5.3 Forces & Elasticity

Question Paper

Course	AQA GCSE Physics
Section	5. Forces
Topic	5.3 Forces & Elasticity
Difficulty	Medium

Time allowed: 60

Score: /45

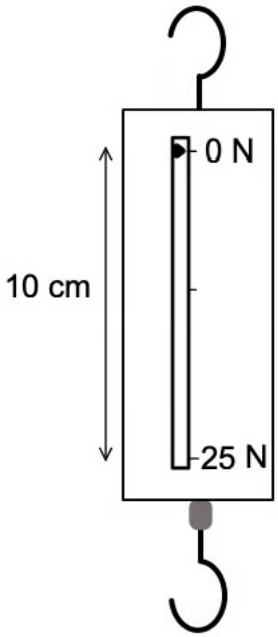
Percentage: /100

Question 1

A newton meter, as shown in **Figure 1**, consists of a point, connected to a metal spring.

When a force is applied to the spring, the spring stretches, and the point moves along the scale.

Figure 1



Use the information provided in the diagram to calculate the spring constant of the spring.

[3 marks]

[3 marks]

Question 2

A student wishes to carry out an investigation to measure the spring constant of a metal spring.

Describe a method that the student could use.

Your answer should include detail of how accurate measurements may be taken and may also include a labelled diagram

[6 marks]

[6 marks]

Question 3a

(a)

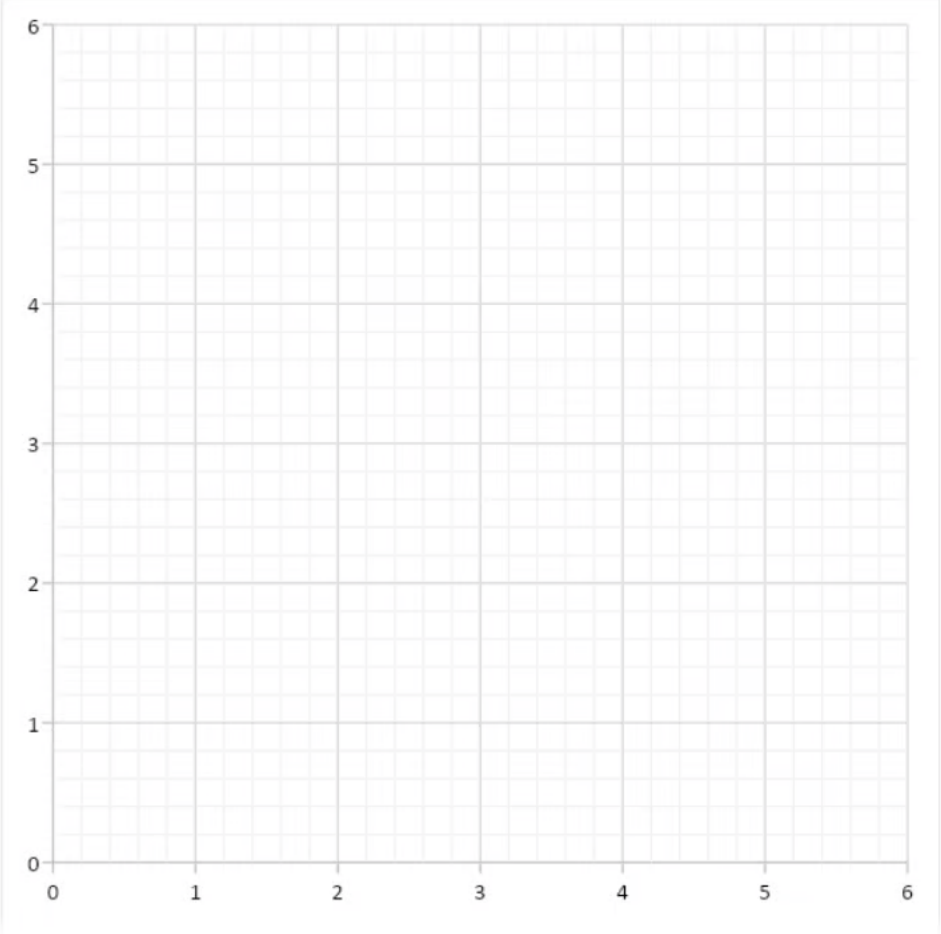
The table below gives the results obtained by the student.

Force in N	Extension in cm
2.0	1.3
4.0	2.1
6.0	2.9
8.0	3.7
10.0	4.5
12.0	5.9

The student finds that after stretching, the spring **does not** return to its original length.

Plot a graph of force (y-axis) against extension (x-axis) on the grid below.

[6 marks]



[6 marks]

Question 3b

(b)
Mark the position of the elastic limit on the graph, using an **X**.

Give your reason for choosing this point.

[2 marks]

[2 marks]

Question 3c

(c)
The student has made an error whilst calculating some of the results.

Suggest what the error was and how the results could be corrected.

[2 marks]

[2 marks]

Question 3d

(d)

Use the graph to calculate the spring constant of the metal spring.

[3 marks]

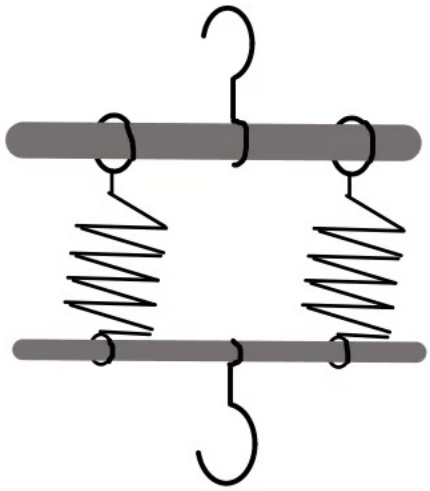
[3 marks]

Question 3e

(e)

The student decided to repeat the experiment using a double spring set up, as shown in **Figure 2**

Figure 2



Add a line to your original graph showing the results you would expect the student to get.

You should assume that the initial extension of the springs is the same as with the original experiment.

[2 marks]

[2 marks]

Question 3f

(f)

Explain how the elastic limit of the double spring will compare with the original spring.

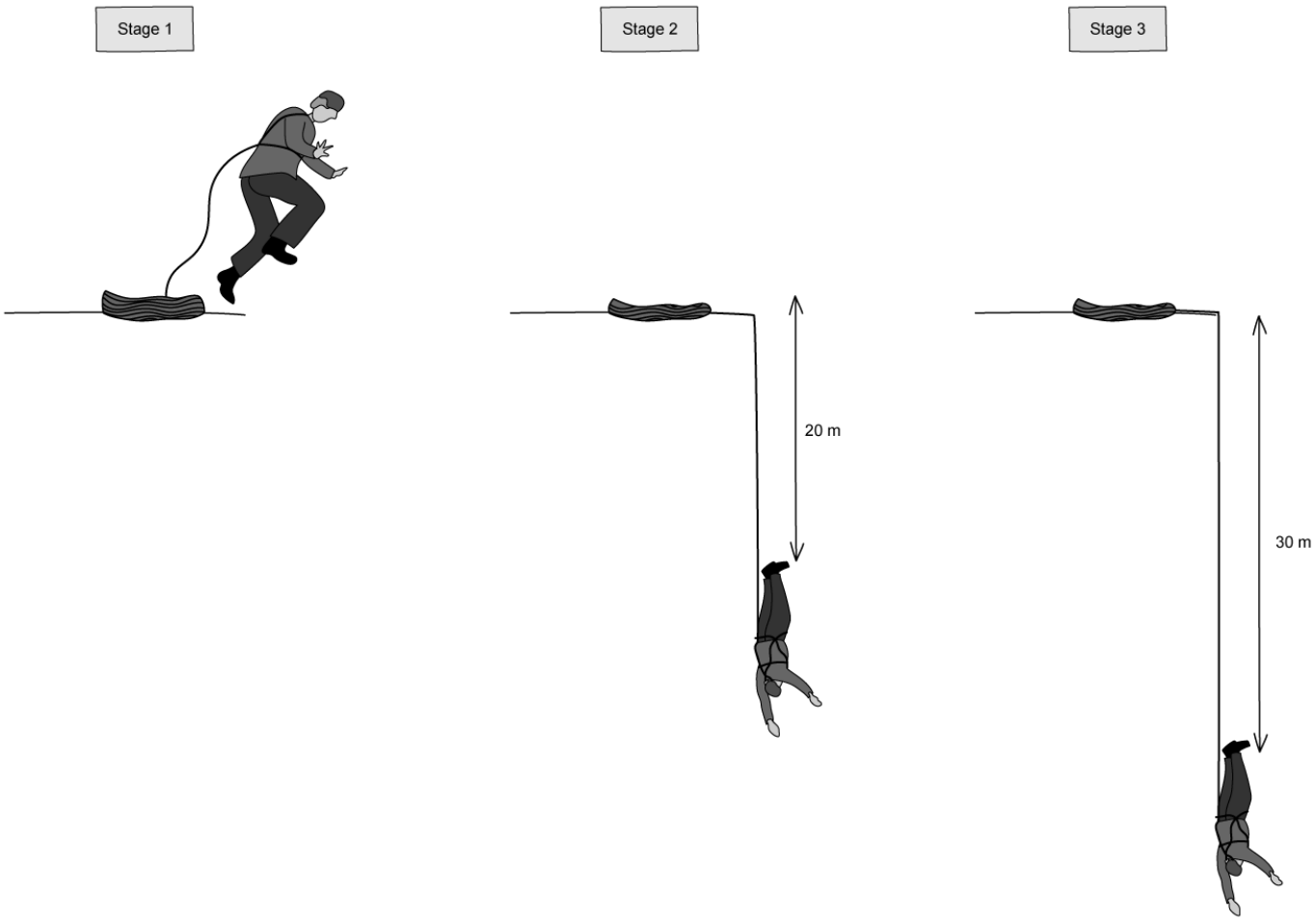
[2 marks]

[2 marks]

Question 4a

Figure 3 shows three different stages in a bungee jump.

Figure 3



Stage 1: The jumper is stationary and the bungee cord is slack

Stage 2: The bungee cord has no slack, but is not yet exerting a force on the jumper.

Stage 3: The jumper is at the lowest point and has temporarily stopped moving.

(a)
Describe the change in energy stores that occur between **stage 1** and **stage 3.**

[2 marks]

[2 marks]

Question 4b

(b)
Calculate the change in the jumper's gravitational energy store between stage 1 and stage 2.

The jumper has a mass of 60 kg (assume that the mass of the bungee cord is negligible).

Gravitational field strength = 10 N/kg

[3 marks]

[3 marks]

Question 4c

(c)
State the energy in the jumper's kinetic store at **stage 2.**

[1 mark]

[1 mark]

Question 4d

(d)
Calculate the speed of the bungee jumper at **stage 2.**

[3 marks]

[3 marks]

Question 4e

(e)
After reaching **stage 2**, the bungee cord starts to stretch, exerting an upwards force on the jumper which eventually brings the jumper to a stop at stage 3.

Between **stage 1** and **stage 3** the jumper's gravitational energy store decreases by a total of 18 000 joules.

State the energy in the bungee's elastic store at **stage 3**.

[1 mark]

[1 mark]

Question 4f

(f)
Calculate the extension of the bungee cord at **stage 3.**

[1 mark]

[1 mark]

Question 4g

(g)
Using an appropriate equation from the Physics equation sheet, calculate the spring constant of the bungee cord.

You may assume that the bungee cord behaves like a perfect spring.

[3 marks]

[3 marks]

Question 4h

(h)
Use your answers to (f) and (g) to calculate the force exerted by the bungee cord on the jumper at **stage 3.**

[3 marks]

[3 marks]

Question 4i

(i)

At **stage 3** the jumper's spine stretches a small but safe amount.

Explain why

[2 marks]

[2 marks]