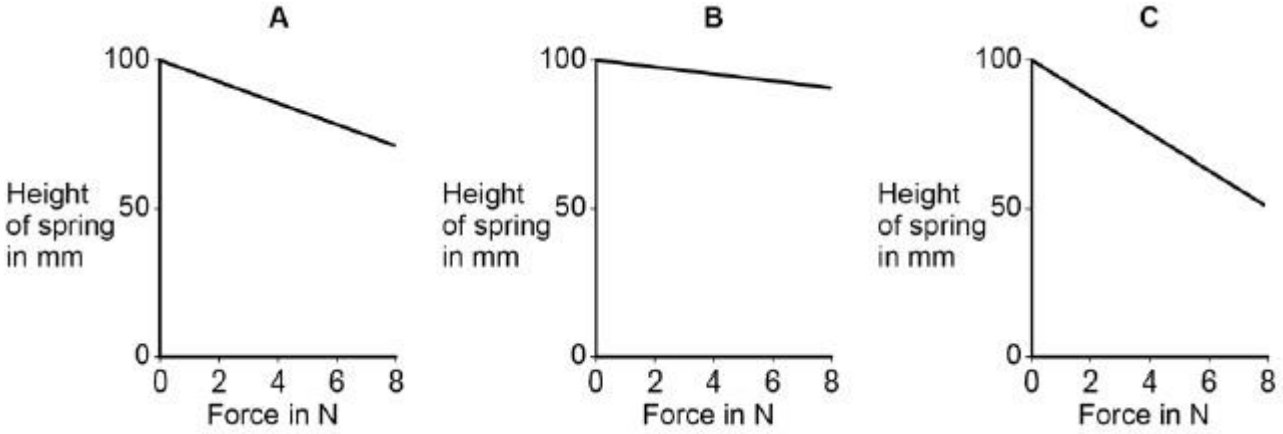
(a) Draw another arrow on **Figure 1** to represent the second force involved in compressing the spring.

(2)

A student investigated three different springs to compare the spring constants.

The results of the investigation are shown in **Figure 2**.

Figure 2



(b) Which **one** of the springs has the smallest spring constant?

Tick **one** box.

A ☐ **B** ☐ **C** ☐

Give the reason for your answer.

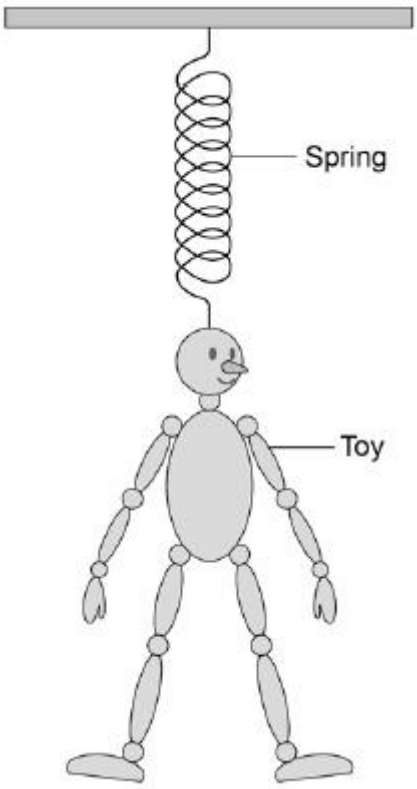
_____

_____

(2)

Figure 3 shows a child's toy. The toy hangs from a hook in the ceiling.

Figure 3



A child pulls the toy downwards and then releases it.

The toy oscillates up and down with a frequency of 1.25 Hz

(c) How many times each second will the toy oscillate up and down?

_____

(1)

(d) Calculate the period of the oscillating toy.

Use the Physics Equations Sheet.

_____

_____

_____

Period = _____ s

(2)

(e) When the toy is stationary, its weight causes the length of the spring to increase from 0.05 m to 0.25 m

The spring constant = 7.0 N/m

Calculate the elastic potential energy stored in the spring.

_____

_____

_____

_____

_____

Elastic potential energy stored = _____ J

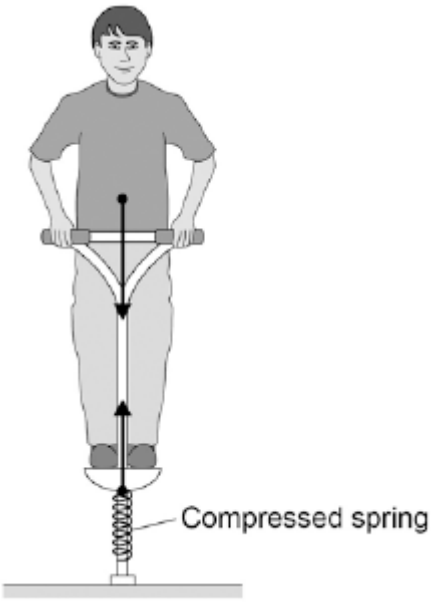
(3)

(Total 10 marks)

Q4.

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)

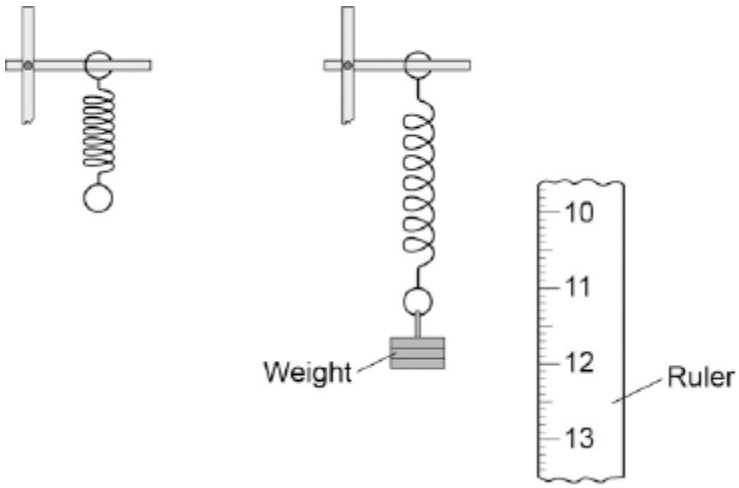
(Total 11 marks)

Q5.

A student suspended a spring from a laboratory stand and then hung a weight from the spring.

Figure 1 shows the spring before and after the weight is added.

Figure 1



(a) Measure the extension of the spring shown in **Figure 1**.

Extension = _____ mm

(1)

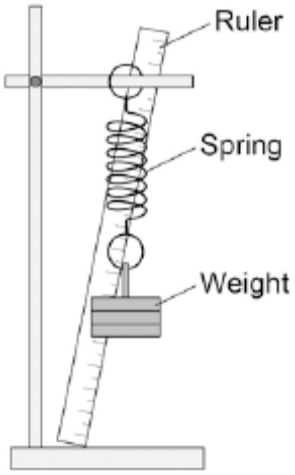
(b) The student used the spring, a set of weights and a ruler to investigate how the extension of the spring depended on the weight hanging from the spring.

Before starting the investigation the student wrote the following prediction:

The extension of the spring will be directly proportional to the weight hanging from the spring.

Figure 2 shows how the student arranged the apparatus.

Figure 2



Before taking any measurements, the student adjusted the ruler to make it vertical.

Explain why adjusting the ruler was important.

_____

_____

_____

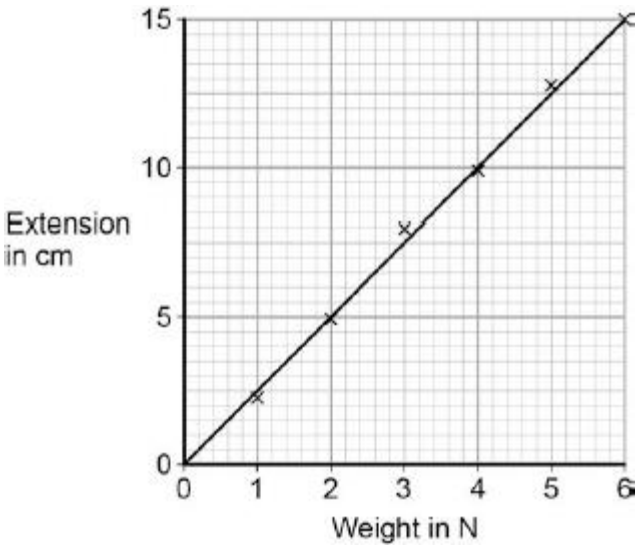
_____

(2)

(c) The student measured the extension of the spring using a range of weights.

The student's data is shown plotted as a graph in **Figure 3**.

Figure 3



What range of weight did the student use?

_____

(1)

(d) Why does the data plotted in **Figure 3** support the student's prediction?

_____

_____

(1)

(e) Describe **one** technique that you could have used to improve the accuracy of the measurements taken by the student.

_____

_____

_____

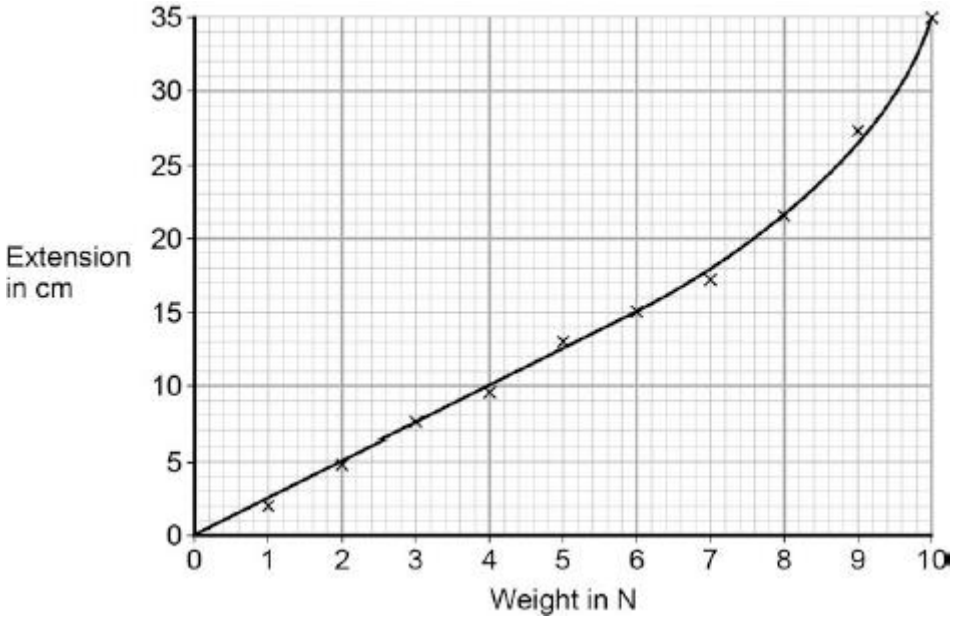
_____

(2)

(f) The student continued the investigation by increasing the range of weights added to the spring.

All of the data is shown plotted as a graph in **Figure 4**.

Figure 4



At the end of the investigation, all of the weights were removed from the spring.

What can you conclude from **Figure 4** about the deformation of the spring?

_____

_____

Give the reason for your conclusion.

_____

_____

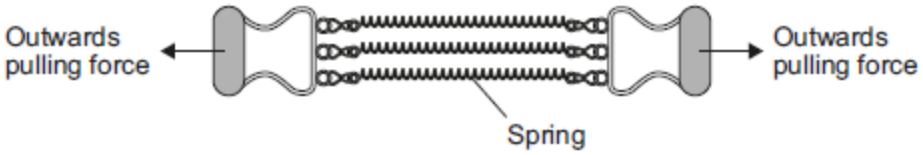
(2)

(Total 9 marks)

Q6.

Figure 1 shows an exercise device called a chest expander. The three springs are identical.

Figure 1



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

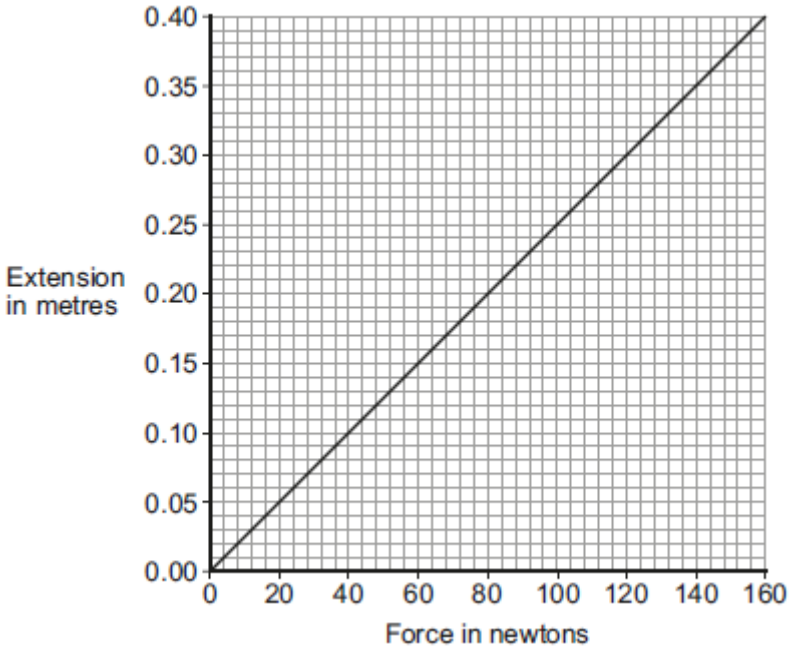
(a) Complete the following sentence.

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

(1)

(b) **Figure 2** shows how the extension of a single spring from the chest expander depends on the force acting on the spring.

Figure 2



(i) How can you tell, from **Figure 2**, that the limit of proportionality of the spring has

not been exceeded?

_____

_____

(1)

(ii) Use data from **Figure 2** to calculate the spring constant of the spring.
Give the unit.

_____

_____

_____

Spring constant = _____ Unit _____

(3)

(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 2** to determine the total force exerted on the chest expander when each spring is stretched by 0.25 m.

_____

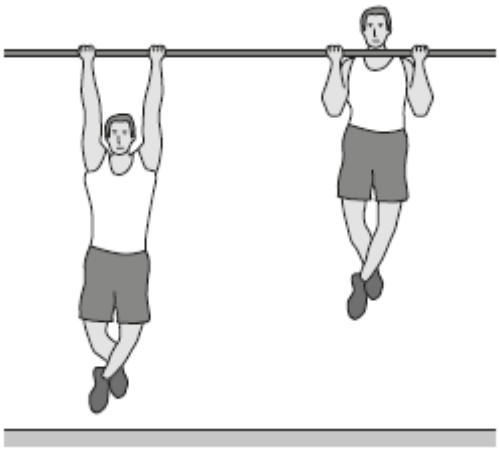
_____

Total force = _____ N

(2)

(c) The student in **Figure 3** is doing an exercise called a chin-up.

Figure 3



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

Power = _____ W

(3)

(Total 10 marks)

Q7.

(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.

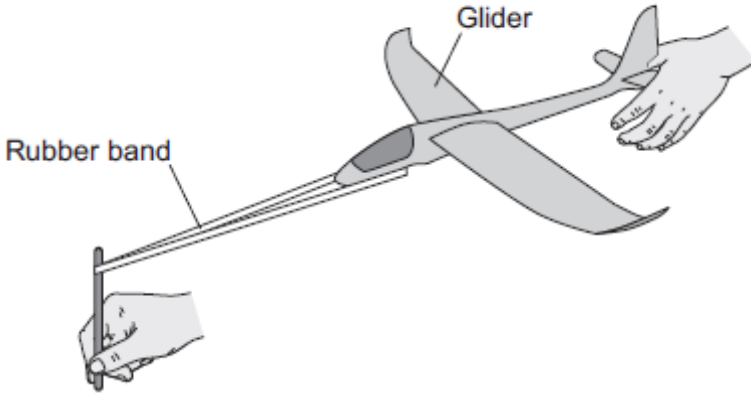
Calculate the force applied to the spring.

Force = _____ N

(2)

(b) **Figure 1** 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 1



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

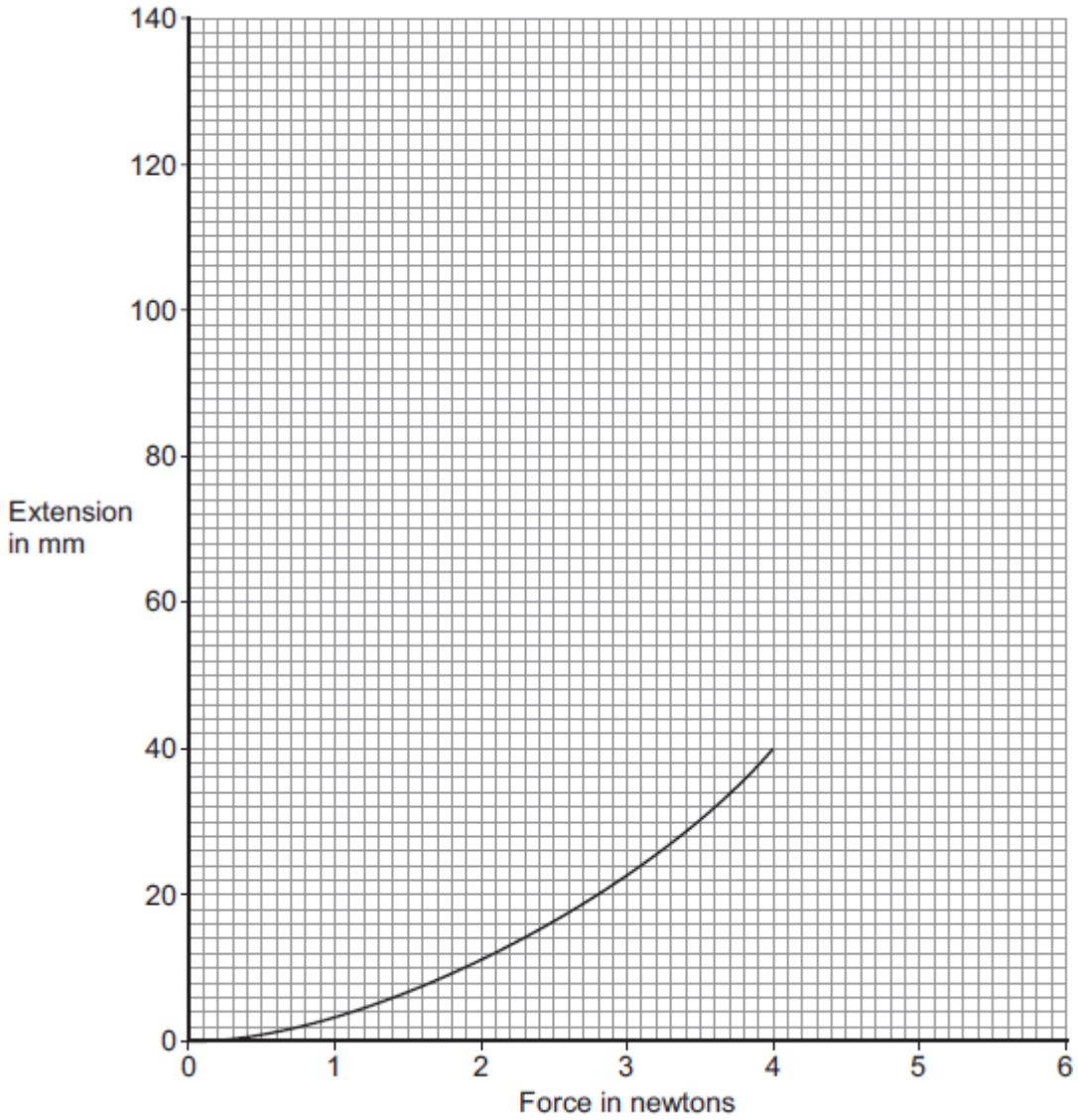
chemical	elastic potential	kinetic	thermal

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

(2)

(ii) **Figure 2** shows how the extension of the rubber band varies with the force applied to the rubber band.

Figure 2



What can you conclude, from **Figure 2**, 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.

_____

_____

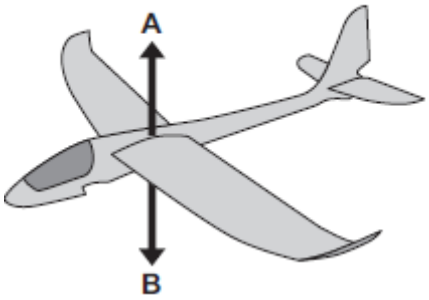
_____

_____

(2)

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

Figure 3



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

Draw a ring around the correct answer.

drag **friction** **weight**

(1)

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

Tick (✓) **one** box.

Downward speed increases ☐

Downward speed is constant ☐

Downward speed decreases ☐

(1)

(Total 8 marks)

Q8.

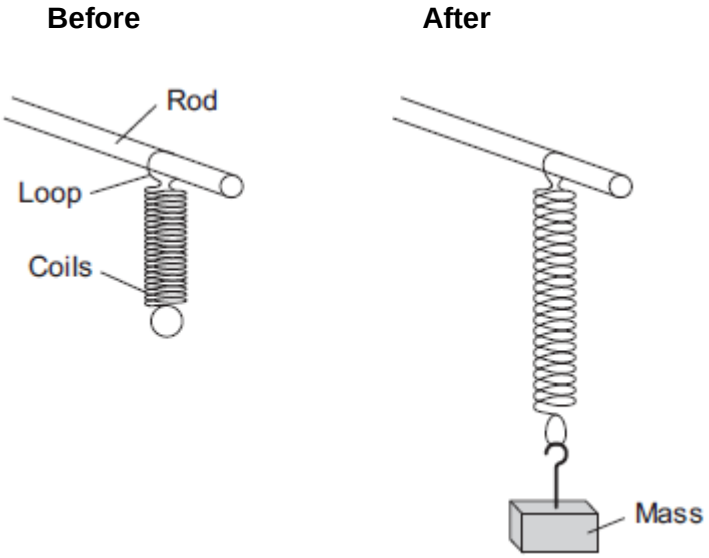
A student investigated the behaviour of springs. She had a box of identical springs.

(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 _____

_____

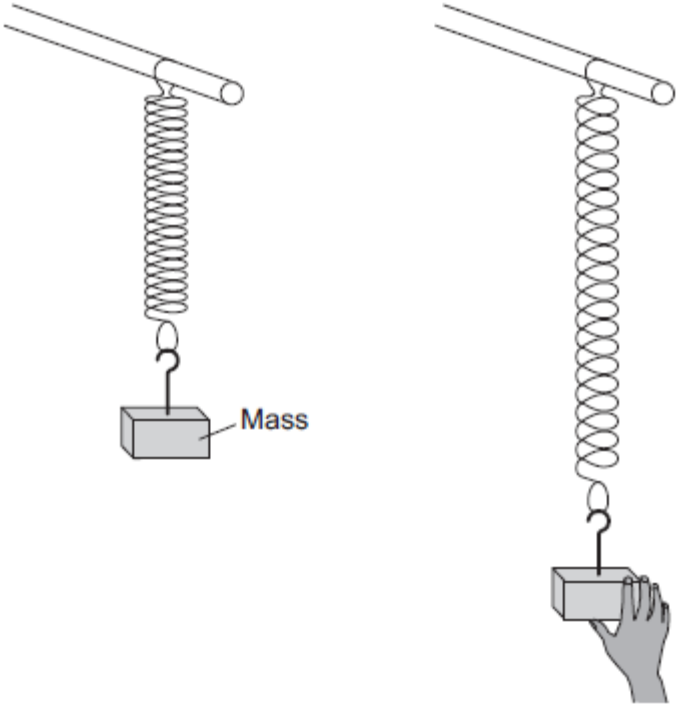
_____

(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?

_____

_____

_____

_____

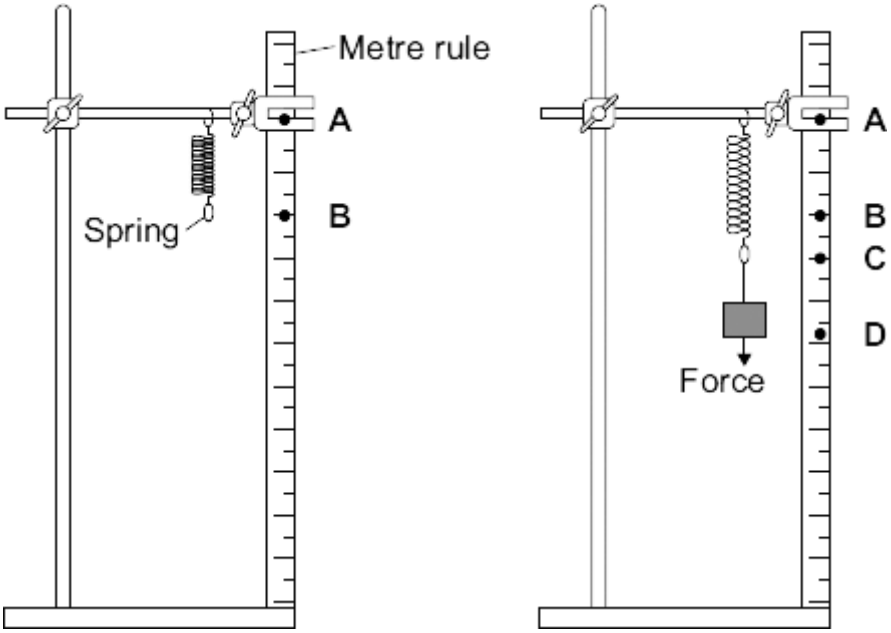
(2)

(Total 17 marks)

Q9.

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.



(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.

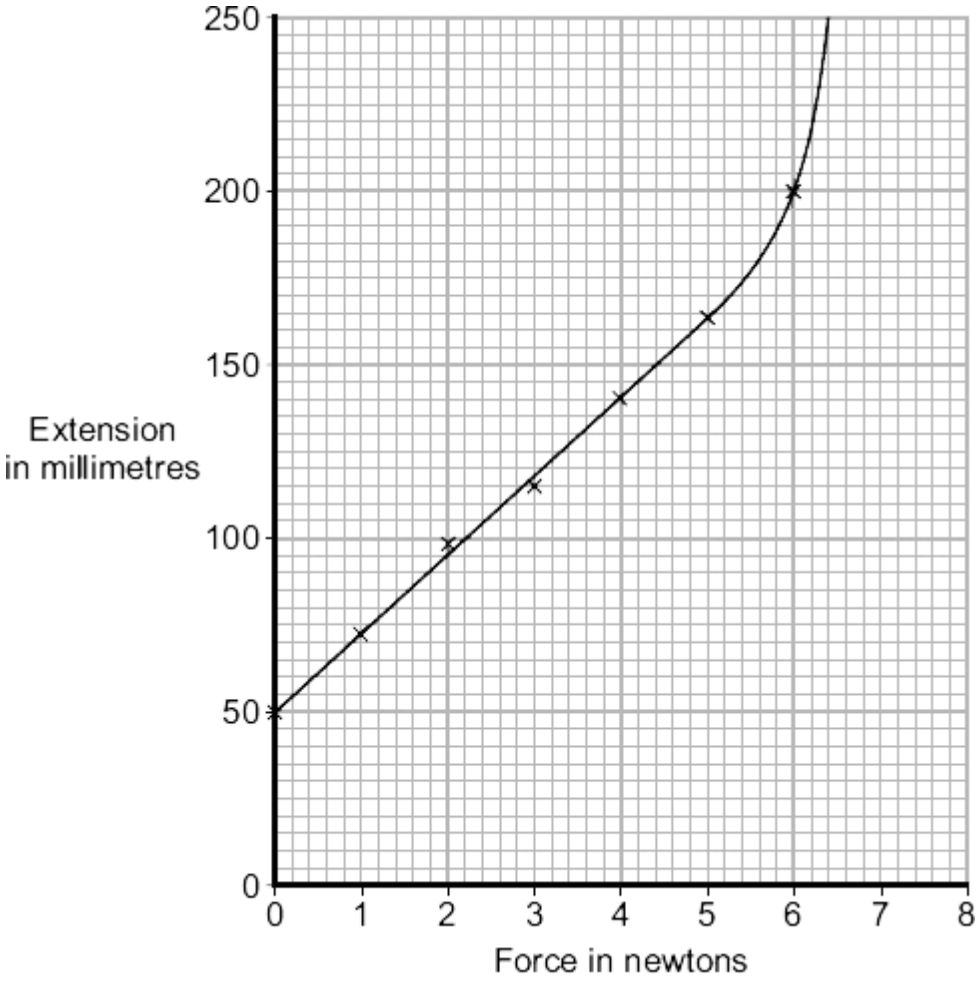
(1)

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

_____

(1)

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



(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)

(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)

(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

Show clearly how you work out your answer.

_____

_____

Force = _____ N

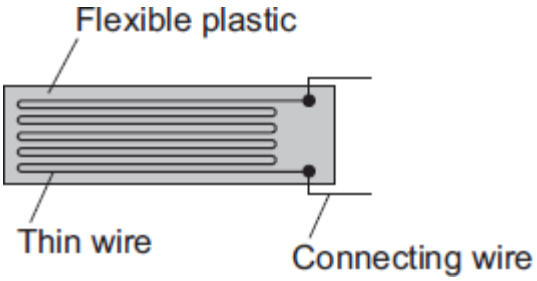
(2)

(Total 8 marks)

Q10.

The diagram shows a strain gauge, which is an electrical device used to monitor a changing force.

Applying a force to the gauge causes it to stretch.
This makes the electrical resistance of the wire change.



(a) (i) Using the correct symbols, **add** to the diagram to show how a battery, an ammeter and a voltmeter can be used to find the resistance of the strain gauge drawn above.

(2)

(ii) When in use, the strain gauge is always connected to a d.c. power supply, such as a battery.

How is a d.c. (direct current) power supply different from an a.c. (alternating current) power supply?

_____

_____

_____

(1)

(b) Before any force is applied, the unstretched gauge, correctly connected to a 3.0 V battery, has a current of 0.040 A flowing through it.

(i) Calculate the resistance of the unstretched gauge.

Show clearly how you work out your answer.

_____

_____

Resistance = _____ Ω

(2)

(ii) Stretching the gauge causes the current flowing through the gauge to decrease.

What happens to the resistance of the gauge when it is stretched?

_____

_____

(1)

(iii) What form of energy is stored in the gauge when a force is applied and the gauge stretches?

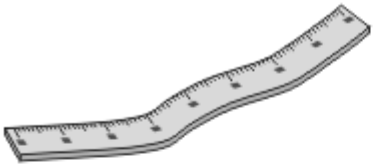
_____

(1)

(Total 7 marks)

Q11.

(a) The pictures show four objects. Each object has had its shape changed.



Bent metal ruler

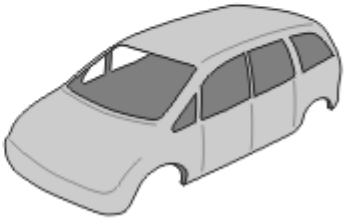
A

Stretched bungee cords

B

Springs on a playground ride

C



Moulded plastic model car body

D

Which of the objects are storing elastic potential energy?

_____

Explain the reason for your choice or choices.

_____

_____

_____

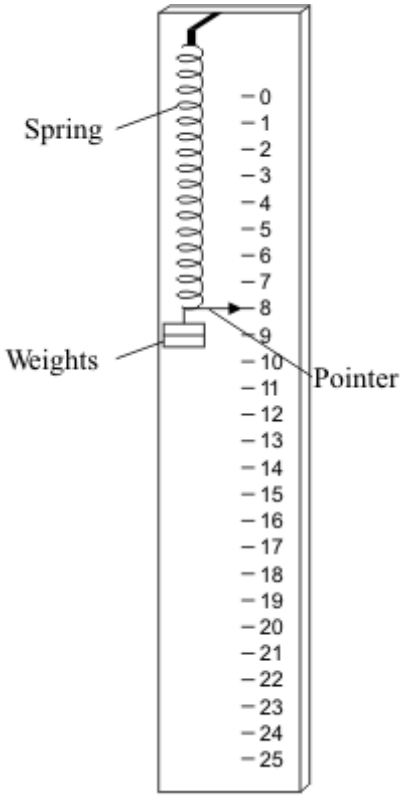
_____

_____

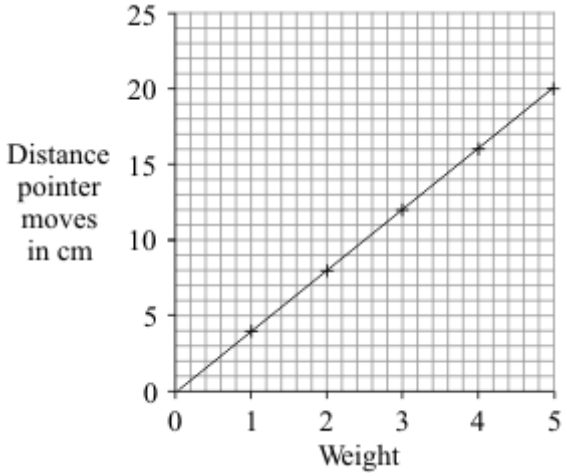
_____

(3)

(b) A student makes a simple spring balance. To make a scale, the student uses a range of weights. Each weight is put onto the spring and the position of the pointer marked



The graph below shows how increasing the weight made the pointer move further.



(i) Which **one** of the following is the unit of weight?.

Draw a ring around your answer.

joule **kilogram** **newton** **watt**

(1)

(ii) What range of weights did the student use?

_____

(1)

(iii) How far does the pointer move when 4 units of weight are on the spring?

_____

(1)

(iv) The student ties a stone to the spring. The spring stretches 10 cm.

What is the weight of the stone?

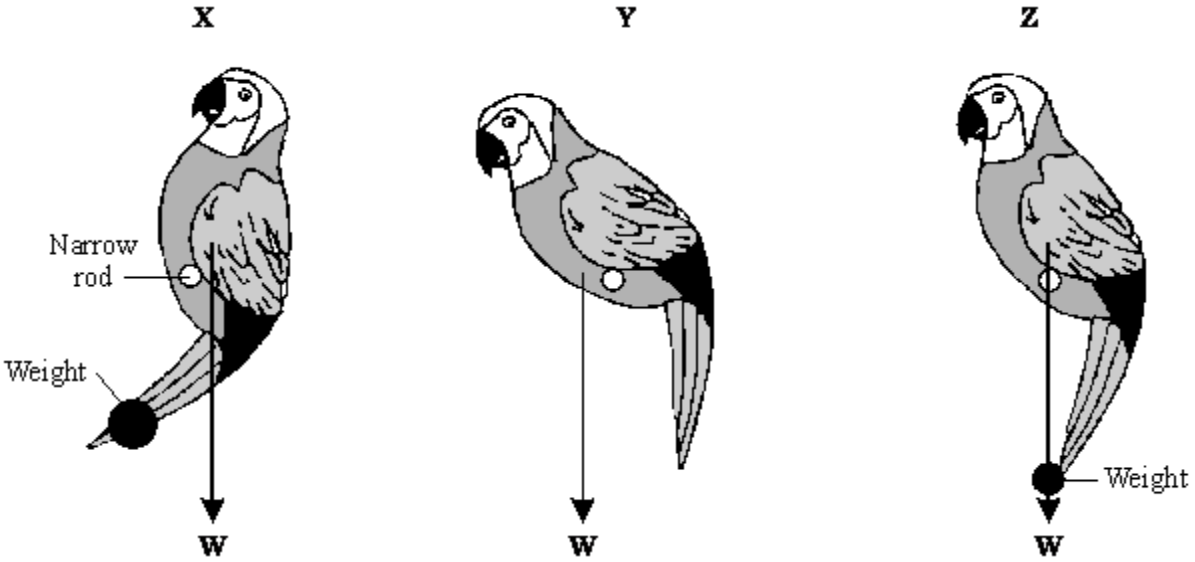
_____

(1)

(Total 7 marks)

Q12.

(a) The diagram shows three similar toys. Each toy should be able to balance on a narrow rod. The arrows show the direction in which the weight of the toy acts.



Only one of the toys balances on the rod, the other two fall over. Which **one** of the toys is balanced? Explain the reason for your choice.

_____

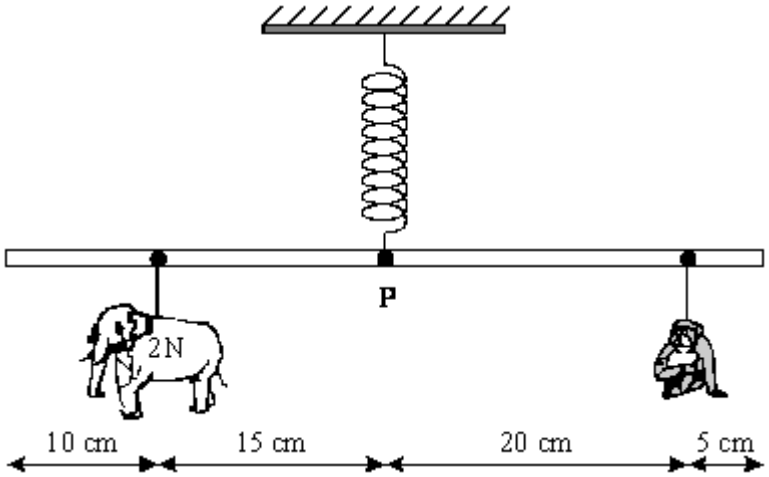
_____

_____

_____

(3)

(b) The diagram shows a simple toy. Different animal shapes can be positioned so that the 50 cm rod balances horizontally.



(i) Calculate the moment exerted by the elephant shape of weight 2N about the pivot **P**. Show clearly how you work out your answer and give the unit.

_____

_____

Moment = _____

(3)

(ii) Use the following relationship to calculate the weight of the monkey shape.

total clockwise moment = total anticlockwise moment

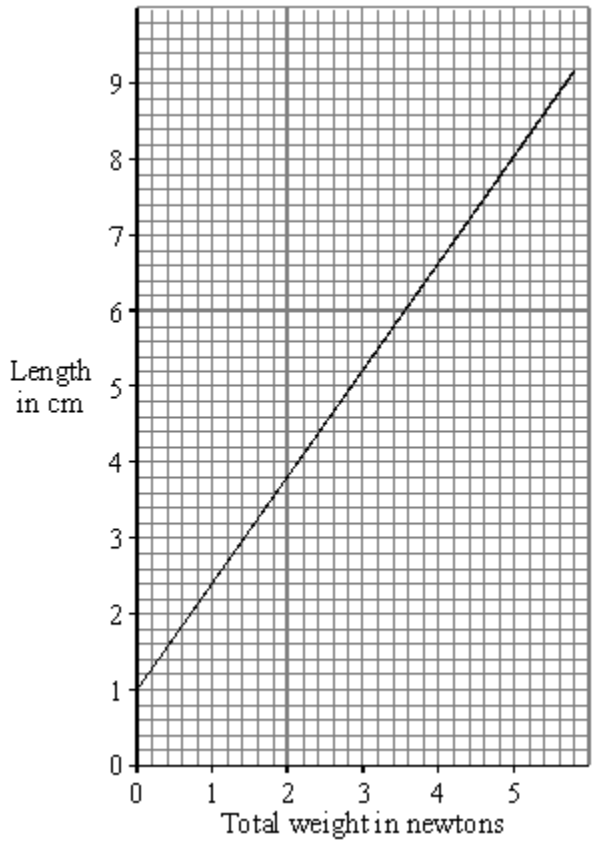
_____

_____

Weight = _____ N

(2)

(c) The graph shows how the length of the spring changes as the total weight of the different animal shapes change.



Use the graph to find how much the spring extends when the elephant shape and the monkey shape are hung from the rod. Show how you get your answer.

_____

_____

Extension of spring = _____ cm

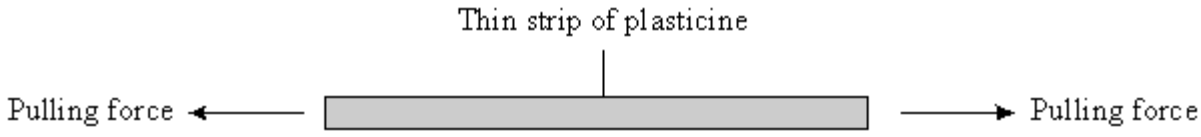
(2)

(Total 10 marks)

Q13.

(a) The diagrams below show pairs of forces acting on different objects. In each case describe what happens when the forces are increased. Then describe what happens when the forces are removed.

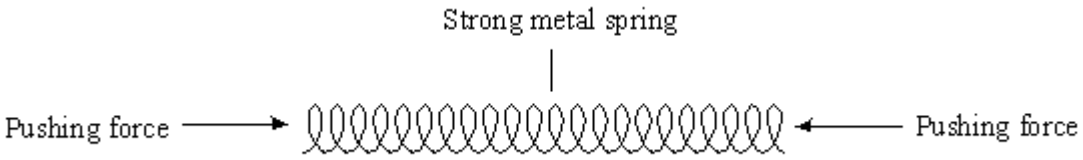
(i)



When the forces are increased

When the forces are removed

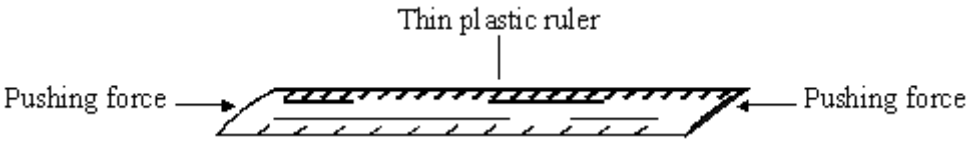
(ii)



When the forces are increased

When the forces are removed

(iii)

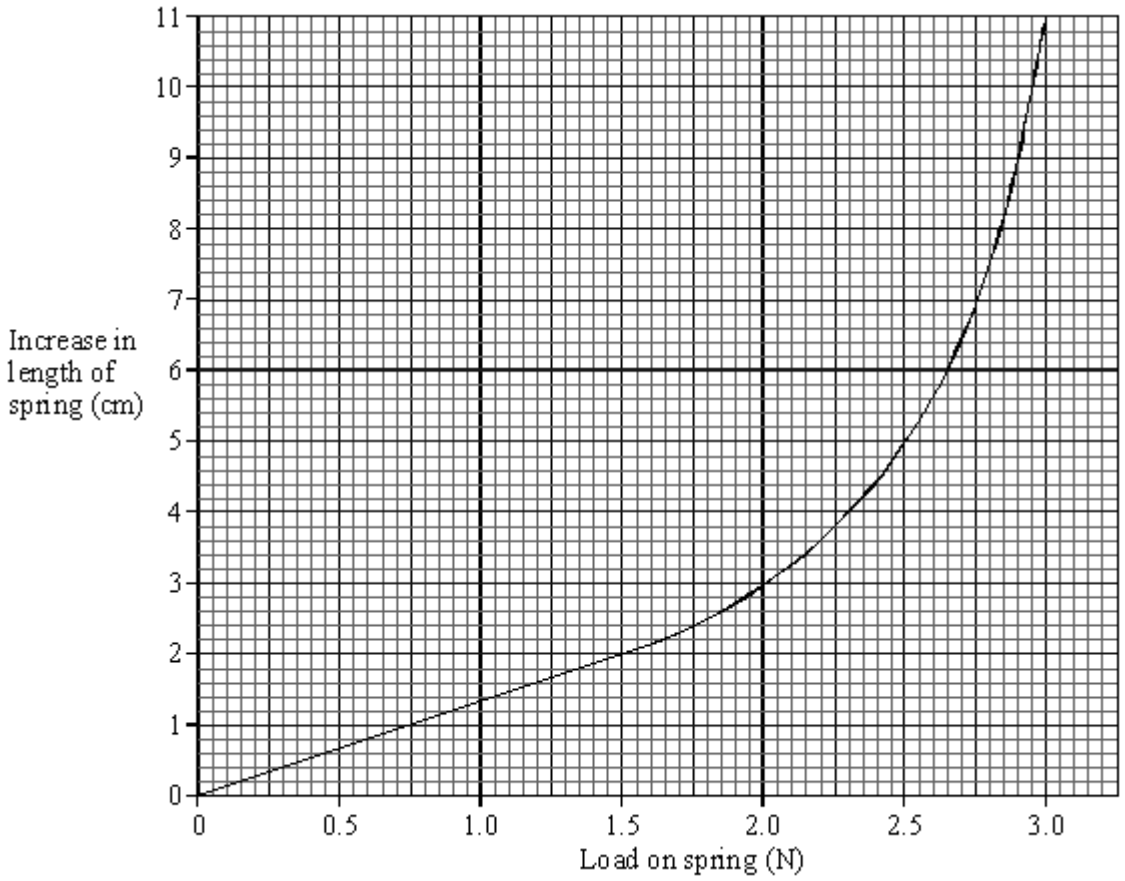


When the forces are increased

When the forces are removed

(6)

(b) The graph shows the increase in length of a spring against **load** (force).



The length of the spring with no load was 15 cm.

Use the graph to find:

(i) The load needed to produce an increase in length of 2 cm.

_____

(ii) The increase in length produced by a load of 2.3 N.

_____

(iii) The **length** of the spring when the load was 2.3 N.

_____

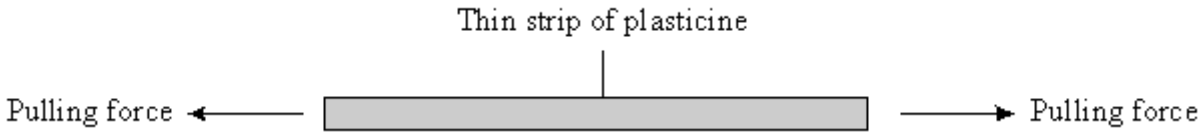
(3)

(Total 9 marks)

Q14.

The diagrams show pairs of forces acting on different objects. In each case describe what happens when the forces are increased. Then describe what happens when the forces are removed.

(a)



When the forces are increased _____

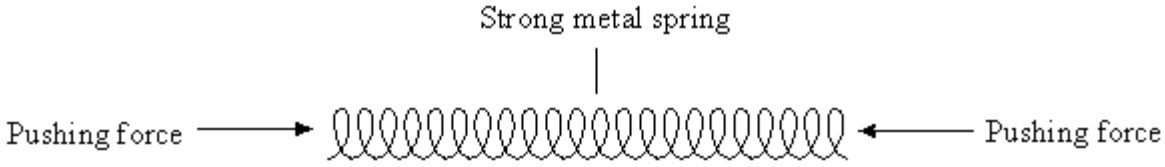
_____

When the forces are removed _____

_____

(2)

(b)



When the forces are increased _____

_____

When the forces are removed _____

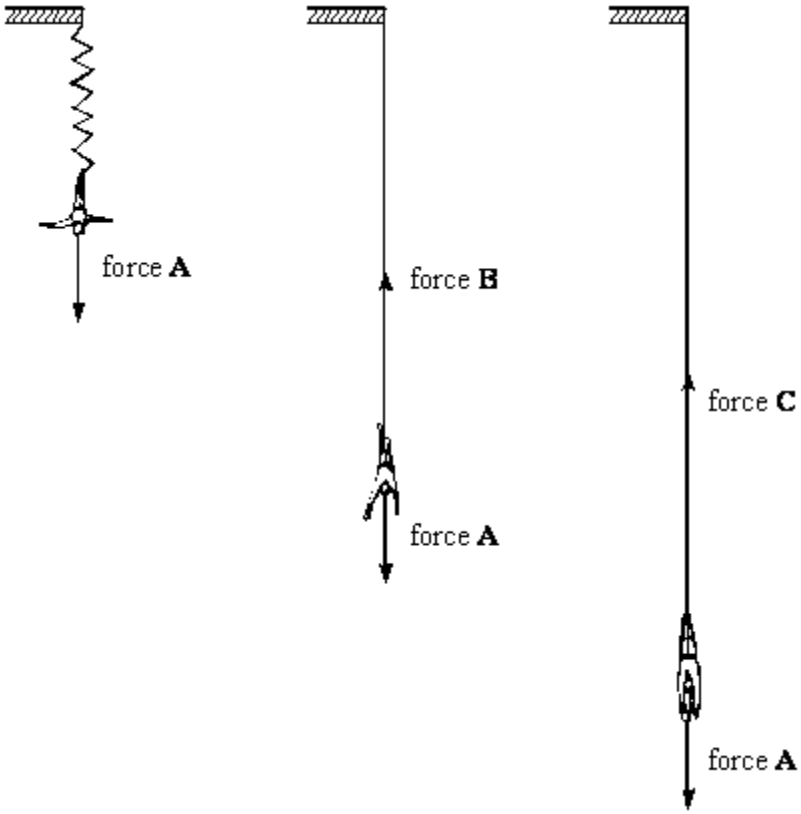
_____

(2)

(Total 4 marks)

Q15.

When a bungee-jump is made the jumper steps off a high platform. An elastic cord from the platform is tied to the jumper.
The diagram below shows different stages in a bungee-jump.
Forces **A**, **B** and **C** are forces acting on the jumper at each stage.



moving down large acceleration	moving down small acceleration	moving down slowing acceleration
diagram **X**	diagram **Y**	diagram **Z**

(a) Name force **A**.

_____

(1)

(b) The motion of the jumper is shown in the diagrams.
By comparing forces **A**, **B** and **C**, state how the motion is caused in:

(i) diagram **X**;

_____

(ii) diagram **Y**;

_____

(iii) diagram **Z**.

_____

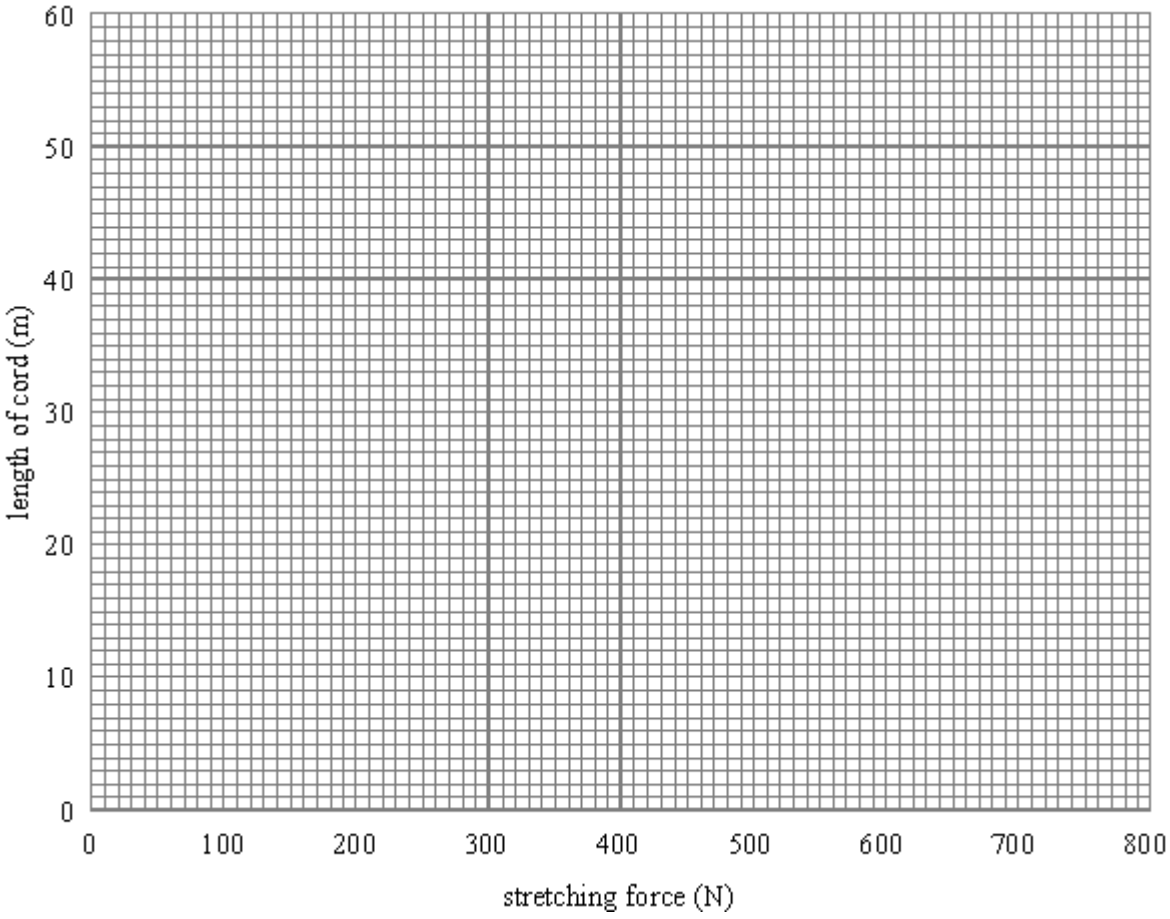
(3)

(c) The table gives results for a bungee cord when it is being stretched.

STRETCHING FORCE (N)	100	200	400	600	800

LENGTH OF CORD (m)	20	24	32	40	48

(i) Plot a graph of these results on the graph paper.



(3)

(ii) Use the graph to find the length of the cord before it was stretched.

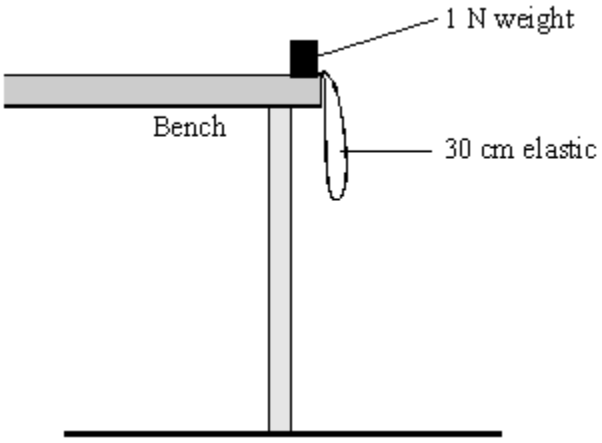
Length _____ m

(1)

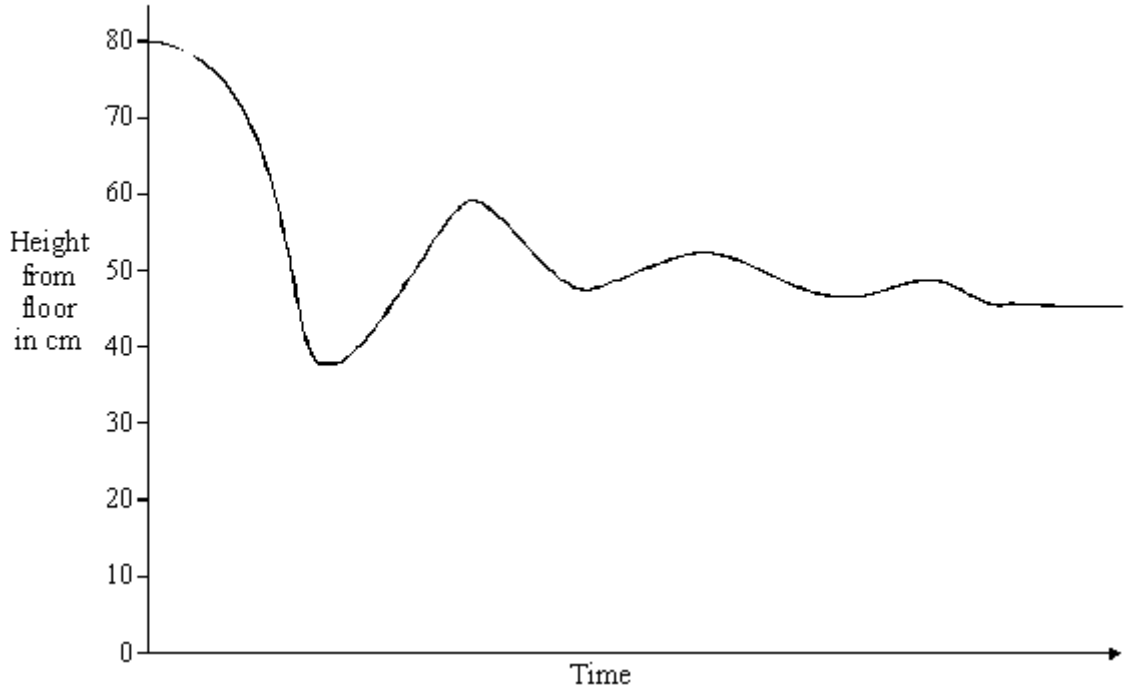
(Total 8 marks)

Q16.

A 1 N weight is tied to a 30 cm long piece of elastic. The other end is fixed to the edge of a laboratory bench. The weight is pushed off the bench and bounces up and down on the elastic.



The graph shows the height of the weight above the floor plotted against time, as it bounces up and down and quickly comes to rest.



(a) Mark on the graph a point labelled **F**, where the weight stops falling freely.

(1)

(b) Mark on the graph a point labelled **S**, where the weight finally comes to rest.

(1)

(c) Mark **two** points on the graph each labelled **M**, where the weight is momentarily stationary.

(1)

(Total 3 marks)

Mark schemes

Q1.

(a) **Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

set up a clamp stand with a clamp

hang the spring from the clamp

use a second clamp and boss to fix a (half) metre ruler alongside the spring

record the metre ruler reading that is level with the bottom of the spring

hang a 2 N weight from the bottom of the spring

record the new position of the bottom of the spring

calculate the extension of the spring

measure the extension of the spring

add further weights to the spring so the force increases 2 N at a time up to 10 N

for each new force record the position of the bottom of the spring and calculate / measure the extension

possible source of inaccuracy

not fixing the ruler in position but simply holding the ruler next to the spring

not clamping the ruler vertical

misjudging the position of the bottom of the spring

parallax error

allow any other sensible suggestion that could reasonably lead to inaccuracy in the data

allow a description that would increase accuracy

repeating the measurements is insufficient

(b) to identify any anomalous results

allow calculate an average for the spring constant

or

to reduce the effect of random error

allow (more) accurate

to obtain an average is insufficient

to be able to draw a graph is insufficient

1

(c) both points plotted correctly

1

correct line of best fit drawn

to pass through (0,0) and (10,20)

1

(d) force = spring constant × extension

allow F = ke

1

(e) extension = 0.2

allow 0.035 / 0.08 / 0.125 / 0.16

1

10 = k × 0.2

force value must match extension

this mark may be awarded if e is in cm

1

$$k = \frac{10}{0.2}$$

allow correct transformation of their chosen values

this mark may be awarded if e is in cm

1

k = 50

*an answer 0.5 scores **3** marks*

1

*an answer of 50 scores **4** marks*

(f) the line is straight

allow the line does not curve

1

and passes through the origin

this mark is dependent on scoring the first mark

allow a correct description of direct proportionality

*for **2** marks*
ignore the line shows they are directly proportional

1

[16]

Q2.

(a) from K to L

1

(b) the same as

1

smaller than

1

correct order only

(c) 4 N

1

(d) the limit of proportionality is reached when a weight of 7N is added to the spring
accept any number from 6.8 to 7.2 inclusive

1

(e) the extension is directly proportional to the weight.

1

(f) C

1

[7]

Q3.

(a) arrow drawn vertically downwards from the weight

1

same length as given arrow

1

(b) **C**
*reason only scores if **C** is chosen*

1

smallest force required for the same compression
steepest gradient is insufficient

1

(c) 1.25

1

(d) $\text{period} = \frac{1}{25}$
*an answer of 0.8 (s) scores **2** marks*

1

period = 0.8 (s)

1

(e) extension = 0.20 m

1

$E_e = 0.5 \times 7.0 \times (0.20)^2$

1

$E_e = 0.14$ (J)

*an answer of 0.14 scores **3** marks*

1

[10]

Q4.

(a) Third Law

1

(b) elastic potential

1

(c) weight = mass × gravitational field strength

accept gravity for gravitational field strength

1

accept W = mg

*accept correct rearrangement ie mass = weight / gravitational field strength **or** m = W / g*

(d) 343 = m × 9.8

1

$m = \frac{343}{9.8}$

1

m = 35

1

*allow 35 with no working shown for **3** marks*

(e) force = spring constant × compression

accept force = spring constant × extension

accept F = k e

*accept correct rearrangement ie constant = force / extension **or** k = F / e*

1

(f) compression = 0.07m

1

343 = k × 0.07

1

k = 343 ÷ 0.07

1

k = 4900

1

*allow 4900 with no working shown for **4** marks*
*allow 49 with no working shown for **3** marks*

[11]

Q5.

(a) accept any value between 12 (mm) and 13 (mm) inclusive

1

(b) to reduce the error in measuring the extension of the spring

accept length for extension throughout

1

as the ruler at an angle would make the measured extensions shorter

1

(c) 1 (N) to 6 (N)

accept from 0 (N) to 6 (N)

1

(d) gives a straight line through the origin

1

(e) any practical technique that would improve the accuracy of length measurement eg

use a set square

1

to line up the bottom of the spring with the ruler scale

or

attach a horizontal pointer to the bottom of the spring (1)

so that the pointer goes across the ruler scale (1)

1

(f) the spring has been inelastically deformed

1

because it went past its limit of proportionality

accept elastic limit for limit of proportionality

1

accept it does not go back to its original length when the weights are removed

[9]

Q6.

(a) elastic potential

1

(b) (i) line is straight

accept line does not curve

1

(ii) 400

*allow **1** mark for correct substitution of any pair of numbers correctly taken from the graph e.g.160 = k × 0.40*

2

newtons per metre **or** N/m

if symbols are used they must be correct

1

(iii) 300

*allow **1** mark for correctly obtaining force on 1 spring = 100N*

2

(c) 52

*allow **2** marks for calculating change in gpe for 1 chin-up as 260 (J) or for 12 chin-ups as 3120 (J)*

*an answer 4.3 gains **2** marks*

*allow **1** mark for correct substitution into gpe equation ie gpe = 65 × 10 × 0.4 (× 12)*

or

correct use of power equation with an incorrect value for energy transferred

3

[10]

Q7.

(a) 3 (.0)

*allow **1** mark for correct substitution i.e. 25 × 0.12 provided no subsequent step*

2

(b) (i) elastic potential

correct order only

1

kinetic

1

(ii) increases

1

to 80 (mm) (or more)

accept any number greater than 75

an answer 'it (more than) doubles' gains both marks

1

(c) (i) weight

1

(ii) downward speed increases

1

[8]

Q8.

(a) (i) any **two** from:

- length of coils increased
- coils have tilted
- length of loop(s) increased
- increased gap between coils
- *spring has stretched / got longer*
- *spring has got thinner*

2

(ii) remove mass

accept remove force / weight

1

observe if the spring returns to its original length / shape *(then* it is behaving elastically)

1

(b) (i) 8.0 (cm)

1

extension is directly proportional to force *(up to 4 N)*

for every 1.0 N extension increases by 4.0 cm (up to 4 N)

evidence of processing figures eg 8.0 *cm* is half way between 4.0 *cm* and 12.0 *cm*

1

allow spring constant (k) goes from to $\frac{1}{4}$ to $\frac{5}{22}$

1

(ii) any value greater than 4.0 N and less than or equal to 5.0 N

1

the increase in extension is greater than 4 cm per 1.0 N (of force) added

dependent on first mark

1

(c) (i) elastic potential energy

1

(ii) misread stopwatch

1

timed too many complete oscillations

1

(iii) 4.3 (s)

accept 4.33 (s)

1

(iv) stopwatch reads to 0.01 s

1

reaction time is about 0.2 s
or
reaction time is less precise than stopwatch

1

(v) use more masses

1

smaller masses eg 50 g
not exceeding limit of proportionality

1

[17]

Q9.

(a) (i) **B C**
either order

1

(ii) elastic potential (energy)
accept strain for elastic

1

(b) (i) *mark both parts together*

1

measured / recorded the length of the spring (and not extension)
*accept measured **A–C** (and not **B–C**)*
accept did not work out/measure the extension

extension does not equal zero when force = 0
accept line should pass through the origin

1

(ii) point marked at 5.5 (N)
accept any point between 5.0 and 5.6 inclusive

1

up to that point force and extension are (directly) proportional
accept it's at the end of the straight part (of the graph line)
accept past that point force and extension are no longer (directly) proportional
accept the line starts to curve

1

(c) 1.8

*allow **1** mark for correct substitution, ie 25 x 0.072 provided no subsequent step shown*
*an answer 1800 gains **1** mark*
an incorrect conversion from mm to m with a subsequent

*correct calculation gains **1** mark*

2

[8]

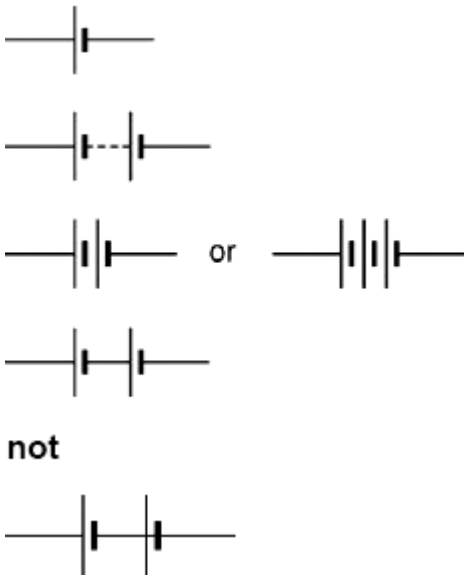
Q10.

(a) (i) ammeter and battery **in series** with the **gauge**

symbols must be correct

ignore a voltmeter drawn in series

accept



not

or cells reversed to cancel out

1

voltmeter in parallel with the gauge

symbol must be correct

accept a freestanding circuit

diagram provided strain gauge is labelled or a resistor symbol used for the strain gauge

1

(ii) d.c. flows only in one direction

a.c. changes direction is insufficient

1

(b) (i) 75

this answer only

*allow **1** mark for correct substitution **and** transformation,*

ie resistance = $\frac{3.0}{0.040}$

2

(ii) increases

1

(iii) elastic / strain potential

*do **not** accept potential*

1

[7]

Q11.

(a) **B** or bungee cords

1

C or springs or playground ride

*each additional answer loses **1** mark minimum mark zero*

1

will go back to original shape/size

1

(b) (i) newton

1

(ii) 0 – 5 (N) or 5

accept1 – 5 (N)
*do **not** accept 4*

1

(iii) 16 (cm)

1

(iv) 2.5 (N)

accept answer between 2.4 and 2.6 inclusive

1

[7]

Q12.

(a) **Z**

1

weight **or** mass acts through pivot

*accept rod **or** base for pivot*
accept centre of gravity in line with pivot

1

no (resultant) (turning) moment

accept clockwise moment equals anticlockwise moment
*do **not** accept same weight on each side of rod*

1

(b) (i) 30

*allow **1** mark for 2 × 15*
***or** 2 × 0.15*

2

N cm

or

for full credit the unit must be consistent with the numerical answer

0.3

Nm

*do **not** accept joules*

1

(ii) 1.5 (N)

*allow **1** mark for correct transformation*

*allow **2** marks ecf their part (b)(i)/20 (ecf only if correct physics)*

2

(c) 5 (cm)

*allow **1** mark for 6.0 (cm)*

*allow **1** mark for a subtraction of 1 from a value clearly obtained from the graph*

*allow **2** marks for correct ecf using an incorrect value for (b)(i) ± 0.2cm*

*allow **1** mark for clearly showing correct use of graph using an incorrect value for (b)(ii)*

2

[10]

Q13.

(a) (i) plasticine stretches/snaps
stays stretched/snapped

for 1 mark each

2

(ii) spring compresses OWTTE
returns to **original** length/shape or gets longer

for 1 mark each

2

(iii) ruler bends/breaks
returns to original shape or stays broken

for 1 mark each

2

(b) (i) 1.5N

for 1 mark

1

(ii) 4 cm

for 1 mark

1

(iii) 19 cm

for 1 mark

1

[9]

Q14.

(a) plasticine stretches/snaps
stays stretched/snapped/same

for 1 mark each

2

(b) spring compresses OWTTE
returns to original length/gets longer

for 1 mark each

2

[4]

Q15.

(a) weight or gravity or gravitational

for 1 mark

1

(b) (i) only force A acts / force A > air resistance / gravity / weight

for 1 mark

1

(ii) force A > force B

for 1 mark

1

(iii) force C > force A

for 1 mark
(Forces A, B and C need not be used, description of forces are OK)

1

(c) (i) graph points all correct ± little square

gains 2 marks

one point wrong

gains 1 mark

2+ points wrong

gains 0 mark

appropriate line – good freehand OK

gains 1 mark
Bar chart gets 0, but if points clear can get 2

3

(ii) *16 or candidates own intercept should be* 16 m in range 1-19
if no kinks on graph line
for 1 mark

1

[8]

Q16.

(a) **F** 50 cm on first part of graph
tolerance + ***or*** *– 3cm*

1

(b) **S** at the far right
credit anywhere to right of last trough

1

(c) **M** on any two tops of peaks **or** bottoms of troughs
both are required for the mark M needs to be central to the trough ***or*** *peak, except if F is in the way in one case*

1

[3]