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Examiners' Report
June 2018

GCSE Science 1SC0 1PF

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June 2018
Publications Code 1SC0_1PF_1806_ER

Introduction

This was the first examination of Physics Paper 1 as part of the Foundation Level of a new specification of the Combined Science examination. The questions were set to test knowledge, application and the candidates' ability to analyse information and ideas having been taught the seven topics which make up the specification.

The topics covered by the specification are:-

- Topic 1 – Key concepts of physics
- Topic 2 – Motion and forces
- Topic 3 – Conservation of energy
- Topic 4 – Waves
- Topic 5 – Light and the electromagnetic spectrum
- Topic 6 – Radioactivity
- Topic 7 – Astronomy

The assessment is through multiple choice questions, short answers, extended writing, calculations and analysis. New to this specification is the testing of the skills acquired by candidates when completing practical work. The specification includes core practicals which should be included in the scheme of work and a number of suggested practicals which exemplify points in the specification to help candidates' understanding.

The work produced for the examination showed that most candidates were able to deal with calculations when given the equation to use. Most candidates showed the substitution so that even with an incorrect evaluation a mark could be obtained. Candidates also coped well with obtaining information from pie charts but were often unable to provide scientific reasoning for the changes they had identified in the data.

The use of indices in the values of the speed of light and the frequency of yellow light showed that some candidates were either unfamiliar with indices or were unable to use a calculator correctly to produce an answer to the correct power of ten.

Candidates were less successful when describing how measurements had to be made to determine a quantity in a practical situation, suggesting more emphasis needs to be placed on practising these skills throughout the course.

The need for accuracy in describing the difference between longitudinal and transverse waves was not appreciated by many candidates and the descriptions given were often vague and not worthy of credit.

Candidates find radioactivity a difficult topic to understand and if apparatus is not available need to try simulations of radioactive decay to plot graphs, appreciate the existence of background radiation and the significance of various materials in absorbing the different types of radiation.

Question 1 (b)

Many candidates thought the quantity measured by a spring balance was mass despite the question showing 3.8 N in the diagram. The answers 'density and volume' were given occasionally.

Tests that candidates know the difference between mass and weight.

(b) Figure 1 shows a block hanging from a spring balance.

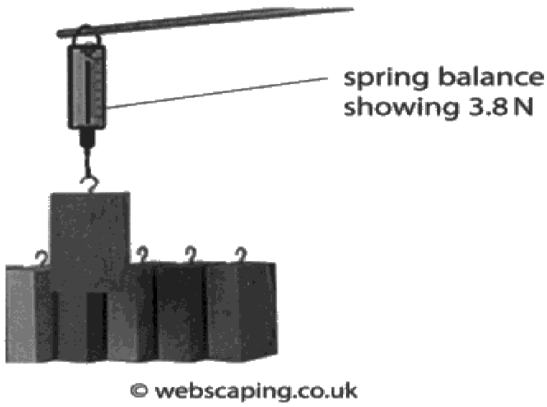

Figure 1

Use a word from the box to complete the sentence below.

density	mass	volume	weight

The quantity measured by the spring balance in Figure 1 is

(1)

Mass

ResultsPlus
Examiner Comments

This example shows the confusion that candidates have between mass and weight and that this student chose the wrong one.

ResultsPlus
Examiner Tip

Look at the diagram it is meant to help. It shows the measurement in newtons, which is the clue that weight is being measured.

Question 1 (c)

The equation was given and only a substitution and evaluation were required and many candidates were able to correctly evaluate the force as 0.2. However many did not give the unit, newton (N) or did not appreciate what was required in the space for unit. Quite commonly candidates squared the value for the acceleration, confused by the unit for acceleration of m/s^2. This error meant no marks could be awarded for the calculation as even with the working shown the substitution was incorrect. Many candidates attempted to give the derived units for force but tended to write $kg/m/s^2$ rather than the correct derived unit kg m/s^2.

To gain three marks the candidate must complete the calculation and give the correct unit for force.

(c) A toy car has a mass of 0.10 kg.
The toy car accelerates at 2.0 m/s^2.

Calculate the force producing this acceleration.
State the unit.

Use the equation

$F = m \times a$

(3)

0.10 x 2 = 0.2 N

force = 0.2 unit = N

ResultsPlus
Examiner Comments

This example shows the substitution, evaluation and the correct unit.

ResultsPlus
Examiner Tip

Always show the substitution into the equation.

Using derived unit is acceptable.

(c) A toy car has a mass of 0.10 kg.
The toy car accelerates at 2.0 m/s².

Calculate the force producing this acceleration.
State the unit.

Use the equation

$F = m \times a$

(3)

0.10 x 2.0 =

force = 0.2 unit = kgm/s².

ResultsPlus
Examiner Comments

It is preferred that the unit of force is given as the newton (N) but as the units on both sides of the equation must be equivalent then kgm/s^2 is acceptable.

ResultsPlus
Examiner Tip

Look at the units for the quantities in the question; this may provide a way of finding the unit for the answer.

Values must be correctly substituted into formulae.

(c) A toy car has a mass of 0.10 kg.
The toy car accelerates at 2.0 m/s².

Calculate the force producing this acceleration.
State the unit.

Use the equation

$F = m \times a$

0.10kg x 2.0m/s²
= 0.4

(3)

force = 0.4 unit = kgm/s²

ResultsPlus
Examiner Comments

This answer shows the value for acceleration which should be 0.2 substituted as 0.4 because the candidate has confused the quantity in the equation with the units used for acceleration.

ResultsPlus
Examiner Tip

Just insert the value into an equation. It is only when the quantity is squared in the equation as in KE=½mv^2 that the value has to be squared for the substitution.

Question 1 (d)

The majority of candidates were familiar with the definitions of vector and scalar giving direction for vector and size for the scalar.

Question 2 (a) (i)

Many candidates drew a 'triangle' and then went on to write the equation incorrectly usually speed = distance x time, confirming the view that the use of 'triangles' does not necessarily assist foundation candidates in producing a correct equation . If candidates learn one version of an equation they can at least gain a mark for substitution even if the rearrangement is incorrect and consequently the evaluation. Some candidates are not aware that an equation requires an equality.

A complete equation must be written.

2 (a) A sound wave in air travels a distance of 220 m in a time of 0.70 s.

(i) State the equation linking speed, distance and time.

(1)

$\frac{\text{distance}}{\text{speed}} =$

ResultsPlus
Examiner Comments

An equation must have an equal sign to relate the quantities.

ResultsPlus
Examiner Tip

Make sure you use all the quantities given in the question to produce the equation with an equal sign.

Question 2 (a) (ii)

2b Many candidates were able to give the answer 314 with a variety of decimal places shown; these answers gained both marks. Very few candidates rounded correctly to give 310m/s. A common incorrect answer was 154 obtained by multiplying speed by time. This could gain a mark if working was shown and the answer obtained as the result ofa correct substitution into an incorrect equation. However with no working shown no mark could be awarded.

Calculation using an equation which had to be recalled in both parts of the question were shown for the marking of 2aii so that an error could be carried forward.

2 (a) A sound wave in air travels a distance of 220 m in a time of 0.70 s.

(i) State the equation linking speed, distance and time. **(1)**

~~D = S × t~~

S = D × t

(ii) Calculate the speed of the sound wave in air. **(2)**

220 ÷ 0.70 = 314.28

wave speed = 314.3 m/s

ResultsPlus
Examiner Comments

This answer shows a correct equation which is crossed out and replaced by an incorrect equation in 2ai. 2aii then has the correct substitution for the speed to be calculated and the rounding to one decimal place is correct.

ResultsPlus
Examiner Tip

It should be noted that the unit of speed is given as m/s at the end of the question as metres is the unit of distance and seconds is the unit of time. It should be realised that speed is distance /time from the unit for speed.

Use of incorrect equation

2 (a) A sound wave in air travels a distance of 220 m in a time of 0.70 s.

(i) State the equation linking speed, distance and time. **(1)**

S = T × D

(ii) Calculate the speed of the sound wave in air. **(2)**

0.70 × 220 = 154

wave speed = 154 m/s

ResultsPlus
Examiner Comments

When an equation has to be recalled and this is done incorrectly a correct substitution into an incorrect equation will gain a mark

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ResultsPlus
Examiner Tip

The equation and the substitution must be seen to get the mark. An answer of 154 m/s with no working shown does not gain a mark.

Question 2 (b)

Candidates were rarely able to score two marks and when one mark was awarded it was usually for some method of making the waves appear stationary such as taking a photograph or occasionally using a stroboscope. Only a few candidates clearly suggested measuring across more wavelengths Candidates rarely mentioned measuring across more than one wavelength and dividing by the number of wavelengths but frequently gave the idea of repeating the measurement of a wavelength which is not an improvement and did not gain a mark. The use of a longer ruler was not credited unless it was clear that this was used to measure across more wavelengths and candidates rarely commented on the accuracy of the ruler. A few candidates were not able to relate the distance between the two crests shown on the diagram to the measurement of the wavelength required in the question.

Various methods of improving the way in which the wavelength of the water wave can be measured were given.

(b) Figure 2 shows water waves spreading out from a source.

A student measures the wavelength of the waves.

He uses a ruler to measure the distance from one crest to the next crest.

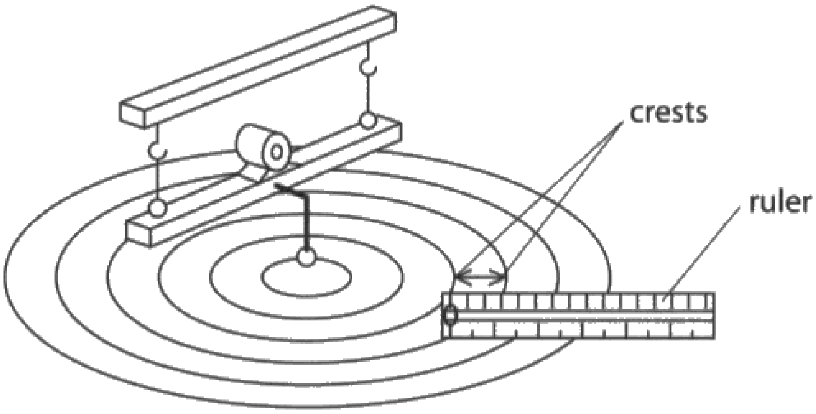

Figure 2

Explain how to improve the student's method for measuring the wavelength.

(2)

The student could take a picture of the water waves so it will be more accurate They should print it out and measure the wavelength.

ResultsPlus
Examiner Comments

Taking the picture gains a mark in the additional guidance column of the mark scheme but the second mark is not given as there is no indication that measurements will be made across more than one wavelength and the answer divided by the number of waves.

ResultsPlus
Examiner Tip

It should be noted that the question has two marks and therefore needs two points to be made for the answer.

This answer gives the most common way of improving a measurement which has a large uncertainty

(b) Figure 2 shows water waves spreading out from a source.

A student measures the wavelength of the waves.

He uses a ruler to measure the distance from one crest to the next crest.

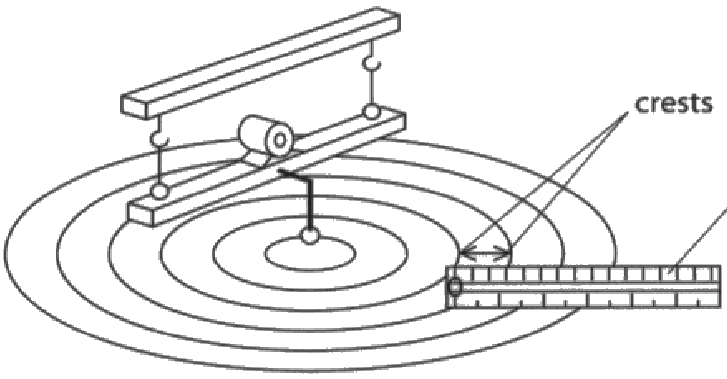

Figure 2

Explain how to improve the student's method for measuring the wavelength.

(2)

He could measure all of the wavelengths and then divided it by how many there are.

ResultsPlus
Examiner Comments

The student measures a larger distance and then counts how many waves are in that distance to find one wavelength.

ResultsPlus
Examiner Tip

Remember that if the measuring instrument is not sensitive enough or the experimental set up leads to variations, then results can be improved by measuring more of the quantity or using a more sensitive measuring device.

Question 2 (c)

Most candidates were aware that one of the waves moved up and down or at right angles and the other moved back and forth but did not mention this applied to vibrations rather than waves and often related the motion to the wrong type of wave. If the direction of vibration was related correctly to the wave it was rare to find the motion of the vibrations linked to the direction of travel of the wave.Candidates need to be able to describe accurately the motion of each type of wave as well as being able to give an example of each.

The answer requires a description of the direction of the vibrations in both longitudinal and transverse waves and how this direction of vibration is linked to the direction of travel of at least one of the waves.

(c) Sound waves are longitudinal waves.

Water waves are transverse waves.

Describe the difference between longitudinal waves and transverse waves.

(3)

In transverse waves the vibrations are perpendicular to the direction the wave is traveling.
In longitudinal waves the vibrations are the same as the direction the wave is traveling.

ResultsPlus
Examiner Comments

This answer gives the correct relationship between the vibrations and the direction of travel for both types of wave.

ResultsPlus
Examiner Tip

To remember the relationship between the direction of vibration and the direction of travel of the waves it is often helpful to use a labelled diagram. Correctly labelled diagrams of longitudinal and transverse waves showing the direction of travel would have been sufficient to gain full marks for this answer.

The differences between the two types of waves must be included together with the direction of travel of the waves.

(c) Sound waves are longitudinal waves.

Water waves are transverse waves.

Describe the difference between longitudinal waves and transverse waves.

(3)

longitudinal waves are waves that are carried parallel whereas transverse waves are carried out perpendicular-ly. 90° angle.

ResultsPlus
Examiner Comments

The student has used parallel and perpendicular correctly with respect the waves but has not stated what the vibrations are parallel and perpendicular to.

ResultsPlus
Examiner Tip

Remember to include the whole description of a wave not just the direction of the vibrations.

Question 3 (a) (i)

Many candidates did not recognise kinetic energy as a store of energy and others were not familiar with the term flywheel.The majority of candidates were not therefore able to gain the mark for this question.

Question 3 (a) (ii)

As candidates did not generally recognise kinetic energy as a store of energy it was not surprising that the majority were unable to state how the energy stored could be increased. Those that did gain a mark stated that the flywheel would need to rotate faster with a few suggesting the mass would increase. Using 'a bigger flywheel' did not gain a mark as it is not clear that the candidate is referring to mass rather than volume increasing.

Question 3 (b) (i)

Most candidates were able to gain the two marks for this calculation and most showed their working, which allowed one mark for substitution with an incorrect evaluation.

The substitution of three values into an equation was done correctly by the majority of candidates and the use of ΔGPE and Δh in the equation to represent the change in gravitational energy and change in height respectively did not cause a problem to candidates.

(b) Figure 4 shows a skier going down a hill.

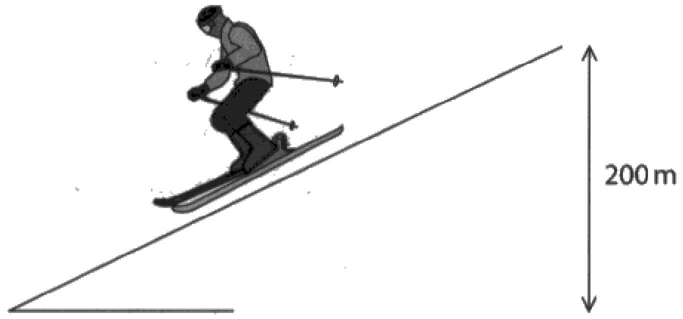

Figure 4

She descends through a vertical height of 200 m.

The skier's mass is 65 kg.

(i) Calculate the change in gravitational potential energy.

Use the equation

$$\Delta GPE = m \times g \times \Delta h$$

Take the gravitational field strength, g, as 10 N/kg.

(2)

65 × 10 × 200 = 130000 J

change in gravitational potential energy = 130,000 J

ResultsPlus
Examiner Comments

Having been given the equation most candidates could successfully carry out the substitution and evaluation.

ResultsPlus
Examiner Tip

Showing the substitution into the equation allows a mark to be scored even if the evaluation is incorrect.

Question 3 (b) (ii)

Many candidates were able to gain three marks for this calculation. If the substitution mark was often lost it was often for showing the square of the mass or vertical height rather than the velocity or not showing that 36 was squared. Candidates could still gain two marks if, in the calculation, the ½ was omitted or 36 or 36 x 2 were used to give the correct answers for the use of these values.

Units should not be included with the substitution as this often causes confusion.

(ii) At the bottom of the slope her speed was 36 m/s.

Calculate her kinetic energy at the bottom of the slope.

Use the equation

$$KE = \frac{1}{2} \times m \times v^2$$

(3)

$\frac{1}{2} \times 65\,kg \times 36\,m/s^2 = 1170\,J$

kinetic energy = 1170 J

ResultsPlus
Examiner Comments

The 36 has been substituted as a square but the power of two has been attached to the unit and the calculation has been completed without 36 being squared. One error has been made and this answer gains two marks.

ResultsPlus
Examiner Tip

Just substitute numerical values and if necessary put in the unit of the quantity being found at the end of the calculation.

Although full marks would be awarded for the correct answer without any working two marks would be given for the substitution including 36^2 without any evaluation.

(ii) At the bottom of the slope her speed was 36 m/s.

Calculate her kinetic energy at the bottom of the slope.

Use the equation

$$KE = \frac{1}{2} \times m \times v^2$$

(3)

$\frac{1}{2} \times 65 \times 36^2$

kinetic energy = 42,120 J

ResultsPlus
Examiner Comments

Full marks for correct answer.

ResultsPlus
Examiner Tip

Always show the substitution to make sure you can be awarded marks.

Question 3 (c)

3c Candidates on average only managed to gain 1 mark for this question partly because the requirements of the question were misinterpreted.It was the speed at the ‘bottom of the slope’ that was required not the average speed for the whole slope and ‘how the speed can be determined’ requires the use of instruments to determine both distance and time at the bottom of the slope and then, for the last mark, the use of the equation speed = distance/time. Candidates that gained a mark usually did so for measurement of time which did not have to be related to the correct part of the slope. However a mark was rarely awarded for measuring the distance travelled at the bottom of the slope as most answers inferred the distance had been from top to bottom had been considered. Some candidates gained a mark for the use of the equation but did not mention how the measurement of the quantities in the equation was to be achieved.

This question requires candidates to apply their knowledge of measuring quantities in an unfamiliar situation. In order to answer the question properly candidates needed to appreciate that it was the speed at the bottom of the slope that was required and not the average speed down the slope. It was also necessary to realise that in order to determine speed measurements of time and distance needed to be taken.

(c) Describe how her speed at the bottom of the slope could be determined.

(3)

The Skiers speed at the bottom of the slope could be measured using light gates at a certain lenght apart wich has been measured. The light gates measure the time taken for the skier to pass through them. you could then use the simple equation of speed = distance ÷ time giving you the Skiers speed.

(Total for Question 3 = 10 marks)

ResultsPlus
Examiner Comments

This candidate has likened the skier coming down the slope to the use of slopes and light gates measuring the speed of a trolley and has gained full marks.

ResultsPlus
Examiner Tip

When the question gives an application that you are not familiar with link the quantities that are to be measured to similar measurements made in your practical investigations

Misunderstanding the question.

(c) **Describe how her speed at the bottom of the slope could be determined.**

(3)

Firstly you could get a stop watch and time how long it takes her to come down the slope.
Secondly ~~&~~ you could ask someone what their quickest time was to go down the slope.
Thirdly you could time yourself or someone else going down the slope.

(Total for Question 3 = 10 marks)

ResultsPlus
Examiner Comments

The candidate has not realised that the question is about the speed at the bottom of the slope and is timing for the whole slope. This does get a mark for timing but there is no mention of distance and this would need to be relevant to the bottom of the slope to get a mark. The question asks for speed and the candidate is only concerned with comparing times.

ResultsPlus
Examiner Tip

Read the question carefully and note the main points which are in this question. These are concerned with measuring speed at the bottom of the slope.

Question 4 (a)

Most candidates gained both marks from being able to name two non-renewable energy sources. It was only when fossil fuels was given as one energy source and a fossil fuel such as coal was given as a second source that the mark was reduced to one.

Question 4 (b)

Many candidates were able to gain a mark for each part of this question giving a total of three marks.Candidates found it easiest to give the energy source that gave the greatest amount of renewable energy but found it more difficult to justify their choice because they did not refer to the pie chart. More than half the candidates were able to work out that 20% of the pie chart represented wind energy to gain the third mark.

Use of pie charts to give data which is to be interpreted.

(b) Figure 5 shows the renewable energy sources used in the UK in 2015.

Figure 5 is to scale.

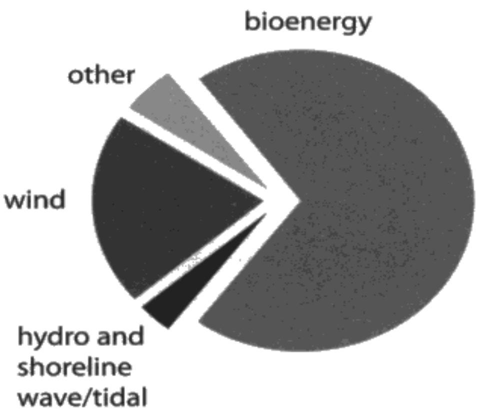

Figure 5

(i) State the energy source that gave the greatest amount of renewable energy for the UK in 2015.

(1)

bioenergy

(ii) Justify your choice of energy source in part (i).

(1)

Because it has the most shaded in on the pie chart.

(iii) State which of these energy sources gave about 20% of the energy from renewable sources for the UK in 2015.

(1)

hydro and shoreline wave/tidal

ResultsPlus
Examiner Comments

The answer shows that the candidate can analyse information using the pie chart but is not able to see that 20% of the pie chart is occupied by wind.

ResultsPlus
Examiner Tip

Learn the relative percentages of slices of pie charts.

Question 4 (c)

Only a few candidates gained full marks on this question. Many were able to compare the two pie charts and to note the changes that were predicted between 2014 and 2040. However, some candidates only noted in which energy sources there was a change and did not state if this was an increase or decrease so no mark was awarded. The environmental effect of the change given proved to be more difficult for the candidate to gain marks. Scientific reasons such as ‘reduces greenhouse gases’ or ‘less radioactive waste produced’ were awarded marks whereas the general comments such as ‘less pollution’ or ‘more environmentally friendly’ did not gain credit.

The question tests the ability of candidates to compare two sets of information and then to use scientific ideas to describe how these changes will affect the environment.

(c) Figure 6 shows all the energy sources used in Canada in 2014 and a prediction for 2040.

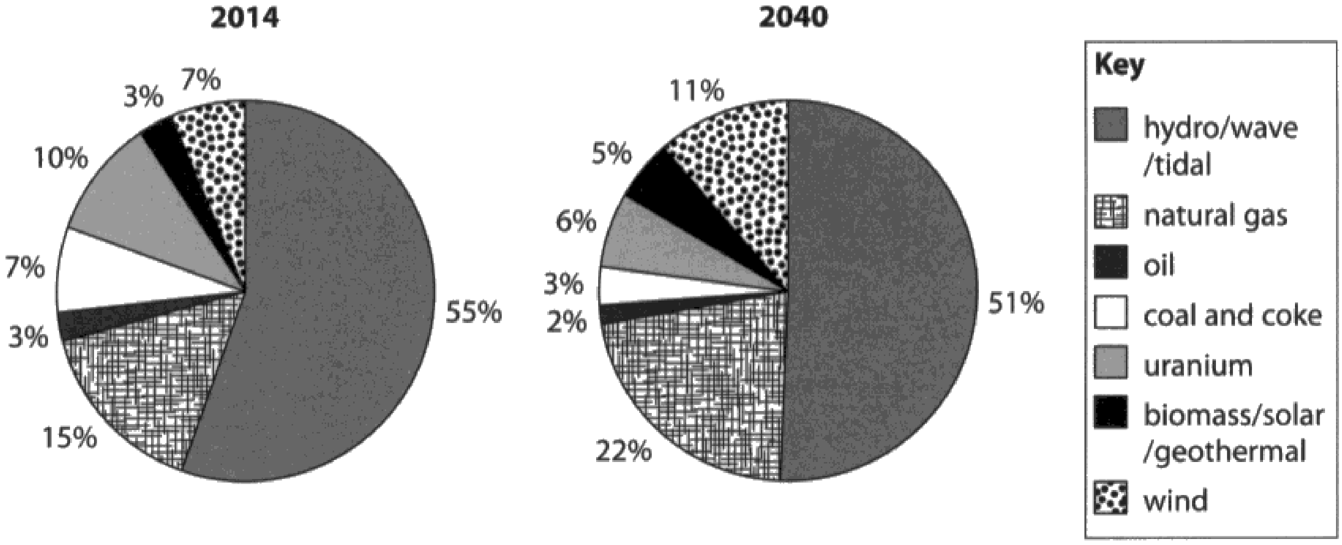

Figure 6

Discuss the effects on the environment of **two** predicted changes between 2014 and 2040.

(4)

change 1 less coal will be consumed in 2040 than 2014.

effect on the environment This will have a positive effect as less carbon dioxide (greenhouse gas) will be released into the atmosphere.

change 2 More wind energy will be consumed in 2040 than 2014.

effect on the environment It ~~will~~ won't produce any by-products but could cause visual pollution to some areas.

ResultsPlus
Examiner Comments

The response gains full marks because both the changes given are correct in terms of increases and decreases and the effect that each is likely to have on the environment is correctly described in scientific terms.

ResultsPlus
Examiner Tip

Identify the largest changes that you can see from the two pie charts and then consider if there is an increase or decrease. A change without the accompanying increase or decrease will not gain a mark. Then use your knowledge of factors like global warming or carbon dioxide emissions to give a scientific effect on the environment.

The answer shows a good analysis of the pie charts but does not give any scientific reason for the effect of the increase in the use of natural gas on the environment.

(c) Figure 6 shows all the energy sources used in Canada in 2014 and a prediction for 2040.

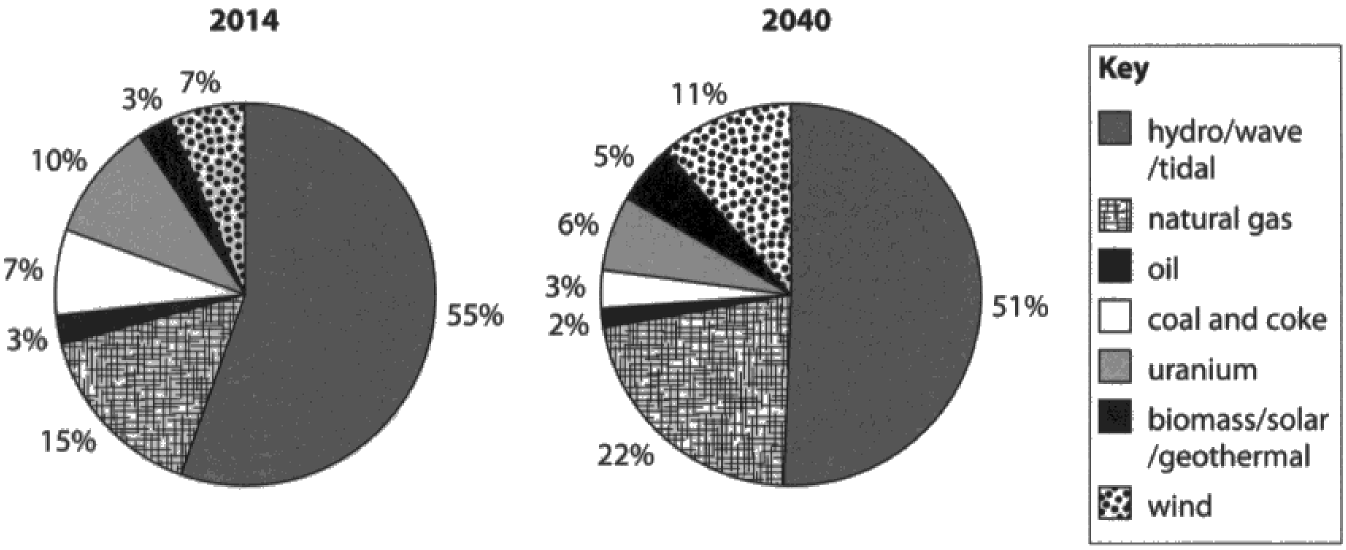

Figure 6

Discuss the effects on the environment of **two** predicted changes between 2014 and 2040.

(4)

change 1 oil is used less ~~[illegible]~~ in 2040 by 1%

effect on the environment less greenhouse gases being released into the atmosphere.

change 2 Wind power more in 2040 by 4%

effect on the environment It's renewable so it has less damage on the environment.

ResultsPlus
Examiner Comments

Indicates changes correctly but 'less damage to the environment' is not a scientific statement and is incorrect as it would give an increase in carbon dioxide.

ResultsPlus
Examiner Tip

Remember natural gas is a fossil fuel and is therefore non-renewable.

Question 4 (d)

There was only the occasional correct answer which suggested lubrication and even fewer that gave the reason for this as ‘reducing friction’.

Question 5 (a) (ii)

About half of the candidates could select a pair of co-ordinates from the line and determine a value for angle Y /angle X.

This question tested the skill of transferring information from one form to another.

(ii) Figure 9 is a graph of the student's results.

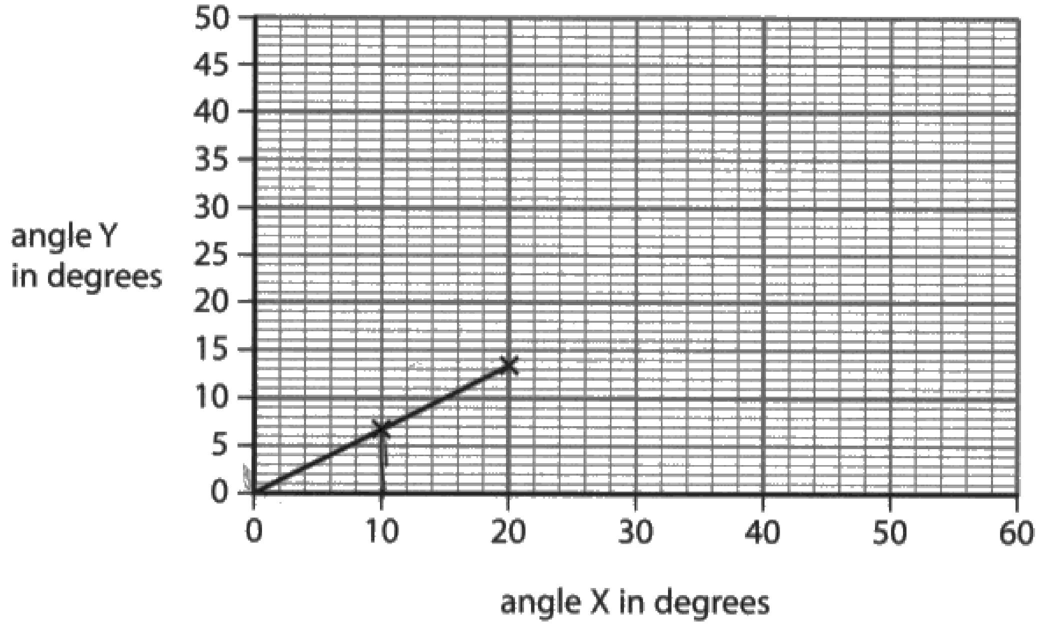

Figure 9

Use the graph to calculate a value for

$\frac{7}{10}$ $\frac{13}{20}$

$$\frac{\text{angle Y}}{\text{angle X}}$$

(2)

$$\frac{\text{angle Y}}{\text{angle X}} = 1.35$$

ResultsPlus
Examiner Comments

Most candidates could take the reading of angles X and Y but sometimes used them wrongly to give the wrong ratio.

ResultsPlus
Examiner Tip

Note the labels on the axes of the graph and the ratio to be found.

The sill of reading a graph correctly was tested.

(ii) Figure 9 is a graph of the student's results.

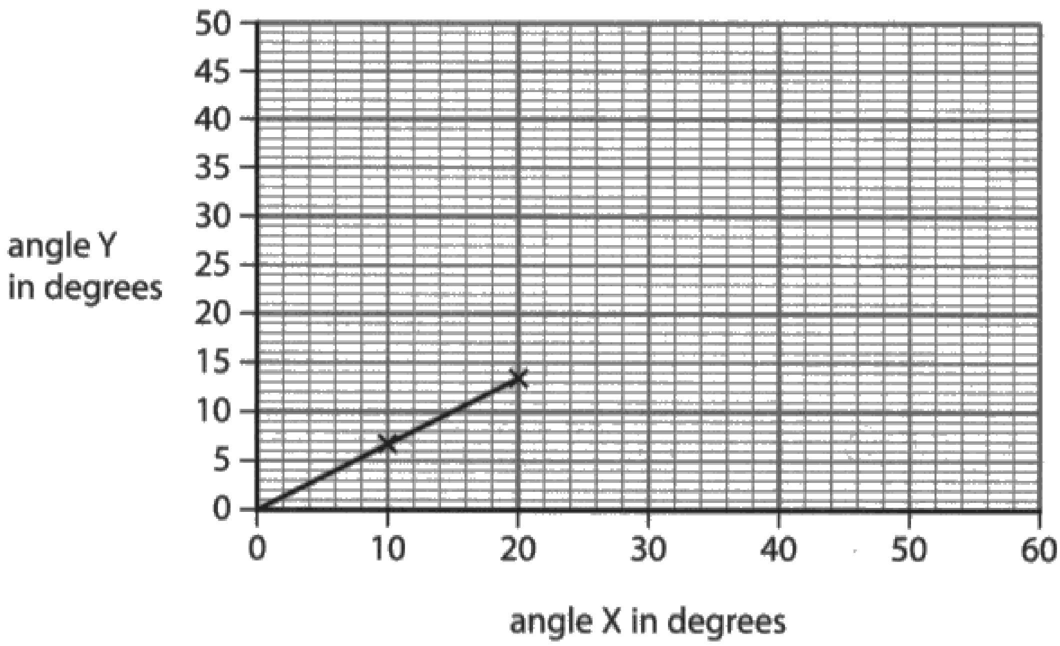

Figure 9

Use the graph to calculate a value for

$$\frac{\text{angle Y}}{\text{angle X}}$$

$\frac{14}{20}$

(2)

$\frac{\text{angle Y}}{\text{angle X}}$ = 0.7

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Examiner Comments

Information correctly transferred from the graph to the ratio.

ResultsPlus
Examiner Tip

The ratio was noted and then converted to a decimal.

Question 5 (a) (iii)

Although three marks were available for this question many candidates did not gain any marks. The question was based on a practical exercise and asked what a student must do to test the conclusion arrived at in 5aii in more detail. Many candidates stated 'plot more points 'and gained no marks because what is required is how the experiment has to be carried out to enable the results to be obtained so that the points can be plotted. Some candidates did suggest repeating the experiment or collecting more data but very few extended this to 'repeat for larger angles of X'.

The question requires a description of what the student must to practically to test the conclusion in more detail.

(iii) The student concludes that angle Y is directly proportional to angle X.

Explain what the student must do to test this conclusion in more detail.

(3)

get more data and plot it on the graph to see if it makes a straight line

ResultsPlus
Examiner Comments

'Get more data' was sufficient to gain one mark as was 'do a repeat'.

ResultsPlus
Examiner Tip

Remember this is a practical exercise and therefore you need to explain what you would do practically.

The practical work that needs to be done to test the conclusion in more detail is fully explained.

(iii) The student concludes that angle Y is directly proportional to angle X.

Explain what the student must do to test this conclusion in more detail.

(3)

Repeat the investigation op refraction until angle X has been changed - by intivals op 10 - to reach 60 degrees. This will then show a full investigation which will either prove or disprove the students original hypothesis.

ResultsPlus
Examiner Comments

The response includes the need to repeat at different angles and to extend the range of angles used. This is worth 3 marks.

ResultsPlus
Examiner Tip

Remember that when carrying out experiments to test conclusions more results are needed so the experiment has to be repeated and the validity of the conclusion can be tested by increasing the range over which the measurements are made.

Question 5 (b)

Only a few candidates gained more than one mark for this calculation although the equation was given and only a direct substitution was required to calculate the frequency. Candidates found the positive and negative indices very difficult to deal with but usually obtained 5.2 which was given to random powers of ten. Candidates usually gained a mark either for showing the substitution or giving the answer with a power of ten error. Hertz(Hz) was sometimes given as the frequency but s^{-1} was very rarely seen.

Using positive and negative powers of ten in a division calculation.

(b) The speed of light is 3.0×10^8 m/s.

The wavelength of yellow light is 5.8×10^{-7} m.

Calculate the frequency of yellow light.

State the unit.

Use the equation

$$\text{frequency} = \frac{\text{speed}}{\text{wavelength}}$$

(3)

$$\frac{3.0 \times 10^8}{5.8 \times 10^{-7}} = 5.17$$

frequency = 5.17 unit Hz

ResultsPlus
Examiner Comments

Candidates were able to show the substitution but could not use their calculators to deal with the negative power of ten as a divisor.

ResultsPlus
Examiner Tip

Practice using calculators to do negative power of ten calculations.

Question 5 (c) (i)

Many candidates were not able to recall the order of the colours of the visible spectrum with respect to wavelength.

Question 5 (c) (ii)

Many candidates were not able to recall the order of the colours of the visible spectrum with respect to frequency.

Question 6 (a)

Only a few candidates were able to gain more than one mark for this question and from the number of blank spaces it would appear that some candidates were not familiar with the apparatus shown. Those candidates that did gain marks generally achieved them for 'putting the rocks in front of the GM tube' or 'measuring each rock separately'. There was rarely a mention of background radiation, or keeping each rock at the same distance from the tube.A popular misconception was that the rock was put inside the GM tube.There was also much irrelevant information on safety precautions or the addition of absorbers such as paper or aluminium.

It was apparent from the responses to this question that many candidates were not familiar with experiments that showed measurements being made with a Geiger-Muller(GM) tube

6 Figure 10 shows a Geiger-Müller (GM) tube used for measuring radioactivity.

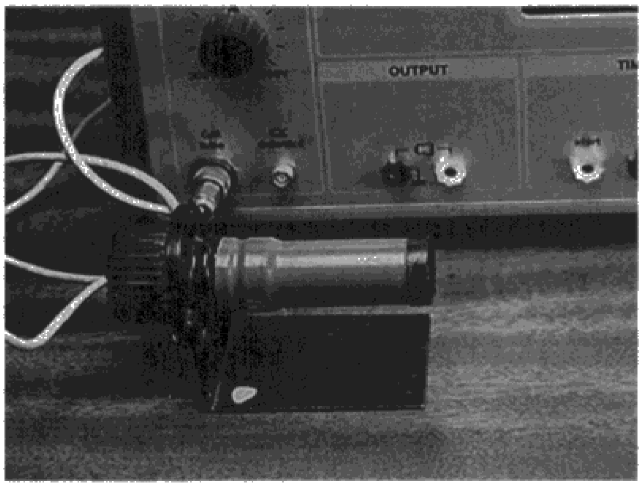

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Figure 10

(a) Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

→ Placing the one rock near the GM for a certain time

→ Recording amount of radio activity per minute.

→ Placing other rock near the GM for the same amount of time and recording the amount of radio activity from the rock.

→ Put both result's into a graph to see differ-ences.

ResultsPlus
Examiner Comments

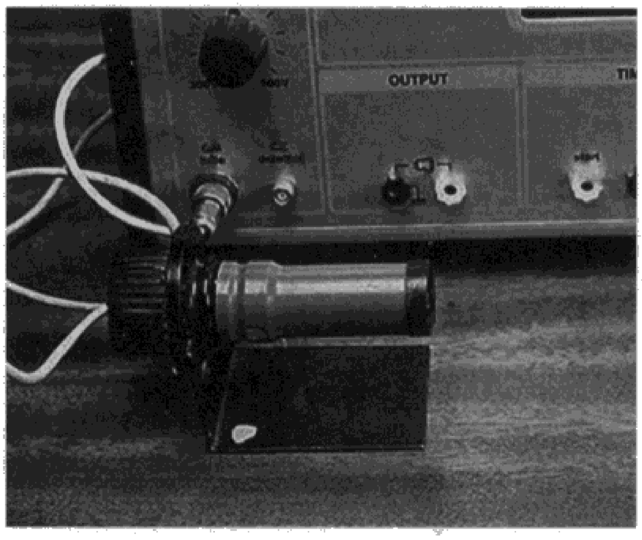
This response gives the three most common responses of having a rock near the GM tube, for a given time and then repeating the experiment with the second rock.

ResultsPlus
Examiner Tip

Learn the experimental procedures that are used for measuring instruments given in the specification.

This response fully explains how the GM tube should be used to compare the count rate of two different radioactive rocks.

6 Figure 10 shows a Geiger-Müller (GM) tube used for measuring radioactivity.



©Andrew Lambert Science Photo Library

Figure 10

(a) Describe how a teacher should use a Geiger-Müller (GM) tube to compare the count-rates from two different radioactive rocks.

(4)

~~add~~ place ~~Rad~~ a radioactive rock ~~to~~ next to the GM tube and see how much it counts in 10 seconds, reset the GM meter Then get a different radioactive rock, place it at the same distance from the GM tube, ~~then compare the results,~~ ~~the~~ and leaves the same amount of time. then compare the results, the more counts it has, the more radio active the rock

ResultsPlus
Examiner Comments

The answer gives a very good description of the experimental process and could only be improved if the background count had been taken into consideration.

ResultsPlus
Examiner Tip

The use of instruments used to make measurements needs to be learnt so that a detailed description can be given.

Question 6 (b)

There were many blank responses. The concept of half-life was not well enough understood by many candidates to allow them to work out the points that had to be plotted using the information in the stem of the question. However, a significant number of candidates did gain a mark for drawing the shape of a radioactive decay curve which started at 80 but did not pass through any of the calculated points. Those few candidates that were able to work out the count rate for each of the half-lives were then likely to plot the second point wrongly because they misread the horizontal scale on the graph.

In this question candidates had to plot a graph from points which they had to be determine.

(b) A hospital uses a radioactive isotope with a half-life of 6 hours.

A technician measures a count rate of 80 counts per minute (cpm) from this isotope.

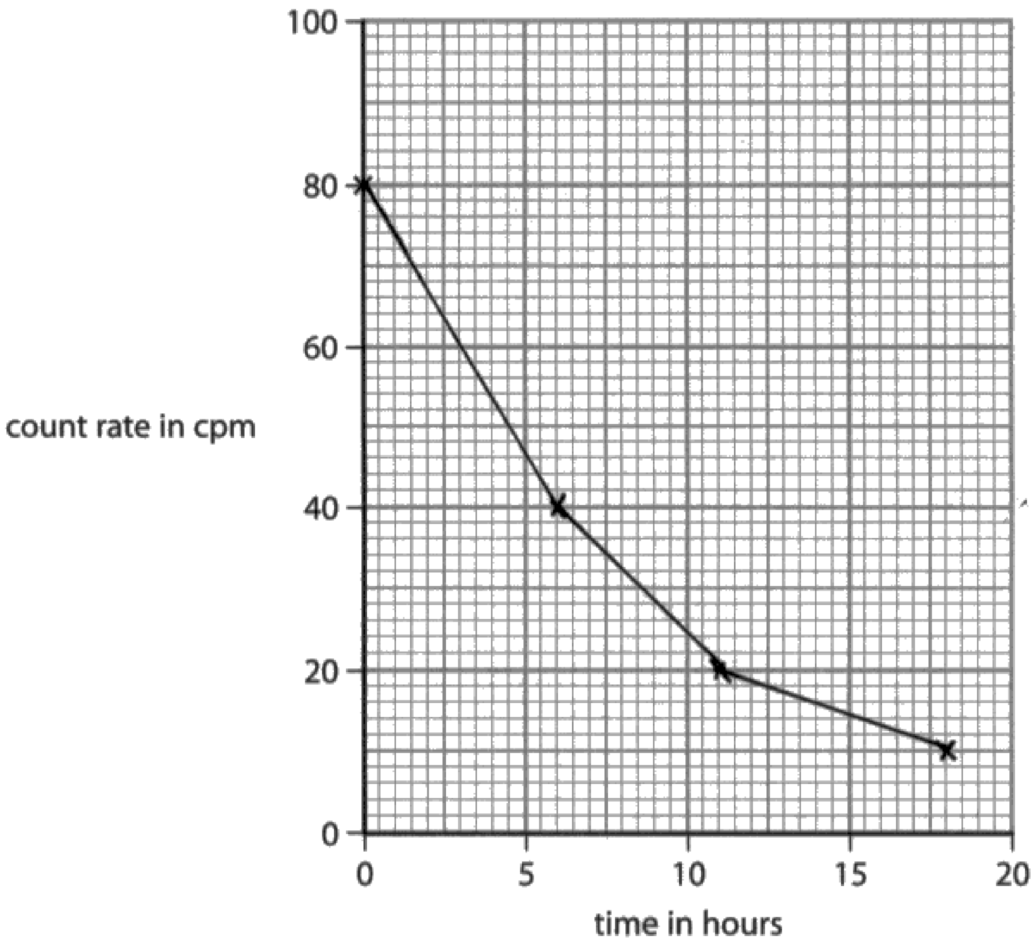


Figure 11

Complete the graph on Figure 11, as accurately as possible, to show how the count-rate from this isotope will change from the time of the first measurement.

The first point is already drawn in Figure 11.

(3)

ResultsPlus
Examiner Comments

The first and third points plotted on the graph are correct, however the second point is plotted at 11,20 stead of 12,20 because the scale on the horizontal axis has been misread. With only two correct points, if the graph had been a smooth curve instead of dot-to dot, then the third mark would have been awarded.

ResultsPlus
Examiner Tip

Read scales on graphs carefully to plot points correctly and use a smooth curve to join points that appear to be in the form of a curve.

Plotting a graph.

(b) A hospital uses a radioactive isotope with a half-life of 6 hours.

A technician measures a count rate of 80 counts per minute (cpm) from this isotope.

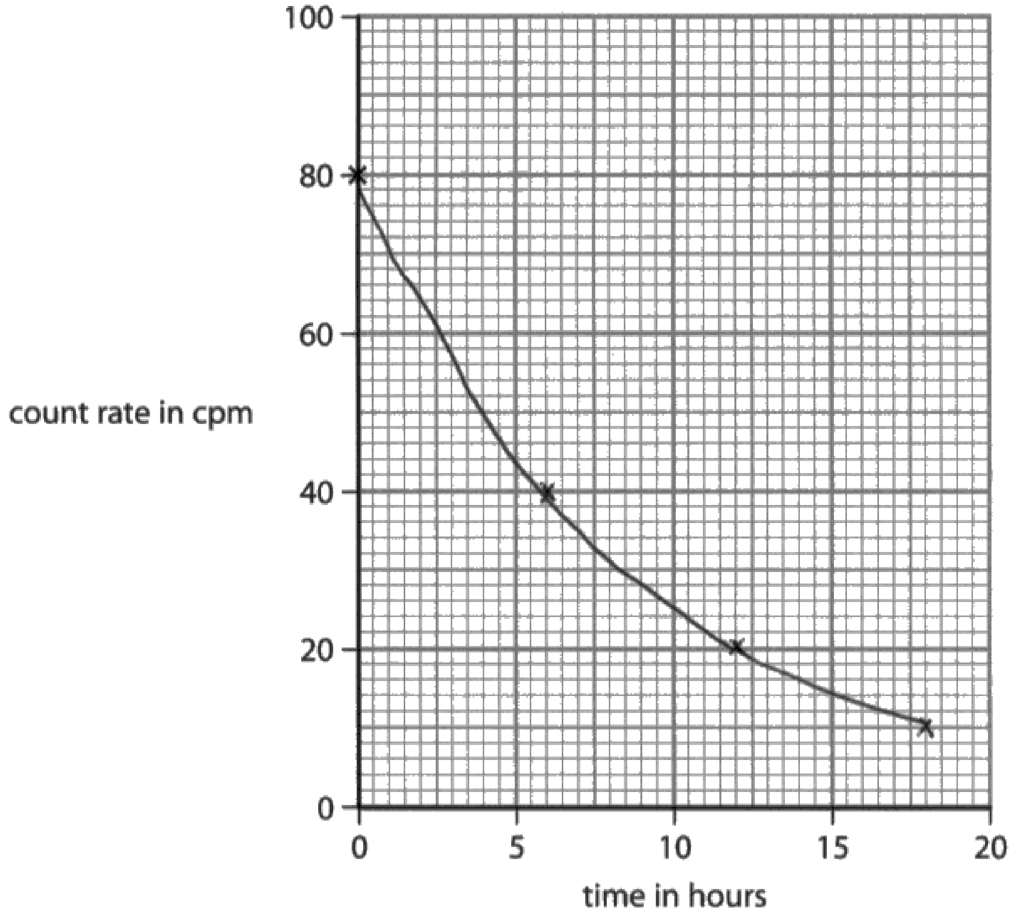


Figure 11

Complete the graph on Figure 11, as accurately as possible, to show how the count-rate from this isotope will change from the time of the first measurement.

The first point is already drawn in Figure 11.

(3)

ResultsPlus
Examiner Comments

The response shows the points plotted correctly and a smooth curve used to join them.

ResultsPlus
Examiner Tip

If you know that a decay curve is a smooth curve starting at 80 with a decreasing gradient then show this on the graph even if you cannot calculate the points. Give the examiner the opportunity to award marks for what you do know.

Question 6 (c)

6c The majority of candidates were able to achieve level 1 generally because they made some reference to one of the columns of data. The candidates generally did not associate the data with the need to mention alpha, beta and gamma radiation. If this link was made and the names of the radiations included then level 2 or 3 could be achieved. Candidates were often confused by the four count rates in the table and three types of radiation being mentioned and were not aware of background radiation.Those candidates that realised the question referred to alpha,beta and gamma radiation often limited their response to level 2 by not making effective use of the data in the table or suggesting the absorbers were in fact emitting the radiation.

This response attempts to use the data but does not link this to alpha, beta and gamma radiation. This limits the response to Level 1.

*(c) A radioactive rock is placed near to the front of a Geiger-Müller (GM) tube. A radioactivity count-rate is first made in air.

The count-rate is measured again with each of three different absorbers between the rock and the GM tube.

Figure 12 shows the count-rates measured.

absorber	count-rate in counts per minute
3 cm of air	1272
thin sheet of paper	931
3 mm thick sheet of aluminium	328
2 cm thick sheet of lead	21

Figure 12

A scientist has an idea that the rock emits three different types of radiation.

Explain how the data in this table supports the scientist's idea.

(6)

this is because some radiations can't pass through paper ~~as~~ ~~pa~~ and nor pass through alluminium whereas some can pass through ~~p~~ ~~both~~ paper and another can even pass through lead ~~a~~ Meaning 3 radiations are emitting as they are all able to pass these barriers to get a count ~~of~~ rate?

ResultsPlus
Examiner Comments

There is no use of the quantitative values given in the table and there is no mention of the types of radiation which can pass through the absorbers.

ResultsPlus
Examiner Tip

Read the question carefully and use the information in the stem, as well as that given in the table. Remember if numerical values are given then you will be expected to use them.

The response uses more of the information provided and shows relevant understanding. Judgements are supported by evidence which makes this response Level 2.

*(c) A radioactive rock is placed near to the front of a Geiger-Müller (GM) tube. A radioactivity count-rate is first made in air.

The count-rate is measured again with each of three different absorbers between the rock and the GM tube.

Figure 12 shows the count-rates measured.

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Figure 12

A scientist has an idea that the rock emits three different types of radiation.

Explain how the data in this table supports the scientist's idea.

(6)

Because it can go through a 2 cm thick sheet of lead this means that it could be gamma. The thin sheet of paper could be alpha and because it goes through aluminium it could be beta so this shows that it could be three different types of radiation. eg gamma, alpha and beta

ResultsPlus
Examiner Comments

This answer meets the requirements of a level 2 response. There are some logical connections but the work is unbalanced and incomplete.

ResultsPlus
Examiner Tip

Remember to use all the information that is available and quote values whenever possible.

The response deals with the three radiation types, presents a coherent argument concerning the penetration of the radiations by the different absorbers and is worthy of a Level 3.

*(c) A radioactive rock is placed near to the front of a Geiger-Müller (GM) tube. A radioactivity count-rate is first made in air.

The count-rate is measured again with each of three different absorbers between the rock and the GM tube.

Figure 12 shows the count-rates measured.

	absorber	count-rate in counts per minute
	3 cm of air	1272
alpha	thin sheet of paper	931
beta	3 mm thick sheet of aluminium	328
gamma	2 cm thick sheet of lead	21

Figure 12

A scientist has an idea that the rock emits three different types of radiation.

Explain how the data in this table supports the scientist's idea.

(6)

- alpha particles are able to be stopped by a thin sheet of paper as it is very ionising, but not very penatrating, which in the results table can be seen to be decrease to 931.
- beta particles are stopped by 3mm thick sheet of aluminium, as beta particles are modetly ionising; which is shown in the decrease of count-rate per minute.
- gamma rays are able to be stopped by a thick sheet of lead as it isn't very ionising however, is very penatrating which again in the table shows a decrease.

ResultsPlus
Examiner Comments

Although the candidate has only quoted one of the numerical values and has included irrelevant statements about ionisation there is enough of a logical argument linked to the data to award a Level 3.

ResultsPlus
Examiner Tip

When the question asks for the data in the table to be used, consider the data as the start of your reasoning and link this to the types of radiation that you know are detected by the Geiger-Muller tube.

Paper Summary

Based on their performance on this paper, candidates are offered the 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
- Learn to evaluate positive and negative indices using your calculator
- 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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