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Examiners' Report
June 2013

GCSE Physics 5PH3F 01

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June 2013

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Introduction

This was the first examination of the third unit of the new specification. The unit was divided into five topics and all five topics were tested in the examination.

The topics were:

- Radiation in treatment and medicine
- X-rays and ECGs
- Production,uses and risks of ionising radiation from radioactive sources
- Motion of particles
- Kinetic theory and gases.

It was intended that the examination paper would allow every candidate to show what they knew, understood and were able to do. To achieve this, each question increased in difficulty as the questions progressed. Within the question paper, a variety of question types were included, such as objective questions, short answer questions worth one or two marks each and two longer questions worth three marks each. The two six mark questions were used to test quality of written communication (QWC).

It was encouraging to note the positive way in which the vast majority of candidates approached the paper.

Successful candidates were:

- well grounded in the fundamental knowledge required
- willing to think, use their knowledge to solve new problems and apply their knowledge to unfamiliar situations
- able to analyse and interpret data in graphical form
- able to tackle calculations methodically and show the stages in their working
- able to construct their explanations in a logical order, using the marks at the side of the questions as a guide.

Less successful candidates:

- had gaps in their knowledge
- found difficulty in applying their knowledge to new situations
- found difficulty in analysing and interpreting data in graphical form
- did not think through their answers before writing.

The quality of written communication was generally appropriate to the level of response.

When it was not, the mark within that level was reduced, if possible.

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.

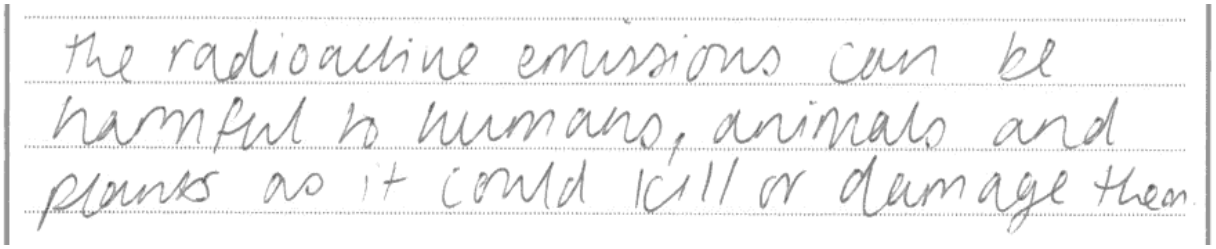
Question 1 (b) (i-ii)

Many candidates showed a lack of understanding of the terms 'mass number' and 'atomic number' and many mixed the answers up to this question. A number of candidates failed to recognise that the alpha particle was leaving the radium and added 2 or 4 to the mass/ atomic number as if the alpha particle was joining the radium nucleus.

Question 1 (c)

Most of the candidates were able to get 2 marks for referring to 'mutates' and linking this with cells. This was a very well answered question with only a few getting one mark or less.

Other common correct answers included 'damages cell' and 'cancer.'



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Examiner Comments

This answer is too general. It does not refer to cells and the changes which ionisation can cause.

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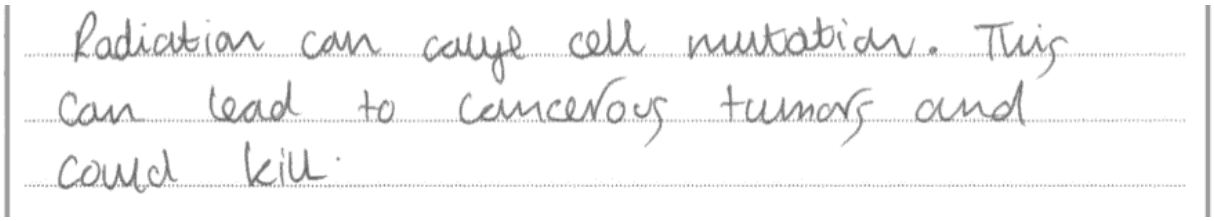
Examiner Tip

Ask yourself, 'Does my answer include the physics I know?'



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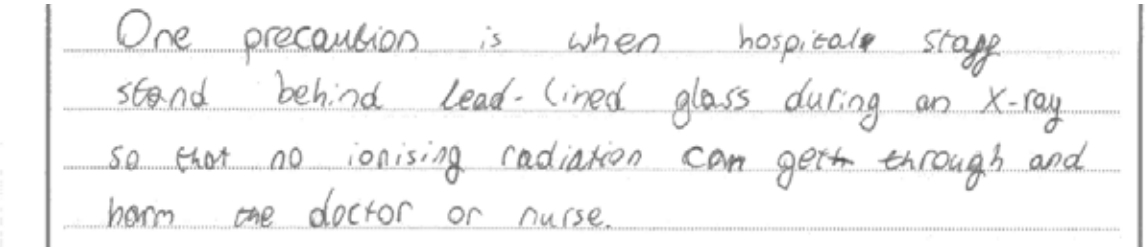
Examiner Comments

This answer gains the two marks for the first line. The reference to cancerous tumours confirms the understanding.

Question 1 (d)

Most candidates showed knowledge of the precautions used in hospitals despite using 'colloquial' rather than technical descriptions. Common stated precautions were 'use lead/ screen/shield monitor' etc (for one mark), but some found it hard to link the precaution with the right reason. Those that mentioned lead or monitor as precaution often got the reason right, while those that gave other precautions for example 'doctor leaves the room' usually did not.


One precaution is when hospital staff stand behind lead-lined glass during an X-ray so that no ionising radiation can get through and harm the doctor or nurse.

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Examiner Comments

This answer states the precaution and then goes on to explain that no ionising radiation can get through to the person taking the X-ray. It would be even better to add that the 'lead lined' glass absorbs the radiation.

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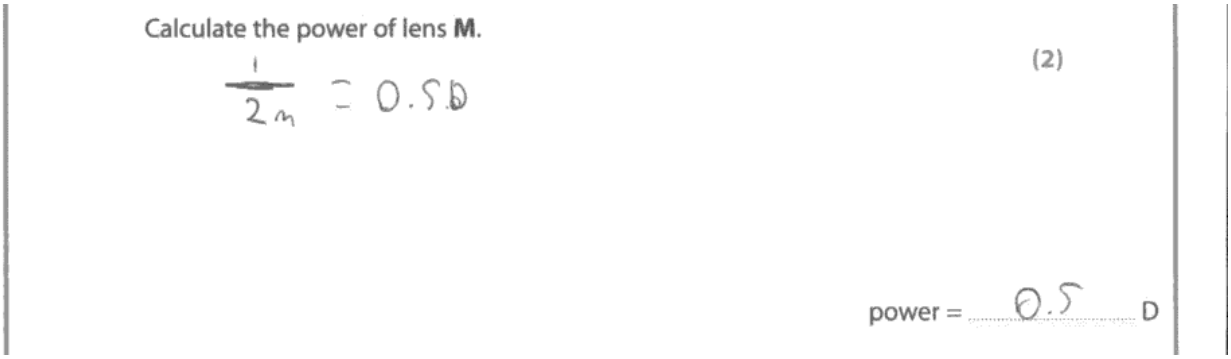
Examiner Tip

Note the important word 'explain' and the total of two marks. This should guide you to giving a good answer.

Question 2 (a) (ii)

Generally this question was answered correctly. Most candidates could select the correct formula and substitute in the focal length. Errors occurred when candidates converted metres into centimetres or millimetres and then substituted this into the correct equation. A number of students calculated ½ to be 2 or 1.


Calculate the power of lens **M**.

$\frac{1}{2m} = 0.5D$

(2)

power = 0.5 D

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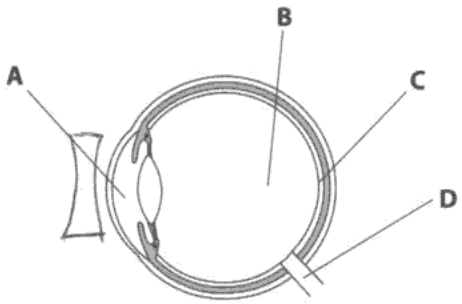
Examiner Comments

This is a correct answer.

Notice that this candidate has included units in the working which may help in this particular question, but is not essential.

Question 2 (b) (ii)

Many correct responses were given to this question, but a number of candidates placed the lens inside the eye. Some lenses were poorly drawn, making their shape unclear. Some candidates even drew both concave and convex lenses.



(i) The eye will form an image of a distant object.

Which letter shows where the image will form for the short sighted eye?

Put a cross (☒) in the box next to your answer.

(1)

☒ A

☒ B

☒ C

☒ D

(ii) Draw on the diagram a diverging lens in a position which would correct the short sightedness.

(1)

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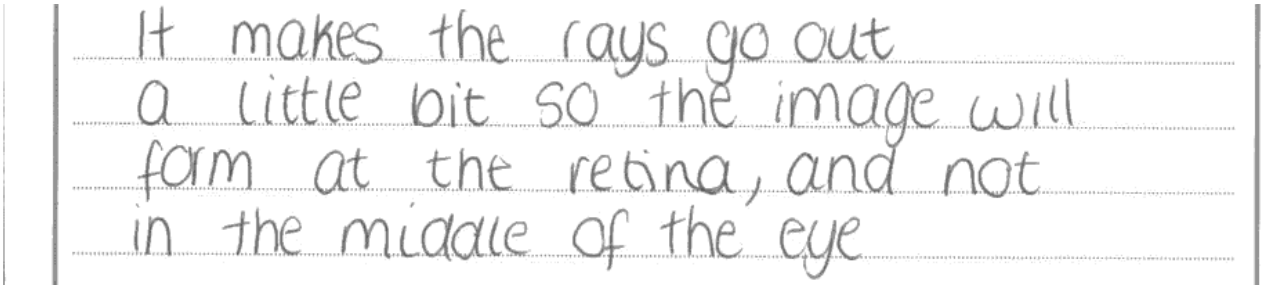
Examiner Comments

This candidate has drawn the lens clearly and in the right place.

Question 2 (b) (iii)

This question showed misuse of key scientific terms such as 'focus', 'image', 'focal point'. Most candidates scored at least one mark usually for recognising that the image needs to be formed on the retina. Many students simply repeated 'diverge light' without demonstrating that they know what the diverging lens does.



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Examiner Comments

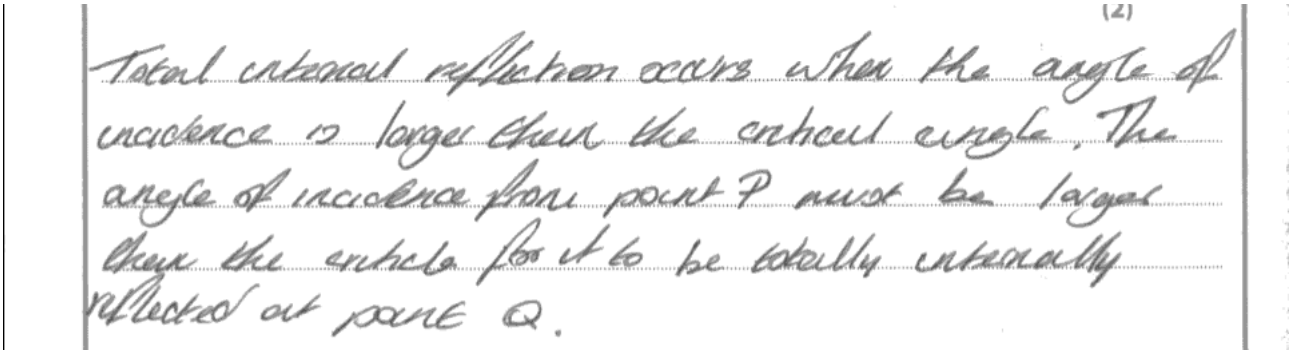
This answer shows an understanding of 'diverging' and also the change that this will make on where the image is formed.

Question 2 (b) (iv)

Generally this question was well answered with laser eye surgery being the most common response even though this is a requirement for higher tier rather than foundation. Some candidates lost the mark for imprecise answers – for example just writing 'wear lenses' instead of contact lenses or referring to 'eye surgery' rather than 'laser eye surgery'.

Question 3 (a) (i)

In general, responses to this question were very limited. Most students described how the image was 'flipped' or how the rays 'bounce off' but without recognising that the question was asking them to refer to the critical angle to explain why total internal reflection occurs. Where candidates did mention the critical angle there was often not a clear understanding of what this meant.


(2)
Total internal reflection occurs when the angle of incidence is larger than the critical angle. The angle of incidence from point P must be larger than the critical for it to be totally internally reflected at point Q.

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Examiner Comments

This answer compares the angle of incidence in the prism to the critical angle in a correct way.

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Examiner Tip

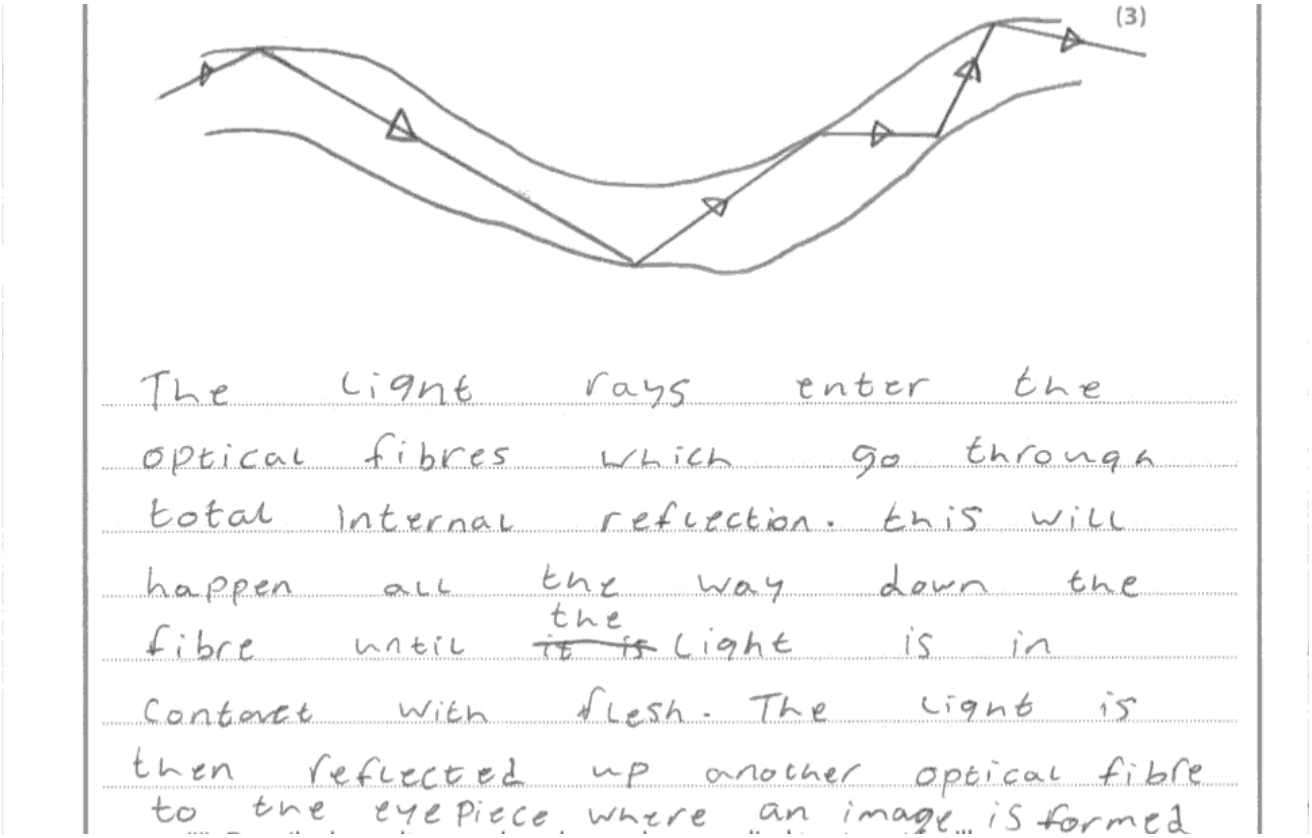
Read the question carefully to make sure that you are answering the question actually asked.

Question 3 (a) (ii)

Only a relatively small proportion of the candidates were able to label both angles correctly for 2 marks. Candidates usually realised that angle i was in air and angle r was in glass. A number of candidates did not attempt this question.

Question 3 (b) (i)

Many candidates showed that they had an idea of what an endoscope was often by drawing a simple diagram of it. Those who included a diagram generally did better than those who did not. Many responses noted the fact that light is sent into the body and that the image is sent back out, but failed to explain that this occurs in two separate fibres or that the light reflects off the target organ within the body. Not many gained the possible mark for explaining that the endoscopes are flexible/bend easily. There were five marking points and so many candidates gained at least two marks.



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Examiner Comments

Even though it reads as if it is the optical fibres rather than the light rays which undergo total internal reflection, this answer has still met at least three of the marking points. The question does suggest drawing a labelled diagram and this diagram on its own could have gained two or three marks if it had been well labelled.

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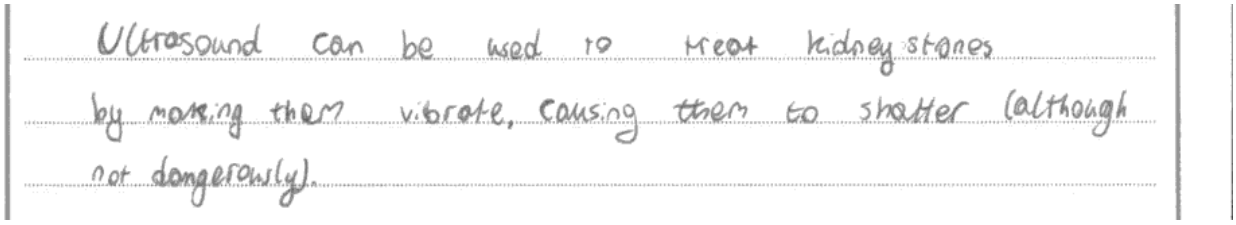
Examiner Tip

Drawing a good diagram can often help you organise your written answer.

Question 3 (b) (ii)

The majority of candidates gave the expected answer of 'blasts kidney stones' often with more detail and gained the two marks. Some responses referred only to diagnostics rather than treatment. Some of these gained a mark for a 'suitable' diagnosis eg a prenatal scan, however others were far too vague noting only 'see things in the body' or 'see where the problem is'.



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Examiner Comments

This answer has both marking points.

Question 4 (a) (i)

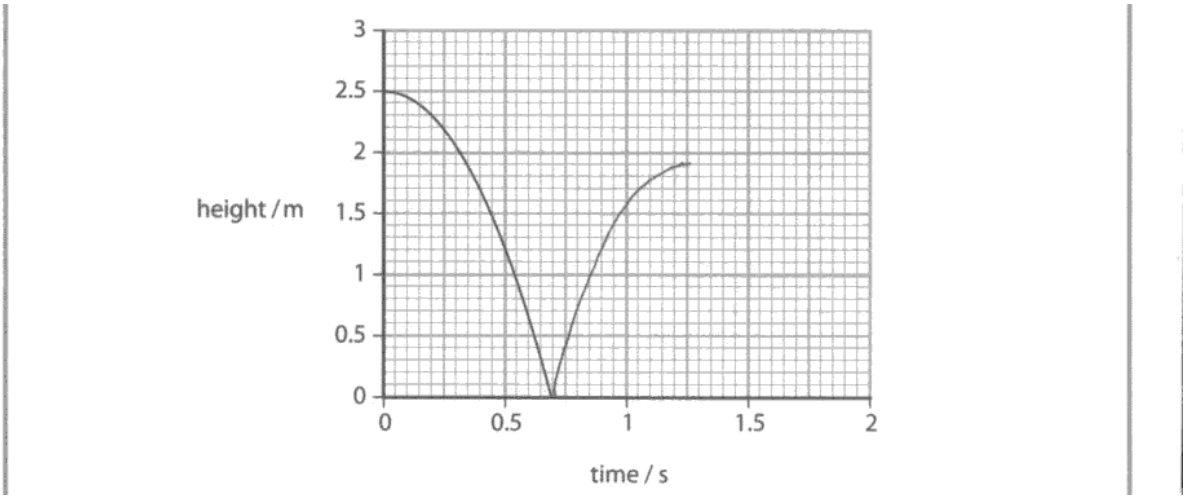
Most candidates successfully read the intercept of the line with the y-axis to give the starting height of 2.5m.

Question 4 (a) (ii)

Most candidates successfully read the intercept on the x axis to give the time taken for the ball to reach the ground as 0.7s.

Question 4 (a) (iii)

Most responses included a curved line replicating the shape of the original. Several responses showed a vertical line with a peak at 1.9m, for which one mark was awarded ('no time at all') does not fall into the category of taking less time than 0.7s for the third marking point). Some responses showed the ball travelling back in time with a line going back towards the Y axis. Most responses gained at least two marks and the failure to gain three marks was often down to drawing a straight line which was otherwise correct.



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Examiner Comments

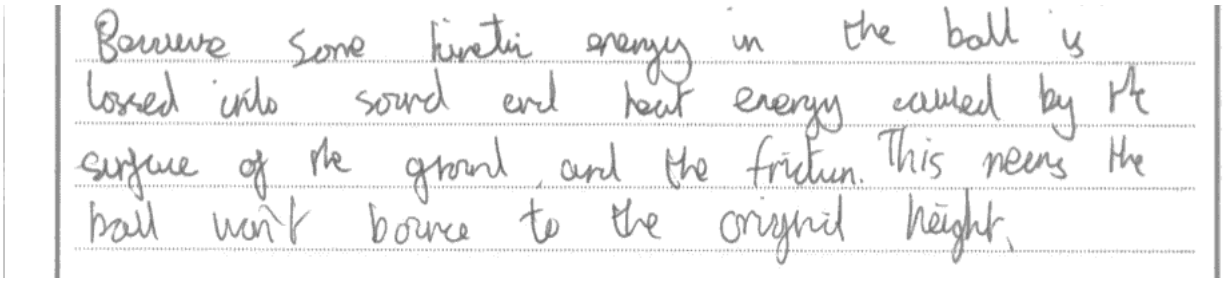
All three marking points are clear in this answer. The graph line peaks at 1.9m, takes less than 0.7s from the bounce and shows a correct curve.

Question 4 (a) (iv)

Many candidates noted loss of energy 'in the bounce' which clearly meant 'in the collision'.

Very few candidates adopted the air resistance route although a number correctly discussed the loss as sound/heat.

A number of responses showed lack of subject understanding by referring to there being more gravity pulling the ball down after the bounce, or implying that the man had thrown the ball to the ground (additional force) rather than just dropping it.


Because some kinetic energy in the ball is lossed into sound and heat energy caused by the surface of the ground and the friction. This means the ball won't bounce to the original height.

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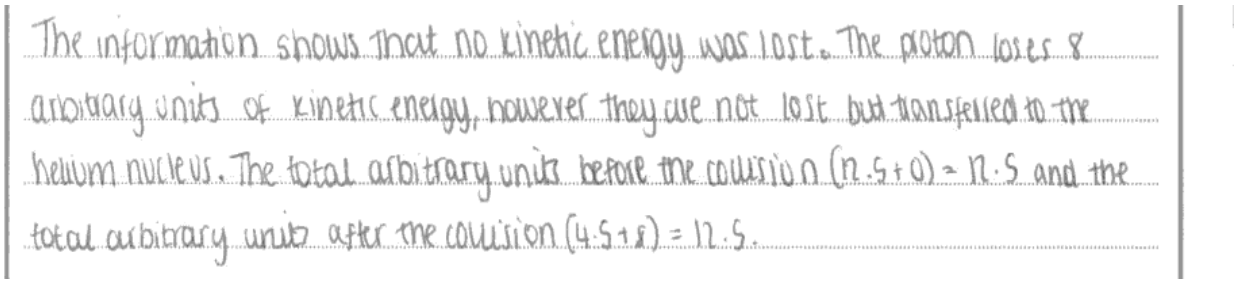
Examiner Comments

This answer has the idea of the ball losing energy when it hits the ground. In addition the energy loss appears as heat and sound. 2 marks were awarded.

Question 4 (b) (i)

Only a small number of candidates used the data given to justify why the collision was elastic and so few gained full marks for this question. A number gained a mark for a comment about kinetic energy being conserved.

There were a number of references to 'p' and 'He' moving in opposite directions (‘bouncing’ off each other misinterpreted as ‘elastic’) after the collision and these comments on their own would not gain marks. Some students used the information in the table but only to simply restate the values without drawing any conclusion or noting that the total kinetic energy before and after the collision was equal and this too does not gain credit.


The information shows that no kinetic energy was lost. The proton loses 8 arbitrary units of kinetic energy, however they are not lost but transferred to the helium nucleus. The total arbitrary units before the collision (12.5 + 0) = 12.5 and the total arbitrary units after the collision (4.5 + 8) = 12.5.

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Examiner Comments

This answer uses the data from the table to explain that kinetic energy before the collision is equal to the total after the collision and gains both available marks.

ResultsPlus
Examiner Tip

Make sure that you address the question. In this case the question states use the information from the table.

Question 4 (b) (ii)

A good number of candidates gained the mark here usually for Hadron Collider (LHC) or cyclotron. Inadequate reponses included 'Particle accelerator'. Some wrote 'Proton accelerator' which simply restates the question. There were a number of guesses, including catalyst and magnet.

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Examiner Comments

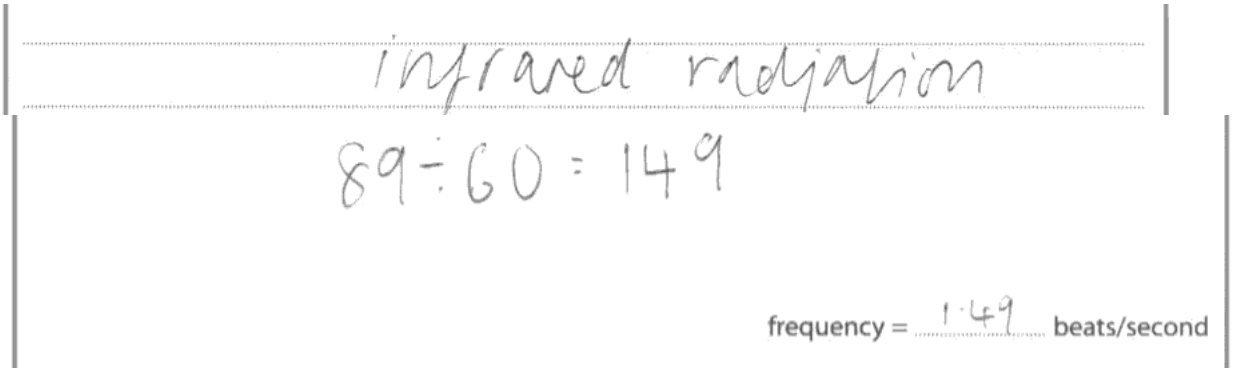
This is correct.

Question 5 (a) (ii-iii)

Surprisingly, there were lots of incorrect responses for this first part; candidates gave names of any particle they could think of such as alpha or beta. About half gave the correct answer of infra-red.

In part (iii), full marks were awarded for the correct answer without working. If the correct answer was not obtained then a mark could be gained for the working if clearly shown.

Some candidates gave incorrect numerical values such as 1/89, 1/60 and 89 x 60. In other cases candidates lost a mark for incorrect rounding of numbers.



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Examiner Comments

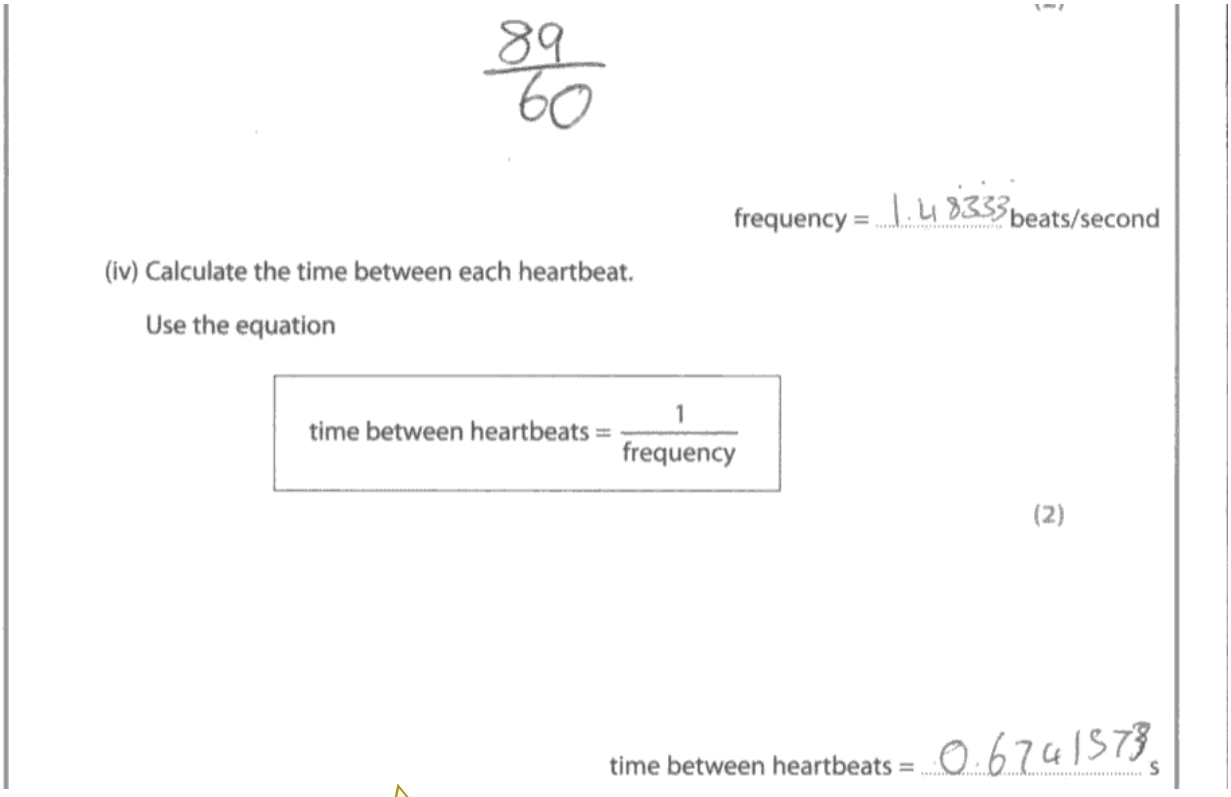
1.49 gains 2 marks.

Question 5 (a) (iv)

Full marks were awarded for the correct answer without working.

If the correct answer was not obtained then a mark could be gained for the working if clearly shown.

If the answer to part a (iii) was incorrect, but then used correctly in part (iv) full marks could be gained (called error carried forward).



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Examiner Comments

Here are two correct answers.

$\frac{1}{89} = 0.011$ (3dp)

frequency = 0.011 beats/second

(iv) Calculate the time between each heartbeat.

Use the equation

$$\text{time between heartbeats} = \frac{1}{\text{frequency}}$$

(2)

$\frac{1}{0.011} = 90.9$ (1dp)

time between heartbeats = 90.9 s

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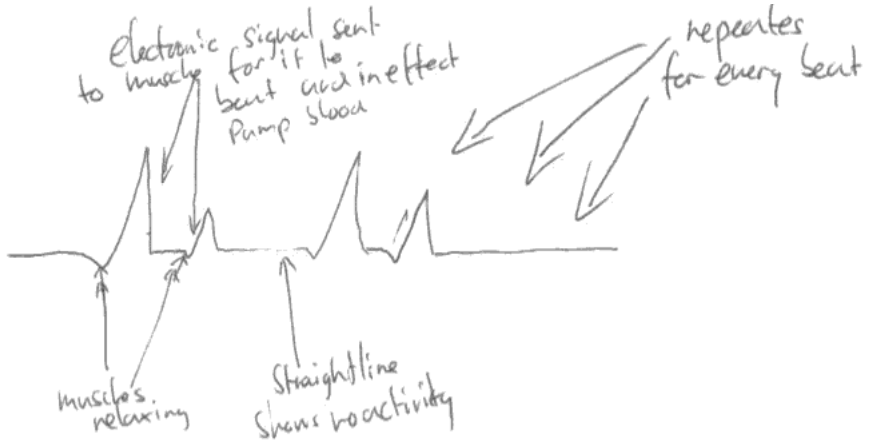
Examiner Comments

This is an example of error carried forward. This candidate gained the full two marks for part iv.

Question 5 (b)

A number of candidates confused the oximeter with the ECG machine. In many cases, the detail within responses focussed mainly on action of heart rather than the role of the ECG machine. Few responses linked the two electrical signals (some mentioned electrical signals or action potentials in the heart but without linking to the ECG machine, some mentioned the fact that the ECG machine detects electrical signals but without linking this to the heart action.) Diagrams aided responses in most cases, although labelling was often limited. There were however some excellent responses.

(6)



The ECG machine is used to monitor a persons heart and how efficiently it is beating. Electrods are attached to pads which are placed on the persons chest. These pads lead to the ECG machine which leads to a monitor. Every heartth time the heart beats it is shown on the monitor as a wavey line. The up parts are when the hearts beats and the slightly down parts are when the part of the heart is relaxing. When the line is straight there is no activity in the heart and it is either resting between each beat or not beating at all. If this straight line goes on for to long an alarm will sound for assistance to the person. The time between each beat is recorded by the machine to show heart problems.

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Examiner Comments

A good answer focussing on an electrical input, a monitor for the output and some correct detail regarding the action of the heart related to output. The diagram may well have focussed the candidate into thinking about the answer. With a few more carefully chosen labels it might have gained a level 2 score on its own. In this case the writing alone gains level 3.

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Examiner Tip

Notice how this candidate has underlined important parts in the question. You might also underline 'describe' and 'ECG machine.'

Question 6 (a) (i)

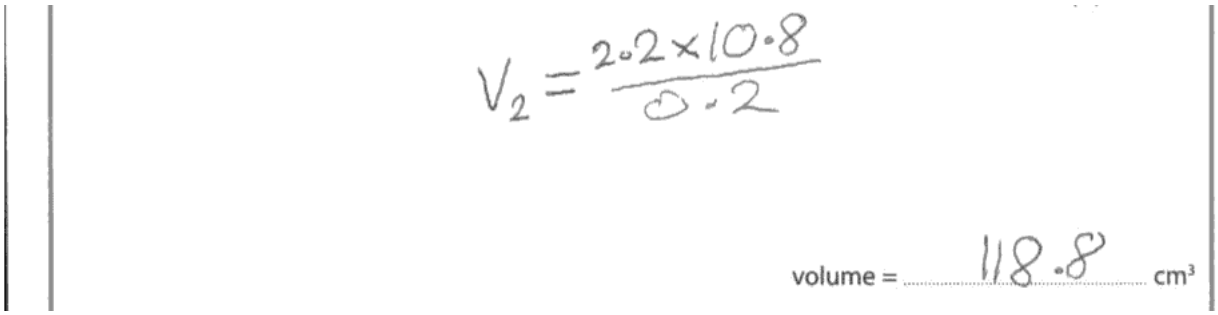
Generally this question was well answered with most candidates scoring 2 marks for putting readings (within the correct ranges) into the table.

Question 6 (a) (iii)

Only a small proportion of candidates seemed to be able to score on this part by extending the graph line on and reading off the required estimated value for volume or by carrying out a calculation.

Question 6 (a) (iv)

Generally there were poor responses to this question, with candidates not recognising that they just needed to substitute in data from the question. Many students used the value of P1 for both P1 and P2, giving 10.8 and did not recognise that the pressure must have changed. Another common error was to add P1 and V1 instead of multiplying, showing a lack of understanding of the algebra needed for this question.



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Examiner Comments

This is a correct answer together with working shown.

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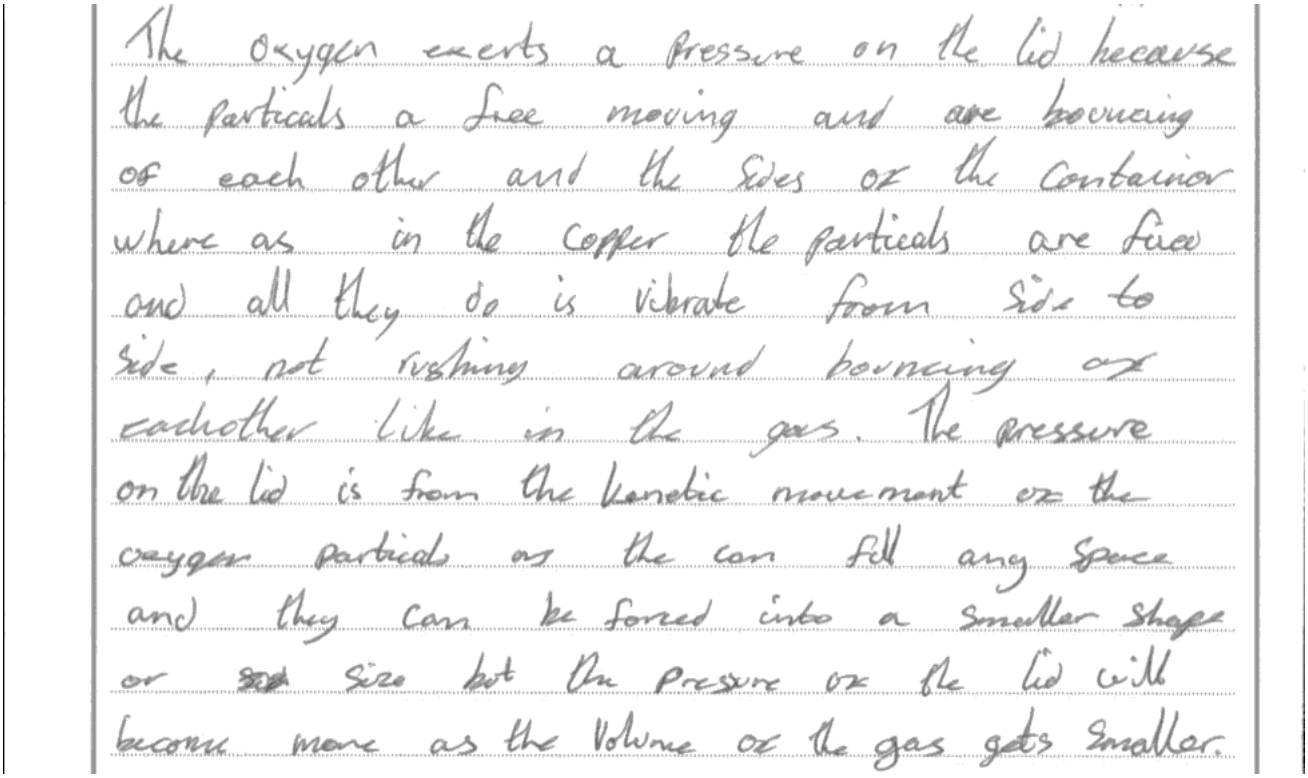
Examiner Tip

It is wise to show your working. Not only might this guide you to the correct answer, but you might gain a mark for the working even if you do not carry out the calculation correctly.

Question 6 (b)

Most candidates attempted this six mark question whereas there were more gaps for Q5b. The general idea that solids could not move while gases could move came across, but the question does emphasise in terms of 'kinetic theory'. A few of the candidates did not link the movement of gases with collisions, hence staying in level 1. A large number of candidates gained four marks for answering in terms of the gas. There were some excellent responses which discussed both the gas and the solid in terms of particles.

General **misconceptions** included the idea that particles in gases have no forces of attraction and/or that particles in solids do not have any kinetic energy.


The oxygen exerts a pressure on the lid because the particals a free moving and are bouncing of each other and the sides of the container where as in the copper the particals are fixed and all they do is vibrate from side to side, not rushing around bouncing of eachother like in the gas. The pressure on the lid is from the kinetic movement of the oxygen particals as the can fill any space and they can be forced into a smaller shape or size but the pressure of the lid will become more as the volume of the gas gets smaller.

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Examiner Comments

A good answer focussing on comparing the movement of particles in the oxygen and those in the copper and realising the importance of collisions with the lid.

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Examiner Tip

Again the advice is to underline important words in the question such as 'explain', 'kinetic theory', 'pressure on the lid'.

Paper Summary

In order to improve their performance candidates should:

- make sure that they have a sound knowledge of the fundamental ideas in all five topics
- get used to the idea of applying their knowledge to new situations by attempting questions in support materials or previous examination papers
- show their working at each stage of a calculation
- use the marks at the side of a question as a guide to the form and content of their answer
- use diagrams to help them to structure their answers, for example in Q3bi
- read the question carefully and underline the key words, for example in Q5b 'Describe how a doctor can use an ECG machine to collect **and** display information from a person's beating heart in order to check heart action'.

Grade Boundaries

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