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Examiners' Report
June 2015

IAL Physics WPH03 01

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Introduction

The paper is designed to test practical skills for candidates in overseas centres. As such it uses similar criteria to the paper 6PH03 which tests the coursework skill of home candidates.

Candidates are expected to be familiar with the apparatus and techniques used for A level experiments relevant to the specification content, including the concepts of experimental error and uncertainties.

Questions 1, 3 and 4 were answered correctly by the majority of candidates. In question 2 some candidates did not omit the value of 0.72 mm which was clearly an outlier. A number of candidates were unable to successfully deal with the powers of ten, in question 5.

Question 6 (a)

Question 6 is reviewed as a whole below.

Question 6 (b)

Question 6 is reviewed as a whole below.

Question 6 (c)

Question 6 involved simple apparatus used to measure the internal resistance of a 1.5 V cell. Many answers showed familiarity with the practical aspects.

Good answers to part (a), such as the one below, were drawn using a ruler and the correct circuit symbols. These did not need to be labelled.

Common reasons for not scoring were the use of multiple cells and incorrect voltmeter placement. A few students made the error of placing the voltmeter in series.

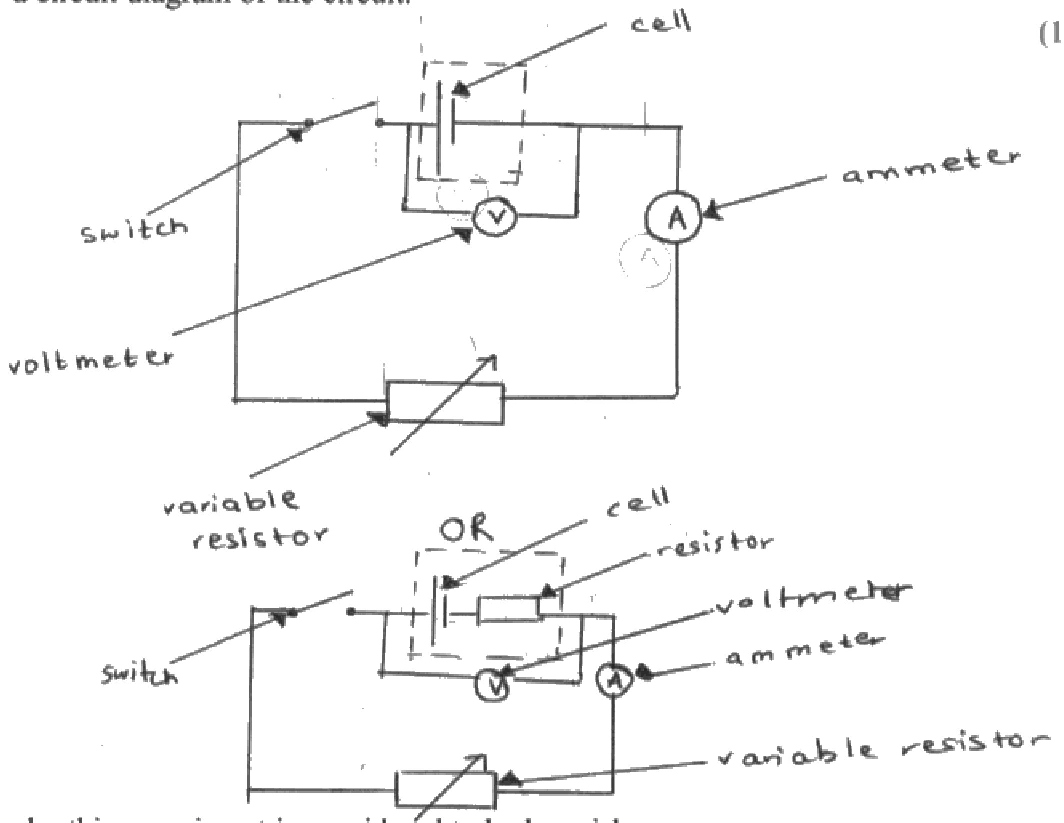
Most students realised that the experiment was safe because of the low voltages being used. A few incorrectly attributed safety to low current.

Many students found this part (c) of the question difficult to answer clearly, despite realising that the current would increase. Very few included the idea of a short circuit in their response. A sizeable minority mistakenly stated that the current would fall to zero, in line with resistance.

This was a good answer which showed understanding of the experimental set up and gained all 3 marks.

(a) Draw a circuit diagram of the circuit.

(1)



(b) State why this experiment is considered to be low risk.

(1)

Because the ~~power~~ voltage supplied or p.d across to the circuit ~~through the cell~~ is only 1·5V so there is a low risk.

(c) The teacher says that the resistance of the variable resistor should **not** be reduced to zero.

Suggest why.

(1)

If the resistance is reduced to zero the current passing through the circuit will be very high and this will damage components such as ammeter

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Examiner Comments

The candidate has used physics terms correctly.

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Examiner Tip

Use a pencil and ruler to draw circuit diagrams and learn circuit symbols.

Question 7 (a-h)

7a

Most students did this well and drew a labelled set-up, with a list of appropriate extra equipment. Some were familiar with this investigation and included both a balance and a set square with their metre rule.

A few students misread the aim and described the apparatus needed to find the Young modulus. When equipment common to both experiments was described, some of the marks remained accessible.

7b

Most students identified the independent and dependent variables correctly. Incorrect responses usually gained a mark for naming the correct quantities, even though they were wrongly attributed.

7c

Most students gained two of the four marks available. Their responses gave an appropriate choice of instruments, but did not give an acceptable reason for each choice.

Only a minority of students went on to give suitable reasons for their choices - either linking the instrument's precision/sensitivity to the size of the measurements or linking the instrument's scale to the range of expected measurements.

7d

Many students realised that taking readings at eye level was a useful technique. Fewer students were able to suggest appropriate uses for the set square - for transferring readings from the scale or for ensuring that the rule was vertical.

7e

Students found this mark difficult to score. Responses about repeating the readings were usually general, rather than being targeted at this particular experiment – as the question required. Students who thought about the possibility of the spring becoming stretched permanently usually gave a satisfactory response.

7f

Most students scored two marks for explaining how the data should be used. These marks were for identifying the correct graph and then stating that the area between the line and axis would give the amount of energy stored. Fewer students went on to define the area in quantitative terms or to explain how this area could be calculated.

Some students were successful in describing an alternative method that would yield a value from the graph. Either reading off the force that would cause an extension of 300 mm or finding the spring constant from the gradient gives data that can be substituted into an appropriate equation.

7g

Most students realised that measurement of the extension would be a source of uncertainty or error. However, many went on to spoil their response by adding a second or even a third source of error. There can only be one main source of error.

7h

Most students seemed to be well prepared and answered this successfully, offering the standard safety concerns and precautions.

7 A student is asked to plan an experiment to determine the energy stored in a stretched spring when it is extended by 300 mm. The student is told to use a graphical method.

For a 1 N load the extension of the spring is 40 mm.

Write a plan which could be used for this experiment.

You should:

(a) draw a labelled diagram of the experimental set-up and list any additional apparatus required,

(3)

(b) state which quantity is the independent variable and which quantity is the dependent variable,

(2)

(c) state and explain your choice of measuring instruments for the independent and dependent variables,

(4)

(d) describe how you would ensure that your measurement of the extension is as accurate as possible,

(2)

(e) comment on whether repeat readings are appropriate in this case,

(1)

(f) explain how the data collected will be used to determine the energy stored,

(4)

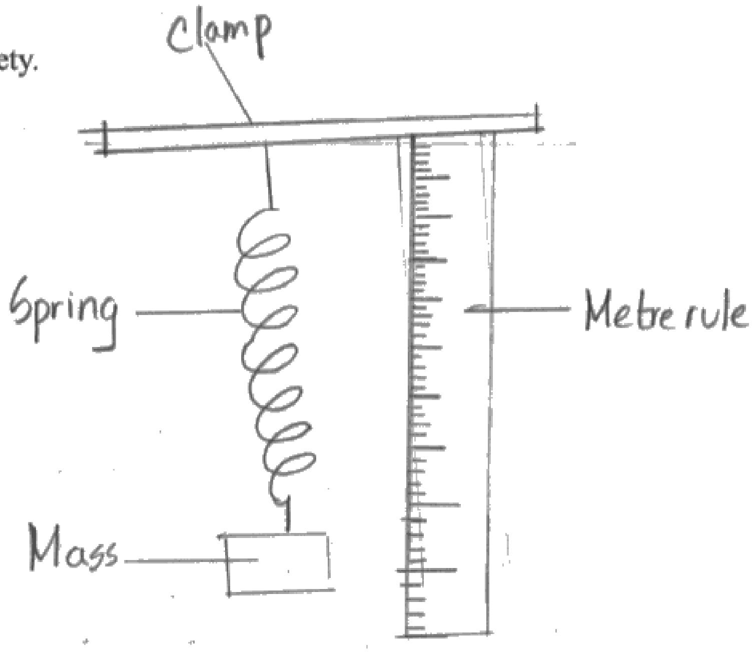
(g) explain the main source of uncertainty and/or systematic error,

(1)

(h) comment on safety.

(1)

(a)



Additional apparatus required - electronic balance, set square, pin

(b) Independent variable - force
Dependent variable - extension

(c) For mass of weights use electronic balance which has a precision of 0.01g and can measure upto and beyond 0.80 grams.
For ~~initial length~~ extension use metre rule which has a precision of 1mm ~~Initial length~~ and can measure upto and beyond 300mm.
Since ~~initial length~~ extension is a large value, metre rule is appropriate for this experiment
~~For extension use vernier calliper which has a precision of 0.1mm and can~~

(d) Use a set square to make metre rule vertical
Take readings from eye level to avoid parallax error
Use a fiduciary marker or pin to mark the ~~beginning~~ point from which extension is being measured, each time the masses are added
Do not cross elastic limit, and add masses of

(e) Repeat readings needed to identify anamolies and calculate mean extension.

(f) Multiply masses of weights by 9.81 to get force.
Subtract final length from initial length to find extension.
Plot a graph of force (y axis) against extension (x axis)
Calculate area under the ~~graph~~ linear region of the graph, ~~and find e~~ using formula $E = \frac{1}{2} F \Delta x$, which will give the energy stored, when extension is 300mm, and force 7.5 N.

(g) ~~A~~ Parallax error while taking readings from metre rule
Zero ~~error on~~ error in balance for measuring masses.

(h) Wear safety goggles to prevent breaking spring snapping into eyes
Wear protective shoes to prevent foot injury from falling weights

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Examiner Comments

This is an example of a very good answer which addresses many of the points made above.

Question 8 (a)

Over 80% of candidates gained the mark for this question. The most common errors were to omit the minus sign or to write 1 instead of 2.

Question 8 (b)

Most students were able to score at least one mark. However, it is important that responses relate to the context of the investigation given. Standard responses, such as comments about the quantity or range of the data, needed some further qualification in this case. Very few students pointed out that there was an obvious need for more data between the last two points. Their own difficulties when drawing the graph could have led them towards this.

This answer gained 2 marks.

(b) Criticise the results table.

(2)

- not consistent significant figure for distances d from a light bulb.
- There is no repeat readings.
- no average of value be taken
- small range of value.

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Examiner Comments

The comment about small range alone would not have gained a mark if it had been the only answer offered. As it was, data was lacking between the last two points rather than the range being small.

Question 8 (c)

Most students scored well here. The most common error was to give an additional significant figure for either or both values.

Question 8 (d) (e) (f)

8d

Most responses gained at least one of the marks. Many students were able to show clear links between the equation given and the equation for a straight line. Fewer were able to demonstrate that the line must pass through the origin, either by giving the proportionality or by showing that the intercept is zero.

8e

Most graphs were done very well, with many students gaining all five marks. The weakest skill shown was that of drawing the line of best fit. Many lines were drawn so as to ignore the last point. Some students used a short ruler and drew a two-part line with more than one gradient.

Examiners took care to ensure that those who had answered part 8(a) incorrectly did not suffer a double penalty when labelling the axis of their graph.

8f

Most candidates dealt with the last part of the question correctly. Even if their final value was out of range, many candidates still scored a mark for applying the correct method.

This answer gained all available marks.

(d) The relationship between I and d is given by

$$I = \frac{k}{d^2}$$

where k is a constant.

Explain why a graph of I on the y-axis against $\frac{1}{d^2}$ on the x-axis should be a straight line through the origin.

(2)

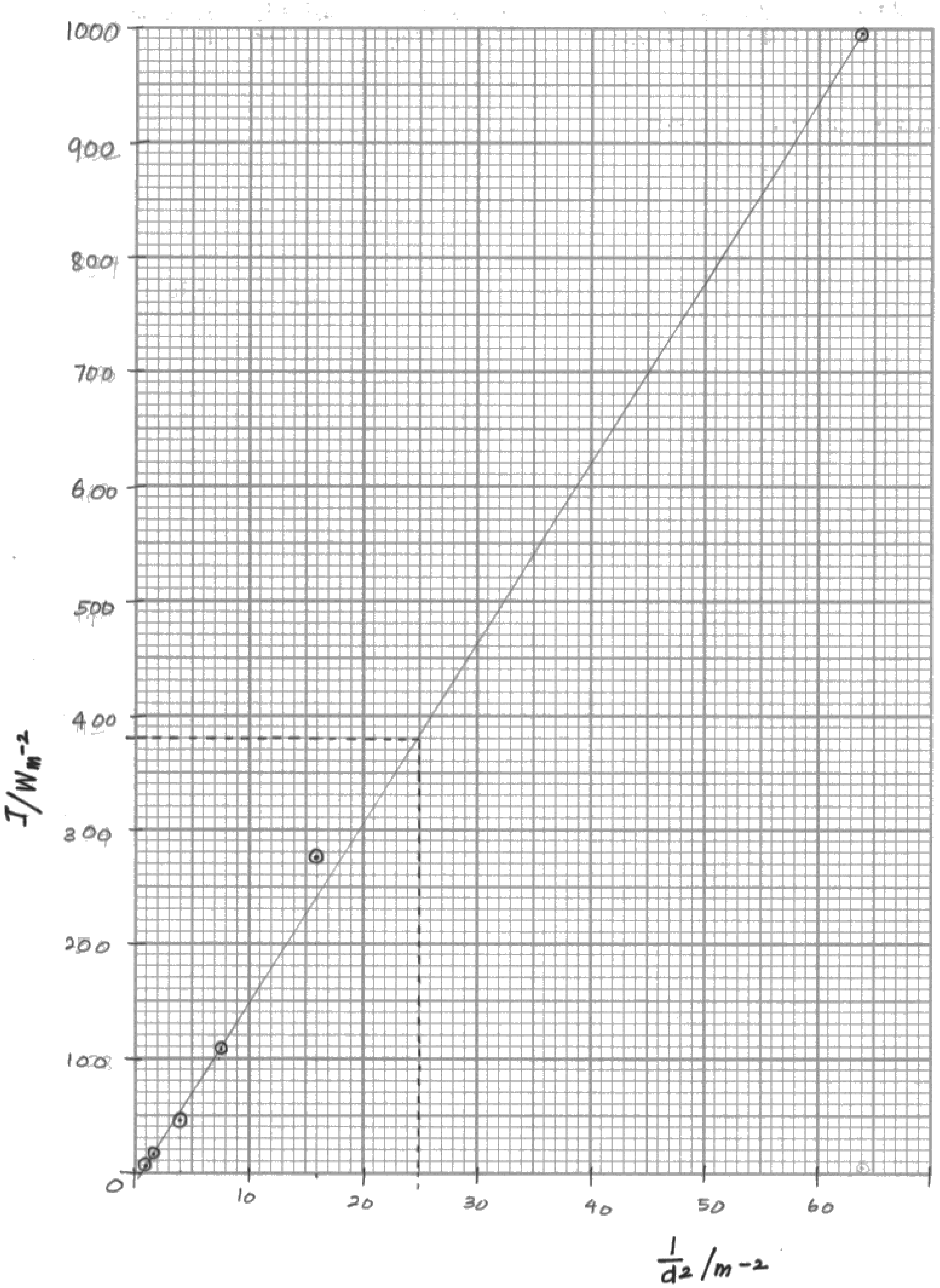
$y = mx + c$

$I = k \times \frac{1}{d^2} + 0$

The k value is a constant / its the gradient of the graph and hence, this will be a straight line passing through the origin.

(e) Plot a graph of I on the y-axis against $\frac{1}{d^2}$ on the x-axis on the grid provided and draw a line of best fit.

(5)



(f) Use your graph to determine I when $d = 20$ cm.

(2)

$d = 20$ $\frac{1}{d^2} = \frac{1}{(20 \div 100)^2} = \frac{1}{0.04} = \frac{1}{0.04}$ ~~25~~ $\frac{1}{d^2} = 25$

Scale → 10 — 1 $x =$

x — 38

$I =$ 380 W m^{-2}

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Examiner Comments

A very well drawn graph.

Paper Summary

Based on their performance on this paper, candidates should:

- ensure they are familiar with common apparatus
- know relevant circuit symbols
- use schematic diagrams rather than 3D pictures
- ensure their answers relate to the context of the questions asked
- justify the choice of an instrument by relating its scale to the size of the expected measurement
- draw a straight line or curve as the line of best fit for a graph and not force the line through the origin if inappropriate
- use a 30 cm ruler for graphical work.

Grade Boundaries

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