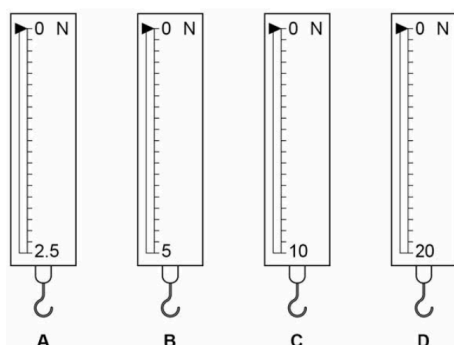


Q1. (2018)

0 4 . 1 Figure 6 shows four newtonmeters.

Each newtonmeter contains a spring.

Figure 6



Which newtonmeter has the spring with the greatest spring constant?

Give a reason for your answer.

[2 marks]

Newtonmeter _____

Reason _____

Q2. (2018)

0 4 . 3 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.

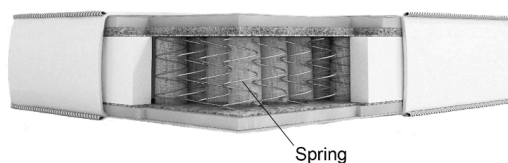
Spring constant = 400 N/m

[6 marks]

Q3. (2019)

0 5 Figure 8 shows some springs inside a mattress.

Figure 8



a)

0 5 . 1 Which proportionality is true when a force is applied to a spring?

[1 mark]

Tick (✓) **one** box.

Force $\propto$ energy stored

☐

Force $\propto$ extension

☐

Force $\propto$ length

☐

Force $\propto$ spring constant

☐

b)

A mattress contains 1200 identical springs.

A person lies on the mattress and the springs compress.

The mean force on each spring in the mattress is 0.49 N

0 5 . 2 Calculate the mass of the person.

gravitational field strength = 9.8 N/kg

[4 marks]

c)

0 5 . 3 The mean compression of each spring is 3.5×10^{-3} m

Calculate the spring constant of each spring in the mattress.

Give the unit.

[4 marks]

d)

0 5 . 4 For a given force, different springs compress by different amounts.

Explain what property of the springs would make the mattress soft.

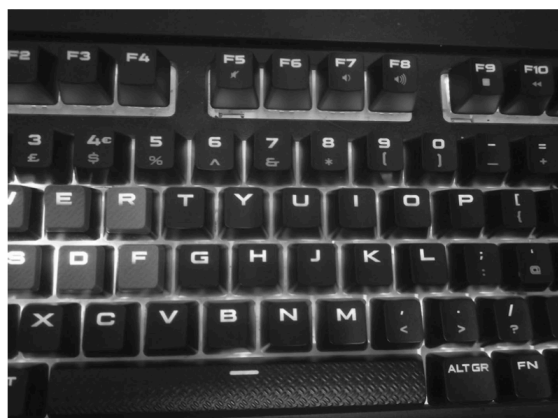
[2 marks]

Q4. (2020)

0 3 Figure 5 shows a computer keyboard.

There is a spring under each key.

Figure 5



a)

0 3 . 1 The springs behave elastically when a force is applied.

What is meant by elastic behaviour?

[1 mark]

Tick (✓) **one** box.

The spring will be compressed when the force is applied to it.

☐

The spring will become deformed when the force is applied to it.

☐

The spring will become longer when the force is removed.

☐

The spring will return to its original length when the force is removed.

☐

b)

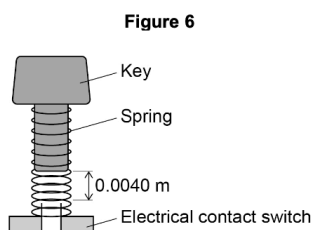
0 3 . 2 Suggest **two** properties that should be the same for each spring. [2 marks]

1 _____

2 _____

c)

0 3 . 3 Figure 6 shows one of the keys and its spring.



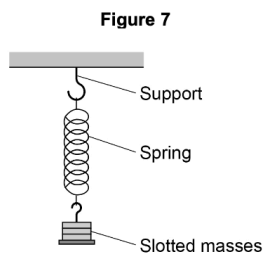
The key must be pressed with a minimum force of 0.80 N before the key touches the switch.

Calculate the spring constant of the spring in Figure 6. [3 marks]

Q5. (2020)

0 3 . 4 Figure 7 shows a spring that has been hung from a support.

The spring is stationary and has been stretched beyond its limit of proportionality.



Which **two** statements are true for the spring in Figure 7? [2 marks]

Tick (✓) **two** boxes.

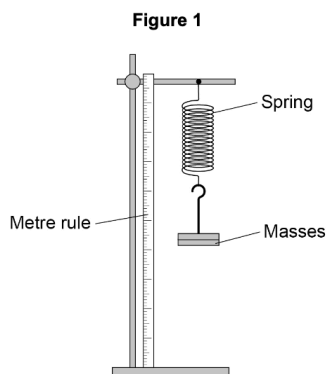
- | | |
|--|--------------------------|
| The elastic potential energy of the spring is zero. | ☐ |
| The extension of the spring is directly proportional to the force applied. | ☐ |
| The upward force on the spring is equal to the downward force. | ☐ |
| The spring cannot be stretched any further. | ☐ |
| The spring is inelastically deformed. | ☐ |

Q6. (2021)

0 1

Figure 1 shows a stretched spring.

The spring is elastically deformed.



a)

0 1 . 1

What is meant by 'elastically deformed'?

[1 mark]

Tick (✓) **one** box.

As the force on the spring increases the length of the spring increases.

☐

Only a very small force is needed to stretch the spring.

☐

The force on the spring causes it to change shape.

☐

The spring will return to its original length when the force is removed.

☐

b)

0 1 . 2

Describe a method to determine the extension of the spring.

[2 marks]

c)

0 1 . 3

The extension of the spring is 80 mm.

spring constant = 40 N/m

Calculate the elastic potential energy of the spring.

Use the Physics Equations Sheet.

[3 marks]

d)

0 1 . 4

Write down the equation which links extension (e), force (F) and spring constant (k).

[1 mark]

e)

0 1 . 5

A force of 300 N acts on a different spring.

The force causes the spring to extend by 0.40 m.

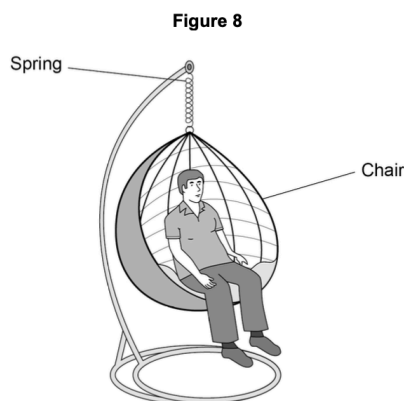
Calculate the spring constant of the spring.

[3 marks]

Q7. (2023)

0 5

Figure 8 shows a garden chair hanging from a spring.



a)

0 5

1 Which of the following describes the relationship between the weight (W) acting on the spring and the extension (e) of the spring?

[1 mark]

Tick (✓) **one** box.

- | | |
|---------------|--------------------------|
| $W = e$ | ☐ |
| $W \propto e$ | ☐ |
| $W \sim e$ | ☐ |
| $W < e$ | ☐ |

b)

0 5

2 The person in **Figure 8** has a weight of 750 N.

The person's weight causes the spring to extend by 60 mm.

Calculate the spring constant of the spring.

Use the Physics Equations Sheet.

[3 marks]

c)

The manufacturer of the chair tests a new spring to see if it is suitable to hang the chair.

The spring can store a maximum of 1800 J of elastic potential energy before it becomes inelastically deformed.

0 5

3 Describe what is meant by 'inelastically deformed'.

[2 marks]

d)

0 5

4 Calculate the maximum extension of the spring before the spring becomes inelastically deformed.

spring constant = 225 N/m

Use the Physics Equations Sheet.

[3 marks]

e)

0 5 . 5 Evaluate the suitability of the new spring to hang the chair.

maximum elastic potential energy = 1800 J

spring constant = 225 N/m

weight of person = 750 N

distance between the bottom of the chair and the ground = 30 cm

Include a calculation in your answer.

Use the Physics Equations Sheet.

[3 marks]

Q8. (2024)

0 2 Figure 2 shows an Olympic gymnast performing a floor routine.

Figure 2



The floor contains springs.

When the gymnast lands on the floor, a force compresses the springs in the floor.

a)

0 2 . 1 When a spring is compressed, the elastic potential energy of the spring increases.

Explain why compressing the springs in the floor helps the gymnast to jump higher.

Use ideas about energy in your answer.

[2 marks]

b)

0 2 . 2 When the gymnast lands on the floor, one of the springs compresses by 1.2 cm.

spring constant = 8500 N/m

Calculate the elastic potential energy stored in the spring.

Use the Physics Equations Sheet.

Give the unit.

[4 marks]

Q9. (2024)

A student investigated a spring with a different spring constant.

When masses are placed on the spring it compresses.

The student measured the compression of the spring for different masses.

Figure 3 shows some of the equipment used.

Figure 3



a)

0 2 . 3 Describe how the compression of the spring could be determined.

[2 marks]

b)

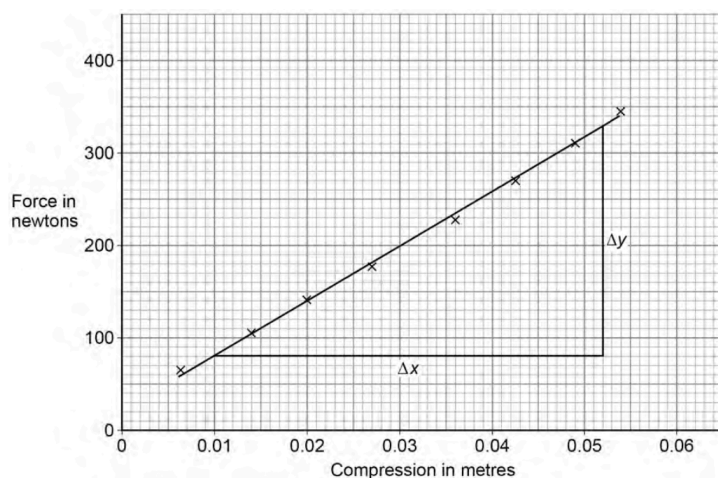
0 2 . 4 Explain why the investigation should be done on the laboratory floor rather than on a table.

[2 marks]

c)

Figure 4 shows the results.

Figure 4



The spring constant is the gradient of the line of best fit shown on Figure 4.

0 2 . 5 Determine the value Δy on Figure 4.

[1 mark]

$\Delta y =$ _____ N

d)

0 2 . 6 Determine the value Δx on Figure 4.

[1 mark]

$\Delta x =$ _____ m

e)

02.7 Determine the spring constant of the spring.

Use your answers to Question **02.5** and Question **02.6**.

Give your answer to 3 significant figures.

[2 marks]

Spring constant (3 significant figures) = _____ N/m