GCE PHYSICS

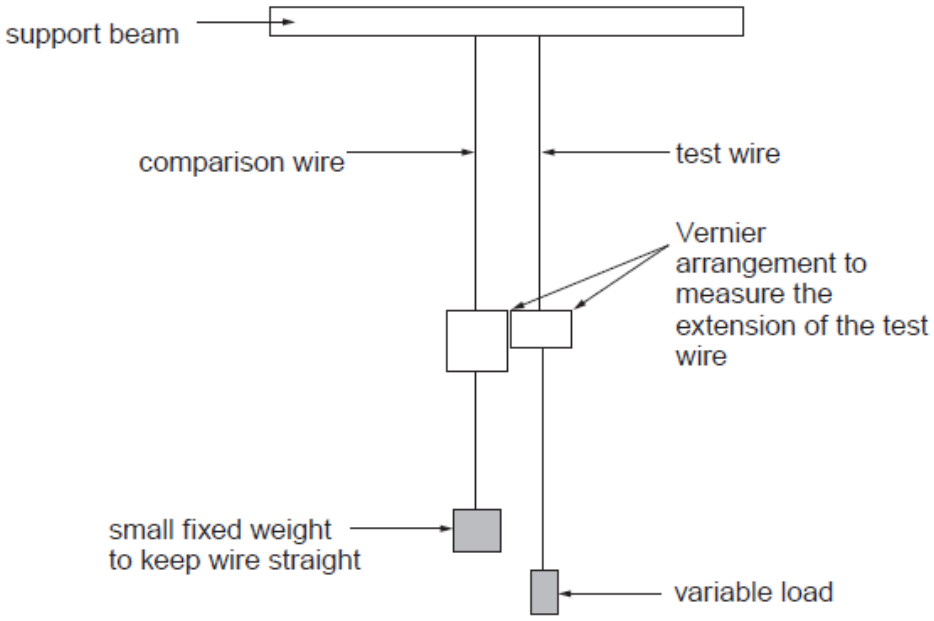
S21-A420QS

Assessment Resource number 11

Electricity and the Universe Resource B

1.

Kiera uses the following apparatus to find the Young modulus of a metal alloy in the form of a wire.



(a) Explain how the choice of a suitable comparison wire minimises the effect of a change in temperature. [2]

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(b) Kiera uses a micrometer of resolution 0.01 mm to measure the mean diameter of the wire. She determines the mean diameter to be 0.16 mm. Calculate the cross-sectional area of the wire **in m^2**, along with its **percentage uncertainty**. [3]

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(c) Kiera then uses a metre ruler with a resolution of 1 mm to measure the initial length of the wire. She determines the length to be 1.680 m. Show, with an appropriate calculation, that the percentage uncertainty in this reading can be considered negligible. [2]

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(d) Kiera adds various masses to the test wire and measures the extension. The table shows the extension of the wire for increasing load.

Load (negligible absolute uncertainty) / N	Mean extension / mm	Absolute uncertainty in extension / mm
1.96	1.4	± 0.2
3.92	2.7	± 0.2
5.89	4.1	± 0.2
7.85	5.5	± 0.2
9.81	6.8	± 0.2

Kiera plots a graph (shown opposite) of load against extension from her data, but does not include error bars.

(i) I. **Add error bars** for the extension on the plotted points. [1]

II. Draw lines of maximum gradient and minimum gradient and determine the gradients of both lines. [3]

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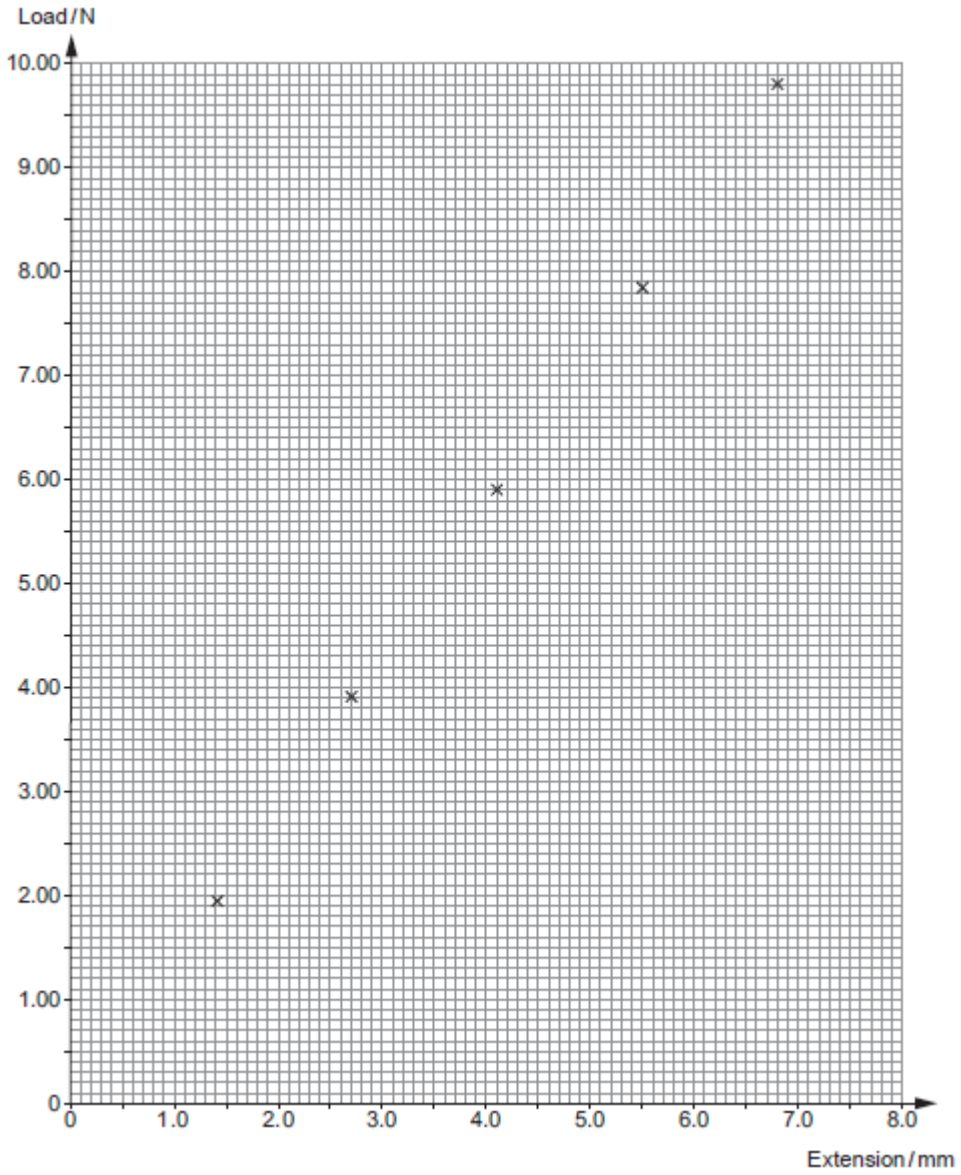

(ii) Hence, calculate the mean gradient and the **percentage** uncertainty in its value.

[2]

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(e) Determine the Young modulus of the metal alloy, along with its **absolute** uncertainty. Give your answer to an appropriate number of significant figures. [5]

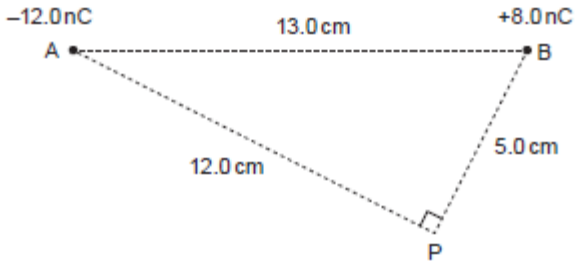
(f) State which of the measurements contributes most to the overall uncertainty in your answer and suggest **one** change Kiera could make to her experiment which would reduce the size of this uncertainty. [2]

2

(a) Complete the following table: [3]

Quantity	Definition	Vector or Scalar
Electric field strength, E	.....	.....
Electric potential, V	.....	.....

(b) Point charges of –12.0 nC and +8.0 nC are placed at A and B, 13.0 cm apart as shown. P is a point in space which is 12.0 cm from A and 5.0 cm from B.



(i) Draw on the diagram **two** arrows to show the directions of the field strength at P due to each charge. [1]

(ii) Hence draw on the diagram **one** arrow to represent the direction of the resultant field strength at P. **Label this arrow R.** [1]

(iii) Calculate the **magnitude and direction** of the electric field strength at P. [4]

(c) (i) Show that the potential at P is + 540 V. [2]

(ii) Calculate the gain in kinetic energy in joules of an electron as it moves from infinity to P. [2]

(d) Without calculation, explain how the de Broglie wavelength of the electron changes as it moves towards P. [3]