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Examiners' Report
June 2016

GCSE Physics 5PH3F 01

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June 2016

Publications Code 5PH3F_01_1606_ER

Introduction

This examination aims to allow students to demonstrate that they can accurately recall concepts and phenomena in physics and can communicate their understanding using both qualitative and quantitative models. The specification uses physical principles and links these to medical applications.

The assessment is through multiple choice questions, short answers, extended writing, calculations and analysis. Students need to be able to apply mathematical skills, express their ideas clearly and concisely and interpret scientific data which is presented in a variety of ways.

The work produced for the examination showed that some students lack confidence in their use of mathematical models. Many students were able to demonstrate their understanding of the main features of the shape of an electro-cardiogram trace but only a few could use data to determine a heart rate. Many candidates knew about the precautions that are necessary to maintain the safety of radiographers and patients and explained why these precautions are necessary. The use of total internal reflection to pass light through an optical fire was also well understood and many candidates provided diagrams to illustrate this phenomenon. However, simple reflection from a plane mirror was less well described or drawn. Some candidates were able to show or explain that the angle of incidence was equal to the angle of reflection but very few mentioned a virtual image or lateral inversion even though this was evident in the photograph used for this question.

Students need to be aware that the gas laws relate to temperatures measured in Kelvin and that all Celcius values of temperature must be converted to Kelvin before putting values into an equation. There is confusion concerning radioactive emissions with some candidates mistakenly thinking that it is the alpha and beta particles that emit radiation rather than that these particles are the radioactivity that is emitted by radioactive sources. Also the majority of candidates were unaware that radioactive emissions of alpha and beta are accompanied by the emission of gamma radiation so that the nucleus can return to a stable state.

It is important that students are able to interpret diagrams and charts and add correctly to them. Surprisingly few candidates were able to determine the correct angle for refraction of a ray of light passing from glass into air and very few were able to show total internal reflection in the semi-circular glass block although they could relate this effect to an optical fibre.

Most students made use of the formulae sheet at the front of the examination paper and were able to quote equations correctly. Although full marks are given to correct answers to calculations, with or without working, it was pleasing to see that most candidates quoted the equation and then completed the substitution. This allowed them to gain marks even if the final answer was not correct . However, the significance of subscripts in the gas law equation was not appreciated by many candidates and as V_2 was quite often written numerically as V^2. All candidates should be equiped with a calculator as this together with a ruler is a requirement for the examination.

Question 1 (a)(i)

The behaviour of particles in the different states of matter is not clearly understood. Candidates should know that this refers to kinetic theory and therefore movement and that all particles regardless of their state are continually in motion. The main misconceptions were that particles in a solid do not move.

Question 1(b)(ii)

This question tested an understanding of a gas law and knowledge of the link between the temperature scales of Celcius and Kelvin. In many cases candidates did not appreciate that calculations using temperature for a gas can only be carried out when the temperature is converted to Kelvin. The Kelvin temperature is proportional to the volume of the gas.

The example shows the correct use of temperature in Kelvin in the calculation, correct substitutions in working giving the correct annswer.

(ii) At this temperature, the volume of air in the balloon is 0.25 m^3.

When the balloon is cooled the volume becomes 0.10 m^3.

Assume that there is no change in pressure.

Calculate the new temperature of the air in the balloon in kelvin.

Use the equation $T_2 = \frac{V_2 T_1}{V_1}$ $T = \frac{293 \times 0.10}{0.25}$ (2)

$T = 117.2$

temperature of the air in the balloon = 117.2 K

ResultsPlus
Examiner Comments

Shows substitution of values in the equation.

ResultsPlus
Examiner Tip

Substituting correctly in an equation by reading carefully the information given makes it much more likely that the evaluation will be correct.

The temperature has not be converted to Kelvin in this example.

(ii) At this temperature, the volume of air in the balloon is 0.25 m^3.

When the balloon is cooled the volume becomes 0.10 m^3.

Assume that there is no change in pressure.

Calculate the new temperature of the air in the balloon in kelvin.

Use the equation $T_2 = \frac{V_2 T_1}{V_1}$

(2)

$V_2 T_1$ $\quad V_1 \longrightarrow 0.25$

0.10

$T_2 = \frac{(0.10 \times 20)}{0.25} = 8$

temperature of the air in the balloon = 8 K

ResultsPlus
Examiner Comments

The substitution is correct for the volumes and one mark was gained for this but the celcius temperature must be converted to Kelvin to get the correct evaluation.

ResultsPlus
Examiner Tip

Remember to convert degrees Celcius to Kelvin before using the gas law equations.

Candidates must realise that the unit of volume is centimetre cubed and that it is not necessary to cube the value for the volume.

(ii) At this temperature, the volume of air in the balloon is 0.25 m^3.

When the balloon is cooled the volume becomes 0.10 m^3.

Assume that there is no change in pressure.

Calculate the new temperature of the air in the balloon in kelvin.

Use the equation $T_2 = \frac{V_2 T_1}{V_1}$

(2)

$\frac{0.25^3}{0.10^3} = 15.625$

temperature of the air in the balloon = 156 K

ResultsPlus
Examiner Comments

Example has not included temperature but volume has been unnecessarily cubed. No marks scored.

ResultsPlus
Examiner Tip

When a volume is given just substitute it into the equation.

The calculation cannot be done using the Celcius temperature scale and then adding 273. This does not convert to the correct Kelvin result.

(ii) At this temperature, the volume of air in the balloon is 0.25 m^3.

When the balloon is cooled the volume becomes 0.10 m^3.

Assume that there is no change in pressure.

Calculate the new temperature of the air in the balloon in kelvin.

Use the equation $T_2 = \frac{V_2 T_1}{V_1}$

(2)

$T_2 = \frac{0.10 \times 20}{0.25}$

$= 8°C$

$8 + 273 = 281 K$

temperature of the air in the balloon = 281 K

1

ResultsPlus
Examiner Comments

Must add 273 to degrees Celcius to get the Kelvin temperature for the calculation.

ResultsPlus
Examiner Tip

Remember to convert to Kelvin before starting the evaluation.

Question 1 (b)(iii)

Various ways of increasing the volume of the balloon were suggested. Answers with a scientific basis were preferred such as 'increase the temperature' but any viable suggestion was accepted.

This answer did not get the mark as it was not specific as to whether the pressure should be increased inside or outside the balloon.

(iii) Suggest one way of increasing the volume of the balloon.

(1)

Increasing the amount of pressure

(Total for Question 1 = 8 marks)

ResultsPlus
Examiner Comments

Answers should be as specific as possible rather than leaving the examiner to interpret your answer.

ResultsPlus
Examiner Tip

Make sure that answers cannot be read in a variety of ways.

Not scientific but a perfectly acceptable answer.

(iii) Suggest one way of increasing the volume of the balloon.

(1)

Blow more air into it.

ResultsPlus
Examiner Comments

Common sense answers are acceptable if they correctly answer the question.

ResultsPlus
Examiner Tip

You can use any idea which is appropriate and is a sensible suggestion.

Question 2 (b)(i)

This question tests an understanding of the trace produced by an electrocardiogram and the use of an equation to find frequency. This equation is given on the formulae sheet at the front of the paper.

This example shows the correct selection of the equation, the substitution is shown and the correct answer given to two decimal places.

(b) Diagram 2 shows the ECG trace for a heart that is beating too fast.

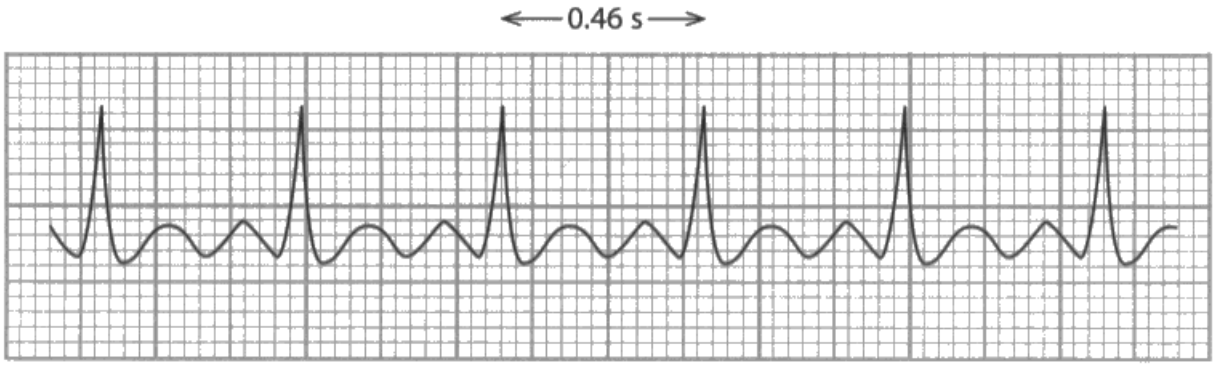


Diagram 2

(i) The time between beats for this heart is 0.46 s.

Calculate the frequency of the heartbeats.

(2)

frequency $= \frac{1}{0.46}$

$= 2.173913$

$= 2.17$

frequency of heartbeats = 2.17 Hz

ResultsPlus
Examiner Comments

Candidates are much more likely to evalute the answer correctly if substitutions in the equation are written down.

ResultsPlus
Examiner Tip

Show the substitution in the equation, then calculate the answer.

Shows working and rounds the answer correctly to one decimal place.

(b) Diagram 2 shows the ECG trace for a heart that is beating too fast.

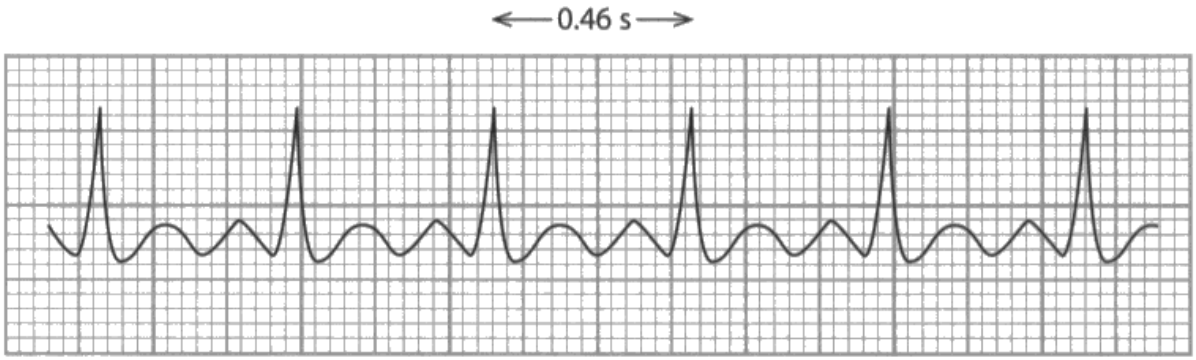


Diagram 2

(i) The time between beats for this heart is 0.46 s.

Calculate the frequency of the heartbeats.

$f = \frac{1}{\text{Time}}$ $\frac{1}{0.46} = 2.17391...$ (2)

frequency of heartbeats = 2.2 Hz

ResultsPlus
Examiner Comments

Take care when rounding 2.2 is correct 2.1 is wrongly rounded and although may be condoned this early in the examination paper should not be thought of as correct.

ResultsPlus
Examiner Tip

Take care with rounding and learn to do it correctly.

Writing down the equation and substituting values is always the best option.

(b) Diagram 2 shows the ECG trace for a heart that is beating too fast.

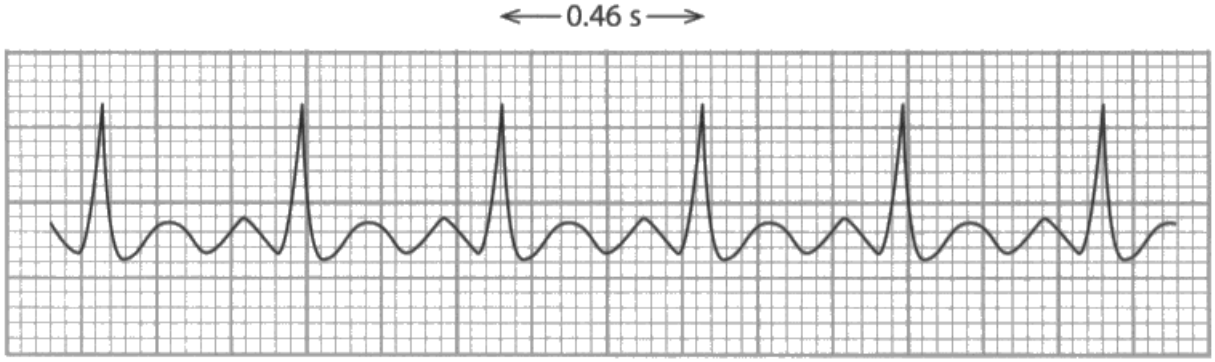


Diagram 2

(i) The time between beats for this heart is 0.46 s.

Calculate the frequency of the heartbeats.

(2)

0·46 x 5 = 2·3

frequency of heartbeats = 2·3 Hz

ResultsPlus
Examiner Comments

Candidates should use the formulae sheet to select the equation and write it down.

ResultsPlus
Examiner Tip

Write down the formula and substitute. Do not guess what to do with the numerical values.

Question 2 (b)(ii)

This question tests if candidates know that a hertz is a wave per second. If they realise that there are 1.25 waves each second then it should be clear that multiplying by 60 will give the number of heart beats each minute.

This example gets one mark because the candidate has realised that hertz are beats per second and has used 60 to convert to minutes but has divided istead of multiplied.

(ii) When a heart is beating at a normal rate it has a frequency of 1.25 Hz.

Calculate this heart rate in beats per minute.

(2)

1.25 ÷ 60 =

heart rate = 48 beats per minute

ResultsPlus
Examiner Comments

Writing down working has given the candidate one mark.

ResultsPlus
Examiner Tip

Always show the examiner what you are thinking this will allow credit to be given for correct ideas.

This example shows the correct answer with no working so gets both marks.

(ii) When a heart is beating at a normal rate it has a frequency of 1.25 Hz.

Calculate this heart rate in beats per minute.

(2)

heart rate = 75 beats per minute

ResultsPlus
Examiner Comments

Giving no working will get both marks if the answer is correct but will get no marks if the answer is wrong as the examiner has no idea how the answer was arrived at.

ResultsPlus
Examiner Tip

Always show your working.

Question 2 (c)

The question was testing the understanding that a good electrical contact is needed between the electrodes and the skin inorder for the ECG machine to give a trace.Some candidates confused the use of the ECG with the pulse oximeter and made connection to a finger.

Some way of attaching the electrodes to the skin was required and sticky pads or sticking the electrodes to the skin was a satisfactory answer.

(c) Suggest how good contact is made between the patient's skin and the electrodes of the ECG machine.

(1)

bySticking the electrodes to the SKIN

ResultsPlus
Examiner Comments

This is a suggestion again and any method of keeplng the electrode in contact with the skin without going into the skin is acceptable.

ResultsPlus
Examiner Tip

Think about the situation if it is unfamiliar and suggest a method of keeing something incontact with the skin.

This answer shows confusion between the use of an ECG and a pulse oximeter.

(c) Suggest how good contact is made between the patient's skin and the electrodes of the ECG machine.

(1)

Finger presser detects puuse

ResultsPlus
Examiner Comments

Candidates should learn the uses of different pieces of medical equipment.

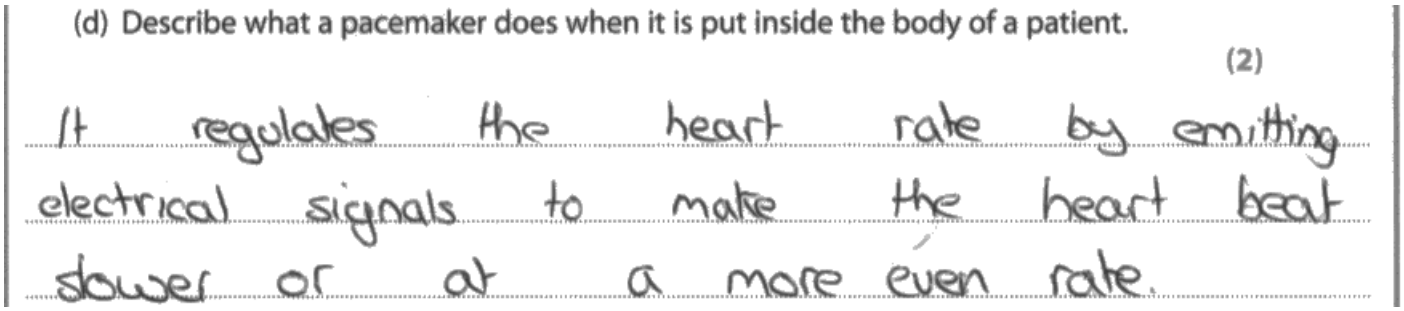
ResultsPlus
Examiner Tip

Make sure the question is read carefully to know which medical device is being referred to.

Question 2 (d)

The purpose of this question was for candidates to show that they appreciated the use of electrical impulses to monitor and regulate the rate at which a heart is beating.

This response fully answers the question, explaining that the pacemaker produces electrical signals and that these can regulate heart beat rate.



(d) Describe what a pacemaker does when it is put inside the body of a patient.

(2)

It regulates the heart rate by emitting electrical signals to make the heart beat slower or at a more even rate.

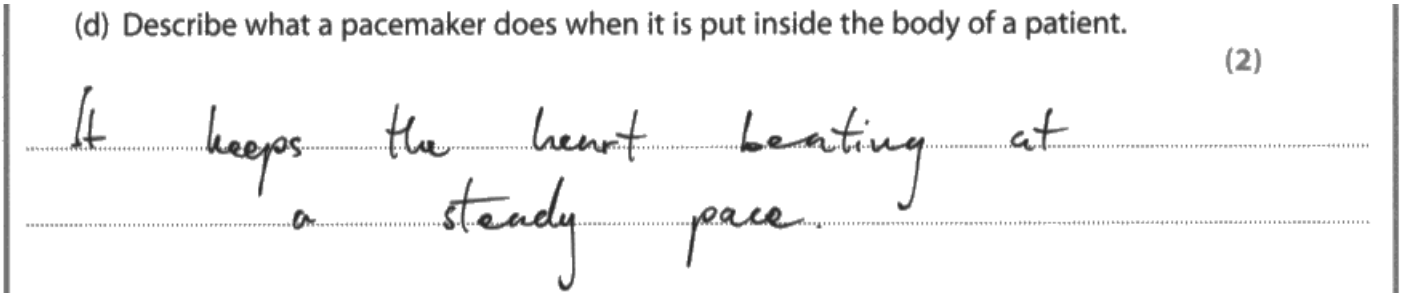
ResultsPlus
Examiner Comments

Those candidates that linked the use of a pacemaker to a heart condition would get at least one mark.

ResultsPlus
Examiner Tip

There are two marks so two points need to be made to get both of them.

This answer links the pace maker to the heart rate and gets a mark.



(d) Describe what a pacemaker does when it is put inside the body of a patient.

(2)

It keeps the heart beating at a steady pace.

ResultsPlus
Examiner Comments

Only one point was made so only one mark can be awarded.

ResultsPlus
Examiner Tip

Remember to make two different points to get two marks.

Question 3ai

Most candidates were able to recognise that it was gravity that provides the force to keep satellites in orbit.

Question 3aii

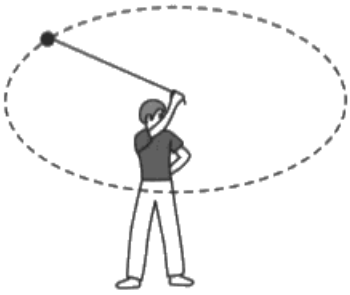
For this question candidates tended to choose either friction or gravity. The idea that it was the friction on the track that provded the centripetal force was not familiar to many candidates.

Question 3bi

Very few candidates showed the direction of the centripetal force being towards the student by putting an arrow on the diagram. Most described the force as being around the circle in some way or outwards instead of inwards as it should be.

The change in perspective from that of the examination paper makes the circle look vertical rather than horizontal but the force required should still be towards the centre of the cicle.

(b) A student investigates circular motion by whirling a ball about his head.
The ball travels in a **horizontal** circle.



(i) State in which direction the centripetal force on the ball acts.

(1)

Outwards

ResultsPlus
Examiner Comments

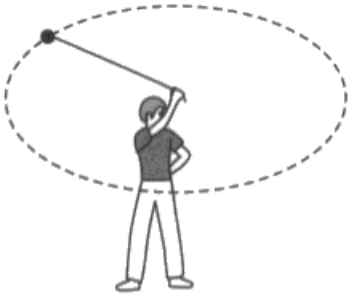
When asked for directions candidates need to ensure the answer is clear if a diagram is available they should use that to show what is intended.

ResultsPlus
Examiner Tip

Draw on the diagram if it is easier than providing a description.

The student may have intended this answer to indicate towards the centre but this is not clear and no mark is awarded.

(b) A student investigates circular motion by whirling a ball about his head.
The ball travels in a **horizontal** circle.



(i) State in which direction the centripetal force on the ball acts.

(1)

in the centre.

ResultsPlus
Examiner Comments

Answers should be clearly defined.

ResultsPlus
Examiner Tip

Use the diagram to make clear what is intended.

Question 3 (c)(i)

The graph just required two points and as the tolerance was plus or minus one square almost all candidates managed to get both marks.

The two points are plotted accurately on this graph.

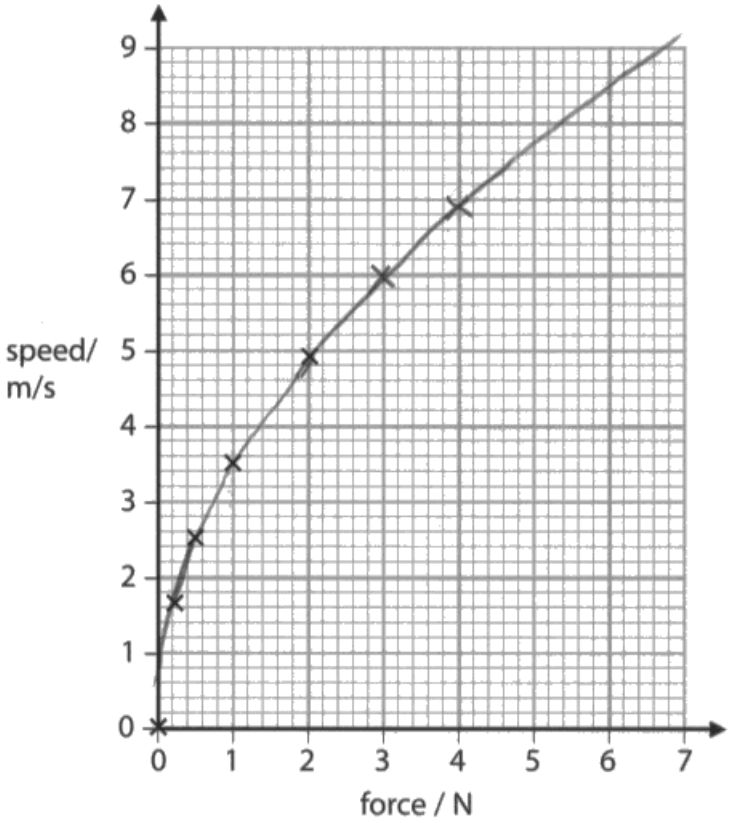
He plots the first five points.

(i) Complete the graph by plotting the other two points.

(2)

(ii) Draw a curve of best fit.

(1)



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Examiner Comments

Some candidates did plot (4.0, 6.8,) instead of (4.0, 6.9) but with the tolerance allowed this this got the mark.

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Examiner Tip

Do not make plots too large a cross is the best way to plot the points. Look carefully at scales before plotting points.

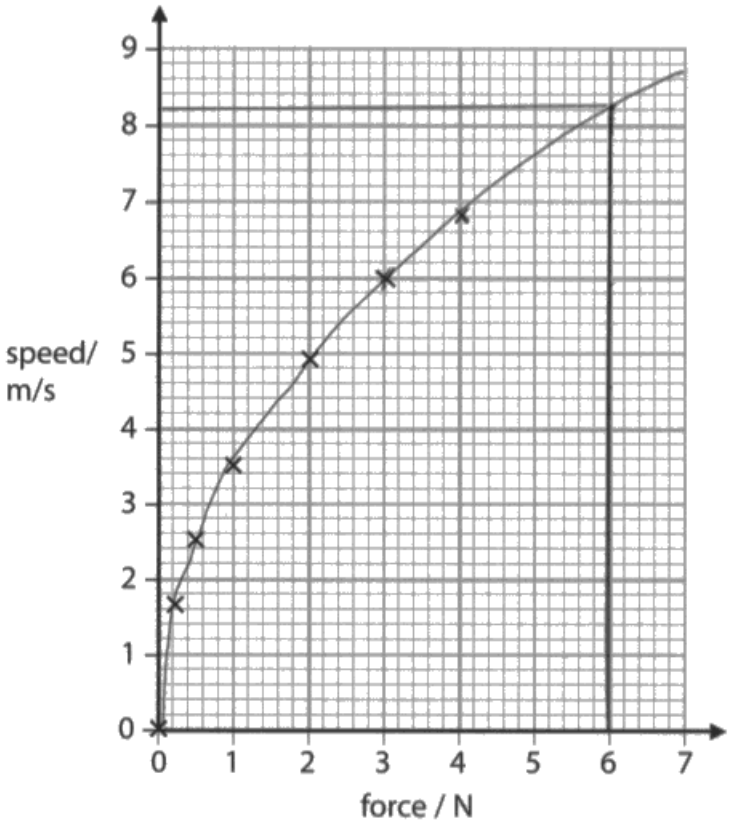
Question 3 (c)(ii)–(iii)

The graph curve of best fit had to pass through at least four points and the origin and not touch the y axis before meeting it at the origin. The points plotted they all appear to lie on a smooth curve and therefore this should be the curve that is drawn. To estimate the speed of the ball at 6N, it was best for the curve to be extrapolated rather than the answer guessed.

This example shows a curve which is on the limit of tolerance for the extrapolation.

(ii) Draw a curve of best fit.

(1)



(iii) Use your graph to estimate the speed of the ball when the force is 6 N.

(1)

8.1

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Examiner Comments

The general direction of the curve should be kept the same the curve should not tend to straighten out when extrapolated.

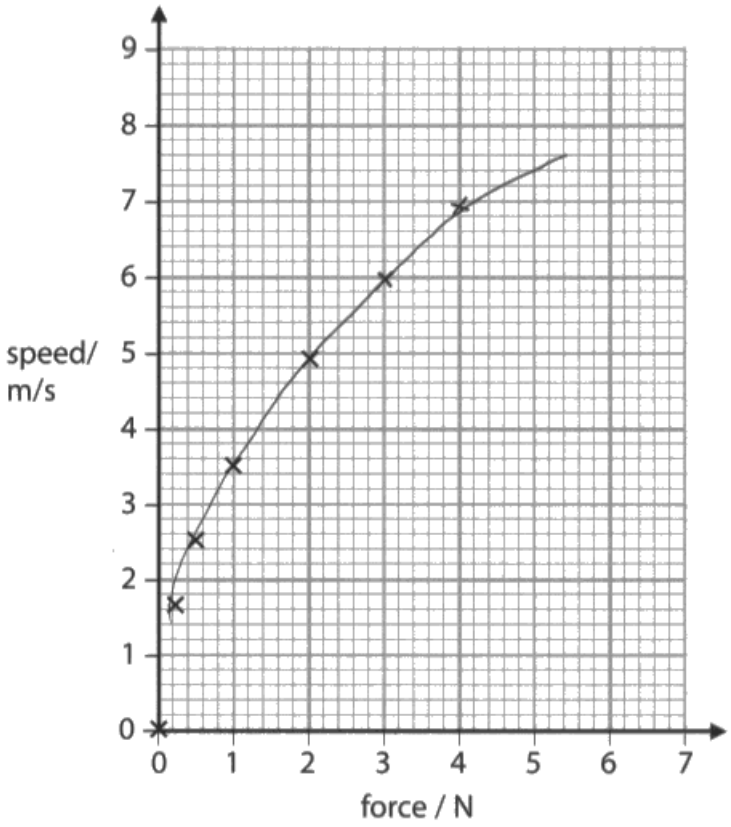
ResultsPlus
Examiner Tip

Practice drawing smooth curves on graphs and making the extrapolation continue in the direction of the curve.

This curve does go through four ponts but does not go down to the origin so the first mark is not awarded. There is some extrapolation but not to 6N even so the answer given comes within tolerance and the second mark is awarded.

(ii) Draw a curve of best fit.

(1)



(iii) Use your graph to estimate the speed of the ball when the force is 6 N.

(1)

8.0

ResultsPlus
Examiner Comments

Use all the points to draw the curve as their do not appear to be any anomalies and extrapolate the full amount to see the value of speed at 6N force.

ResultsPlus
Examiner Tip

Having plotted all the points use them for the curve drawing and try to make the curve as smooth as possible.

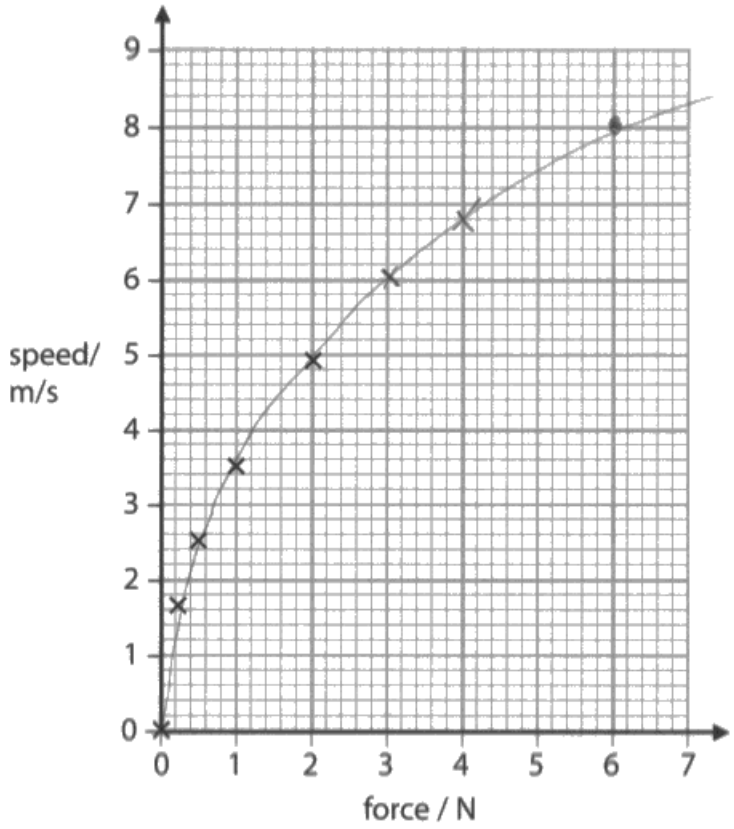
Question 3 (c)(iv)

Most candidates were able to describe that as the force increased the speed of the ball increased and this gave one mark. However, any correct detail of how this speed was changing as the force increased was rarely given for the second mark.

To gain two marks there must be two comments and they must relate to the force and speed and not just to the graph.

(ii) Draw a curve of best fit.

(1)



(iii) Use your graph to estimate the speed of the ball when the force is 6 N.

(1)

8 m/s

(iv) Use the graph to describe how the speed varies with the force on the ball.

(2)

The speed increases with the force, but it looks like the speed, at some point, will be maintained and not increase more.

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Examiner Comments

The first mark is for the speed increases with force and the second mark for realising that the change in speed is getting less and the ball will not increase in speed indefintely.

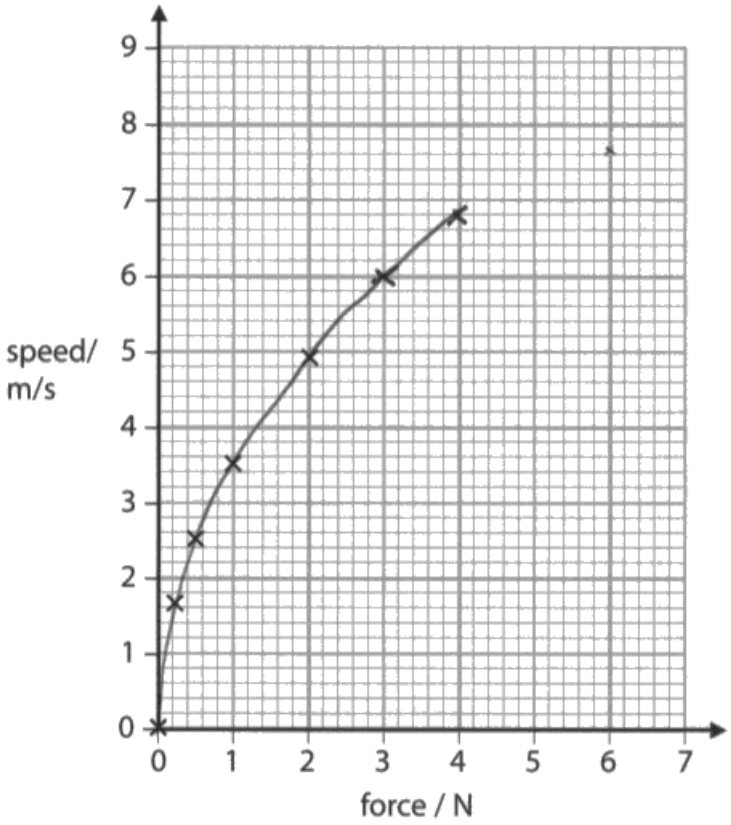
ResultsPlus
Examiner Tip

Remember to get two marks two comments are needed.

This example makes two points about how the speed changes when the force increases and gets two marks.

(ii) Draw a curve of best fit.

(1)



(iii) Use your graph to estimate the speed of the ball when the force is 6 N.

(1)

7.6 m/s

(iv) Use the graph to describe how the speed varies with the force on the ball.

(2)

When you increase the forse exerted on the ball the speed increases. At first the speed rapidly increases then starts to level off

ResultsPlus
Examiner Comments

Detail is given on how the rate of change of speed varies.

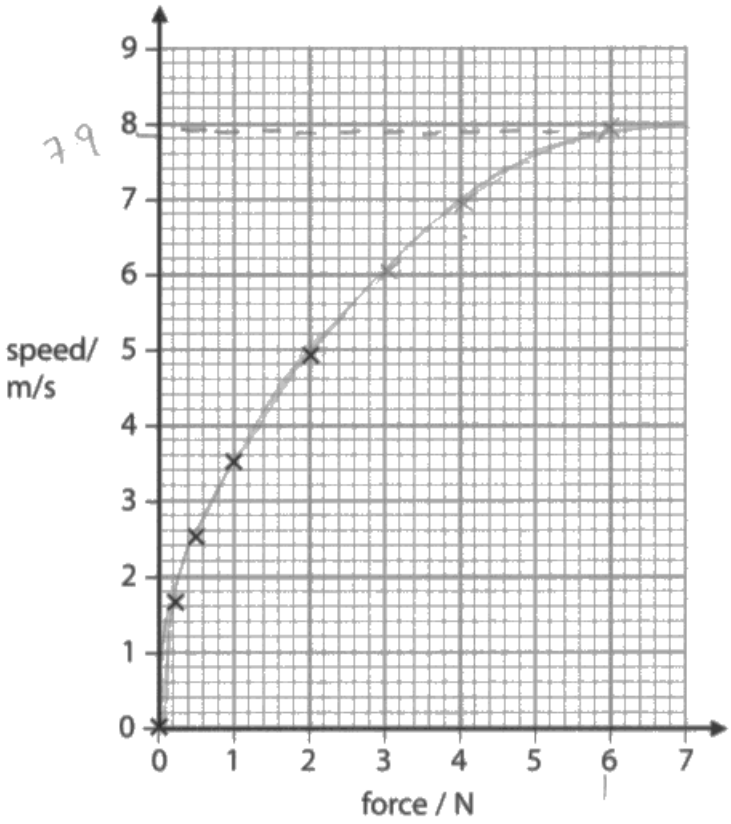
ResultsPlus
Examiner Tip

Two points about the changes are required to get two marks. Look for changes on gradient in a curve to give a second comment.

This response only gets one mark as although values are quoted they are not related to the change in speed. The reference to the force and speed being directly proportional is ignored.

(ii) Draw a curve of best fit.

(1)



(iii) Use your graph to estimate the speed of the ball when the force is 6 N.

(1)

7.9 m/s

(iv) Use the graph to describe how the speed varies with the force on the ball.

(2)

the larger the force, the higher the speed. It is directly proportional with one another. For example, at 1N, the ball travels at 3.5m/s, however at 3N, the ball travels at 6.0m/s

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Examiner Comments

For a curve candidates should consider changes in the slope of the curve.

ResultsPlus
Examiner Tip

Learn the meaning of directly proportional and realise to be directly proportional is represented by a straight line.

Question 4 (b)(i)

Almost all candidates read the chart correctly and attributed Radon with a mass number of 222 and an atomic number of 86.

Question 4 (b)(ii)

To work out that both the mass number and atomic number would decease and by how much, on the emmision of an alpha particle it was necessary to know that an alpha particle has two protons and two neutrons. Candidates confused this with the emission of a beta particle and consequently had the atomic number increasing.

This response gets one mark for knowing that both the mass number and atomic number decrease but not by how much.

(ii) Radon (Rn) decays by emitting an alpha particle from the nucleus.

State what happens to the mass number **and** to the atomic number of radon (Rn) when an alpha particle is emitted.

(2)

when emitted, the mass number and atomic number decrease.

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Examiner Comments

Candidates should consider what the particles are and then work out the result of their emission.

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Examiner Tip

Learn what alpha, beta and gamma are so that the effect of the loss of these particles from a nucleus can be worked out.

This is an example of candidates that tried to remember all the emissions rather than work them out by just remembering what alpha , beta and gamma are.

(ii) Radon (Rn) decays by emitting an alpha particle from the nucleus.

State what happens to the mass number **and** to the atomic number of radon (Rn) when an alpha particle is emitted.

(2)

the mass number goes down by 2 and the atomic number increases by 4

ResultsPlus
Examiner Comments

Trying to memorise emissions will lead to confused answers. Correct numbers used the wrong way.

ResultsPlus
Examiner Tip

Learn the essentials. ie what are alpha beta and gamma what is atomic number and mass number.

Question 4 (b)(iii)

To answer this question it was necessary to identify beta minus as an electron and then to determine how it could be emited from the nucleus. Some candidates were able to identify that an electron was emitted but were not familiar with the idea that a neutron can be considered as a proton plus an electron and once the electron is emitted that leaves an extra proton in the nucleus raising the atomic number of the atom by one but keeping the mass number constant.

This is one of the few correct answers as this process does not seem to be familiar to many candidates.

(iii) Some unstable isotopes of lead (Pb) decay by the emission of a beta minus (β^-) particle.

Describe what happens to a nucleus in the process of the beta minus (β^-) decay.

(2)

In beta decay a neutron turns into a protons increasing the atomic number by 1 and a electrons is thrown offs.

ResultsPlus
Examiner Comments

Candidates should know that the beta minus is an electron and all radiation comes from the nucleus.

ResultsPlus
Examiner Tip

Learn that a beta minus particle is an electron as a start to working out what happens.

Knowing what Beta minus is gets a mark.

It loses electrons a beta minus is an electron.

ResultsPlus
Examiner Comments

It is important to know what alpha, beta and gamma radiation is.

ResultsPlus
Examiner Tip

Put down what you do know that is relevent to the queston even if you are unable to answer it completely.

Question 4 (b)(iv)

Most candidtates did not know that when a nucleus emits alpha or beta radiation it is unstable and has to lose some energy to rearrange the nucleus for it to become stable again. This energy is lost in the form of gamma rays.

If the change is stability of the nucleus was not given then a mark could be awarded for knowing that the emitted gamma ray did not cause any change to the mass number or atomic number.

(iv) Gamma radiation is often emitted with the alpha or beta particles.

Explain what happens to the nucleus when gamma radiation is emitted.

(2)

Gamma radiation is a wave and doesn't have a charge ~~or mass~~. Therefore the atomic number and ~~the mass number stay the same~~ stays the same, However the mass number decreases by 1. The nucleus then becomes stable.

ResultsPlus
Examiner Comments

Giving information relevent to the question has allowed a mark to be awarded.

ResultsPlus
Examiner Tip

Giving information about gamma radiation has allowed a mark to be awarded.

Question 5 (a)(ii)

This question was set to test knowledge of how a cyclotron works. A few candidates recognised that it was a proton that was accelerated to be absorbed by a stable nucleus. The marking point was for knowing that there was an absorption (collison was also acceptable) rather than which particles were colliding. Very few mentioned that the initial nucleus/element was stable to begin with and then became unstable or radioactive once the proton had been absorbed. Candidates also confused this process with electron = proton annihilation and had many gamma rays being emitted.

This response gets one mark as there is no mention of absorption or a collision but it does give that the nucleus becomes unstable.

(ii) Explain how the protons accelerated in a cyclotron are used to produce radioactive isotopes.

(2)

Protons are accelerated from the cyclotron to ~~a~~ atoms. This gives an atom an overall positive charge but makes the nucleus unstable(radioactive)

ResultsPlus
Examiner Comments

It is the collision process that is most important as as the fact that protons are accelerated is given in the stem of the question.

ResultsPlus
Examiner Tip

Remember that the purpose of a cyclotron is not just to speed up particles but to make them collode with others.

Question 5 (a)(iii)

A large number of candidates realised that it was because the neutron does not have a charge that it cannot be accelerated by the cyclotron. It must be stated as neutral or no charge. Infering that the neutron does not have enough charge will not get the mark.

Question 5 (b)(i)

There are quite a number of properties of X-rays that make them suitable for the treatment of cancer. The most frequently mentioned was that X-rays are ionising and therefore can destroy cancerous cells. Other popular reasons were that the X-rays penetrate into the body, although this became confused with diagnosis and high frequency. The ability to focus the X-rays on a target was rarely given.

The answer considers 'penetration of the skin braking into cancer cells' and' killing the bad cells'. Two points providing an explanation gets two marks.

(b) X-rays are used in hospitals for diagnosis and treatment.

(i) Explain why the properties of X-rays make them suitable for the treatment of cancer.

(2)

X-rays kill cancer cells, the waves from a x-ray penetrate the ~~the~~ skin braking into cancer cells, shaking them, the waves kill the bad cells.

ResultsPlus
Examiner Comments

There are two marks for the question and an explantion is required to gain both.

ResultsPlus
Examiner Tip

Note that two marks require two points to be made and in this case linked as an explanation.

Short answer but makes two valid points concisely.

(b) X-rays are used in hospitals for diagnosis and treatment.

(i) Explain why the properties of X-rays make them suitable for the treatment of cancer.

(2)

They are ionising so they can kill cancer cells

ResultsPlus
Examiner Comments

Includes sufficient information to be awarded two marks.

ResultsPlus
Examiner Tip

The whole space does not have to be filled to get both marks.

Question 5 (b)(ii)

This question was answered well with many candidates able to give the precautions needed to ensure the safety of radiographers and patients and therefore achieving a level 2 response. Providing an explanation for the precautions was a little more demanding but was achieved by a significant number of candidates.

This answer makes two succinct points points and relates each correctly either to the radiographer or patient and thus achieves a level 2 response.

*(ii) Exposure to X-rays can be dangerous for patients receiving a diagnosis or treatment and for radiographers who use the X-ray equipment.

Explain the precautions that are taken to ensure the safety of both patients and radiographers exposed to radiation.

(6)

- The patient can only have a certain amount a year of x-rays
- The radiographers has to stay in different room

ResultsPlus
Examiner Comments

A limited answer but contains sufficient relevant information for a level 2 response.

ResultsPlus
Examiner Tip

Read the question to establish of you are to describe or explain. Pick out the points that you know about the topic and provide an explanation if you can.

This answer only includes one reason which could be for either patient or radiographer but as a reason is given, this is worthy of credit.

*(ii) Exposure to X-rays can be dangerous for patients receiving a diagnosis or treatment and for radiographers who use the X-ray equipment.

Explain the precautions that are taken to ensure the safety of both patients and radiographers exposed to radiation.

(6)

the precautions are not to be exposed for to long to the radiation coming from x-rays as it can cause cancer

ResultsPlus
Examiner Comments

A level 1 response awarded 2 marks.

ResultsPlus
Examiner Tip

You do not have to write a lot if it contains relevent information.

This answer provides precautions for the patient and radiographer and explains why these precautions need to be taken, earning six marks for a level 3 response.

*(ii) Exposure to X-rays can be dangerous for patients receiving a diagnosis or treatment and for radiographers who use the X-ray equipment.

Explain the precautions that are taken to ensure the safety of both patients and radiographers exposed to radiation.

(6)

Different precautions are used as a radiographer is exposed to more xrays than a patient. The Radiographer is permitted to wear a colour changing badge that detects the amount of xrays they have been exposed to, once it reaches its end they are no longer allowed to do xrays. To limit the time for this the Radiographer must exit the room before the xray begins.

Similarly the patient is only allowed a certain amount of xrays in their lifetime to limit the amount of radiation they are exposed to. The patients are only allowed a certain amount of time between each xray to reduce the risk of the body reacting and mutating to the xrays.

(Total for Question 5 = 12 marks)

ResultsPlus
Examiner Comments

A complete response to this question.

ResultsPlus
Examiner Tip

Read the question carefully , bring together your knowledge on the topic and then provide an explanation.

Question 6 (b)

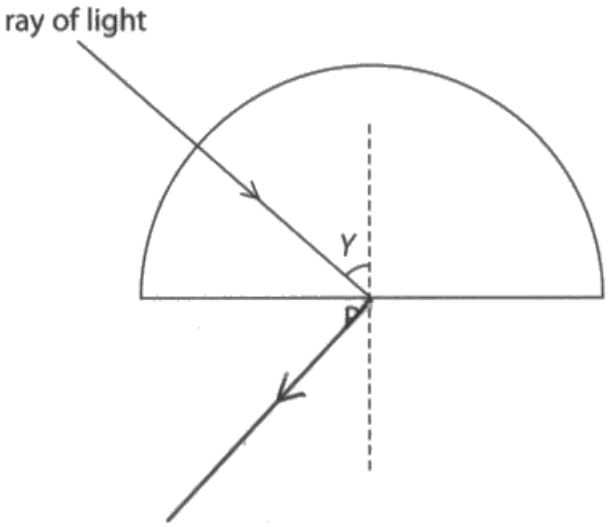
Many candidates did not appreciate the significance of the critical angle so did not show total internal reflection and assumed refraction was occuring or that there was reflection from the normal.

An example showing reflection from the normal, scoring 0 marks.

(b) In the diagram, the angle *Y* is greater than the critical angle.

Complete the diagram to show what happens to the ray of light after it reaches the surface of the glass at point P.

(1)



ResultsPlus
Examiner Comments

Candidates should read the question carefully and then use the information to complete the diagram.

ResultsPlus
Examiner Tip

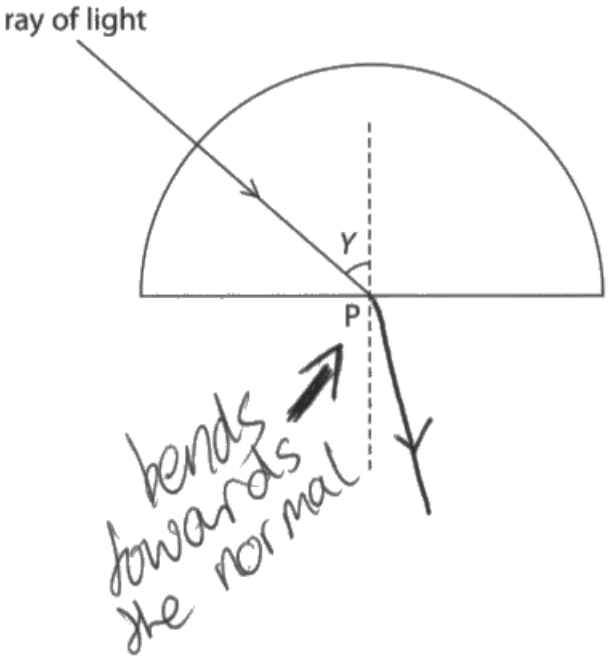
Make sure you understand the information in the diagram.

Candidate has assumed that refraction is occuring.

(b) In the diagram, the angle *Y* is greater than the critical angle.

Complete the diagram to show what happens to the ray of light after it reaches the surface of the glass at point P.

(1)



ResultsPlus
Examiner Comments

Candidate has not understood the relevence of the critical angle.

ResultsPlus
Examiner Tip

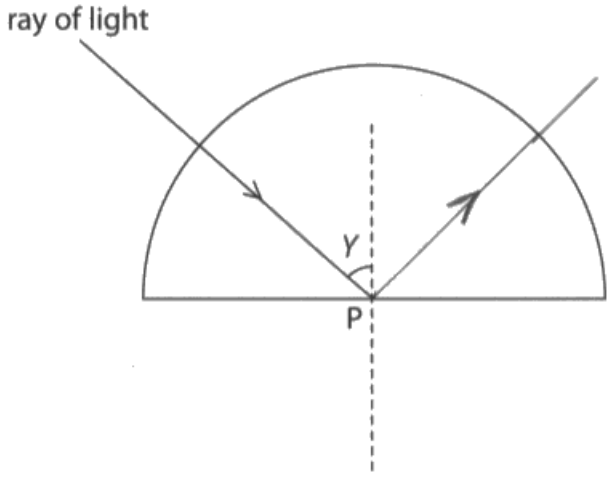
Make sure you read and understand the question.

This response correctly shows total internal reflection.

(b) In the diagram, the angle *Y* is greater than the critical angle.

Complete the diagram to show what happens to the ray of light after it reaches the surface of the glass at point P.

(1)



ResultsPlus
Examiner Comments

Candidate has noted the relevence of the critical angle to earn the mark.

ResultsPlus
Examiner Tip

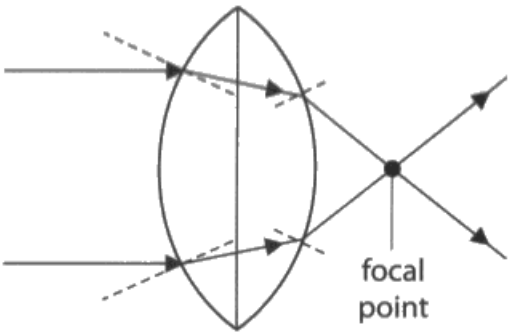
Bring a ruler to the examination to complete ray diagrams wth straight lines.

Question 6 (c)

Showing a change of direction on both surfaces of a thick lens caused some difficulties as it was in a situation which is not usually given. However most candidates were able to identify the change in direction as due to refraction, the change in optical density of the medium or to the light slowing down in glass.

Candidate shows an understanding that refraction is the cause of the light changing direction.

(c) The diagram shows light passing through a powerful converging lens.



Explain why the light changes direction when it passes from air into the glass lens.

(2)

Refraction occurs when passing through a new medium

ResultsPlus
Examiner Comments

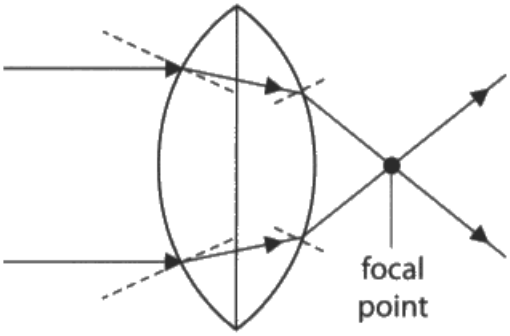
Gets one mark for refraction, and this is only awarded as no other mark is given. The new medium needs to be described as (optically) denser to get a mark and a second point about speed needs to be made to get both marks.

ResultsPlus
Examiner Tip

Remember the reason for a change in direction of a wave is a change in speed.

The candidate gives the answer in terms of change of speed of the light.

(c) The diagram shows light passing through a powerful converging lens.



Explain why the light changes direction when it passes from air into the glass lens. (2)

because the glass is denser than air so the light slows down through glass but speeds up again when in air.

ResultsPlus
Examiner Comments

The light slows down through the glass is sufficient for both marks.

ResultsPlus
Examiner Tip

For a new situation, take what you already know and try to apply it to the situation.

Question 6 (d)

Almost all candidates were able to select the correct equation from the formulae sheet, substitute, and produce the correct answer.

Two marks for the correct answer and the working is shown.

(d) The focal length of a lens is 0.25m.

Calculate the power of this lens.

(2)

$\frac{1}{0.25} = 4$

power of the lens = 4 D

ResultsPlus
Examiner Comments

This question shows that when values are substituted into an equation candidates find it easier to get an answer.

ResultsPlus
Examiner Tip

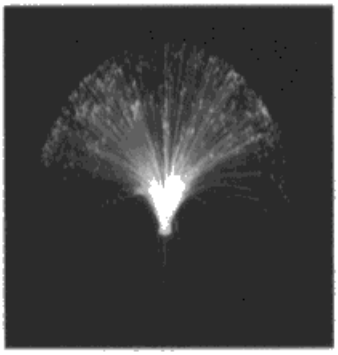
Take a calculator into the examination and always show substitution into an equation.

Question 6 (e)

Responses to this question showed that more candidates were familiar with light travelling through optical fibres by total internal reflection than light being reflected by a plane mirror. Many of the marks awarded were given because the science could be seen from the diagrams rather than the written work.

There is sufficient correct information about the mirror to be awarded 4 marks for level 2 response.

*(e) The photographs show two effects of light.



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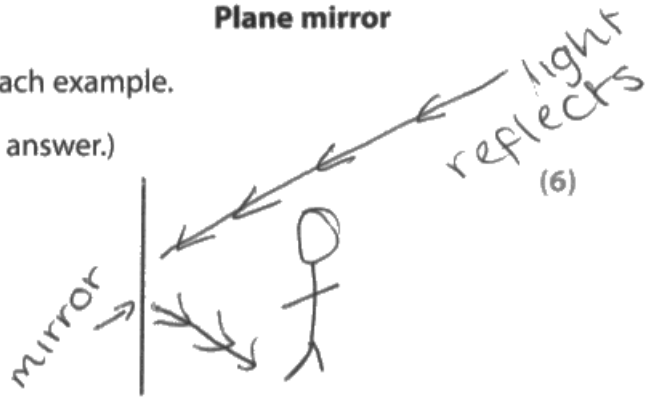
Fibre optic lamp

© www.scienceblogs.com

Plane mirror

Discuss what is happening to the light in each example.

(You may draw diagrams to help with your answer.)



(6)

In the mirror, the light is being reflected back onto the person. In a fibre optic light, there is a bulb and colour slides which change the colour of the light. However the light is being travelled along this thin wire which refracts the the light whilst going along the wire and then leading it to the end where the colour light is shown.

ResultsPlus
Examiner Comments

The diagram gives sufficient information about what happens to light reflected from a plane mirror and the writing includes that the light is reflected to the eye for a level 2 response.

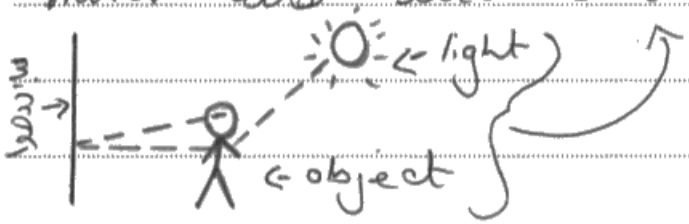
ResultsPlus
Examiner Tip

Remember to use diagrams as these will convey information more accurately that you can describe.

Correct information and diagrams on both effects of light which is awarded six marks for a level 3 response.

~~Mirror~~ **Fibre Optic Lamp** - The light generated travels down the fibre optic strands by total internal reflection and shows at the tip of each strand. The light reflects off the inside of each fibre optic strand.

Mirror - The mirror reflects light too. However, the light which is on the object reflects off the surface of the mirror and into the eye, creating an image.



ResultsPlus
Examiner Comments

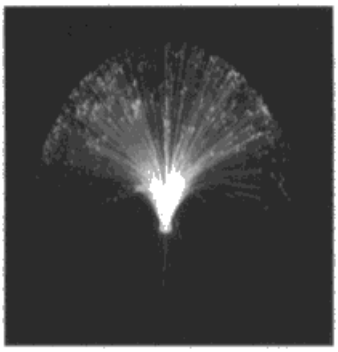
Well described written response with diagrams showing both effects, worth full marks.

ResultsPlus
Examiner Tip

Use diagrams to improve your answer.

Very short response but enough for a level 2 response as it gives several peices of information about reflection.

*(e) The photographs show two effects of light.



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Fibre optic lamp

© www.scienceblogs.com

Plane mirror

Discuss what is happening to the light in each example.

(You may draw diagrams to help with your answer.)

(6)

The light in the plane mirror is being reflected. That's why the image is flipped. In the fibre optic lamp, light is being given off.

ResultsPlus
Examiner Comments

All 4 marks are gained from response relating to reflection from a plane mirror.

ResultsPlus
Examiner Tip

Think about what you know about a topic and keep your response as concise as possible.

Paper Summary

Based on their performance on this paper, candidates are offeredthe following advice.

- Always show your working for calculations.
- If the question has two marks then you need to make two points to get both marks.
- Understand when and why units need to be changed or can be left unchanged.
- Use the information provided by diagrams and images to help answer questions.
- Learn the meanings of scientific terms in physics.
- Read all questions carefully and take note of the command words.
- Have a calculator with you in the examination.
- Plot points on graphs and practice drawing lines or curves of best fit accurately.
- Learn what alpha, beta and gamma radiations are.

Grade Boundaries

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

http://www.edexcel.com/iwantto/Pages/grade-boundaries.aspx

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