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Examiners' Report
June 2019

GCSE Combined Science 1SC0 1PF

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June 2019
Publications Code 1SC0_1PF_1906_ER

Introduction

The questions on this paper test the knowledge, application and the ability to analyse information at foundation level. The paper covers physics topics as one of the three papers that make up the Combined Science specification, the other two papers covering topics in biology and chemistry.

The following topics are covered by the specification:

- 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 carried out through multiple choice, short answers, extended writing, calculations and analysis. The specification includes core practical investigations. Questions are set to test the skills that students have acquired in completing these practical activities. Some students appear to be unfamiliar with the use of standard laboratory equipment and how the experimental work is carried out. The specification also includes a number of suggested practical activities which will help students' understanding and exemplify points in the specification.

Most students could substitute into equations correctly although a few were unable to identify the meaning of some symbols used in equations, seemingly being unaware that each symbol is named in the list of equations on the back page of the examination paper. Rearrangement of equations still presents some difficulties, as does the use of standard form, significant figures and rounding. Many students were unable to recall equations and need to become familiar with the equations in the specification that they may need to recall.

Students found questions based on Topic 6, radioactivity, the most challenging. It is apparent that students have difficulty in visualising the models used to explain the structure of the atom and the radioactive particles, as many responses were very confused.

Question 1 (a) (i)

The question shows a speed-time graph for a car with four sections labelled P, Q, R and S.

Section P shows a rising slope, section Q a horizontal velocity, section R a falling slope, and section S, a horizontal line at zero speed.

Four boxes then give possible descriptions of the motion of the car.

This question tested the candidates ability to identify the sections of a speed time graph by linking the the part of the graph to the description of the motion.

The majority of candidates were able to identify the rising slope on the graph in section P as the car accelerating, the horizontal line in section Q as the car travelling at a constant speed, the falling slope in section R as the car decelerating, and the horizontal line at zero speed in section S as the car standing still.

Question 1 (a) (ii)

The candidates had to identify which parts of the graph showed that the horizontal forces on the car were balanced.

When forces are balanced there can be no acceleration or deceleration as a resultant force is needed for acceleration or deceleration.

About half of the candidates were able to identify the sections Q and S as the parts of the graph where the forces were balanced because the car was not accelerating or decelerating.

Question 1 (a) (iii)

Students were required to use the equation for distance travelled, which was given, and substitute the values of average speed and time for section Q on the graph.

The average speed for section Q was 30m/s and the majority of students were able to select this as it was the constant value on the graph. However, many students did not select the correct time of 100 seconds by subtracting 50s from 150s as the extent of section Q on the graph.

The correct substitution being distance travelled = 30 x 100 giving the evaluation of 3000m.

Many students used an incorrect time but if the time was substituted correctly in the equation then a mark was awarded.

The graph has to be used to determine values for use in the equation; it is therefore very important to read the graph correctly.

(iii) Calculate the distance travelled by the car in part Q.

Use the equation

distance travelled = average speed × time

(2)

30 x 150 = 4500

distance travelled = 4500 m

ResultsPlus
Examiner Comments

The student has shown the substitution used which allows the first mark to be awarded.The graph had been read incorrectly giving the time for travel in sections P and Q, rather than only for section Q.

ResultsPlus
Examiner Tip

Read the question carefully to check the the correct information has been taken from the graph.

Only one mark is awarded as the time used is incorrect.

(iii) Calculate the distance travelled by the car in part Q.

Use the equation

distance travelled = average speed × time

(2)

average speed = distance / time

30 × 250 = 7500

distance travelled = 7500 m

ResultsPlus
Examiner Comments

The value for average speed has been correctly substituted but the time given is the total time for the journey. This gains one mark

ResultsPlus
Examiner Tip

Read the question carefully and use the correct section of the graph to determine the time taken.

Question 1 (b)

The equation force = mass x acceleration is given for students to substitute values of mass and acceleration directly from the question to determine the force acting on a car.

The working shows a correct substitution of numerical values and subsequent correct evaluation which gains two marks.

(b) A car with a mass of 1800 kg is accelerating at 1.2 m/s².

Calculate the force used to accelerate the car.

Use the equation

force = mass × acceleration

(2)

1800 x 1.2m/s = 2160

force = 2160 N

ResultsPlus
Examiner Comments

Units should not be given in a calculation and it should be noted that the unit given is incorrect for acceleration. It is only the answer line that requires a unit and this is usually given on the paper.

ResultsPlus
Examiner Tip

Just insert numerical values into simple equations.

Although the equation is given in the question the substitution into the equation is not shown and as the evaluation is incorrect no mark can be awarded.

(b) A car with a mass of 1800 kg is accelerating at 1.2 m/s².

Calculate the force used to accelerate the car.

Use the equation

force = mass × acceleration

(2)

force = 2592 N

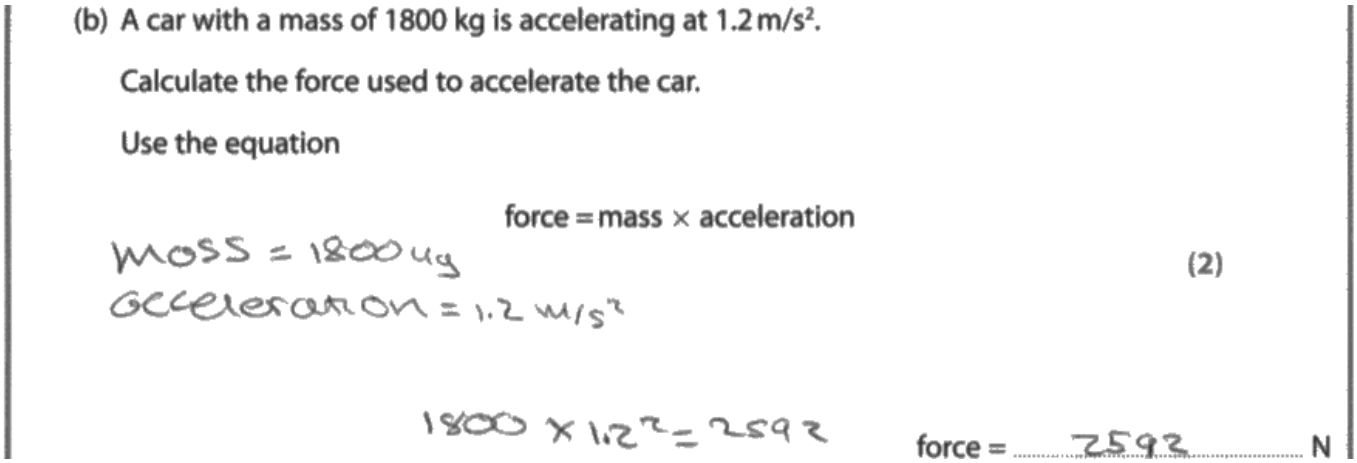
ResultsPlus
Examiner Comments

The working for any calculation should be shown as it may gain a mark.

ResultsPlus
Examiner Tip

Always show the substitution even if the answer is wrong; a mark may be gained

This response shows an incorrect substitution, confusion arising because the unit for acceleration is m/s^2; this has lead the student to square the numerical value for acceleration.



(b) A car with a mass of 1800 kg is accelerating at 1.2 m/s^2.

Calculate the force used to accelerate the car.

Use the equation

force = mass × acceleration

mass = 1800 kg

acceleration = 1.2 m/s^2

(2)

$1800 \times 1.2^2 = 2592$

force = 2592 N

ResultsPlus
Examiner Comments

The acceleration is measured in m/s^2 and the student has squared the numerical value of acceleration, giving an incorrect evaluation.

ResultsPlus
Examiner Tip

Ignore the units, just substitute the numerical values for each symbol in the equation.

It is only if the equation has a squared quantity, as in K E =i/2 x m x v^2, that the numerical value has to be squared.

Question 2 (a) (i)

This question uses a Sankey diagram to test if students can calculate waste energy, being given the input energy and the useful energy.

The majority of students were able to subtract the useful energy from the input energy to find the waste energy:

2000 -160 =1840 J

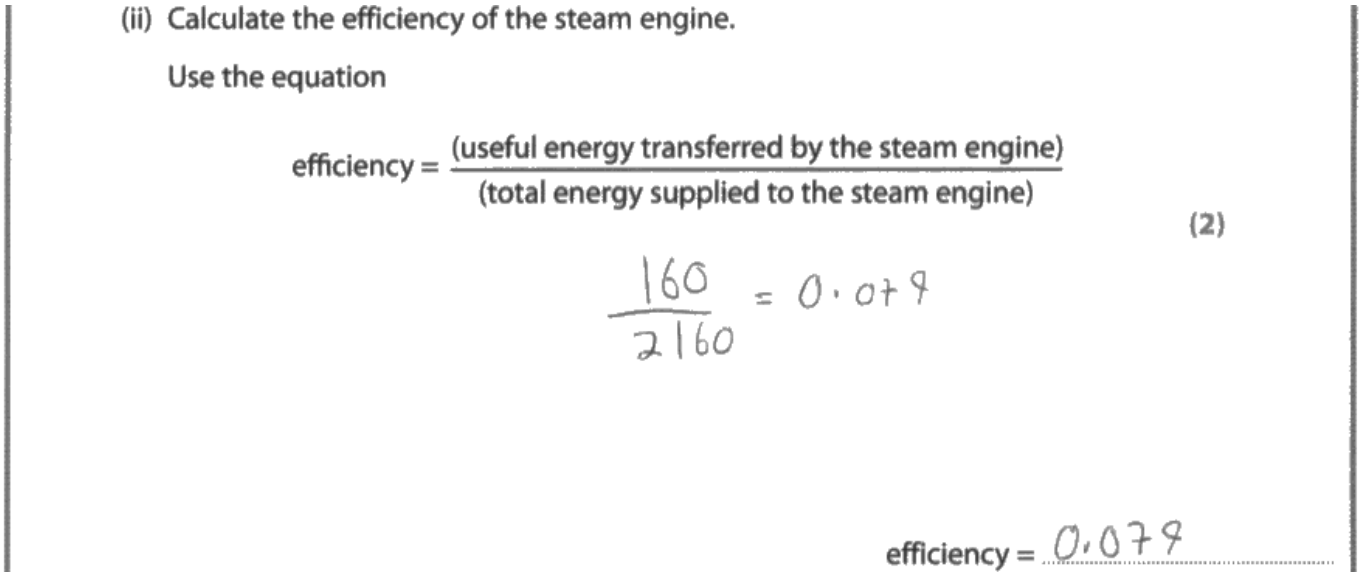
Question 2 (a) (ii)

The question requires students to use the values of input energy and useful energy on the Sankey diagram and use these values to calculate efficiency using the equation that was given.

More than half of the candidates were able to complete this calculation correctly. Most errors came in misreading or transcribing wrongly the values the diagram.

Some students calculated the value as 8% and this was acceptable. Some candidates did not realise that efficiency is a ratio and therefore has no units. Any units given were ignored.

The correct values must be identified for use in the equation.



(ii) Calculate the efficiency of the steam engine.

Use the equation

$$\text{efficiency} = \frac{\text{(useful energy transferred by the steam engine)}}{\text{(total energy supplied to the steam engine)}}$$

(2)

$\frac{160}{2160} = 0.074$

efficiency = 0.074

ResultsPlus
Examiner Comments

The student has added the useful energy to the input energy when just the input energy should have been used in the equation.

The answer 0.079 does not get a mark. It does round to 0.08 but rounding is not given in the question as this answer derives from an incorrect substitution.

ResultsPlus
Examiner Tip

Make sure you substitute the values that are given in the question.

The student correctly selects values for the input energy and the useful energy and shows the substitution and evaluation.

(ii) Calculate the efficiency of the steam engine.

Use the equation

$$\text{efficiency} = \frac{\text{(useful energy transferred by the steam engine)}}{\text{(total energy supplied to the steam engine)}}$$

(2)

160 / 2000

efficiency = 0.08

ResultsPlus
Examiner Comments

All the information necessary to complete the calculation has been given in the question and it is necessary to realise that the two values shown in the equation have to be divided.

ResultsPlus
Examiner Tip

Look for information in the question and fill in the values in the equation as it is given.

Question 2 (a) (iii)

Having shown that the efficiency of the steam engine is 0.08 then this question asks what happens to the wasted energy and an answer in terms of transfer of energy to another form or where the energy goes is acceptable.

The student has to state what happens to the waste energy and has done this by correctly giving an energy transfer to heat energy.

(iii) State what happens to the wasted energy.

It is wasted in heat energy. (1)

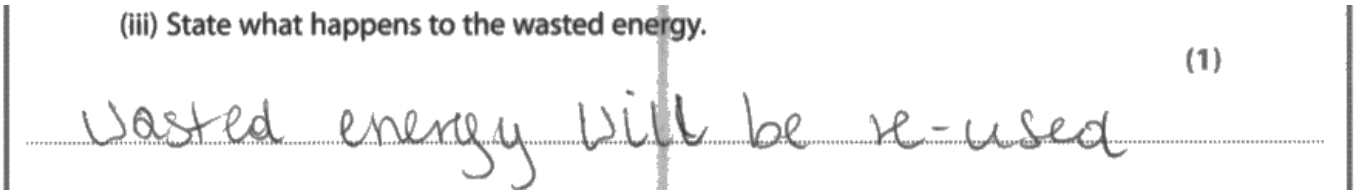
ResultsPlus
Examiner Comments

This answer 'sufficient heat energy' is accepted as an alternative to thermal energy.

ResultsPlus
Examiner Tip

When answering questions on energy always name the energy or where the energy is going.

'Waste energy will be re-used' is not sufficient to gain a mark; it is a generalisation and answers need to be specific.



ResultsPlus
Examiner Comments

The answer is a generalisation and it needs to be specific in naming the energy transfer.

ResultsPlus
Examiner Tip

Give the name of an energy to which the waste energy can be transferred or to where it is transferred.

This answer gives 'where the energy is transferred to', in this case the surroundings, but air, atmosphere or steam (as it is a steam engine) would also have been acceptable.

(iii) State what happens to the wasted energy.

(1)

It goes into the surroundings and transferred into another type of energy.

ResultsPlus
Examiner Comments

Dissipated to the surroundings would be a very good answer.

ResultsPlus
Examiner Tip

Remember to be specific about the energy names.

Question 2 (a) (iv)

The question is concerned with coal as a fossil fuel and how it might be harmful to the environment.

A variety of acceptable answers were related to the production of carbon dioxide. Other specific particles in the air and their effect was also acceptable.

The wide variety of possible correct answers gave most students the opportunity to gain one mark.

'Causes pollution' was not sufficiently specific to gain a mark whereas 'Air pollution' would have gained a mark.

(iv) Coal is a fossil fuel that is burnt in some steam engines.

State **two** ways that the use of coal might be harmful to the environment.

(2)

1 it causes powution

2 it can have an effect on wildlife (~~the~~ darken trees).

ResultsPlus
Examiner Comments

In answering this question specific information needs to be given.

Having an effect on wild life would not have gained a mark but the addition of
'darkening trees' fits the mark scheme under addition guidance.

ResultsPlus
Examiner Tip

Do not use generalisations, give specific examples.

Many students gave the release of carbon dioxide as being harmful to the environment and this gained a mark. However, adding to this 'global warming', climate change', did not gain a futher mark as this is amplification of the same point.

(iv) Coal is a fossil fuel that is burnt in some steam engines.

State **two** ways that the use of coal might be harmful to the environment.

(2)

1 Releases CO_2 in the atmosphere - adds to global warming

2 Coal has to be dugged up from ~~the earths~~ underground

ResultsPlus
Examiner Comments

The answer gains two marks for two different causes of harm to the environment, release of CO_2 and the fact that the coal is 'dug up from under ground'

ResultsPlus
Examiner Tip

When asked for two examples make sure they are different.

Question 2 (b)

This question is a calculation in which all the values and the equation to be used are given.

Many students were unable to complete the substitution correctly because of the confusion between units and equation.

The speed is measured im m/s but the equation gives speed squared and because there is no square on the unit students ignore the need to square the speed for the calculation.

The example shows that the student has put in the unit instead of just using the value of speed and squaring the speed as given in the equation.

(b) A model train has a mass of 8.0 kg.
It travels at a speed of 1.5 m/s.

Calculate the kinetic energy of the model train.

Use the equation

kinetic energy = ½ × mass × (speed)²

(3)

$ke = \frac{1}{2} \times 8.0 \times 1.5\ m/s = 6.$

kinetic energy = 6 J

ResultsPlus
Examiner Comments

Since the evaluation is correct for the working shown then 2 marks are awarded.

ResultsPlus
Examiner Tip

Remember to square the value of speed when it is squared in the equation.

When the equation is given students should always show the substitution as this is not only ensures getting a mark for correct substitution but also helps in seeing how to complete the calculation using their calculator.

(b) A model train has a mass of 8.0 kg.
It travels at a speed of 1.5 m/s.

Calculate the kinetic energy of the model train.

Use the equation

kinetic energy = ½ × mass × (speed)²

(3)

$\frac{1}{2} \times 8.0 \times 1.5^2$

kinetic energy = 9 J

ResultsPlus
Examiner Comments

The correct substitution and evaluation gives 3 marks as the value of 1.5 must have been correctly squared to give the correct evaluation.

ResultsPlus
Examiner Tip

Remember to square 1.5 when calculating the answer.

Question 3 (a) (i)

This question required students to fill in the blanks in two sentences having been given a choice of five words: absorbing, gaining, inner, losing and outer.

The first sentence:

'Atoms may form positive ions by... electrons.' The majority of students realised the answer was 'losing' or 'gaining' but less than half the students gave the correct answer 'losing'

The second sentence:

'The electrons involved in formingpositive ions are the... electrons.' Generally students chose 'inner' or 'outer' with about half selecting the correct answer of 'outer'.

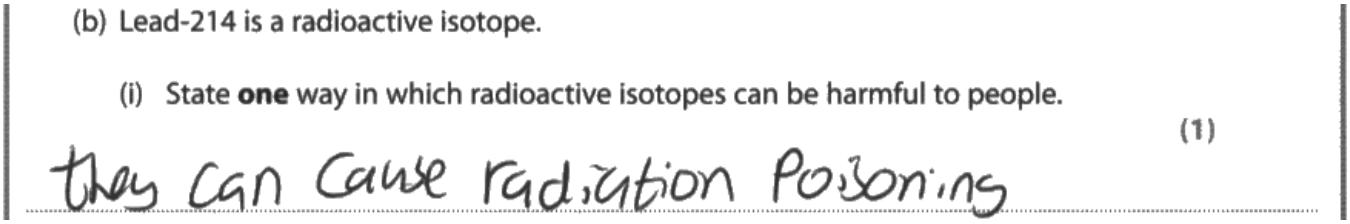
The question shows that whilst students have an idea about the structure of the atom they are not certain of the detail.

Question 3 (b) (i)

A radioactive isotope is named and students are asked why the radioactive isotopes can be dangerous to humans.

The majority of students were able to name cancer as the most likely cause of harm to humans but radiation poisoning was also given quite frequently as was the mutation of cells or damage to DNA.

An answer which was frequently seen.


(b) Lead-214 is a radioactive isotope.

(i) State **one** way in which radioactive isotopes can be harmful to people.

(1)

they can cause radiation poisoning

ResultsPlus
Examiner Comments

Radiation poisoning is the second marking point.

ResultsPlus
Examiner Tip

Remember that just 'is can cause poisoning' or 'it is toxic' is not specific enough to gain a mark.

The type of damage to skin must be specified such as 'it can burn the skin' or 'damage DNA in cells' for a mark to be awarded.

(b) Lead-214 is a radioactive isotope.

(i) State **one** way in which radioactive isotopes can be harmful to people.

(1)

it can damage skin

ResultsPlus
Examiner Comments

The response does not specify the type of damage.

ResultsPlus
Examiner Tip

'Damage' on its own is not specific enough for a mark to be awarded.

This answer is sufficient to gain a mark for two different points although only one mark can be awarded.

(b) Lead-214 is a radioactive isotope.

(i) State **one** way in which radioactive isotopes can be harmful to people.

(1)

can cause cancer due to the radioactivity causing cells to mutate

ResultsPlus
Examiner Comments

'Causes cancer' gains the mark but causes 'cells to mutate' is also a response that could be awarded a mark.

ResultsPlus
Examiner Tip

'Causes mutation' would not be sufficient to gain a mark; the mutation must be linked to cells or DNA or genes.

Question 3 (b) (ii)

Very few students were able to provide the correct answer to this question either because they did not know that the nucleus contained neutrons and protons or they had no understanding that a Beta minus particle is an electron and that it is emitted from the nucleus, and this changes a neutron to a proton. The answer could have been given in terms of mass number and atomic number with the mass number being constant but the atomic number increasing by one.

This answer gains a mark for the recognition that something happens to the neutons in the nucleus when a beta minus particle is emitted. The idea that the loss of beta minus decreases the size of the nucleus of an atom was a popular misconception.

being so high.

(ii) Lead-214 emits β^- particles.

Describe what happens to the nucleus of a lead-214 atom when it emits a β^- particle.

(2)

It begins to decrease in protons and neutrons meaning the nucleus will decrease in size.

ResultsPlus
Examiner Comments

Learn that when a beta minus particle is emitted from a nucleus then a neutron changes to a proton.

ResultsPlus
Examiner Tip

Learn what happens to the protons and neutrons in the nucleus of an atom when a beta minus particle is emitted and also learn that a beta minus particle is an electron.

This response gained both marks.

(ii) Lead-214 emits β^- particles.

Describe what happens to the nucleus of a lead-214 atom when it emits a β^- particle.

(2)

Nucleus takes a neutron splits it into 2 one as a proton and the other as a electron then the electron emits making the lead atom stable

ResultsPlus
Examiner Comments

The neutron splitting into two infers a chain reaction rather than the emission of an electron, but the idea is correct and gains both marks.

ResultsPlus
Examiner Tip

The student knows the process of beta minus emission and explains it quite well.

Question 3 (d)

The question gave the mass of the proton and the mass of the electron in standard form and students were required to calculate how many times the mass of the proton was greater than the mass of the electron.

Students needed to show in their working the ratio of the mass of the proton to the mass of the electron and then divide the numbers to evaluate how many times greater was the mass of the proton compared to the mass of the electron.

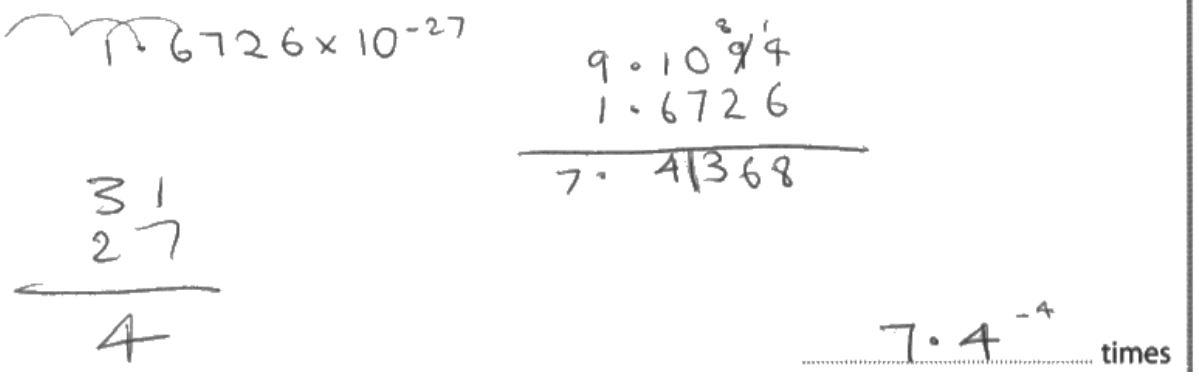
Although the student has shown their working, the ratio is inverted giving an incorrect value. However the value obtained has been given to two significant figures and a mark is gained for this.

(d) The mass of a proton is 1.6726×10^{-27} kg.
The mass of an electron is 9.1094×10^{-31} kg.

Calculate how many times the mass of a proton is greater than the mass of an electron.

Give your answer to two significant figures.

(3)



ResultsPlus
Examiner Comments

As the mass of the proton compared to the mass of the electron is required then the ratio should be written as the mass of proton divided by the mass of the electron.

ResultsPlus
Examiner Tip

Remember to look at the negative powers of ten to see that the proton is much heavier than the electron.

The working is set out correctly giving the correct evaluation and this is then given as two significant figures.

(d) The mass of a proton is 1.6726×10^{-27} kg.
The mass of an electron is 9.1094×10^{-31} kg.

Calculate how many times the mass of a proton is greater than the mass of an electron.

Give your answer to two significant figures.

(3)

1.6726×10^{-27} [redacted]

9.1094×10^{-31}

$= 1836.125321$

1800 times

ResultsPlus
Examiner Comments

The student is able to use the calculator to complete the calculation and understands significant figure rules.

ResultsPlus
Examiner Tip

Learn to use a calculator for calculations which are given in standard form.

Question 4 (a) (ii)

The question is about a cyclist travelling down a slope, the height of the slope is 20m and the mass of the cyclist is 75kg. Students had to recall the equation for gravitational potential energy GPE = m x g x delta h in order to complete the calculation to find the change in the gravitational potential energy as the cyclist comes down the slope. The value of g, the gravitational field strength, was given as 10N/kg.

The majority of candidates were unable to recall the equation accurately, many divided by 10 rather than multipling by 10. Very few actually wrote down the equation and then made the substitution. If it was done correctly this was seen from the numbers 75 x10 x 20 multiplied together.

Writing the equation in a recall question is very helpful as is making a correct substitution and evaluation.

(ii) A cyclist travels down a slope.
The top of the slope is 20 m vertically above the bottom of the slope.
The cyclist has a mass of 75 kg.

Calculate the change in gravitational potential energy of the cyclist between the top and the bottom of the slope.

The gravitational field strength, g, is 10 N/kg.

(3)

GPE = m x g x Δh

GPE = 75 x 10 x 20

© = 15000

change in gravitational potential energy = 15000 J

ResultsPlus
Examiner Comments

This example is completely correct and fits all the points on the mark scheme.

ResultsPlus
Examiner Tip

Learn the equations that you may have to recall.

This student has correctly recalled the equation for gravitational potential energy and knows that delta h is a change in height and has not taken the bottom of the slope to be at zero metres.

(ii) A cyclist travels down a slope.
The top of the slope is 20 m vertically above the bottom of the slope.
The cyclist has a mass of 75 kg.

Calculate the change in gravitational potential energy of the cyclist between the top and the bottom of the slope.

The gravitational field strength, g, is 10 N/kg.

(3)

gpe = gfs x mass x Δh

gpe = 10 x 75 x 18 =

change in gravitational potential energy = 13,500 J

ResultsPlus
Examiner Comments

The substitution and evaluation need to be correct to gain the second and third mark.

ResultsPlus
Examiner Tip

Read the question carefully to understand the values that are given and how they relate to the equation.

With no working shown and an incorrect evaluation no mark can be awarded.

(ii) A cyclist travels down a slope.
The top of the slope is 20 m vertically above the bottom of the slope.
The cyclist has a mass of 75 kg.

Calculate the change in gravitational potential energy of the cyclist between the top and the bottom of the slope.

The gravitational field strength, g, is 10 N/kg.

(3)

change in gravitational potential energy = 1500 J

ResultsPlus
Examiner Comments

It is most likely that the student either missed the ten in the equation or got the equation right and wrongly evaluated but there is no way of knowing and questions which have g= 10N/kg in the calculation are not allowed a power of ten error, therefore no marks are scored.

ResultsPlus
Examiner Tip

Learn equations that may need recalling and always show your working.

Question 4 (b)

The question requires students to substitute into a given equation and evaluate.

Students needed to know the meaning of the symbols or look them up on the back page of the examination paper then substitute into the equation noting that the values of v and u had to be squared; the acceleration had to be multipiled by 2.

The student has shown a substitution and has recognised the correct values for each symbol but has not recognised the relevance of the squaring of v and u in the equation.

(b) An aircraft waits at the start of a runway.
The aircraft accelerates from a speed of 0 m/s to a speed of 80 m/s.
The acceleration of the aircraft is 4 m/s^2.

Calculate the distance, x, travelled by the aircraft while it is accelerating.

Use the equation

$$x = \frac{v^2 - u^2}{2a}$$

(2)

$x = \frac{80 - 0}{2 \times 4} = 10$

$x =$ 10. m

ResultsPlus
Examiner Comments

In the mark scheme the squaring of v and u is in brackets, therefore it was not necessary to see the value squared in the substitution. The substitution scores the first mark. Without the working being shown this mark could not be awarded and as the evaluation is incorrect the response would not score a mark.

ResultsPlus
Examiner Tip

Remember to show substitution into an equation.

This student has correctly substituted into the equation and then evaluated correctly.

(b) An aircraft waits at the start of a runway.
The aircraft accelerates from a speed of 0 m/s to a speed of 80 m/s.
The acceleration of the aircraft is 4 m/s².

Calculate the distance, *x*, travelled by the aircraft while it is accelerating.

Use the equation

$$x = \frac{v^2 - u^2}{2a}$$

(2)

$\frac{80^2 - 0^2}{2 \times 4} = 800$

$x =$ 800 m

ResultsPlus
Examiner Comments

The values of v and u have been identified correctly and each value has been squared

ResultsPlus
Examiner Tip

Remember that the meaning of the symbols used in equations is given on the back page of the examination paper.

Some students were able to insert the values of v and u as squares but also inserted acceleration as a squared value because the unit of accelleration is m/s^2

(b) An aircraft waits at the start of a runway.
The aircraft accelerates from a speed of 0 m/s to a speed of 80 m/s.
The acceleration of the aircraft is 4 m/s^2.

Calculate the distance, *x*, travelled by the aircraft while it is accelerating.

Use the equation

$$x = \frac{v^2 - u^2}{2a}$$

(2)

$x = \frac{80^2 - 0^2}{4^2} = x$

$x = 6400$

$x =$ 6400 m

ResultsPlus
Examiner Comments

The term in the equation must be substituted with the value as it is given and not confused with the units of the quantity.

ResultsPlus
Examiner Tip

Identify the difference between substitution into equations with squares and those quantities which have a square in the unit.

Question 4 (c) (i)

This question was less challenging for those students that had carried out the practical investigation to determine the average speed of an accelerating trolley. The picture of the apparatus shows a stop watch being used and students, knowing that average speed is found by dividing distance by time, should have worked out that some way of measuring distance was needed.

A light gate was acceptable for measuring distance without any requirement as to how it should be set up.

Any piece of apparatus that could be used to measure the distance shown in the picture was acceptable.

(c) A student needs to measure the average speed of an accelerating trolley between two marks on a bench.

Figure 3 shows the arrangement of some apparatus that the student can use.

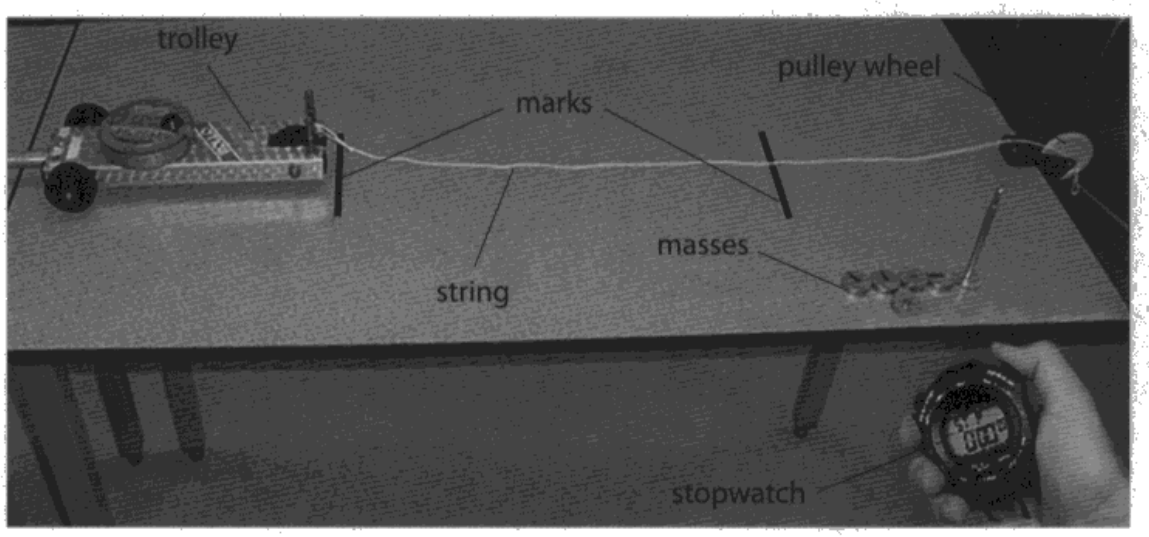


Figure 3

(i) One piece of apparatus is missing from the diagram.
This piece of apparatus is needed to determine the average speed.

State the extra piece of apparatus needed to determine the average speed.

(1)

Tape measure / ruler

ResultsPlus
Examiner Comments

A meter rule would have been better choice rather than a ruler, as the distance looks to be more than 30 cm, but the tape measure is another possible option.

ResultsPlus
Examiner Tip

Look carefully at any picture or diagram given to gain as much information as possible.

Question 4 (c) (ii)

About half of the students were able to give a way of making the trolley accelerate along the bench. The methods varied from the standard experimental method of adding a weight to the end of string which goes over the pulley, to sloping the bench or just pushing or pulling the trolley. Any clear method which would accelerate the trolley was acceptable.

A method of accelerating the trolley is given.

(ii) Describe how the student can make the trolley accelerate along the bench.

(2)

If the student put the bench an angle facing downwards than the ~~the~~ trolley would accelerate at a fast rate.

ResultsPlus
Examiner Comments

Putting the bench at an angle may be quite difficult but if done would cause the trolley to accelerate.

ResultsPlus
Examiner Tip

Remember to refer to the either the bench or the trolley in the answer as 'it' does not make it clear which is being referred to.

The first part of the answer does not gain a mark but can be ignored; the second part of the answer 'push the trolley' gains both marks, from the additional guidance in the mark scheme.

(ii) Describe how the student can make the trolley accelerate along the bench.

(2)

Pull the Pully weal or Push the trolley.

ResultsPlus
Examiner Comments

The first part of the answer does not contradict the second part therefore it can be ignored and marks awarded for the second part of the answer.

ResultsPlus
Examiner Tip

Be careful not to write statements that contradict each other as no mark can be awarded.

Question 4 (c) (iii)

Only a few students were able to gain a mark, as distance had already been considered and it was another measurement that was required. Students need to know that acceleration is the change in velocity in a given time and therefore a measurement of speed or time was needed to determine the acceleration of the trolley.

This response correctly gives the required measurement as velocity.

(iii) The student wishes to develop the experiment to determine the acceleration of the trolley.

State **one other** measurement that the student must make to determine the acceleration of the trolley.

(1)

must measure the velocity
2 x acceleration x distance

ResultsPlus
Examiner Comments

The 2 x acceleration x distance can be ignored as this is just making use of the equation on the back page of the examination paper.

ResultsPlus
Examiner Tip

Use the equation at the back of the examination paper, the fist equation $v^2 - u^2 = 2ax$ linking velocity, acceleration and distance. As distance had already been used the only other measurement needed was velocity.

Question 5 (b)

The question is based on the difference that exists between the waves that make up the electromagnetic spectrum.

About half of the students realised that the remote control using radiowaves would swich on the television from behind the armchair because the radiowaves passed through the armchair or that the infra red remote control would not work from behind the armchair because the infra red signal is blocked. Less students were able to explain this as being due to the difference in wavelength or frequency of the two waves.

This response correctly gives that the infra red waves are blocked by the armchair.

(b) Some television remote controls use infrared radiation and other remote controls use radio waves.

Explain why an infrared remote control may not switch on the television from behind an armchair but a radio wave remote control always will.

(2)

Because the infrared Ray will be blocked by the arm chair so will not be able to reach the tv

ResultsPlus
Examiner Comments

The student specifies infrared is blocked rather than 'it is blocked'. This would not gain a mark because it is unclear which wave is being referred to.

ResultsPlus
Examiner Tip

Specify the type of wave that you are referring to.

The response states that the infrared radiation will not penetrate the armchair and then adds the explanation to gain both marks.

(b) Some television remote controls use infrared radiation and other remote controls use radio waves.

Explain why an infrared remote control may not switch on the television from behind an armchair but a radio wave remote control always will.

(2)

Infrared radiation cannot penetrate through other materials such as an armchair whereas radio waves can. This is because radio waves have the longest wavelength.

ResultsPlus
Examiner Comments

'Does not penetrate' is the same as 'cannot pass through' which is given in the mark scheme.

The explanation is that 'radiowaves have a longer wavelength'; this is true but 'longer' or 'shorter' wavelength would have gained the second mark as all that is required is that the wavelength is 'different'.

ResultsPlus
Examiner Tip

To gain both marks then a reason must be given.

Question 5 (c) (i)

This question tested that students could remember the difference between wavelength and amplitude and could use the graph to determine the wavelength.

The student realises that the wavelength is measured on the x-axis (distance in cm) by the use of 30 cm.

(c) Figure 4 is a diagram of a water wave.

A cork is floating on the water.

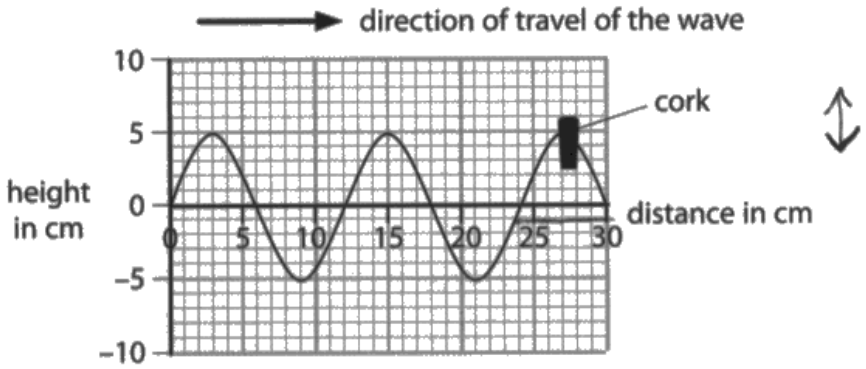


Figure 4

(i) Use the scale on the diagram to measure the wavelength of the wave.

30 ÷ 5 = 6

(2)

wavelength = 6 cm

ResultsPlus
Examiner Comments

The number of half wavelengths shown is 5 so 30/5 gives the 1/2 wavelength. As the amplitude is also 5 this mark is made certain by the marking of 1/2 a wavelength on the diagram.

ResultsPlus
Examiner Tip

Use the diagram to show if the x or y axis is where the measurement is being taken.

The wavelength has been correctly determined without any indication on the diagram.

(c) Figure 4 is a diagram of a water wave.

A cork is floating on the water.

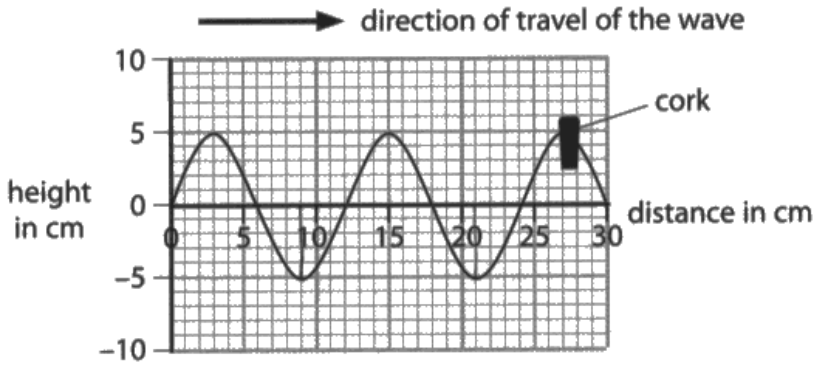


Figure 4

(i) Use the scale on the diagram to measure the wavelength of the wave.

(2)

21 − 9 = 12

wavelength = 12 cm

ResultsPlus
Examiner Comments

Both marks are awarded for the correct answer of 12cm. Both points on the graph have been read correctly to give the answer.

ResultsPlus
Examiner Tip

Indicating the points taken on the diagram and the wavelength between them ensures one mark even if the points are not read correctly.

The diagram shows a wavelength but the value given for the wavelength is incorrect.

(c) Figure 4 is a diagram of a water wave.

A cork is floating on the water.

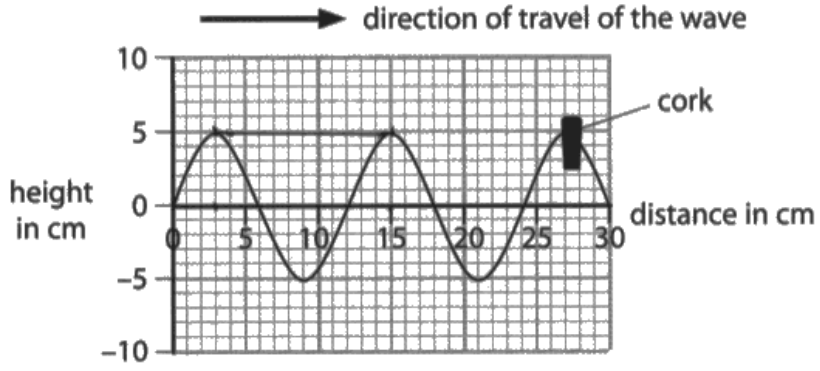


Figure 4

(i) Use the scale on the diagram to measure the wavelength of the wave.

(2)

wavelength = 2·5 cm

ResultsPlus
Examiner Comments

One mark is gained for the wavelength shown correctly on the diagram, even though the value in the answer line is incorrect.

ResultsPlus
Examiner Tip

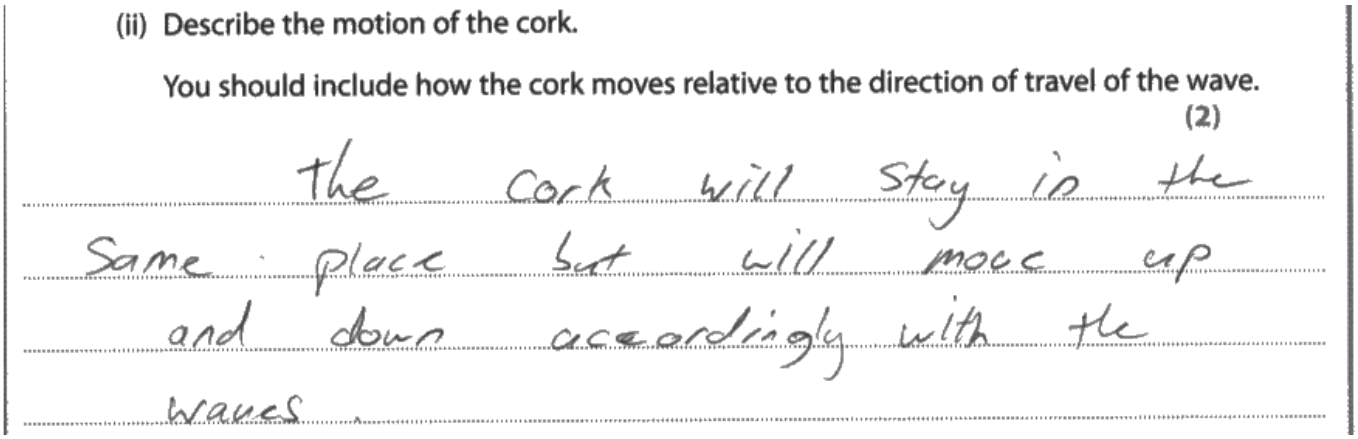
Use the diagram to show wavelength.

Question 5 (c) (ii)

The diagram shows a cork at the top of a wave and above the diagram is the direction of the wave. Students are asked to describe the motion of the cork.

About half of the students realised that the cork would move up and down but very few realised that this was the only movement as the cork would not be carried along by the wave. The wave is a transverse wave and therefore the motion of the particles which produce the wave is at right angles to the direction in which the wave travels.

This answer was one of the very few that gained both marks.



(ii) Describe the motion of the cork.

You should include how the cork moves relative to the direction of travel of the wave.

(2)

the cork will stay in the same place but will move up and down accordingly with the waves.

ResultsPlus
Examiner Comments

The students has realised that the wave is transverse and that a transverse wave is produced by the particles moving perpendicular to the direction in which the wave travels.

ResultsPlus
Examiner Tip

Learn the definition of transverse and longitudinal waves.

The most frequent misconception was that the cork moved in the direction in which the wave was travelling.

(ii) Describe the motion of the cork.

You should include how the cork moves relative to the direction of travel of the wave.

(2)

The cork moves foward and goes with the waves when they rise. This makes it travel across the waves.

ResultsPlus
Examiner Comments

The response does give that besides moving forward the cork also rises but this is not sufficient to give the mark for 'moves up and down'

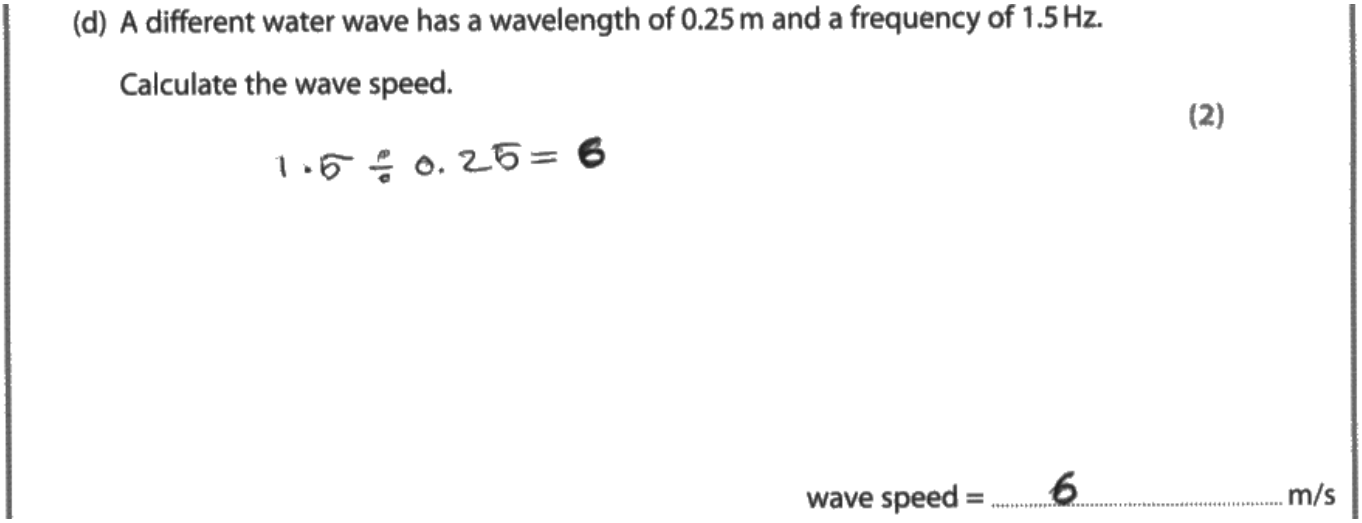
ResultsPlus
Examiner Tip

Always consider the type of wave that the question is asking about.

Question 5 (d)

This question required students to recall the equation for the velocity of a wave and then to substitute into the correct equation to evaluate an answer.

The student is unlikely to have recalled the equation correctly and there is no evidence of this.


(d) A different water wave has a wavelength of 0.25 m and a frequency of 1.5 Hz.

Calculate the wave speed.

(2)

1.5 ÷ 0.25 = 6

wave speed = 6 m/s

ResultsPlus
Examiner Comments

The student made this response a choice of either multipling or dividing the two values given and chose wrongly in this case.

ResultsPlus
Examiner Tip

Learn the equations that you may be asked to recall.

This response shows the correct equation has been recalled, the substitution is given and the correct answer has been evaluated.

(d) A different water wave has a wavelength of 0.25 m and a frequency of 1.5 Hz.

Calculate the wave speed.

(2)

wave speed = frequency x wavelength

= 1.5Hz x 0.25m

= 0.375

wave speed = 0.375 m/s

ResultsPlus
Examiner Comments

The student has written out the whole equation and set out the calculation as it should be.

ResultsPlus
Examiner Tip

Always write out the equation that has been recalled then complete the working and evaluation.

Question 6 (a)

This question tests if students are able to describe the structure of isotopes of atoms and was accessible to about half the students.

Students needed to recognise that the top number to the left of the symbol C for carbon is the mass number and that the bottom number to the left of the symol C is the atomic number.

Students also need to know that the mass number is the number of protons and neutons in the atom and that the atomic number is the number of protons.

The question asked for the number of neutrons in carbon 13 and carbon 14 on one side of the table and the number of electrons in each atom on the other.

The number of neutrons 1s the mass number minus the atomic number for each atom.

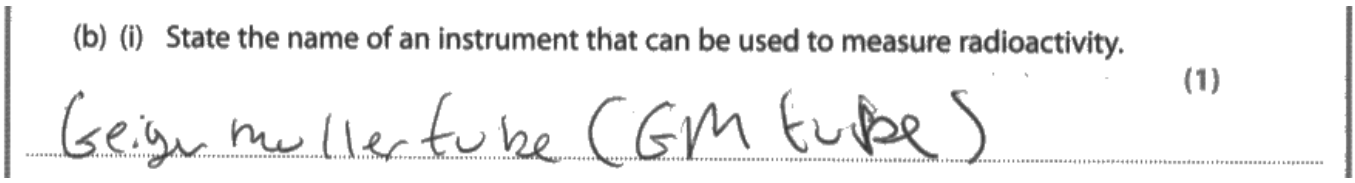
The number of electrons is equal to the number of protons: this is the the mass number.

Question 6 (b) (i)

Many candidates were unable to name the instrument used to measure radioactivity and even if the name was remembered the spelling was very variable.

The use of the word 'instrument' caused confusion and the names of many different musical instruments were given in responses.

This example gives the correct name 'Geiger-Muller Tube' and an acceptable abbreviation 'GM tube'.


(b) (i) State the name of an instrument that can be used to measure radioactivity.

(1)

Geiger muller tube (GM tube)

ResultsPlus
Examiner Comments

Many other spellings of Geiger were accepted such as 'giga', 'gigger' and 'geigar'.

ResultsPlus
Examiner Tip

Learn the name of the Geiger-Muller Counter or Geiger Counter and learn to spell the name correctly.

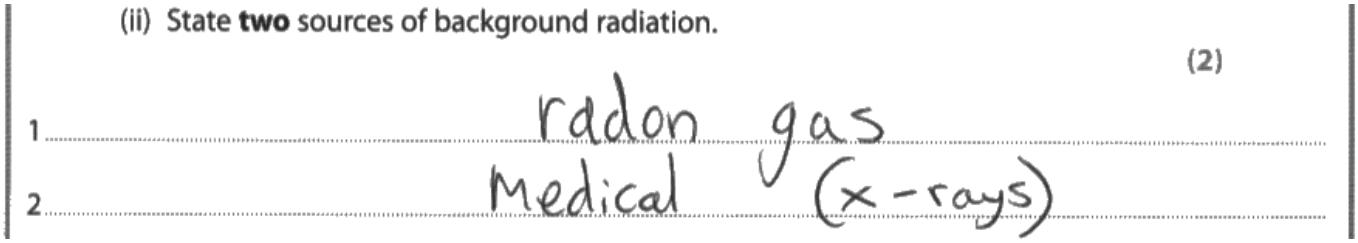
Question 6 (b) (ii)

The sources of background radiation, although there are very many, are not generally known, with only about a third of students able to give at least one source.

Almost everything around us emits background radiation: buidings, plants, food, and rocks.

The popular misconception was that background radiation was emitted by alpha, beta and gamma radiation or mobile phones.

The student has chosen two correct sources of backgound radiation.


(ii) State **two** sources of background radiation.

(2)

1 radon gas

2 Medical (x-rays)

ResultsPlus
Examiner Comments

The response shows two correct answers: radon gas is emited by rocks and there are various medical treatments which are a source of background radiation including X-rays.

ResultsPlus
Examiner Tip

You must distinguish between sources of background radiation and the radiation itself. Alpha, beta and gamma are radiation not a source of radiation.

Neither of the responses given are credit worthy.

(ii) State **two** sources of background radiation.

(2)

1 Nuclear

2 gamma

ResultsPlus
Examiner Comments

Nuclear on its own is not a source of background radiation whereas nuclear waste and nuclear accidents such as Chernobyl are.

Gamma is a radiation and not a source of radiation.

ResultsPlus
Examiner Tip

Remember to be specific; the word 'nuclear' alone is not sufficient.

Question 6 (c)

Students had to calculate the age of a piece of wood being told that the radiactive count for the carbon -14 in the wood had fallen from 1000000 to 125000 and that the half life of carbon -14 is 5700 years.

Many students were unable to complete the calculation because they did not see the relationship between 1000000 and 125000, that is, that the 1000000 count rate has to be halved 3 times to give 125000 and therefore the age of the wood is equivalent to 3 half-lives 5700 x = 17100 years.

1000000/125000 = 8 was a common answer which was not credit worthy.

(c) Carbon-14 is radioactive and has a half-life of 5 700 years.

The number of radioactive carbon-14 atoms in a very old piece of wood is found to have decreased from 1 000 000 to 125 000.

Determine the age of the piece of wood.

(2)

$\frac{1000000}{125000} = 8$

age of wood = 8 years

ResultsPlus
Examiner Comments

If 125000/1000000 was given as 1/8 then this would indicate that the count rate had been halved three times to give 1/2, 1/4 and 1/8 and a mark could be awarded without the final calculation of the age.

ResultsPlus
Examiner Tip

In questions about half lives look for a halving relationship for the count rate.

The division by two is shown to be done three times and then the half life is muliplied by three.

(c) Carbon-14 is radioactive and has a half-life of 5 700 years.

The number of radioactive carbon-14 atoms in a very old piece of wood is found to have decreased from 1 000 000 to 125 000.

Determine the age of the piece of wood.

(2)

1 000 000
500 000
250 000
120 000

3 half lives

age of wood = 17100 years

5700 x 3

ResultsPlus
Examiner Comments

The working is shown and it can clearly be seen how the correct answer is arrived at.

ResultsPlus
Examiner Tip

Show the stages in your working.

Question 6 (d)

The extended writing question was based on Rutherfords Scattering Experiment. A fine beam of alpha particles was fired at a thin piece of gold foil. The scattering of the alpha particle is shown in Figure 5 and students should note that some alpha particles went straight through the foil to point P, some were deflected to pont Q, and the remainder were reflected by the gold foil and detected at R. The table Figure 6 gives the number of particles that are detected at each position at P 72340, at Q 25 and at R just 2.

The question asks the students to explain what the information given in the diagram and the table tells them about the structure of the atom.

This response gains Level 1, 2 marks.

Explain what the information in Figure 5 and Figure 6 shows about the structure of an atom.

(6)

On figure 5 it shows that position p was the highest number of alpha particles detected and that is right opposite the beam of alpha particles so thats gaining the most. Position Q has just a medium range and position R is getting the least because the beam is going at the same way.

ResultsPlus
Examiner Comments

The student describes the number of alpha particles that reach the different positions. 'Position P has the highest number of alpha particles, Q has a medium range and R has the least'.

This answer shows that the student has used the table, Figure 6, but has not related this to what happens to the alpha particles when they are fired at the gold foil which is shown in the diagram, Figure 5, and has made no link to the structure of the atom.

The response is level 1 and gains 2 marks. This fits well with the summary of guidance given in the mark scheme.

ResultsPlus
Examiner Tip

Try to process all the infomation given in the question that is Figure 5 and Figure 6 to make the links to the structure of the atom.

This response is Level 2, 4 mark.

Explain what the information in Figure 5 and Figure 6 shows about the structure of an atom.

(6)

It shows that most of the alpha particles went completely through the gold foil in a straight line and only 2 alpha particles ~~were~~ where reflected back from the gold foil. It also shows that ~~only~~ only 2S alpha particles went through the gold foil ~~and~~ but went diagonally to the ring of detectors not straight like most of the alpha particles. ~~This~~ This shows that a structure of an atom have a charge because they all travelled through the gold foil or were reflected. It also shows that the structure of an atom helps it travel through mediums. For example most of the alpha particles travelled through the gold foil.

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

ResultsPlus
Examiner Comments

The student uses the information in the diagram and the table but is unable to explain what this shows about the structure of the atom.

'Most of the particles went completely through the the gold foil in a straight line.' This statement uses information from the diagram and the table, and 'most' is sufficient for the number of particles reaching P rather than quoting the number. This statement alone is enough to gain Level 2, 4 marks. Added to this is 'and only 2 alpha particles were reflected back.' This statement alone would gain Level 2, 4 marks.

Unfortunately the student was unable to explain how this information was useful in showing the structure of the atom.

ResultsPlus
Examiner Tip

How Rutherford scattering leads to showing the structure of the atom is a difficult concept and needs to be learnt.

This response is Level 3, 6 marks

Explain what the information in Figure 5 and Figure 6 shows about the structure of an atom.

(6)

In figure 6 it shows that most alpha particles went through and Rutherford concluded that atoms were mostly empty space but he also noticed that only a couple deflected figure 5 shows this so Rutherford said that that the atom is a small heavy mass in the middle he also stated that it must have positive protons as ~~2 5~~ only few e.g 25 alpha particles ~~w~~ reflected of the nucleus he said that it must have a positive proton as alpha particles do as well and if they were negative they would of attracted

ResultsPlus
Examiner Comments

The student uses the information from the diagram and the table 'Most alpha particles went straight through' and gives the conclusion from this that; 'atoms were mainly empty space'. These first sentences are enough for the award of Level 3, 6 marks.

However the student then goes on to explain that the atom must have a heavy mass in the middle for the 2 alpha particles to be reflected to R.

This is a very good answer and shows an excellent understanding of how the results of the scattering experiment showed the structure of the atom.

ResultsPlus
Examiner Tip

An answer does not have to be long but it does have to be accurate to gain the full six marks

Paper Summary

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

- make careful notes of experimental work and learn them
- make use of the equations sheet on the back page of the examination paper
- learn the equations that have to be recalled
- practise substituting values correctly into equations, especially if there is a square in the equation
- not confuse a square in the units with a square in the equation
- practise using standard form, significant figures and correct rounding
- know the difference between atomic mass and atomic number
- know the difference between a radiation and the source of radiation

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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