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Examiners' Report
June 2012

GCE Physics 6PH07 01

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June 2012

Publications Code US032790

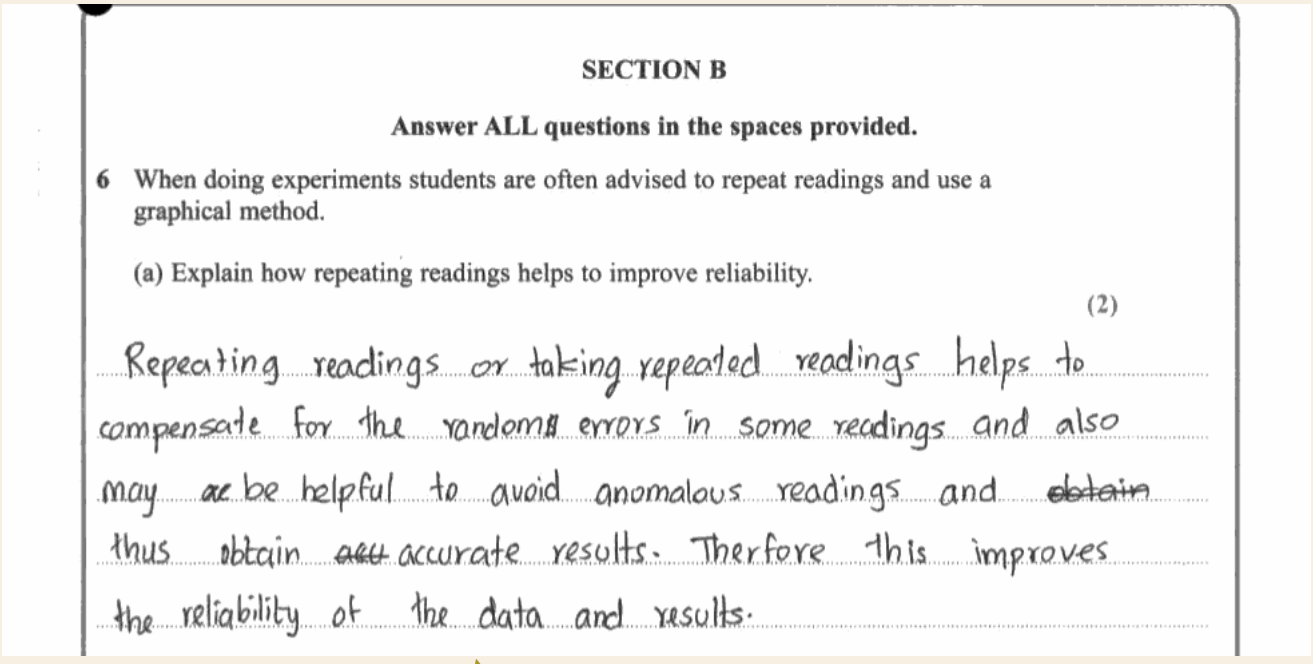
Introduction

This paper is designed to test practical skills and therefore it is expected that, as in a laboratory report, candidates will use an appropriate numbers of significant figures and the correct units throughout their responses. Answers can be in bullet point form but candidates must relate their answers closely to the context of the experiments described. To aid this, candidates are strongly advised to read the whole question before beginning to write their answers. This would have been particularly helpful in question 8.

Question 6(a)

The idea of taking an average was well understood as was identifying anomalies. Weaker candidates mentioned just 'error' without qualifying the term.

This answer clearly justifies the statements made.



SECTION B

Answer ALL questions in the spaces provided.

6 When doing experiments students are often advised to repeat readings and use a graphical method.

(a) Explain how repeating readings helps to improve reliability.

(2)

Repeating readings or taking repeated readings helps to compensate for the random errors in some readings and also may ~~ae~~ be helpful to avoid anomalous readings and ~~obtain~~ thus obtain ~~acc~~ accurate results. Therfore this improves the reliability of the data and results.

ResultsPlus
Examiner Comments

This answer gained full marks.

ResultsPlus
Examiner Tip

Justification of assertions is usually needed in questions which ask for explanations.

This answer shows another clear way of setting out an answer.

SECTION B

Answer ALL questions in the spaces provided.

6 When doing experiments students are often advised to repeat readings and use a graphical method.

(a) Explain how repeating readings helps to improve reliability.

(2)

Repeating readings helps to :-
(i) Take a mean value.
(ii) Reduces the uncertainty as several readings are taken and then taking the average from that.
(iii) Figure out whether one of the readings were taken wrong by comparing with other readings.

ResultsPlus
Examiner Comments

This also gained full marks.

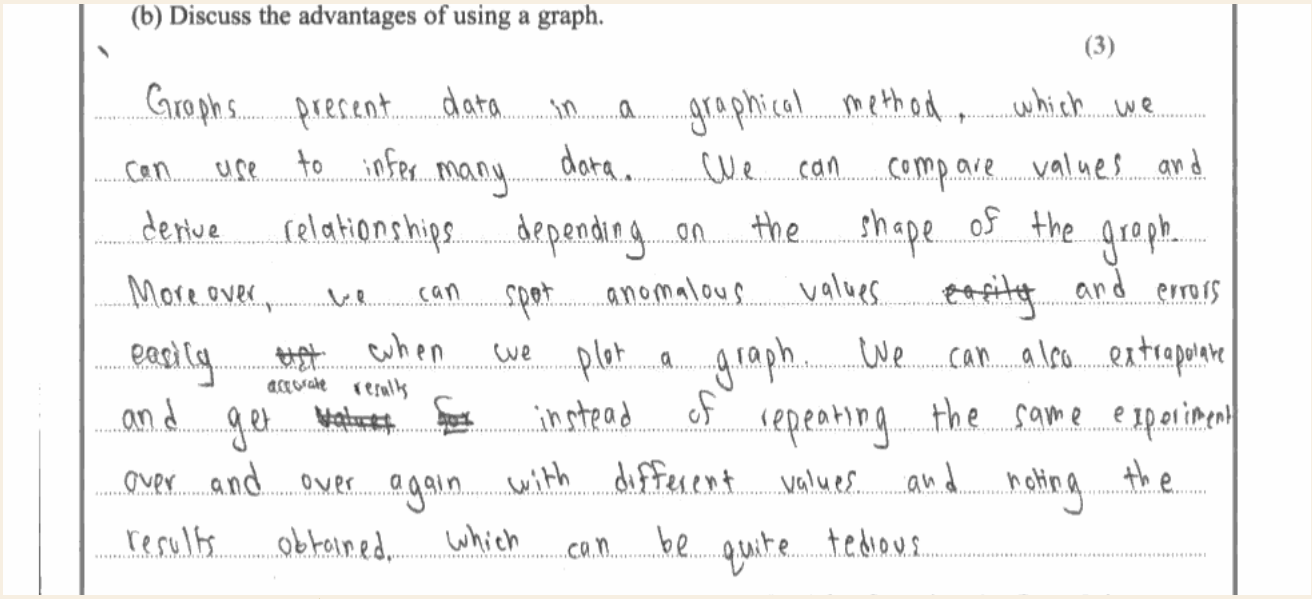
ResultsPlus
Examiner Tip

Consider carefully how you set out your answers.

Question 6(b)

The best candidates scored three marks easily here. Identifying the trend, finding the intercept/area/gradient and identifying anomalies were the top three responses. A pleasing number mentioned interpolation/extrapolation, although not all used the correct terms.

In general, longer descriptive answers are not recommended.



(b) Discuss the advantages of using a graph.

(3)

Graphs present data in a graphical method, which we can use to infer many data. We can compare values and derive relationships depending on the shape of the graph. Moreover, we can spot anomalous values ~~easily~~ and errors easily ~~not~~ when we plot a graph. We can also extrapolate and get accurate results ~~values~~ ~~for~~ instead of repeating the same experiment over and over again with different values and noting the results obtained, which can be quite tedious

ResultsPlus
Examiner Comments

The candidate made three good points but the first sentence was not specific enough to gain a mark by itself.

ResultsPlus
Examiner Tip

Try not to repeat the question in your answer.

This is a more focused response.

(b) Discuss the advantages of using a graph.

(3)

A graph gives us an average result. This gives us a more reliable result. Using a graph, systematic errors can be identified. and This will further improve accuracy in readings. We can use the gradient of the graph to calculate constants in equations. Using a graph saves time compared to calculating using individual readings for calculation. Using a graph helps us to compare with other similar experiments easily.

(Total for Question 6 = 5 marks)

ResultsPlus
Examiner Comments

The first sentence would have made a valid point if it had referred to a line of best fit.

ResultsPlus
Examiner Tip

Make sure you have justified statements made.

Question 7

Some good answers to this question were seen by candidates who clearly knew the required theory. The best answers related the responses clearly to a 1.5 V cell. This was particularly important in part (c) and (f). In (c) it is essential for full marks that candidates relate the expected size of the quantity to be measured to the scale division of the instrument to be used. In (f) comments must relate realistically to the context of the question and the degree of risk: rubber gloves and goggles did not receive a mark.

This is a good answer but would have been better if the candidate had said that the meters were analogue.

7 A student is asked to determine the emf and internal resistance of a 1.5 V cell. Write a plan for an experiment which could be used to do this using standard laboratory apparatus and a graphical method.

You should:

(a) draw a diagram of the circuit to be used, (2)

(b) state the quantities to be measured, (1)

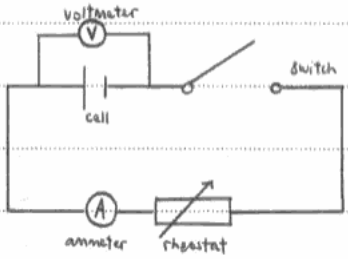
(c) for **two** of these quantities state and explain your choice of measuring instrument, (4)

(d) explain how the data collected will be used to find the emf and the internal resistance, (3)

(e) identify the main sources of uncertainty and/or systematic error, (2)

(f) comment on safety. (1)

(a)



(b) Quantities to be measured : current, potential difference

(c) Current is measured by an analogue ammeter with a range of 20A. This range is suitable because the current measured ~~with~~ will not exceed this range as only one 1.5V cell is used. Besides, an analogue ammeter is easy to use and connect.

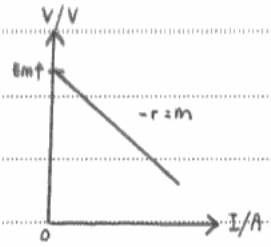
Potential difference across the cell is measured by a voltmeter with a range of 5V. This range is suitable because the emf of the cell is 1.5V so the maximum value of p.d. measured is only 5V

(d) - A graph of potential difference, V, against current, I, is plotted.

$E = Ir + V$

~~$V = -Ir + E$~~ $\quad V = -rI + E$

~~$y = mx + c$~~ $\quad y = mx + c$



- A straight line graph is obtained
- Emf of the cell = y-intercept of the graph
- $-r$ = - gradient of the graph ∴ internal resistance of the cell = negative gradient of the graph

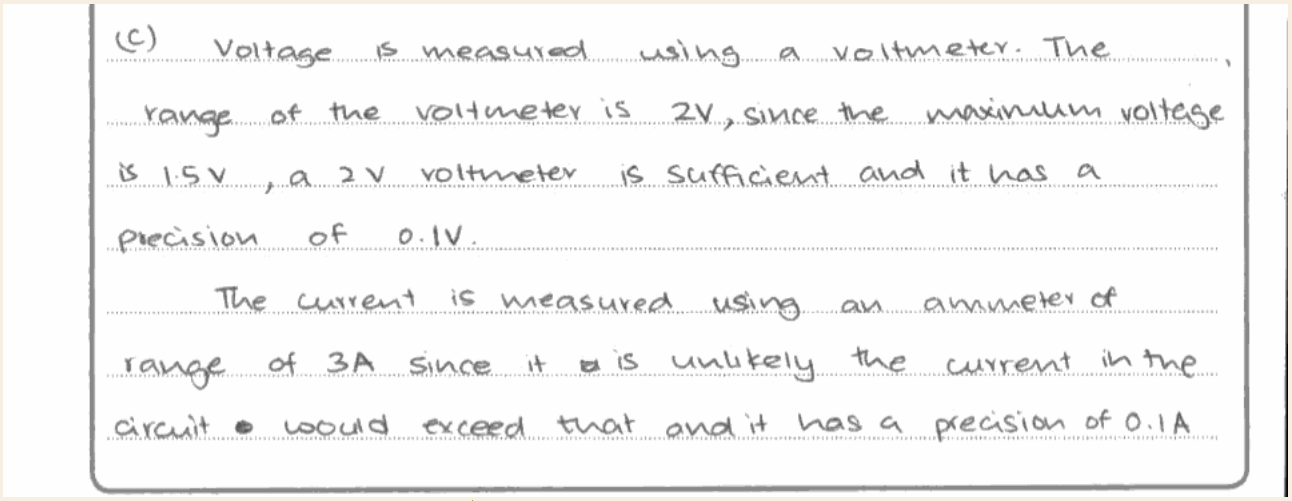
(e) - constant resistance of ammeter and voltmeter
- zero error of ammeter and voltmeter
- parallax error when taking the readings from ammeter and voltmeter
- internal resistance of the cell may not stay constant for a large current due to heating effect

(f) Overall this is a low risk experiment. The voltage and current used in the circuit is small.

ResultsPlus
Examiner Comments
The circuit diagram is well drawn using accepted symbols.

ResultsPlus
Examiner Tip
Use a ruler and pencil for diagrams.

This is a good concise answer.


(c) Voltage is measured using a voltmeter. The range of the voltmeter is 2V, since the maximum voltage is 1.5V, a 2V voltmeter is sufficient and it has a precision of 0.1V.

The current is measured using an ammeter of range of 3A since it is unlikely the current in the circuit would exceed that and it has a precision of 0.1A

ResultsPlus
Examiner Comments

The candidate has clearly realised that a 1.5 V cell is to be used.

ResultsPlus
Examiner Tip

Refer where possible to the scale readings expected as well as the precision of the instrument.

Question 8(a)

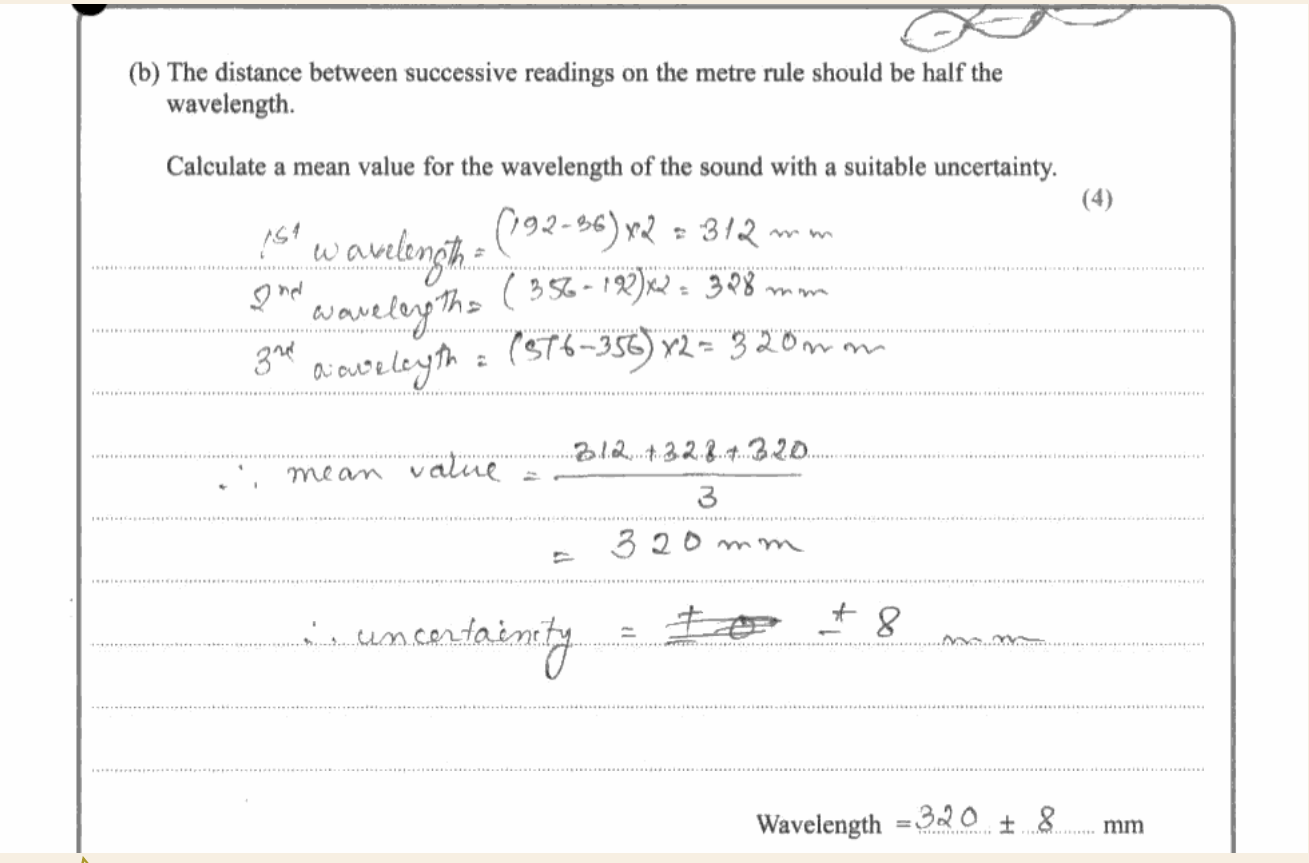
Candidates could gain full marks to this question by writing five words however, many wrote much more than this and in the process displayed some misconceptions. Two common ones were that readings from metre rules should be in given in metres not millimetres, and that all readings from a metre rule should have the same number of significant figures. The latter comment may arise from confusion between significant figures and decimal places and a lack of understanding of uncertainty.

Question 8(b)(c)

In part (b), some candidates had misinterpreted the introduction, taking the values given to be either the wavelength or half wavelength, rather than the positions between which there is a half wavelength. Students were also unsure how to calculate uncertainty from a set of values (e.g. half the range of the values) rather the uncertainty in a measurement (e.g. half/whole smallest scale division).

In part (c), some candidates lost the final mark, either because they did not convert the length to metres or used too many significant figures in their final answer.

The candidate gained full marks for part (b).



(b) The distance between successive readings on the metre rule should be half the wavelength.

Calculate a mean value for the wavelength of the sound with a suitable uncertainty.

(4)

1st wavelength = (192 - 56) x2 = 312 mm

2nd wavelength = (356 - 192) x2 = 328 mm

3rd wavelength = (516 - 356) x2 = 320 mm

∴ mean value = $\frac{312 + 328 + 320}{3}$

= 320 mm

∴ uncertainty = ~~± 0~~ ± 8 mm

Wavelength = 320 ± 8 mm

ResultsPlus
Examiner Comments

This was a clearly reasoned argument, well set out.

ResultsPlus
Examiner Tip

Always try to show your working.

This candidate carried out the calculation correctly but lost the final mark as the unit was incorrect.

(c) Use your value of the mean wavelength to calculate a value for the velocity of sound in air.

The frequency of the sound is 1024 Hz.

(2)

$v = f\lambda$

$v = 320 \times 10^{-3} \times 1024$

$= 327.68$

$= 328 \text{ m/s}^2$

Velocity = 328 m/s²

ResultsPlus
Examiner Comments

This is clearly set out.

ResultsPlus
Examiner Tip

Remember to check the significant figures of measurements and use the correct unit.

Question 9

There were many correct responses for the extension values in the table which was pleasing. A number of candidates misunderstood however and calculated a variety of unsuitable quantities such as energy stored.

The graphs were in general well drawn, the weaker candidates chose unsuitable scales and even the best were sometimes tripped up by the missing values of force at 1.00N and 1.40N. This led to scales missing these values and/or plots being incorrect. A small number plotted length rather than extension though there was a pleasing lack of 'blobs' for plotted points. The best straight line proved elusive for many, even some of the more able candidates joined the final result (1.60, 120) to the origin.

Many candidates gained full marks on the final section although again conversion to metres and using an appropriate number of significant figures tripped up some candidates.

This was a good answer.

9 A student is investigating the energy stored in a stretched spring. She hangs weights on the end of the spring and measures the length of the spring. Her results are shown below.

Force / N	Length of spring / mm	Extension / mm
0.00	400	0
0.20	416	16
0.40	432	32
0.60	448	48
0.80	455	55
1.20	487	87
1.60	520	120

(a) On the grid opposite plot a graph of force on the *y*-axis against extension on the *x*-axis.

Use the blank column in the table for your processed data.

(5)

(b) Use your graph to determine the energy stored in the stretched spring when it is extended by 100 mm. Show all your working.

(4)

Energy stored in spring = $\frac{1}{2}F\Delta x$

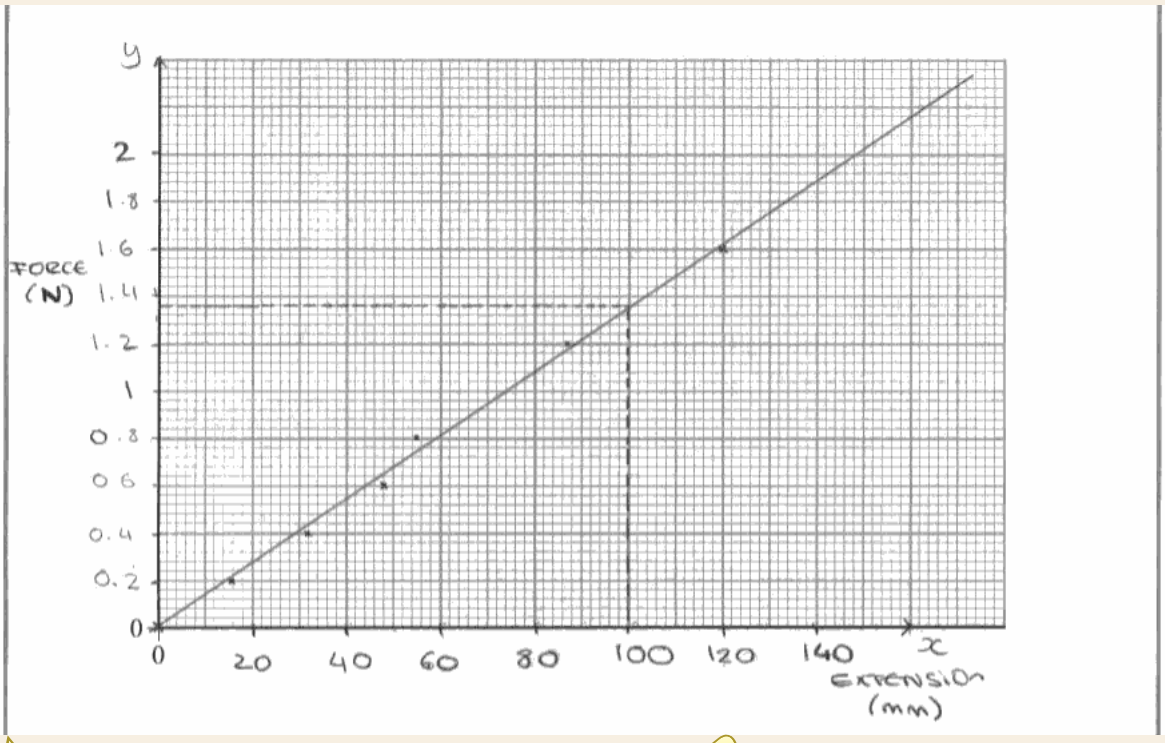
(area under graph.)

extended by 100 mm force = 1.38

extension = 0.1m force = 1.38 N

$\frac{1}{2}(0.1 \times 1.38) = 0.069$ J. (2sf)

Energy stored in spring = 0.069 J



ResultsPlus
Examiner Comments
The graph has a well chosen scale and has a good line of best fit.

ResultsPlus
Examiner Tip
State the relationship you are using in your answer.

This used an alternative valid approach.

9 A student is investigating the energy stored in a stretched spring. She hangs weights on the end of the spring and measures the length of the spring. Her results are shown below.

Force / N	Length of spring / mm	Extension / mm
0.00	400	0
0.20	416	16
0.40	432	32
0.60	448	48
0.80	455	~~55~~ 55
1.20	487	87
1.60	520	120

(a) On the grid opposite plot a graph of force on the *y*-axis against extension on the *x*-axis.

Use the blank column in the table for your processed data.

(5)

(b) Use your graph to determine the energy stored in the stretched spring when it is extended by 100 mm. Show all your working.

(4)

Energy stored = area under graph

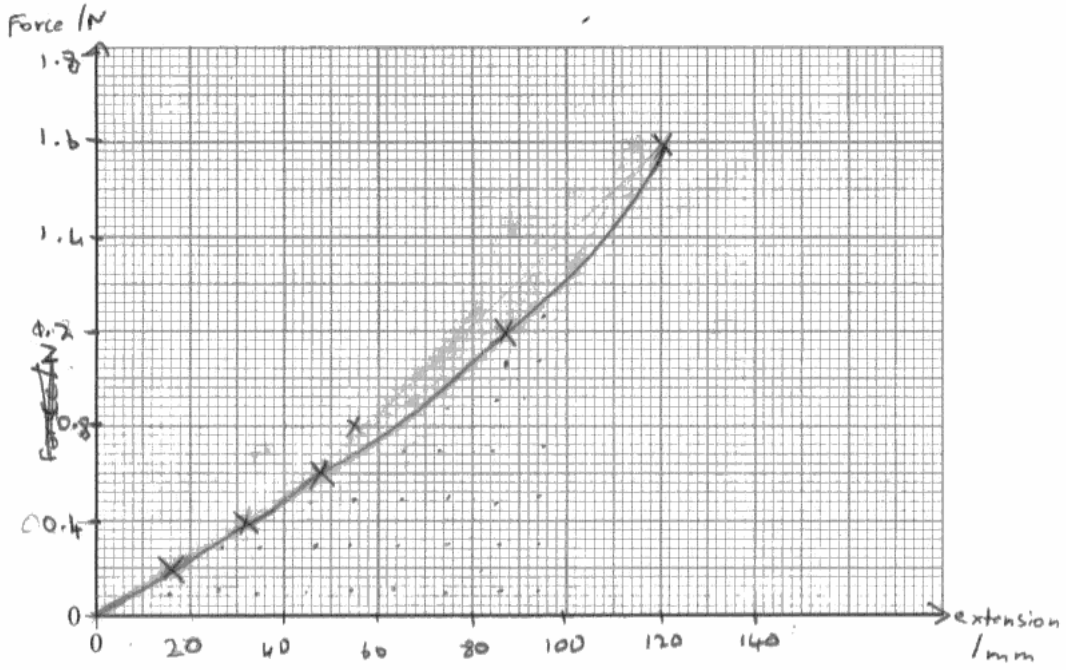
1 square = 0.2 N × 10 mm

$= 0.2 \times \left(\frac{10}{1000}\right)$

$= 2 \times 10^{-3}$ J per square

Energy for Total squares = $34 \times 2 \times 10^{-3} = 0.068$

Energy stored in spring = 0.068 ~~0.066~~ J



ResultsPlus
Examiner Comments
It was a pity that the graph was not well drawn.

ResultsPlus
Examiner Tip
Show your working clearly.

Paper Summary

There was evidence that some candidates were very familiar with practical apparatus and situations. These candidates gained high marks from excellent answers.

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