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IGCSE PHYSICS 0625 · TOPICAL PAST PAPERS

Forces & Elastic Deformation

Paper 2 — Theory / Structured Questions (topical compilation)

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Question # 1: May June 2010/P21/Q2

Fig. 2.1 shows a weight of 4.0 N attached to a spring.

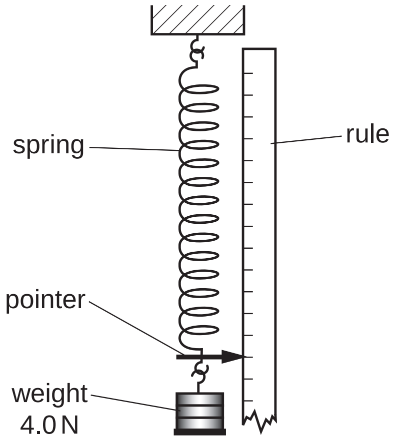

Fig. 2.1

The unstretched length of the spring is 8.0 cm. With the 4.0 N weight attached to the spring, the length is 14.0 cm. The spring is within its limit of proportionality.

(a) State what is meant by the *limit of proportionality* of a spring.

....

....

.... [1]

(b) The 4.0 N weight is replaced with a 2.0 N weight. Calculate the new length of the spring.

new length = ... [2]

(c) Describe how the apparatus in Fig. 2.1 is used to obtain readings to plot an extension-load graph.

....

....

....

.... [2]

Question # 2: May June 2012/P22/Q1

Fig. 1.1 shows apparatus used to obtain the readings for a graph of force against extension for a spring.

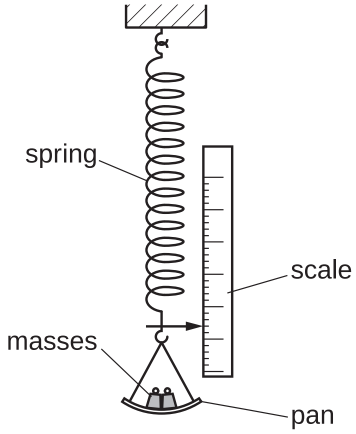

Fig. 1.1

The masses added to the pan produce a force that stretches the spring.

(a) **(i)** State what is meant by the *mass* of a body.

....

....[1]

(ii) Describe how the scale is used to find the extension of the spring.

....

....

....[1]

(b) Fig. 1.2 shows the force-extension graphs for two different springs.

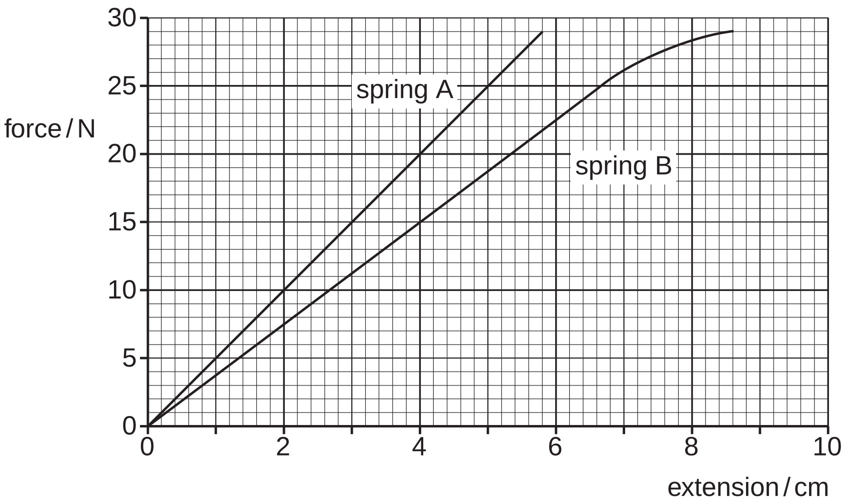

Fig. 1.2

(i) A student states that spring B is easier to stretch than spring A.

Use values from Fig. 1.2 to explain what the student means.

....

....

....[1]

(ii) When a force of 25 N is applied, spring B reaches its limit of proportionality but spring A does not. Explain how Fig. 1.2 shows this.

....

....

....[1]

(iii) The same force is applied to each spring.

Using Fig. 1.2, determine the force that produces an extension of spring B that is 1.0 cm greater than the extension of spring A.

force = ...[1]

Question # 3: May June 2013/P21/Q1

Fig. 1.1 shows how the length of a spring varies as the force applied to it increases.

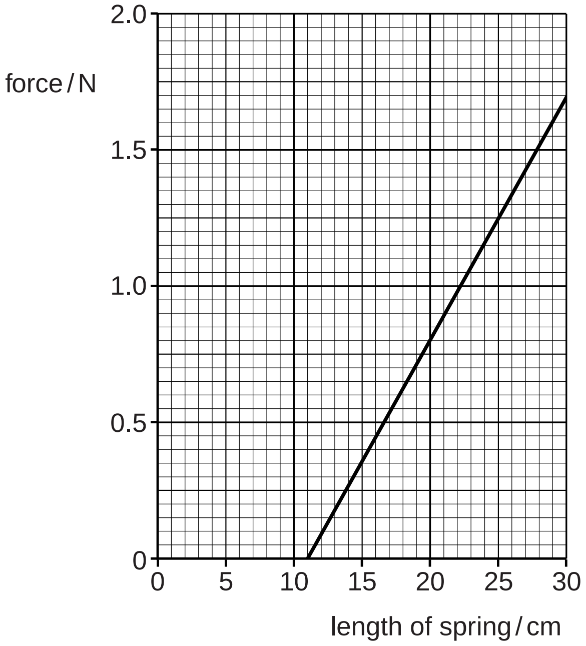

Fig. 1.1

(a) Determine the length of the unstretched spring.

length = ... [1]

(b) Explain how the graph shows that the limit of proportionality is not reached.

....

.... [1]

(c) The spring is attached to a mass M of 0.20 kg and placed on a frictionless surface, as shown in Fig. 1.2.

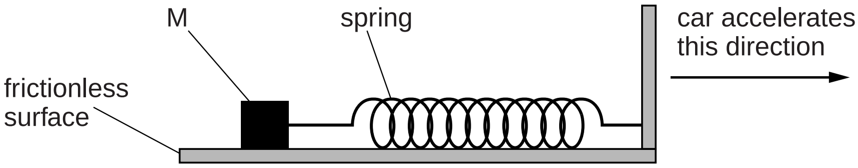

Fig. 1.2 (not to scale)

The apparatus is placed on the floor of a car.

When the car accelerates uniformly in the direction shown, the spring extends.

(i) State what is meant by a *uniform acceleration*.

....

....

.... [2]

(ii) The extension of the spring is 9.0 cm.

Using Fig. 1.1, determine

1. the horizontal force on M,

force = ... [1]

2. the acceleration of M.

acceleration = ... [2]

Question # 4: May June 2013/P22/Q3

Fig. 3.1 shows a man using a chest expander to increase the strength of his arms.

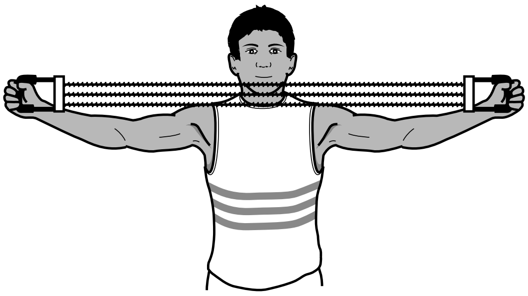

Fig. 3.1

The chest expander may be considered to be a single spring.

Fig. 3.2 shows the force needed to produce different extensions of the spring.

force / N	extension / cm
0	0
60	10
120	20
180	30

Fig. 3.2

(a) The man increases the force on the spring from 0 to 180 N.
The spring extends by 30 cm and the average force exerted during this process is 90 N.

(i) Calculate the work done on the spring.

work = ... [2]

(ii) Twenty extensions are made in 1.0 minute.

Calculate the power used to extend the spring.

power = ... [2]

(b) The force at the limit of proportionality of the spring is 800 N.

(i) Calculate the extension of the spring when the force is 800 N.

extension = ... [2]

(ii) The force on the spring is increased from 800 N to 860 N.

Suggest what happens to the extension.

....

.... [1]

Question # 5: May June 2015/P22/Q1

The apparatus shown in Fig. 1.1 is used to measure the extension of a spring.

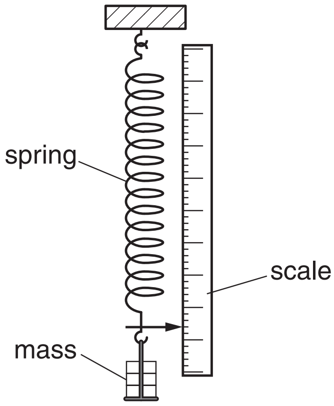

Fig. 1.1

(a) Explain how the mass causes a force on the spring.

....

.... [1]

(b) The force on the spring is a vector quantity. State what is meant by a *vector* quantity.

....

.... [1]

(c) Fig. 1.2 shows a graph of the length of the spring plotted against the force on the spring, for forces between 0 and 10 N.

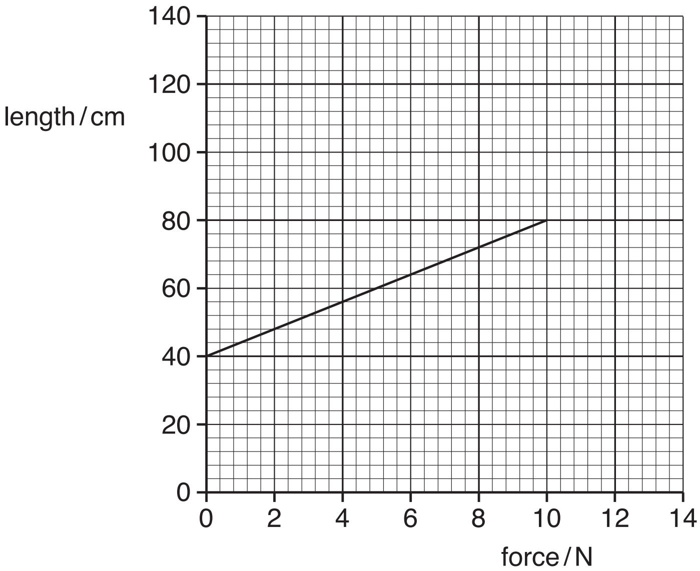

Fig. 1.2

(i) **1.** State a formula that relates the unstretched length l_0 of the spring, the stretched length l of the spring and the extension e of the spring.

.... [1]

2. A mass produces a force of 9.0 N on the spring. Determine the extension of the spring caused by this mass.

extension = ... [1]

(ii) The limit of proportionality of the spring is reached when the force is 10 N.

The spring is easier to stretch after the limit of proportionality.

On Fig. 1.2, continue the line to suggest how the length changes when the force is greater than 10 N. [1]

Question # 6: May June 2016/P21/Q2

A student hangs various masses from the end of a spring and determines the extension produced. Fig. 2.1 shows the spring hanging vertically on its own and with an unknown mass X at one end.

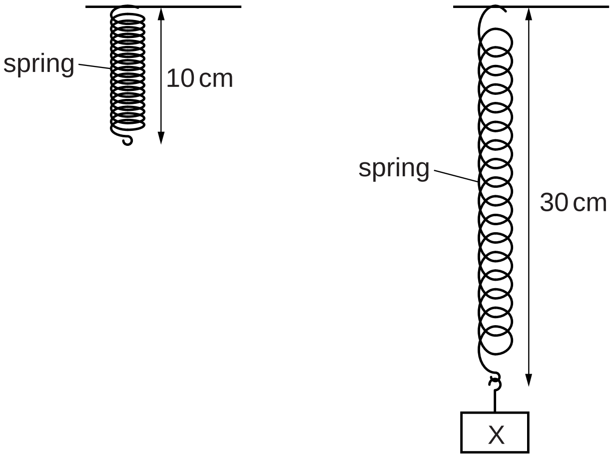

Fig. 2.1 (not to scale)

(a) The student plots a graph of the extension of the spring against the mass hanging on the spring. Fig. 2.2 shows the student's graph.

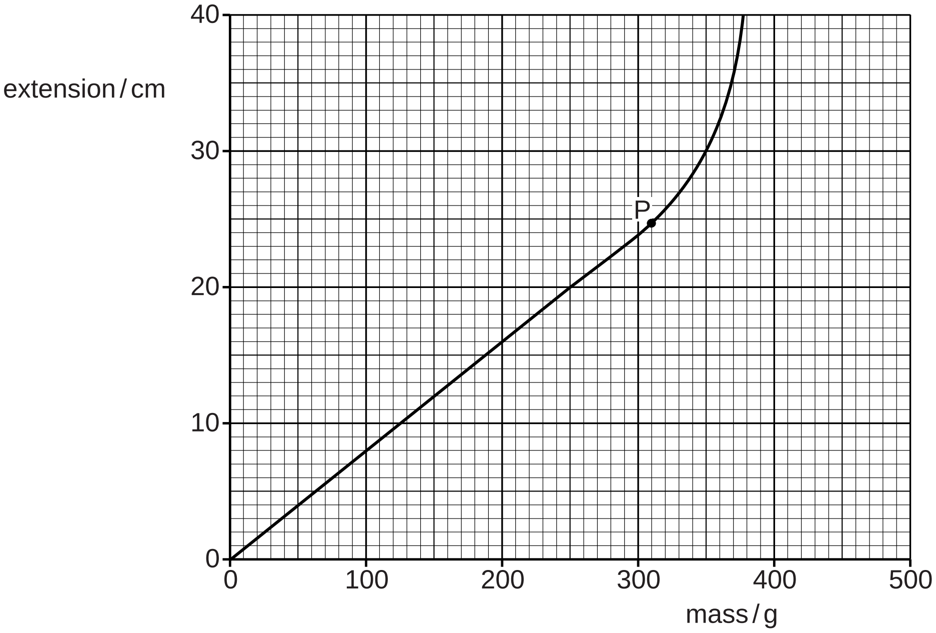

Fig. 2.2

(i) At point P on the graph, the line begins to curve.

State the name of point P.

....[1]

(ii) Using Fig. 2.1 and Fig. 2.2, determine the mass X.

mass = ... [1]

(iii) The gravitational field strength g is 10 N/kg.

Calculate the weight of X.

weight = ... [1]

(b) An identical spring is used with the original spring, as shown in Fig. 2.3.

Together they support the mass X.

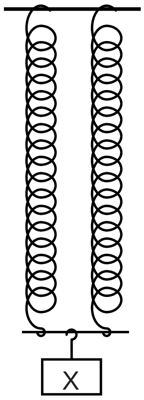

Fig. 2.3 (not to scale)

State and explain how the extension in Fig. 2.3 compares with the extension in Fig. 2.1.

....

....

....

....[2]

Question # 7: May June 2016/P22/Q3

A student has three springs A, B and C. He measures the length of each spring, in turn, when different weights are placed on the end of each spring.

His table of results is shown in Fig. 3.1.

weight / N	length of spring A / cm	length of spring B / cm	length of spring C / cm
1.0	6.1	8.6	9.7
1.5	6.9	9.5	10.5
2.0	7.7	10.4	11.3
2.5	8.5	11.2	13.1
3.0	9.3	12.1	16.9

Fig. 3.1

(a) **(i)** State which spring has been stretched past the limit of proportionality.

....

(ii) Using data from Fig. 3.1, explain how you obtained your answer to **(a)(i)**.

....

....

....

....
[2]

(iii) Calculate the unstretched length of spring A.

unstretched length = ...[1]

(b) Describe how the student can use spring A to determine the mass of a small rock.

....

....

....

....

....[2]

Question # 8: May June 2018/P22/Q2

In an experiment, a student takes measurements and determines the extension of a spring for different loads. The apparatus is shown in Fig. 2.1.

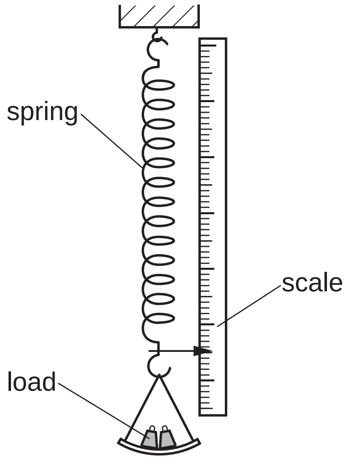

Fig. 2.1

The table in Fig. 2.2 shows the results.

load / N	0	1.0	2.0	3.0	4.0	5.0
length of spring / mm	200	235	270	305	350	420
extension / mm	0	35	70	105		

Fig. 2.2

(a) Only some of the extensions are shown in the table.

Complete the table to show all of the extensions. [1]

(b) Calculate the load that produces an extension of 49 mm.

load = ...[2]

(c) The student pulls a load downwards from position A to position B and holds it fixed at position B, as shown in Fig. 2.3.

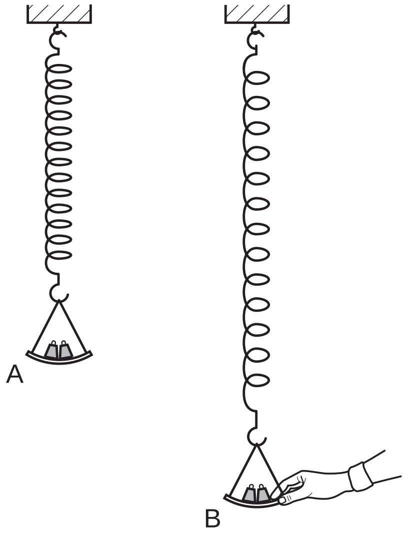

Fig. 2.3

The load is stationary at A and at B. The load has no kinetic energy at either point.

(i) Place ticks (✓) in the boxes to show how the value of each of the forms of energy compares at A and B.

	equal at A and B	larger at A	larger at B
energy stored in spring	☐	☐	☐
gravitational potential energy of load	☐	☐	☐

[1]

(ii) Work is done by the student to pull the load down. The law of conservation of energy states that energy cannot be created and cannot be destroyed.

Explain how this principle applies in this case.

....

....

....

....[2]

Question # 9: May June 2019/P21/Q3

A large spring is stretched by an athlete to increase the strength of his arms.

The athlete extends the spring, as shown in Fig. 3.1, and then releases it gently. He extends and releases the spring several times during a period of 60 s.

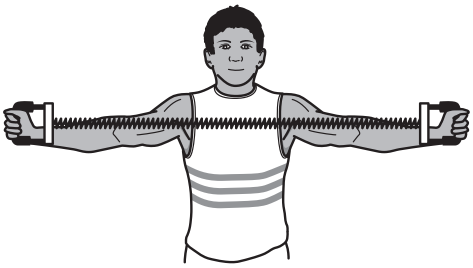

Fig. 3.1

(a) State the form of energy stored in the stretched spring and the form of energy stored in the muscles of the athlete.

form of energy in spring ....

form of energy in muscles ....
[2]

(b) Suggest what happens if he extends the spring beyond the limit of proportionality.

....

.... [1]

(c) During one extension of the spring, its length increases from 70 cm to 93 cm. The average force exerted by the athlete is 400 N.

(i) Calculate the work done by the athlete in one extension.

work done = ... [2]

(ii) Describe how the athlete can use the value obtained in **(i)** to determine his average power during the 60 s.

....

....

....

.... [2]

[Total: 7]

Question # 10: May June 2020/P21/Q3

A student suspends a spring from a support. He attaches different loads to the lower end of the spring. For each load attached, he measures the extension of the spring.

Fig. 3.1 shows the extension–load graph obtained.

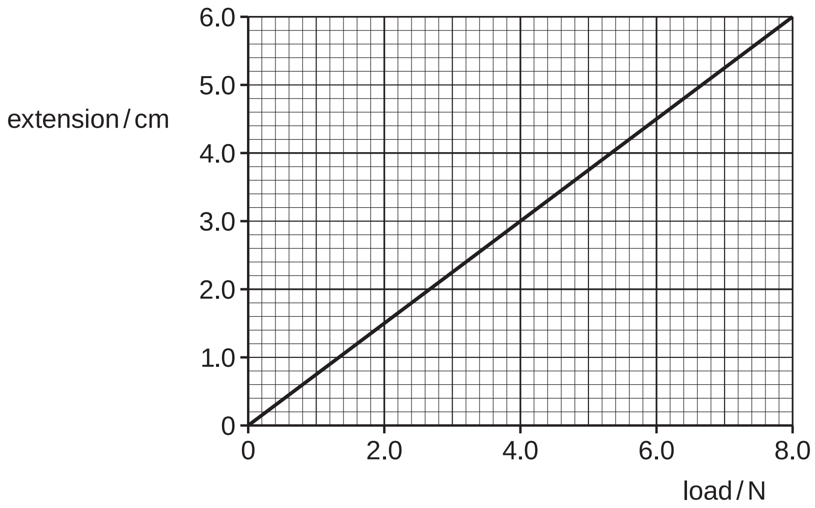

Fig. 3.1

(a) The extension of the spring is directly proportional to the load.

State the **two** features of the graph that show this.

1. ....

2. ....
[2]

(b) Describe how the student can show that the spring reaches its limit of proportionality at 8.0 N.

....

....

....

....

....

.... [2]

(c) The spring is used in a simple device known as an accelerometer, shown in Fig. 3.2.

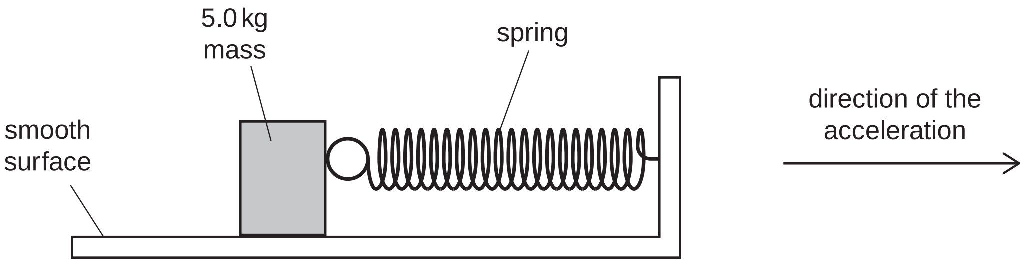

Fig. 3.2

The spring is fixed at one end and attached to a mass of 5.0 kg at the other end.

The mass rests on a smooth, horizontal surface. There is no friction between the mass and the surface.

The whole device is placed in a car.

The car accelerates and the student notices that the extension of the spring is 3.0 cm.

Using Fig. 3.1, calculate the acceleration of the car.

acceleration = ... [3]

[Total: 7]

Question # 11: Oct Nov 2005/P2/Q1

Fig. 1.1 shows a 0.4 kg mass hanging at rest from a spring.

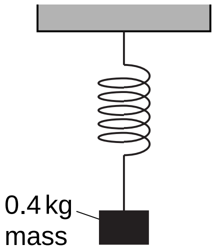

Fig. 1.1

(a) State what is meant by the *mass* of an object.

....

....

.... [1]

(b) **(i)** On Fig. 1.1, draw an arrow showing the direction and the line of action for each of the two forces that act on the mass. Write the name of the force next to each arrow. [2]

(ii) The gravitational field strength is 10 N/kg. Calculate the size of each of the two forces acting on the mass.

first force = ... second force = ... [2]

(c) The mass is pulled downwards. State and explain what happens to the upward force.

....

....

....

....

.... [2]

Question # 12: Oct Nov 2012/P22/Q2

A pupil hangs a load of 45 N from a length of copper wire. The wire extends by 2.5 mm and does not exceed the limit of proportionality.

(a) **(i)** The gravitational field strength is 10 N / kg. Calculate the mass of the 45 N load.

mass = ... [1]

(ii) Use the grid in Fig. 2.1 to plot the extension-load graph for this wire for a load between 0 and 45 N.

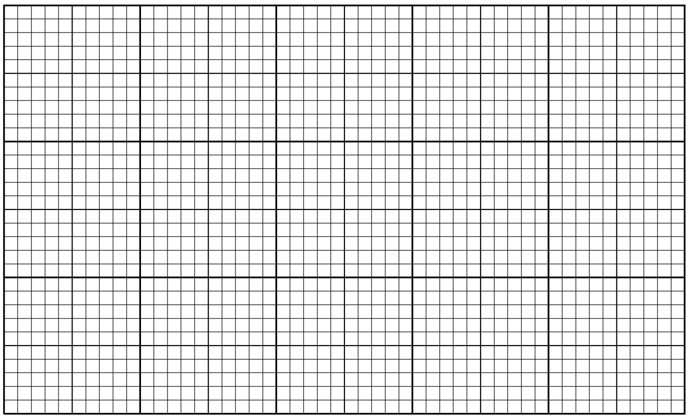

Fig. 2.1 [3]

(b) Use the graph plotted in Fig. 2.1 to determine the load needed to produce an extension of 1.3 mm.

load = ... [1]

Question # 13: Oct Nov 2014/P22/Q1

A student suspends a spring from a clamp stand. He measures the unstretched length of the spring with no load attached. He then attaches different loads to the lower end of the spring and measures the new lengths of the spring.

Fig. 1.1 shows how the total length of the spring depends on the load attached.

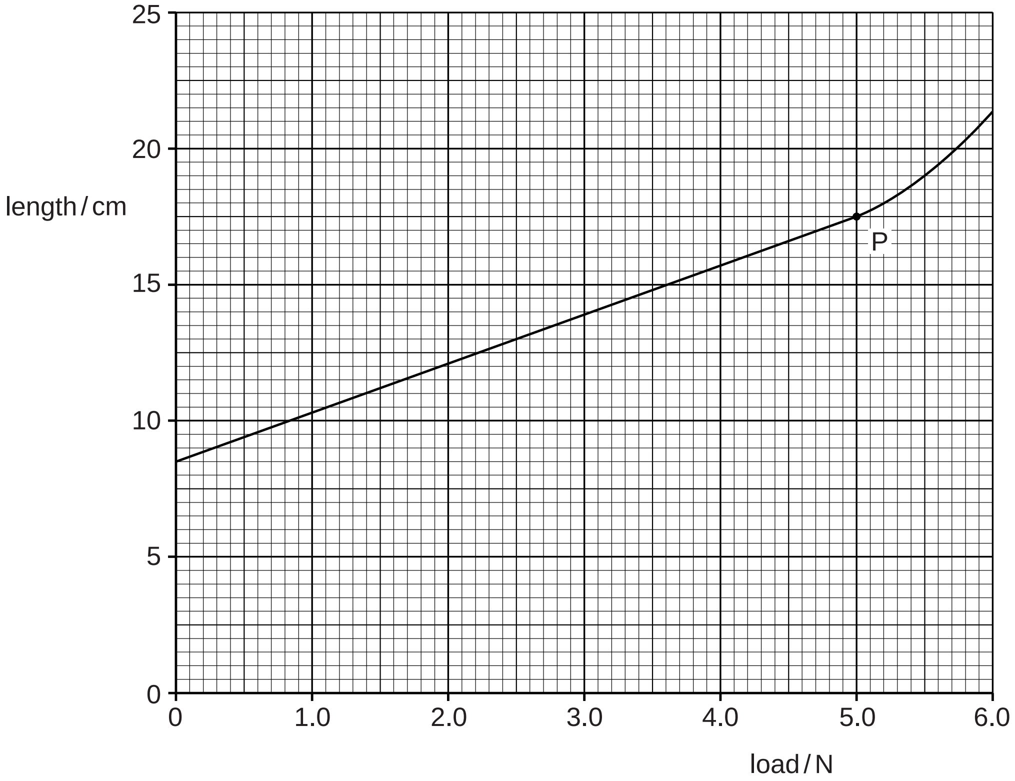

Fig. 1.1

(a) At point P on Fig. 1.1, the line stops being straight and begins to curve.

State the name of point P.

....[1]

(b) **(i)** Using Fig. 1.1, determine the unstretched length of the spring.

unstretched length = ...[1]

(ii) Calculate the extension of the spring for a load of 4.0 N.

extension = ...[1]

(c) The student attaches a small block of wood to an identical spring. The extension of the spring is 2.7 cm. The gravitational field strength *g* is 10 N / kg.

Calculate the mass of the block of wood.

mass = ...[2]

Question # 14: Oct Nov 2015/P22/Q2

(a) The surface of a running track is made of rubber. A heavy trolley is pulled on to the track and it exerts a large force on the rubber track.

State two effects that this force has on the rubber.

1. ....

2. .... [2]

(b) A spring is suspended from a support with a small pan attached to its lower end. Masses are added to the pan until the spring is extended well beyond the limit of proportionality.

Fig. 2.1 shows this apparatus.

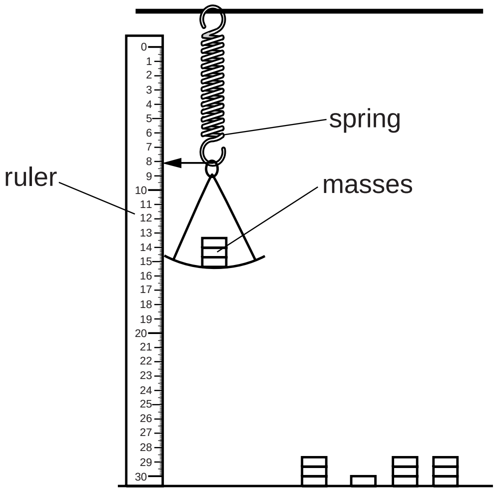

Fig. 2.1

A ruler is used when determining the extension of the spring.

(i) On Fig. 2.2, sketch the extension-load graph for the spring and label the limit of proportionality P. [2]

Fig. 2.2

(ii) The masses are then removed and the extension of the spring decreases.

Suggest what is observed when all the masses are removed.

....

.... [1]

Question # 15: Oct Nov 2017/P22/Q2

A force applied to a solid object may cause it to accelerate so that its velocity changes.

(a) State two other properties of the object which may change when a force is applied.

1. ....

2. ....
[2]

(b) A spring has a mass of 0.012 kg.

(i) The gravitational field strength *g* is 10 N / kg.

Calculate the weight of the spring.

weight = ...[1]

(ii) The spring is suspended vertically and a load is attached to its lower end. The spring extends by 2.7 cm and does not pass the limit of proportionality.

Fig. 2.1 shows the spring and load attached to the lower end of a second identical spring.

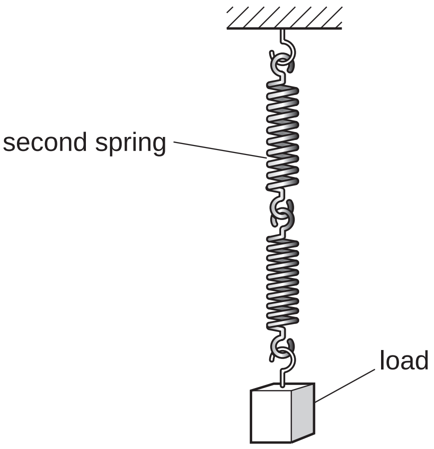

Fig. 2.1

Suggest one reason why the extension of the second spring differs from 2.7 cm.

....

....

....[1]

(iii) Explain what is meant by *limit of proportionality*.

....

....

....[1]

(c) The load in Fig. 2.1 is pulled down below its equilibrium position.

(i) State the form of energy stored in the stretched springs.

....[1]

(ii) The load is released and it moves upwards and downwards. The distance travelled in each movement decreases until the load stops moving.

Explain why the load stops moving.

....

....

....[1]

Question # 16: Oct Nov 2018/P21/Q3

A student uses the apparatus shown in Fig. 3.1 to obtain the extension-load graph of a spring.

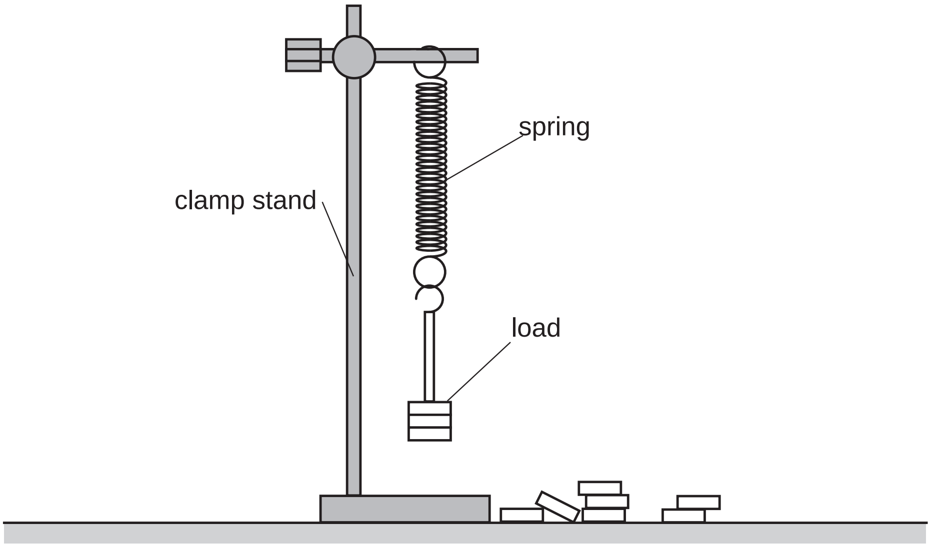

Fig. 3.1 (not to scale)

The weights of the loads are known. The student suspends loads of increasing size from the spring and determines the different extensions produced.

Fig. 3.2 is the graph the student obtains.

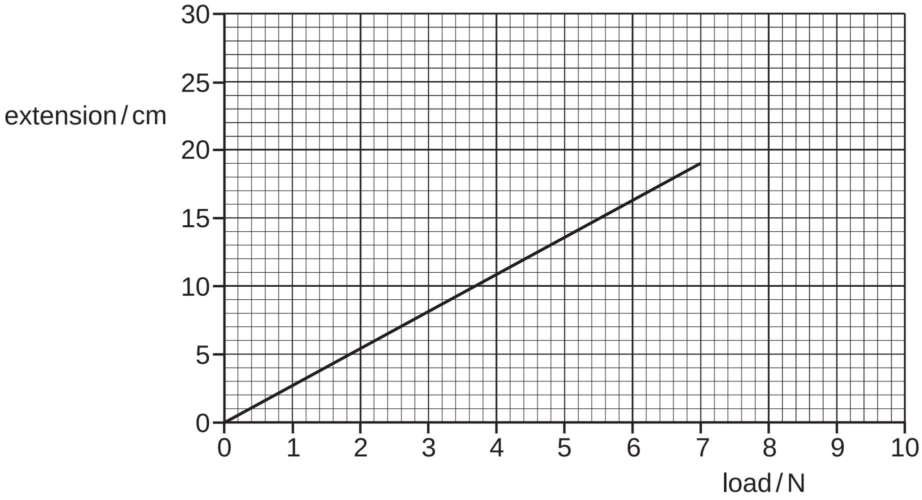

Fig. 3.2

The spring reaches its limit of proportionality when the load is 7.0 N.

(a) On Fig. 3.2, sketch the shape of the graph for loads greater than 7.0 N. [1]

(b) All the loads are removed from the spring. A block of wood is suspended from the end of the spring. The length of the spring increases from 4.9 cm to 13.4 cm.

Determine the weight of the wooden block.

weight = ... [2]

(c) The student takes a second spring that is identical to the one in Fig. 3.1 and hangs it next to the first spring.

Fig. 3.3 shows a light rod passing through the rings at the lower ends of the springs.

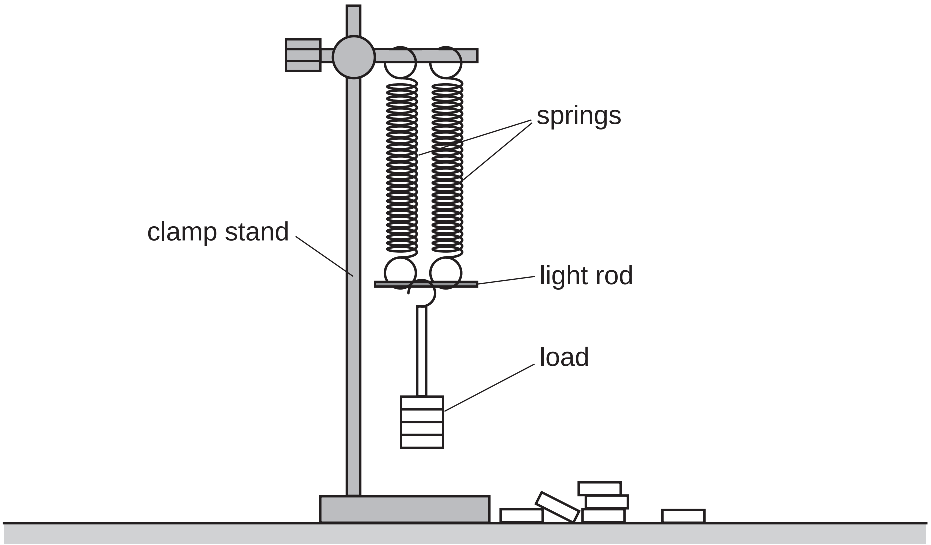

Fig. 3.3 (not to scale)

The student repeats the experiment and gradually increases the load to 9.0 N.

State and explain whether the limit of proportionality is reached.

....

....

....

.... [2]