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Examiners' Report
June 2010

GCE Physics 6PH07

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Introduction

It was pleasing to see a good standard of responses from many candidates, including good use of mathematics and obvious familiarity with the concepts examined. Some candidates misinterpreted the questions, giving stock answers rather than responding to the situation described and the questions asked.

The paper had seven questions and most candidates answered all seven within the time allowed.

The space given for question responses is an indication of the length of the expected answers: candidates should try to write within the space provided.

The multiple choice questions 1-3 caused few problems and were genrally well answered.

This report will provide exemplification of candidates' work, together with tips and/or comments, for a selection of questions. The exemplification will come mainly from questions which required more complex responses from candidates.

Question 4

This question asked candidates to discuss advantages and disadvantages of two methods of measuring temperatures of a cooling liquid.

Answers to this question were often long and unstructured. Few answers mentioned power supplies or portability, many concentrated on errors.

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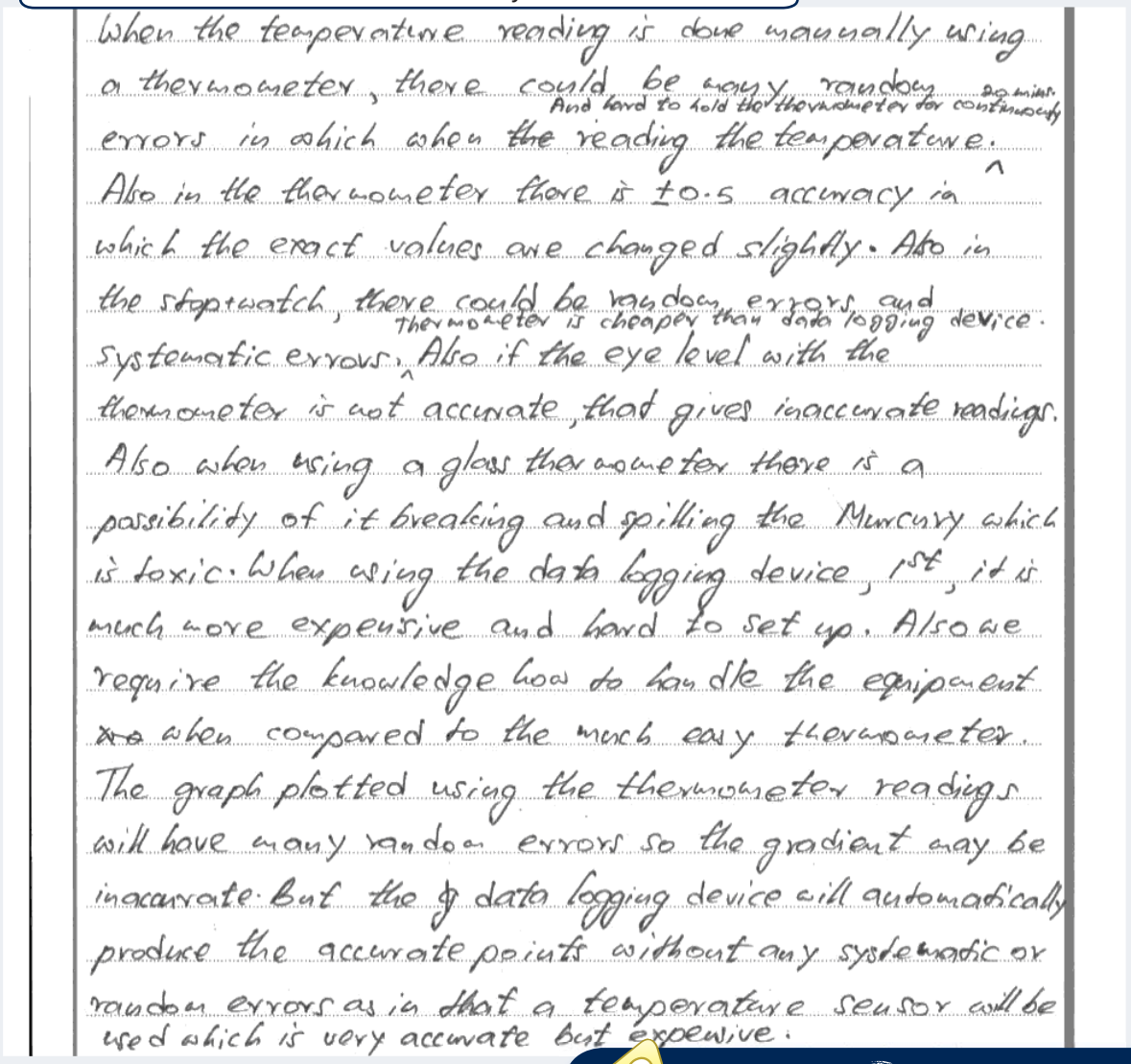
Examiner Comments

This is a typical answer which got full marks. It could have been written in brief and a more structured way.



When the temperature reading is done manually using a thermometer, there could be many random errors in which when the reading the temperature. (And hard to hold the thermometer for continuously 20 mins.) Also in the thermometer there is ±0.5 accuracy in which the exact values are changed slightly. Also in the stopwatch, there could be random errors and systematic errors. (Thermometer is cheaper than data logging device.) Also if the eye level with the thermometer is not accurate, that gives inaccurate readings. Also when using a glass thermometer there is a possibility of it breaking and spilling the Mercury which is toxic. When using the data logging device, 1st, it is much more expensive and hard to set up. Also we require the knowledge how to handle the equipment ~~to~~ when compared to the much easy thermometer. The graph plotted using the thermometer readings will have many random errors so the gradient may be inaccurate. But the data logging device will automatically produce the accurate points without any systematic or random errors as in that a temperature sensor will be used which is very accurate but expensive.

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Examiner Tip

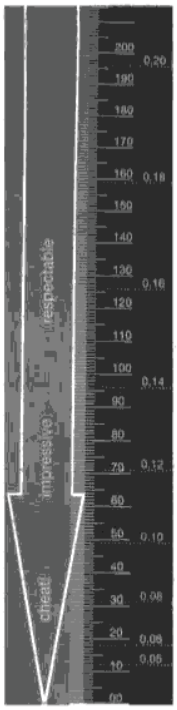
Try to structure your answer carefully. Consider using bullet points and headings.

Question 5(a)

Question 5 concerned a ruler used to measure reaction time. Some candidates suggested a different method rather than addressing their comments to the situation described.

Stronger candidates used two parameters to calculate a third, and then stated clearly that this calculated value agreed with the known value.

5 As part of its marketing, a physics department designed a small cardboard device, rather like a rule, which can be used to measure reaction time. The timer has been marked with distance in millimetres and a number of corresponding times in seconds.



not to scale

The instructions for use are as follows:

Get a partner to hold the timer at the top. Hold your finger and thumb at the bottom edge – keep them slightly apart so that the timer can fall. When your partner lets go, catch the timer as quickly as you can. Then read your reaction time from the scale.

(a) For one pair of readings for distance and time, use an appropriate equation of motion to show that the values are consistent with each other.

(3)

$s = 196\ mm = 0.196\ m \qquad t = 0.205$

Find s using $t = (0.20)$

$s = ut + \frac{1}{2}at^2$

$s = 0 \times 0.20 + \frac{1}{2} \times 9.8 \times (0.20)^2$

$s = 0.196\ m$.

∴ values are consistent.

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Examiner Comments

This is a well presented answer which makes it clear which equation is being used and that u = 0

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Examiner Tip

Set out your answer clearly as this candidate has done.

Question 5(b)

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Examiner Comments

This is a clear answer which shows the candidate has understood how to use the ruler. Three separate points are made.

(b) State the precautions you would take to ensure that measurements of your reaction time are as accurate as possible.

(3)

Make sure that the rule is vertical before letting go.
Make sure the eyes of observer is at level with the rule when ~~taking the~~ readings the ~~of~~ scale
Repeat the experiment and calculate the average reaction time.

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Examiner Tip

Check the number of marks and try to make that number of points.

Question 5(c)

Not all candidates realised that one result was anomalous and should be discarded.

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Examiner Comments

Repeating results is one way of identifying anomalous results.
The candidate has correctly given the absolute uncertainty.

(c) The reaction times for one student are: 0.20, 0.18, 0.19 and 0.08 s.

Calculate the best mean value of his reaction time and state it with a suitable uncertainty.

(2)

Best mean value = $\frac{0.20 + 0.18 + 0.19}{3}$

= 0.19 s ± 0.01 s

Reaction time = 0.19 ± s

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Examiner Tip

Do not include anomalous results in averages.

Question 6(a)-(c)(ii)

Question 6 presented the candidates with results from a standard resistivity experiment.

This candidate has set the answer out very clearly.

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Examiner Comments

In part (c) (i), candidates often gained only one mark because they did not state that rho/A was a constant.

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Examiner Tip

Always check that you have converted units millimetres to metres correctly.
Make sure you know the equation for the area of a circle.

6 In an experiment to find the resistivity ρ of a metal, a student measures the diameter of a wire using a micrometer. She measures it as 0.12 mm.

(a) Calculate the cross-sectional area A of the wire.

(1)

Cross sectional area $= \pi r^2$

$= \pi \left(\frac{0.12}{2} \times 10^{-3} \right)^2$

Area = $1.1 \times 10^{-8}\ m^2$

(b) She varies the length of wire which she measures using a metre rule. For each length l she measures the resistance R using an ohmmeter. The shortest length she uses is 100 mm.
Justify the choice of the metre rule.

(1)

The least count of a metre rule is 1 mm, hence the choice of the metre rule is suitable.

(c) She then plots a graph of R against l.

(i) Explain why this graph should be a straight line using the equation $R = \rho l/A$.

(2)

$R = \left(\frac{\rho}{A} \right) \times l$

$y = m \times x$

Since resistivity and cross sectional area are constants and resistance and length are variables, the graph is a straight line.

(ii) Her value for the gradient, $\Delta R/\Delta l$, of this graph is 41.9 $\Omega\ m^{-1}$.

Calculate the resistivity of the wire.

(3)

gradient $= \frac{\rho}{A}$

$41.9 = \frac{\rho}{1.1 \times 10^{-8}}$

Resistivity of wire = $4.7 \times 10^{-7}\ \Omega m$

Question 6(d)

This part of the question was about experimental uncertainty. Some candidates gave answers which addressed precision rather than sources of uncertainty.

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Examiner Comments

The candidate has understood the practical situation and identifies two sources of uncertainty clearly.

(d) Identify **two** main sources of uncertainty in this experiment.

(2)

There can be a zero error in the micrometer

The wire can be kinked or bend not straighten

Temperature is difficult to keep constant

(when the temperature increases resistance also increases.

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Examiner Tip

Don't confuse uncertainty and precision.

Question 7(a)-(b)

Candidates were presented with data from an optics experiment and were asked to comment on them.

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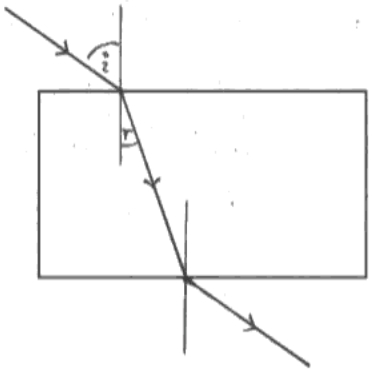
Examiner Comments

The space for part(b), was an indication of the length of answer expected. This is a good answer which includes all the steps.

7 When a ray of light is incident on a rectangular glass block it refracts and emerges at the far side. This can be used to find the refractive index from air to glass.



(a) Add lines to the diagram above to show how the ray will pass through the block and emerge at the opposite side. You should show the refraction at both sides. Label the angle of incidence *i* and angle of refraction *r* on the first side where the light enters the block.

(2)

(b) It is possible to do this experiment by placing the block on a sheet of paper and shining a ray of light through the block. Describe how you would draw the path of the ray through the glass block. You may add to the diagram if you wish.

(2)

First keep the glass block and draw the outline of it by a pencil. Then place the ~~light~~ ray of light and draw the incident ray and the emergent ray by a pencil. Then remove the glass block and connect the two ends of the incident ray and emergent ray

ResultsPlus
Examiner Tip

Try to keep your answers short and to the point.

Question 7(c)

Question 7(d)-(f)

Candidates demonstrated good graph plotting technique in this question.

Candidates commented sensibly on the results, but often missed the fact that you can take readings at the second face.

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Examiner Comments

This is an excellent answer and shows the use of the graph to find the gradient. The candidate has realised that, the answer should only be given to two significant figures.

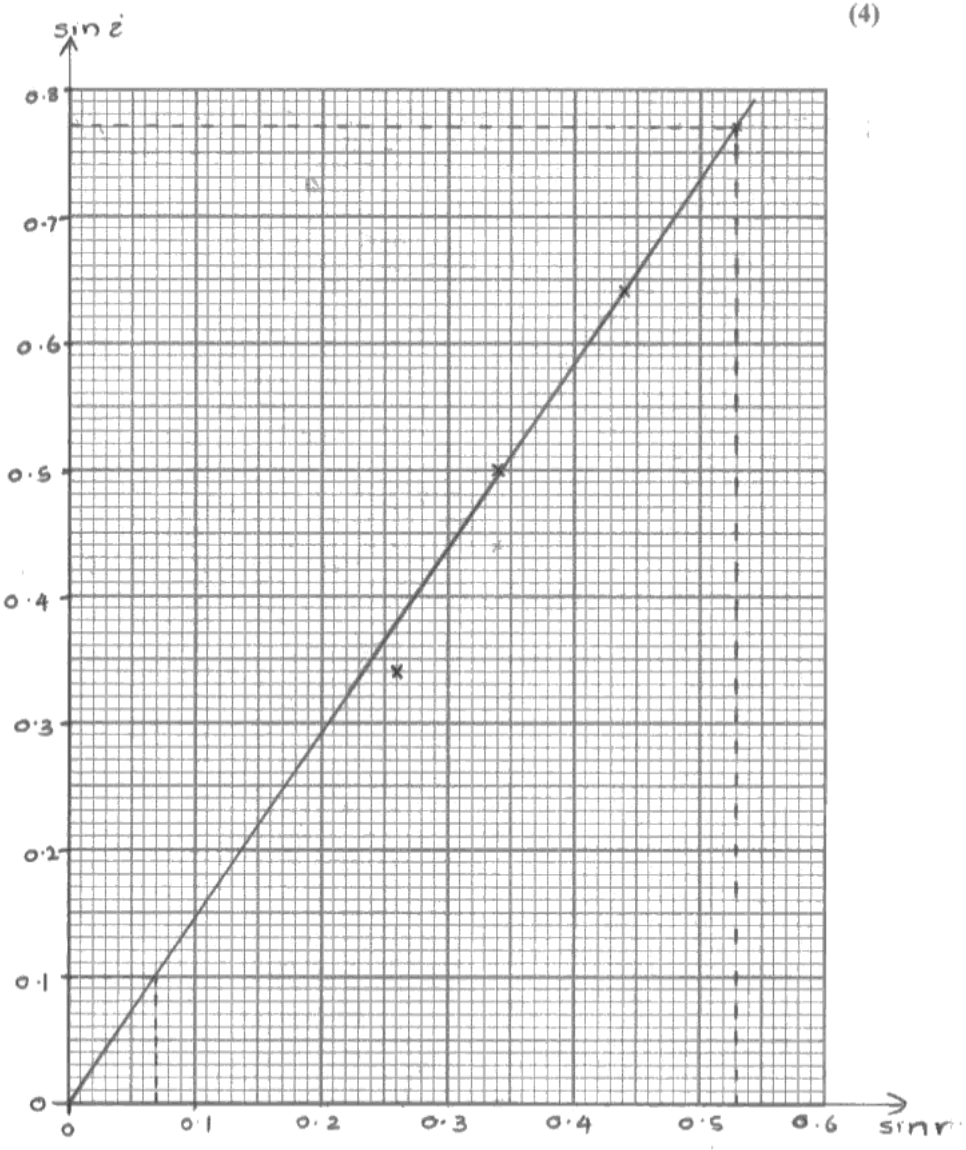
ResultsPlus
Examiner Tip

Remember to draw the triangle that you use for your gradient.
Remember to check that you have used a sensible number of significant figures in your final answer.

i/°	20	30	40	50
r/°	15	20	26	32
sin i	0·34	0·50	0·64	0·77
sin r	0·26	0·34	0·44	0·53

(d) Complete the table, then plot the values of sin i on the y axis against sin r on the x axis on the grid below. Start both scales at zero.

(4)



(e) Draw a line of best fit on your graph and explain why you think it should or should not go through the origin.

(2)

* it should go through the origin.
* Because when the angle of incidence in 0°, angle of refraction is also 0°
* ∴ sin 0° = 0

(f) Use your graph to determine the refractive index from air to glass.

(2)

refractive index = gradient of the graph.

$$= \frac{0.77 - 0.10}{0.53 - 0.07}$$

$$= 1.46 \approx 1.5$$

Refractive index = ...

There were some very good papers which demonstrated good understanding of practical physics.

Grade boundaries

Grade	Max. Mark	A	B	C	D	E	N
Raw boundary mark	40	26	22	18	15	12	9

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