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Examiners' Report
June 2014

IAL Physics WPH03 01

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June 2014

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Introduction

This paper is taken by candidates based overseas.

It is intended to examine the same skills, knowledge and understanding as the practical work undertaken by home candidates on the equivalent paper, 6PH03, including planning and analysis. Candidates are expected to be familiar with standard laboratory equipment and to be able to estimate the magnitude of measurements likely to be met within common experiments. Centres may find it useful to read the guidance for paper 6PH03 on the Edexcel website.

In general candidates attempted all questions. There were some common errors particularly where candidates put themselves at a disadvantage by imprecise use of scientific language and English. It is important that candidates use scientific language and concepts carefully and precisely and justify their answers, particularly in the planning question. In calculations, numerical answers were sometimes given to too many significant figures in a practical context and units were missing.

Some responses indicated that candidates had not really understood what was being asked. They must read the stem of the question fully to get a clear idea of the context to which their response is to be addressed.

Questions 1 to 5

Question	Mean mark (max 1)
1	0.55
2	0.82
3	0.60
4	0.59
5	0.90

In question 1 some candidates did not recognise the need to round up their answer, and some candidates found difficulty with the graph in answering questions 3 and 4.

Question 6 (a) (b)

For this question it was expected that candidates would consider the range of the results given: those who did scored well.

This was a good answer which scored full marks for both parts.

with ± 30 ms⁻¹, the lowest value his stated value can obtain is 299,820 kms⁻¹ ~~kms⁻¹~~, which is still far greater than the accepted value today.
If ~~he~~ Newcomb's stated uncertainty was about ~~±50~~ ± 50 to ± 60, it would have been a ~~good estimate~~ better estimate

(b) In 1926 Michelson determined a value for *c* which he stated as 299 796 ± 4 km s⁻¹.

Comment on the value determined by Michelson.

(2)

His stated value was more accurate ~~and~~ than Newcomb's, (299 796 - 4 km s⁻¹) ~~wt~~ the accept value today overlaps with it. His stated value was also more precise than Newcomb's, (the uncertainty was ~~lower)~~ smaller)

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Examiner Comments

The candidate has calculated the limits and commented on whether today's value lies within these limits.

This also scored all the marks for part (a) but only 1 for part (b).

His uncertainity is ± 30 kms⁻¹ giving the lowest value to be 299820 kms⁻¹ and max value 299 880 kms⁻¹. Compared to the value accepted today there is a huge difference in the value and todays value does not come in his determined range.

(b) In 1926 Michelson determined a value for *c* which he stated as 299 796 ± 4 km s⁻¹.

Comment on the value determined by Michelson.

(2)

The value is ~~more~~ accurate but has a higher uncertinity range compared to the range which is accepted today. But ~~his~~ todays accepted value falls into the ~~ran~~ range he had determined.

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Examiner Comments

In part (b) a numerical approach or a more precise statement about accuracy would have gained the second mark.

Question 6 (c)

Most candidates made a good attempt at calculating the percentage uncertainty. A common mistake was not to multiply by 100 to give the ratio as a percentage. Others used 3 x 10^8 ms^{-1} as todays internationally accepted value, rather than the more precise value given in the question.

This answer is clearly set out.

percentage uncertainty = $\frac{0.001}{299792.458} \times 100$

= 3.33×10^{-7} %

Percentage uncertainty = 3.33×10^{-7} %.

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Examiner Comments

Both marks were gained.

Question 7

7(a)

Many candidates found this question difficult. The common error was lack of care with representing the distance. Some responses showed gaps between arrow-head and trap door or between arrow-head and bottom of ball bearing. Various inappropriate starting points for the distance measurement were chosen, usually the centre or top of the ball bearing.

7(b)

With a single instrument to discuss, very few included references to both precision and range in their response and consequently scored the first marking point only.

7(c)

Some candidates realised that using the electronic timer could avoid errors related to human reaction time, but were unable to relate this advantage to the short time being measured which was required to gain the mark.

7(d)

More candidates were successful here. They succeeded by relating the advantages of repeated readings to the context of the experiment, usually mentioning averaging or the ability to identify anomalous results.

7(e)

Very few answers mentioned the requirement for at least five sets of readings, but most realised that there would be a straight line to draw and a gradient to find. The correct equation was generally given and the best answered mentioned doubling the gradient to find *g*.

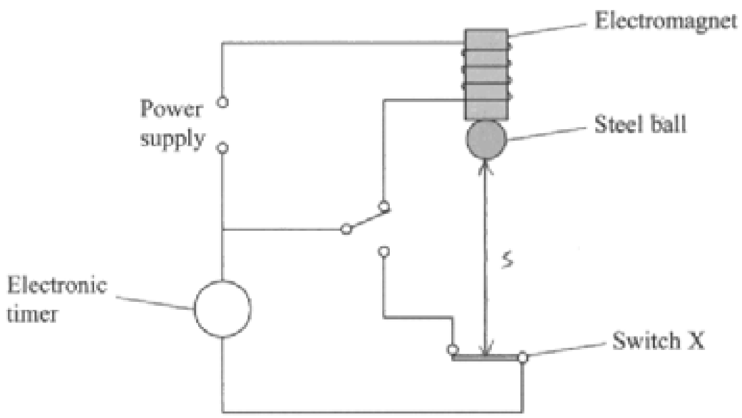
7(f)

Most candidates identified at least one source of uncertainty. Responses were generally in the context of the experiment.

7(g)

Whilst many were able to identify a suitable safety precaution, fewer candidates could link this properly to the hazard it addressed.

This is a very good answer.



The student is told to plot a graph of s against t^2.

Write a plan for an experiment to determine g using this method.

You should:

(a) draw on the diagram the distance s to be measured, (1)

(b) state the apparatus required to measure s and explain your choice, (2)

(c) explain why an electronic timer is used to measure t, (1)

(d) comment on whether repeat readings are appropriate in this case, (1)

(e) explain what data will be collected and how it will be used to determine g, (5)

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

(g) comment on safety. (1)

A metre rule is used to measure s. s is of magnitude ~10 cm, which is within the 0 – 1 m range of metre rule. The metre rule also gives length precise up to 1 mm, which is sufficient accuracy (~1% error) for this purpose.

t is of magnitude ~0.1 s, which is within the 0 – 100 s range of electronic timer. The electronic timer gives time precise up to 0.001 s, so that the accuracy (~1% error) is high enough. Since t is small, uncertainty may be high for other means of recording t.

Repeated readings are appropriate. An average value of t can be obtained from repeated readings, so that anomalies can be spotted out and the uncertainty in t reduced. Since it is expected that acceleration due to gravity is constant, time t recorded will fall into a small range, hence repeated readings and taking average is meaningful.

Repeat the experiment for several times by varying s, each time the distance the steel ball has fallen s and the time needed for steel ball to fall t are recorded. By $s = ut + \frac{at^2}{2}$, since $u = 0$, $a = g$ (taking downwards as positive), $s = \frac{gt^2}{2}$. Plot a graph of s against t^2 by drawing the best fit line. Determine gradient of the line, ☆ (see below) gradient is $\frac{g}{2}$, hence multiply gradient by 2 to get g.

☆ comparing $s = \frac{gt^2}{2}$ and $y = mx + c$

7

Turn over ▶

P 4 3 1 2 5 A 0 7 1 6

Parallax error may arise if the reading of metre rule in measuring s is not taken at eye level. Inprecise ~~[illegible]~~ data brought by ~~[illegible]~~ uncertainties in measuring tools may cause uncertainty. ~~[illegible]~~ ~~[illegible]~~ Due to the weak residue magnetic field. ~~[illegible]~~, the steel ball may not be released immediately after the electromagnet is switched off. The switch X may not open immediately when the steel ball collides with it.

Wear safety footwear and cushion the floor so that the steel ball does not cause damage when it falls onto the floor.

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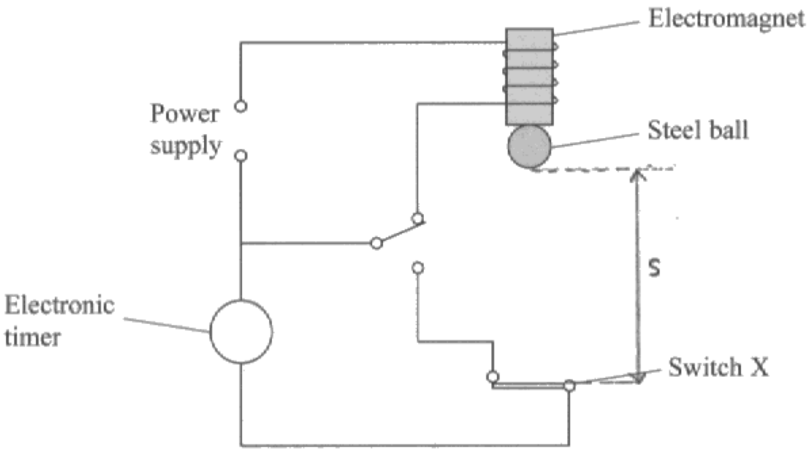
Examiner Comments

Only one mark was not awarded.

This is a well organised answer which, although it does not gain full marks, is concise.



The student is told to plot a graph of s against t^2.

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You should:

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(e) explain what data will be collected and how it will be used to determine g, (5)

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

(g) comment on safety. (1)

b) Meter rule - it has a uncertinaty of 0.1 cm.

c) So the time would be more accurate as human reaction time would be no there.

d) ~~No. because circut~~ No. because the circut will get heat up and cause different readings.

e) measure the distance from end of steel ball to the switch 's' and take the reading on electronic timer which is 't'. square the t measure-ment to get 't^2' Then ~~plot a d~~ plot a graph 's' on ~~x-axis~~ x-axis and ~~y-~~ 't^2' on ~~Y-axis Y-axis~~ Y-axis. as "$s = \frac{1}{2}gt^2$". we will get a graph a straight line passing through origin. The find the ~~gradein~~ gradient which will be equal to $\frac{1}{2}g$. So to find the 'g' multiply the gradient by 2.

f) • zero error while measuring time 't'

• prallex error while measuring distance 's'

g) be ~~carf~~ careful with the steel ball. can place a soft ~~sur~~ surface ~~t bet bat~~ below the steel ball. to prevent any damage.

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Examiner Comments

In (c) and (d) justification of the statement made is required to gain the missing mark.

Question 8 (a)

Most candidates scored well here. They were able to criticise the data confidently and usually picked out the inconsistency of precision together with another valid point.

This is an excellent answer which picks out many of the issues.

> * The precision of the length is ~~keeps~~ inconsistent,
> * so all the values do not have the same significant figures
> * Repeated readings are not taken, and hence average is not taken.
> * Few readings are taken. There should be atleast 6 readings.

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Examiner Comments

There is good use of bullet points in the answer.

Some candidates incorrectly think that there should always be identical intervals between the readings for the independent variable.

> - number of significant figures of readings not constant
> - range of values small. The maximum value should be at least the double of the minimum value.
> - not consistent change in the independent variable values of length.

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Examiner Comments

This candidate has not realised that the experiment uses a standard musical instrument and therefore the number of holes and their separation is fixed.

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Examiner Tip

It is important to read the context of the question carefully.

Question 8 (b)

A common mistake was to not have consistent decimal places in the answers. Expressing the data with the correct number of decimal places was more important than observing an appropriate number of significant figures in the table. Many candidates missed the need to add a unit to the column heading, and of those who did, many forgot to invert the unit.

This answer has noted that there was a unit missing.

l /cm	f /Hz	$\frac{1}{l}$ /cm^{-1}
10	1719	0.10
12.5	1375	0.08
14.5	1185	0.07
16.5	1042	0.06
19	904	0.05

1

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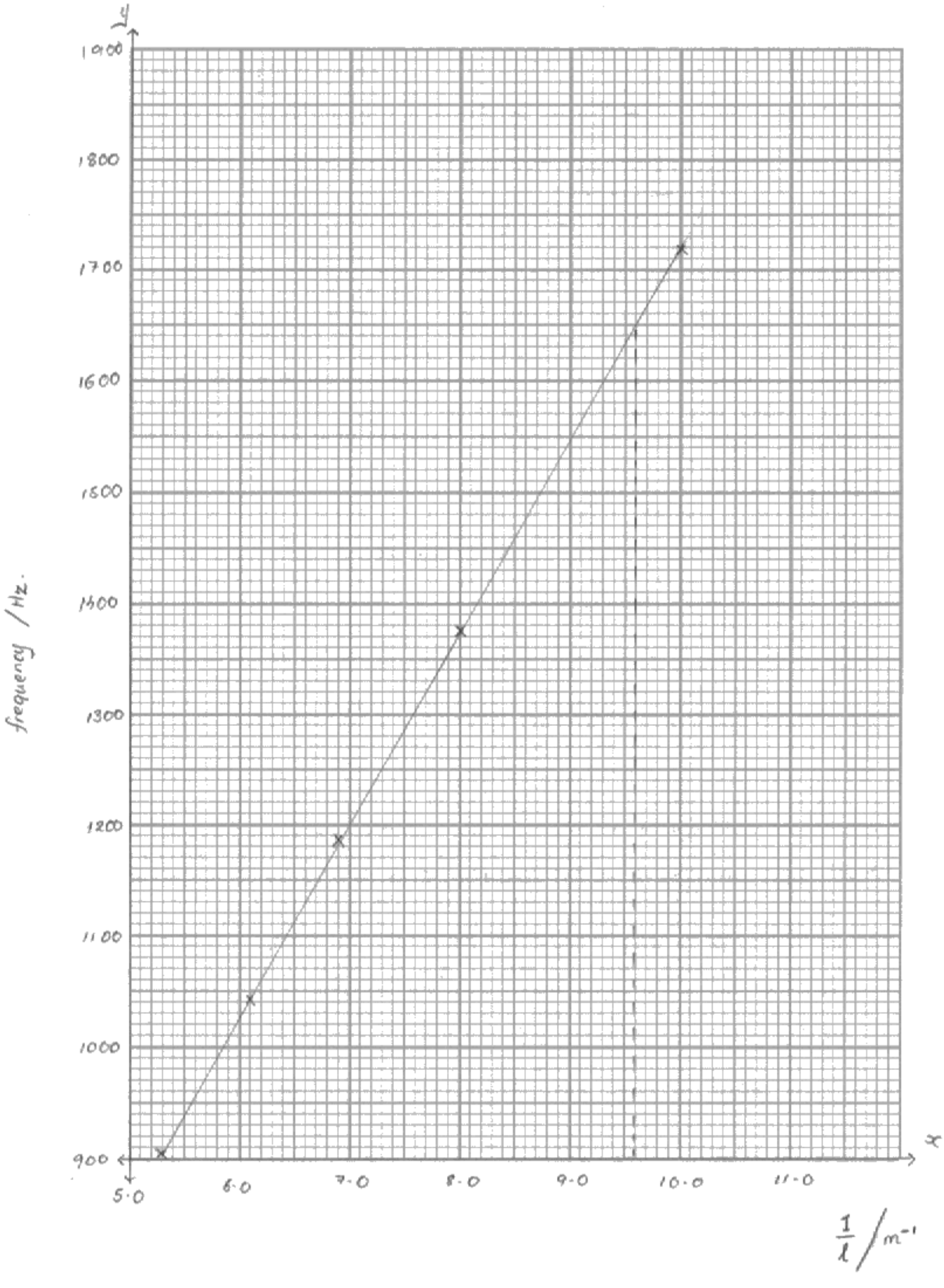
Examiner Comments

Although the decimal places in the $1/l$ column are consistent the answer would have been improved by increasing the decimal places from 2 to 3.

Question 8 (c)

The graph plotting was based on fewer points than usual, but the responses still yielded a range of response and a full range of marks. Candidates tended to be well prepared and most showed good skill when completing their graphs. There were some excellent responses to this question.

This was a very good graph which also showed clearly the triangle used in part (d).



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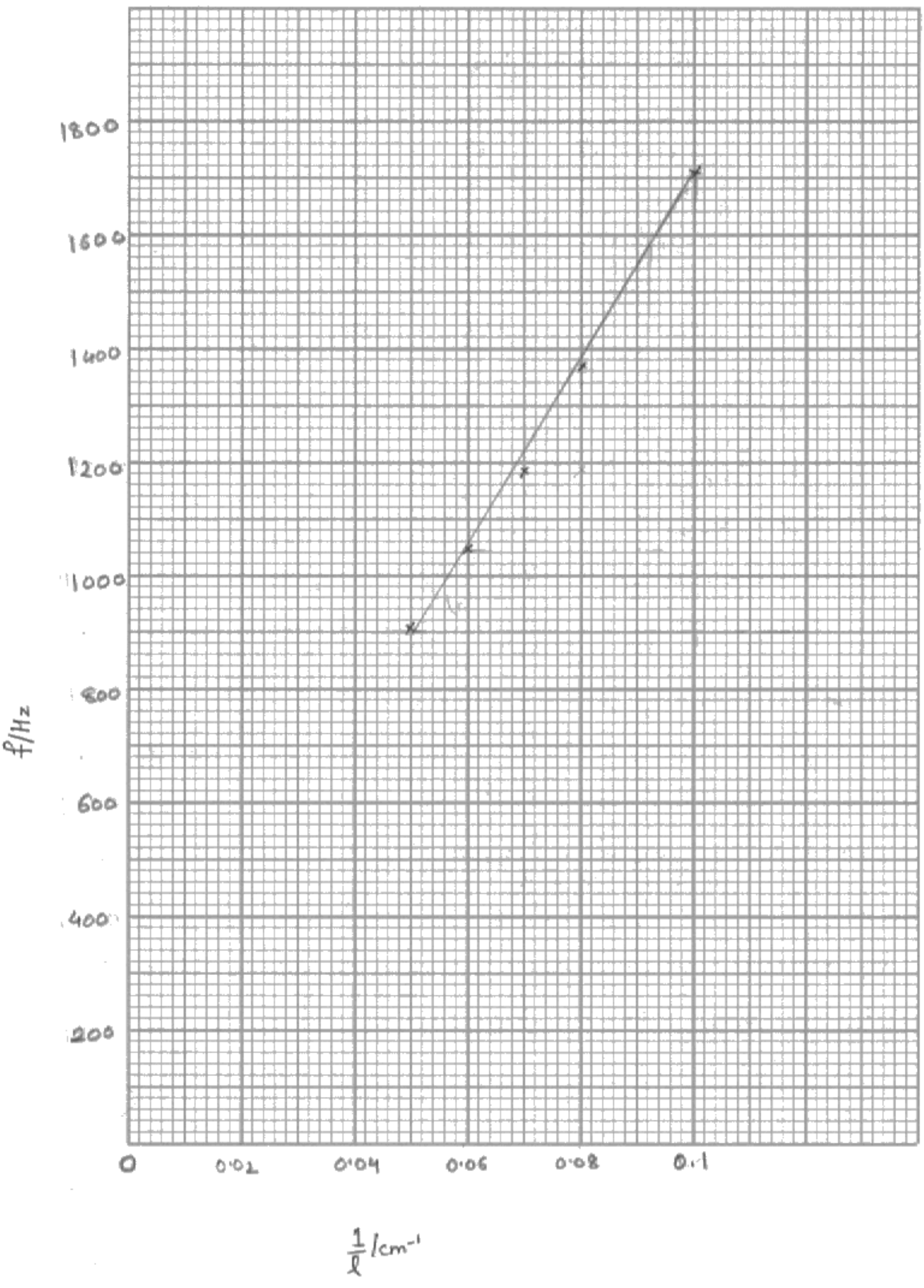
Examiner Comments

The candidate realised that including the origin would not make best use of the space provided.

This scored only 2 marks.



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The scale chosen does not make full use of the space provided and the line of best fit has not balanced the number of points on each side of the line.

Question 8 (d) (e) (f)

8(d)

This tended to be answered well, with most candidates making a good attempt at finding the gradient. Some went on to calculate values that were out of range and this appeared to depend on the quality of their graph work.

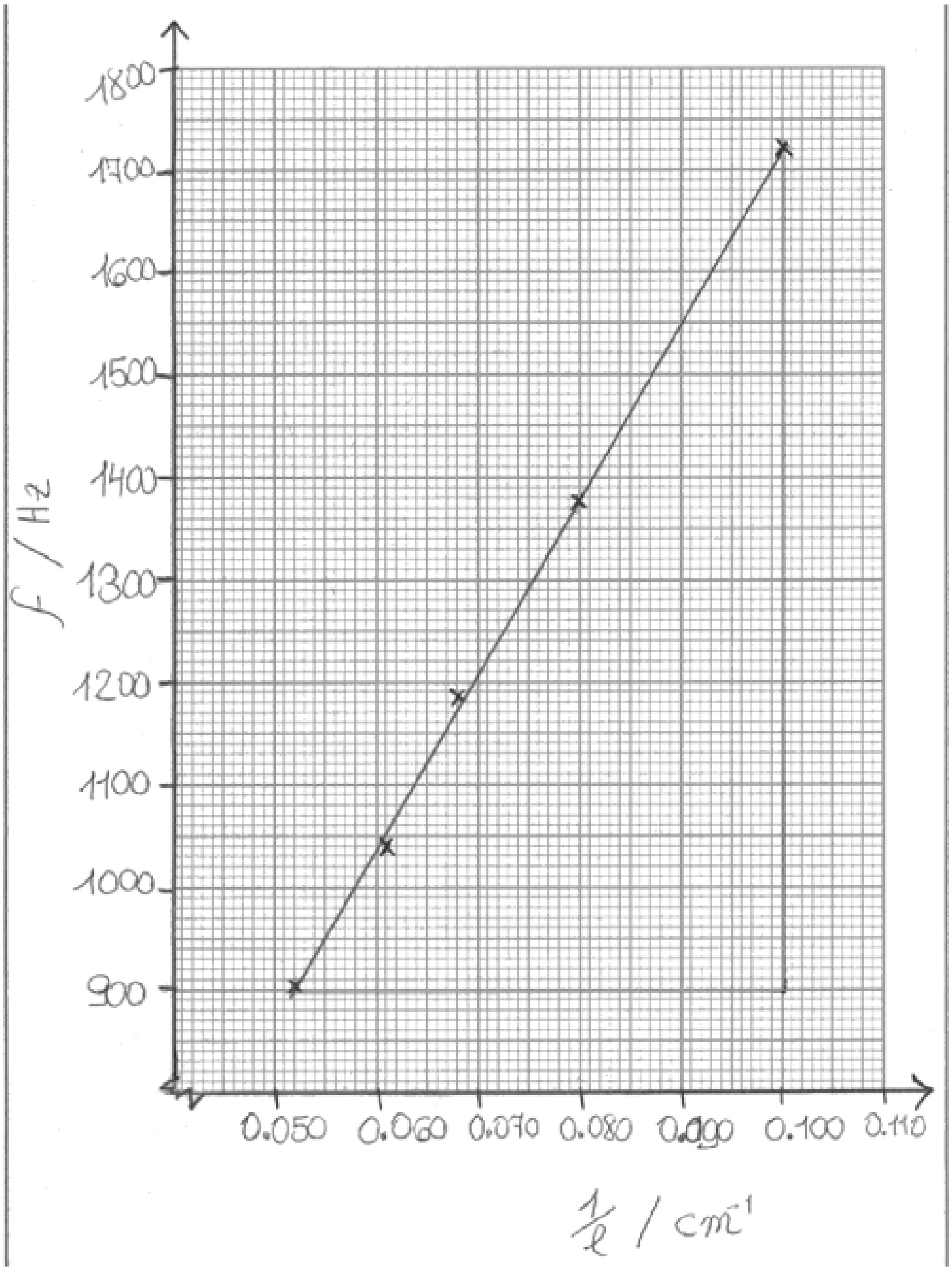
8(e)

Many candidates used their gradient value properly and gave the speed with a matching unit to an appropriate number of significant figures. When they incorrectly used a data pair from the table, rather than the gradient value, they often went on to compound this error by giving too many significant figures or omitting the unit.

8(f)

This was answered very well and many responses included an appropriate reason for the difference.

This was a good answer.



$$\frac{1719 - 900}{0.100 - 0.052} = \frac{819}{0.048} \approx 17062.5$$

Gradient = 17062.5

(e) The equation for the graph is $f = \frac{v}{2l}$. Calculate a value for v.

(3)

gradient $= \frac{v}{2} = 17062.5$ Hz cm

$= 17062.5$ cm/s ≈ 171 m/s

$\therefore v = 2 \times 170.625 \approx 341$ m/s

$v = 341$ ~~171~~ $m\,s^{-1}$

(f) The accepted value for v is 330 m s^{-1}.

Assuming your calculations are correct, suggest why there is a difference between your value for v and the accepted value.

(1)

The speed of sound is affected by the temperature. (The temperature should have been controlled throughout the investigation).

(Total for Question 8 = 16 marks)

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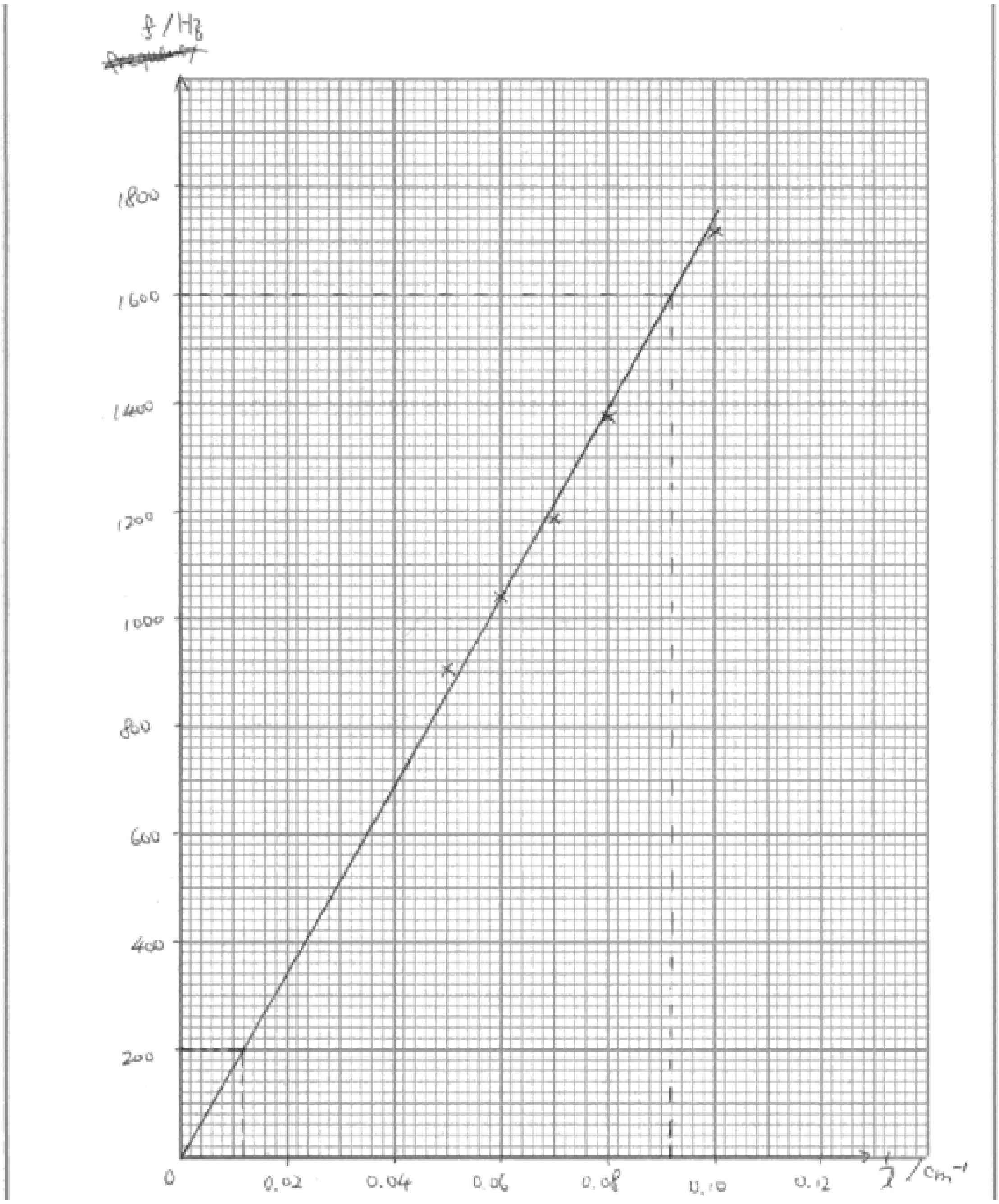
Examiner Comments

All marks were gained.

This candidate showed good appreciation of the difficulties of producing a consistent note.



(3)

Gradient = ~~$\frac{1400-200}{0.88\ 0.08-0.012}$~~ = ~~$\frac{1400-200}{(0.08-0.012)\times10^2}$ = 176.47~~

= $\frac{1600-200}{(0.092-0.012)\times10^2}$ = 175

Gradient = ~~176.47~~ 175

(e) The equation for the graph is $f = \frac{v}{2l}$. Calculate a value for v.

(3)

$f = \frac{v}{2l}$

$2fl = v$

~~$2\times176.47 = v$~~

~~$v = 352.94$ m/s~~

$2\times175 = v$

$v = 350$ m/s

v = ~~352.94 m/s~~ 350 m/s

(f) The accepted value for v is 330 m s^{-1}.

Assuming your calculations are correct, suggest why there is a difference between your value for v and the accepted value.

(1)

Parallax error when measuring l by metre rule

The hole is not fully covered, some air escape from the hole

The rate of blowing is not constant.

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Examiner Comments

Full marks were obtained.

Paper Summary

Some very good answers were seen. These were usually from candidates who organised their answers carefully and related their responses to the specific context of the question set.

Based on their performance on this paper, candidates are offered the following advice:

- Read the question carefully to identify the context.
- Make sure you relate your answer to the context of the question asked.
- Justify the choice of an instrument by referring to the size of the measurement to be taken as well as the scale interval.
- Check that you have included units in your answers.
- Use an appropriate number of significant figures in any numerical answer.
- Use bullet points, where appropriate, in your answer.
- Use scales for graphs which allow plotted points to occupy at least half of the grid.

Grade Boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

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