Examiners' Report/
Lead Examiner Feedback

Summer 2017

BTEC Level 3 Nationals in Applied Science

Unit 1: Principles and Applications of Science (31617H)

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Grade Boundaries

What is a grade boundary?

A grade boundary is where we set the level of achievement required to obtain a certain grade for the externally assessed unit. We set grade boundaries for each grade (Distinction, Merit, Pass and Near Pass). The grade awarded for each unit contributes proportionately to the overall qualification grade and each unit should always be viewed in the context of its impact on the whole qualification.

Setting grade boundaries

When we set grade boundaries, we look at the performance of every learner who took the assessment. When we can see the full picture of performance, our experts are then able to decide where best to place the grade boundaries – this means that they decide what the lowest possible mark should be for a particular grade.

When our experts set the grade boundaries, they make sure that learners receive grades which reflect their ability. Awarding grade boundaries is conducted to ensure learners achieve the grade they deserve to achieve, irrespective of variation in the external assessment.

Variations in external assessments

Each test we set asks different questions and may assess different parts of the unit content outlined in the specification. It would be unfair to learners if we set the same grade boundaries for each test, because then it would not take into account that a test might be slightly easier or more difficult than any other.

Grade boundaries for this, and all other papers, are on the website via this link: qualifications.pearson.com/gradeboundaries

Unit 1: Principles and Applications of Science (31617H)

Grade	Unclassified	Near Pass	Pass	Merit	Distinction
Boundary Mark	0	10	20	39	58

Examiner Report for 31617H Unit 1 Principles and Applications of Science

Section A - Biology

General comments

Exam technique is an issue for the learners. Centre's need to fully prepare learners for the exam by practicing exam technique, especially in relation to reading the question carefully and not repeating the stem of the question. Scientific knowledge was lacking in some questions, only the best learners were able to apply their scientific knowledge to new situations such as those in Q2b, Q3b and Q4b. Learners should also be taught that when they have answered the question to reread their response in order to ensure that the question set has been addressed in the answer they have given, and that they have used appropriate scientific knowledge and vocabulary.

Question 1 (ai)

The majority of learners were able to correctly identify the lysosome from the electro micrograph image.

Question 1 (aii)

The majority of learners did not understand the functions of lysosomes. The idea of digestion within the organelle was only seen rarely. Some learners understood the role in breaking down unrequired cell components or waste materials. Several tried to propose a function in cell division.

If the students were to gain a mark it was for breaking down worn components of the cell etc. rather than the digestion of antigens, bacteria etc.

There were very few 2 marks seen.

(ii) Give **two** functions of lysosomes.

(2)

Function one Contains hydrolytic enzymes to break down old organelles in the cell

Function two To break down pathogens that have been engulfed

A range of misconceptions were given and many learners confused lysosomes with ribosomes which led to a high number of responses involving proteins/fat synthesis/store, the creation of enzymes, DNA, lipase production, gaseous exchange, energy production, and cell division.

Question 1(b)

The great majority of learners understood the basic calculation required to identify the magnification but most were unable to give the correct order of magnitude because they failed to interconvert μm and cm correctly. Many scored well on this question by picking up marks for correct substitution and evaluation.

The majority of the incorrect answers seen included 25,000 and variants of this theme; lots of 81000, 0.81, 81 and 0.075, where the learner had multiplied the figures instead of divide.

Convert cm to um

$\frac{1}{A \times M}$ 1.8 cm = 18mm

$\frac{18 \times 1000}{45} = 400$

Magnification = 400

Convert um to cm

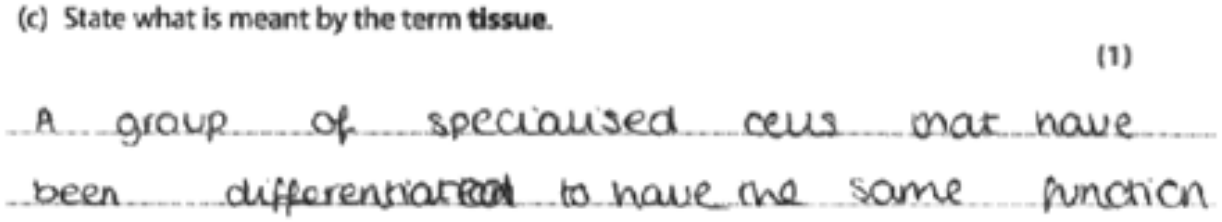
45μm → 0.0045cm

$\frac{1.8}{0.0045} = \times 400$

Magnification = 400

Question 1(c)

This question was well attempted but very few learners were awarded the mark as they tended to give a level 2 definition of the term "tissue". The idea of specialized cells carrying out a specific function was seen rarely. Vague answers relating to the organisation of cells/tissues/organs were common. Answers relating to a "covering" for either bone or muscle were also seen frequently.

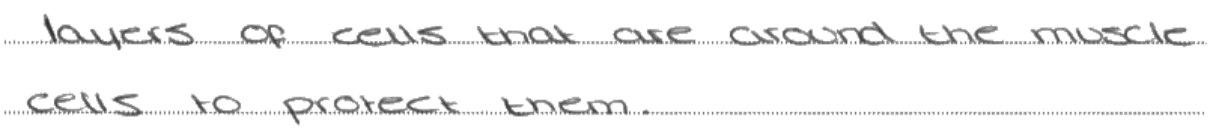

(c) State what is meant by the term **tissue**.

(1)

A group of specialised cells that have been differentiated to have the same function

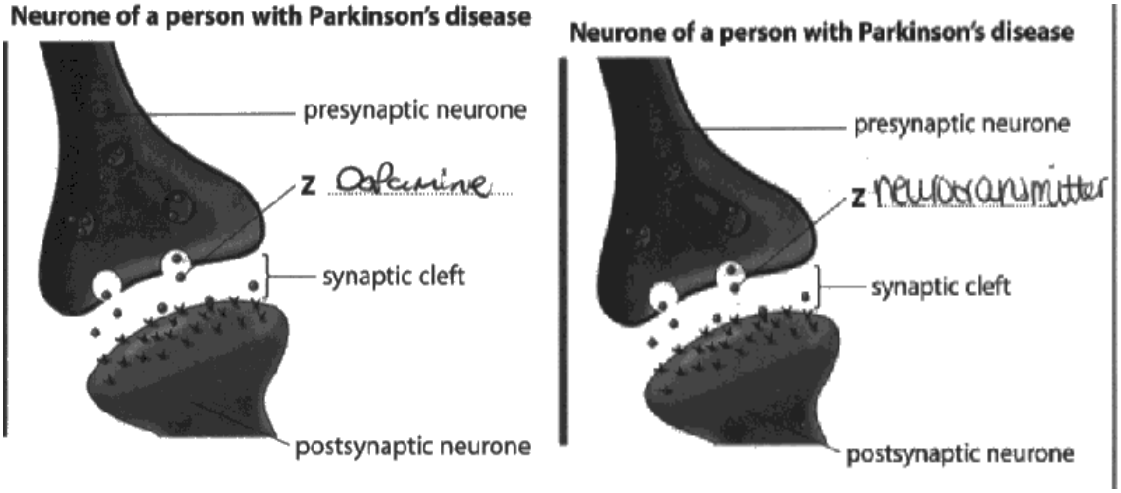
Learners either failed to mention similar/specialised/differentiated group of cells or forgot to mention they carry out a 'specific' function.

Lots of students gave details about specific tissues e.g. lining the organs; skin, or gave "protection" as their answer.


layers of cells that are around the muscle cells to protect them.

Question 2 (a)

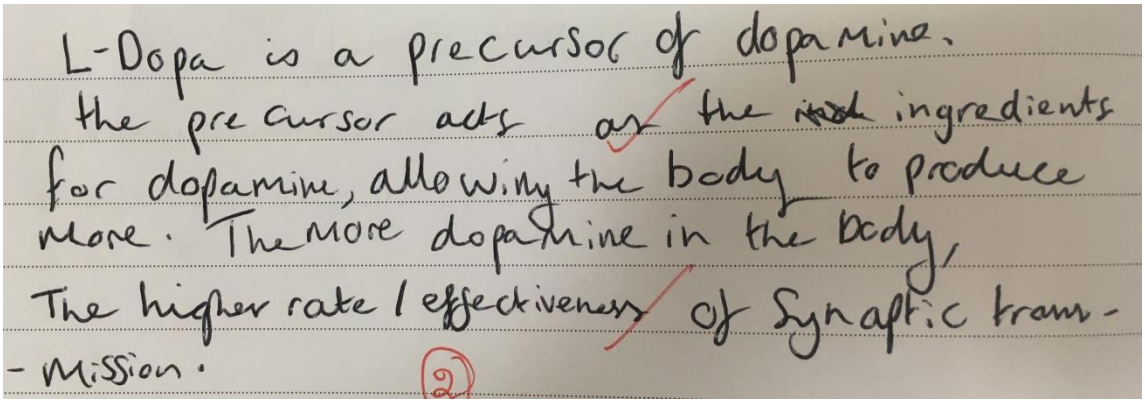
The learners tended to approach this as a comprehension question and, using information in the stem, gave the answer "neurotransmitter". The learner should consider the context of the question and avoid repeating the stem in their response.



Common wrong answers included: Synapse, Vesicle, Neurone, Calcium/potassium/sodium and serotonin.

Question 2b

Very few learners knew that L-Dopa is a precursor of Dopamine.


L-Dopa is a precursor of dopamine. the precursor acts as the ingredients for dopamine, allowing the body to produce more. The more dopamine in the body, The higher rate / effectiveness of Synaptic transmission. (2)

Some learners considered L-Dopa to be a replacement for dopamine and many gave vague descriptions of the wider aspects of Parkinson's disease. Few demonstrated any real understanding of synaptic transmission, hence the vast majority of responses here scored 0 or 1 mark. The 1 mark answers most commonly involved the idea of more dopamine being transmitted across the synapse. Very few learners got the idea of normal levels of neurotransmitter reaching the receptors and even fewer got the idea of L-Dopa being a precursor of dopamine.

Common wrong answers included the misconception that L-Dopa produces more neurons and increased the speed of transmission across the synaptic cleft.

Question 3(a)

This question was well attempted and extremes of either three or zero marks were common. Oddly, many appeared to miss all of the clues in the question and were unable to name the technique but still gained marks for one or both of the correct results.

name of technique	Gram staining
result for Gram-positive	turns purple
result for Gram-negative	turns pink

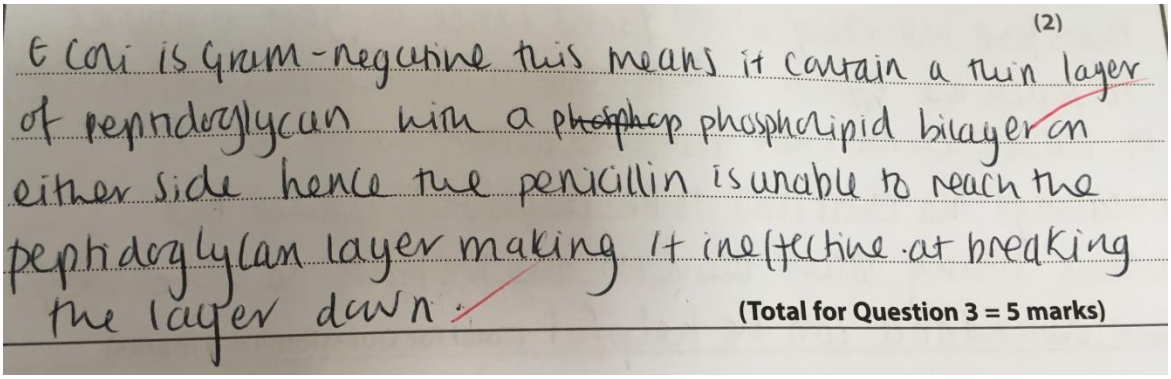
A lot of the students could not remember the name of the test but gained 2 marks for the correct colors.

name of technique	bacteria swab
result for Gram-positive	Purple coloured
result for Gram-negative	Pink coloured

It was often the case that the students got the colors the wrong way around.

Question 3(b)

This question was often not attempted and, when it was, the learners performed badly. The majority of the scripts were not awarded any marks for this question.

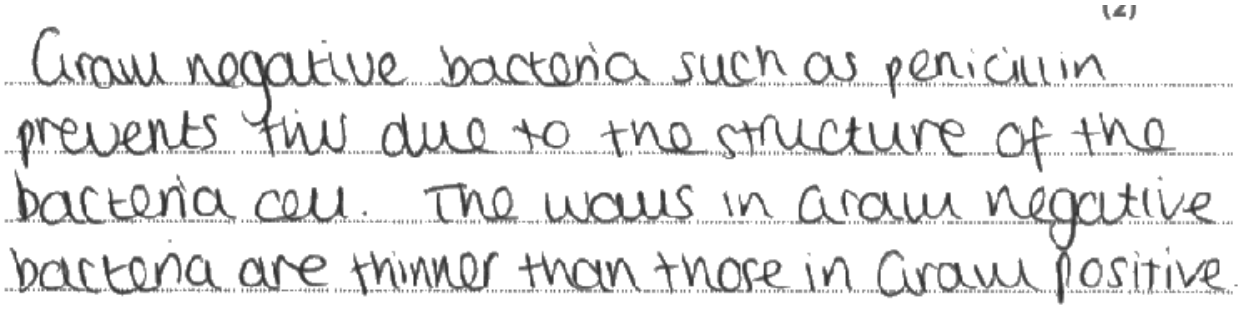

(2)

E Coli is Gram-negative this means it contain a thin layer of peptidoglycan with a ~~phosphop~~ phospholipid bilayer on either side hence the penicillin is unable to reach the peptidoglycan layer making it ineffective at breaking the layer down.

(Total for Question 3 = 5 marks)

Very few responses were seen that matched the mark scheme. Many learners produced some correct ideas but without sufficient detail to meet the marking points. For example, "Gram negative bacteria have a thin cell wall that penicillin cannot penetrate". Many learners repeated the question stem e.g. "Won't work on gram negative bacteria". Some learners gave various descriptions of the gram staining technique and using ethanol to wash penicillin off e coli. One response stated that the flagellum meant that penicillin couldn't catch E. coli. Many learners gave accounts of E.coli becoming resistant to antibiotics. A few gave descriptions of the lock and key mechanism. Very few learners gave responses that discussed the action of penicillin on cell walls. A few vaguely mentioned an outer membrane. Several mentioned lipid membranes but only one. Some mentioned two membranes but not the one was outside the cell wall.

A lot of the responses were very similar e.g: had a thicker cell membrane/thick layer/capsule/ they had different shapes.


(2)

Gram negative bactena such as penicillin prevents this due to the structure of the bactena cell. The walls in gram negative bactena are thinner than those in Gram positive

Incorrect answers gave the idea that the penicillin was unable to penetrate the E Coli or penicillin wasn't strong enough to treat the E Coli or that it couldn't be destroyed.

The learners also attempted to link their answers to the previous staining question.

Question 4(a)

The majority of learners were able to give the name of the epithelial tissue in the artery.

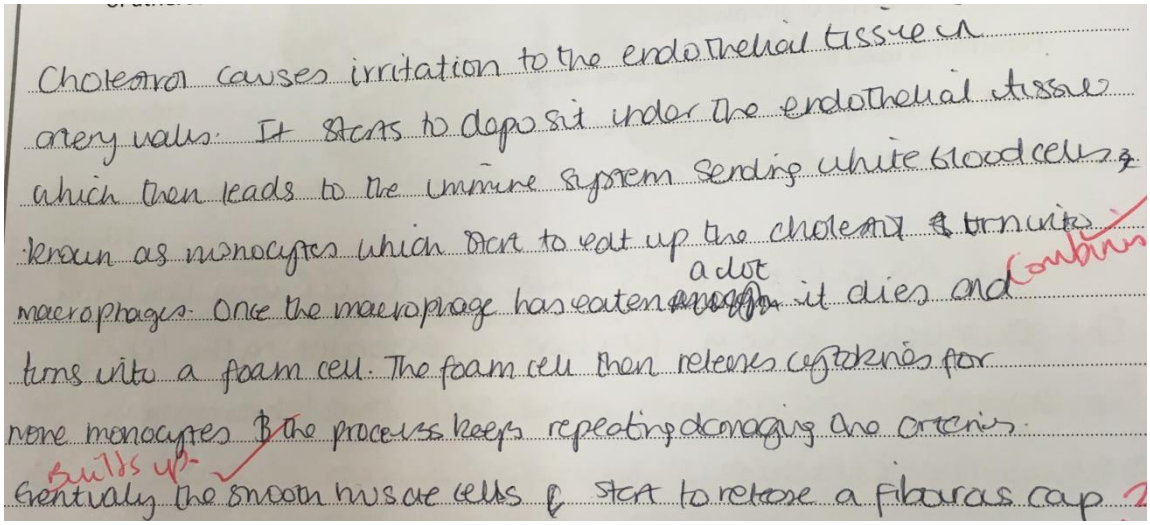
When learners gave an incorrect answer it tended to be a name of another tissue, such as columnar, muscular or ciliated.

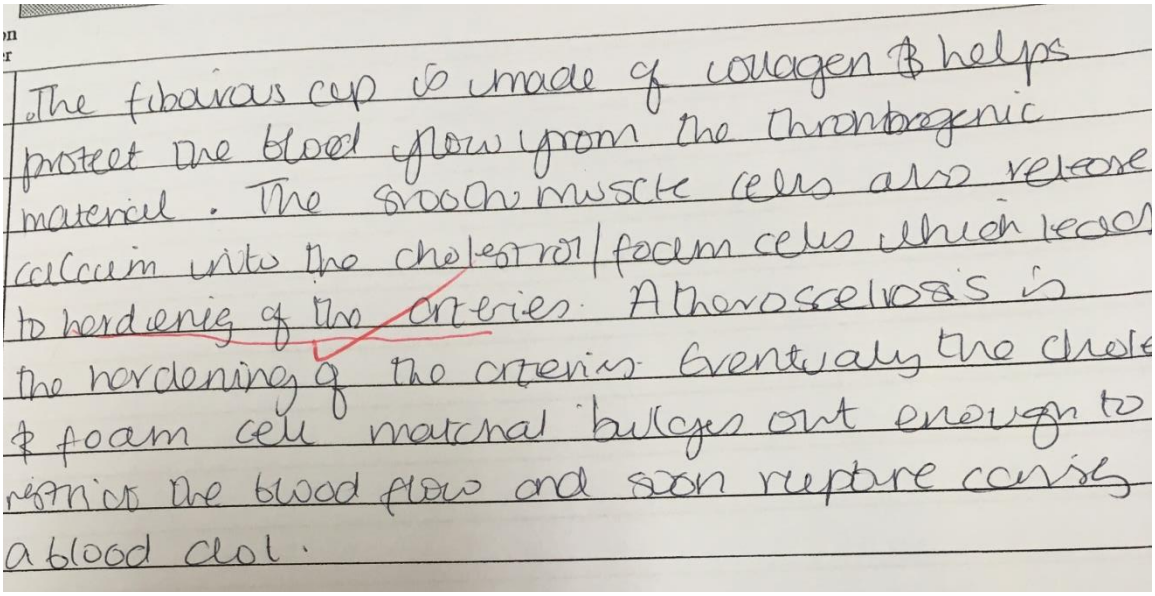
Question 4(b)

This was well attempted and the students often gained the mark but there were a lot of responses seen based around the diffusion of gases, which is not an acceptable answer for the context of an artery.

Question 4(c)

This question was poorly answered. At most 2 marks was the maximum seen.


Cholesterol causes irritation to the endothelial tissue in artery walls. It starts to deposit under the endothelial tissue which then leads to the immune system sending white blood cells known as monocytes which start to eat up the cholesterol & turn into macrophages. Once the macrophage has eaten a lot it dies and combines turns into a foam cell. The foam cell then releases cytokines for more monocytes & the process keeps repeating damaging the arteries. Builds up. Eventually the smooth muscle cells & start to release a fibarous cap.


The fibarous cap is made of collagen & helps protect the blood flow from the thrombogenic material. The smooth muscle cells also release calcium into the cholesterol/foam cells which leads to hardening of the arteries. Atherosclerosis is the hardening of the arteries. Eventually the cholesterol & foam cell material bulges out enough to restrict the blood flow and soon rupture causing a blood clot.

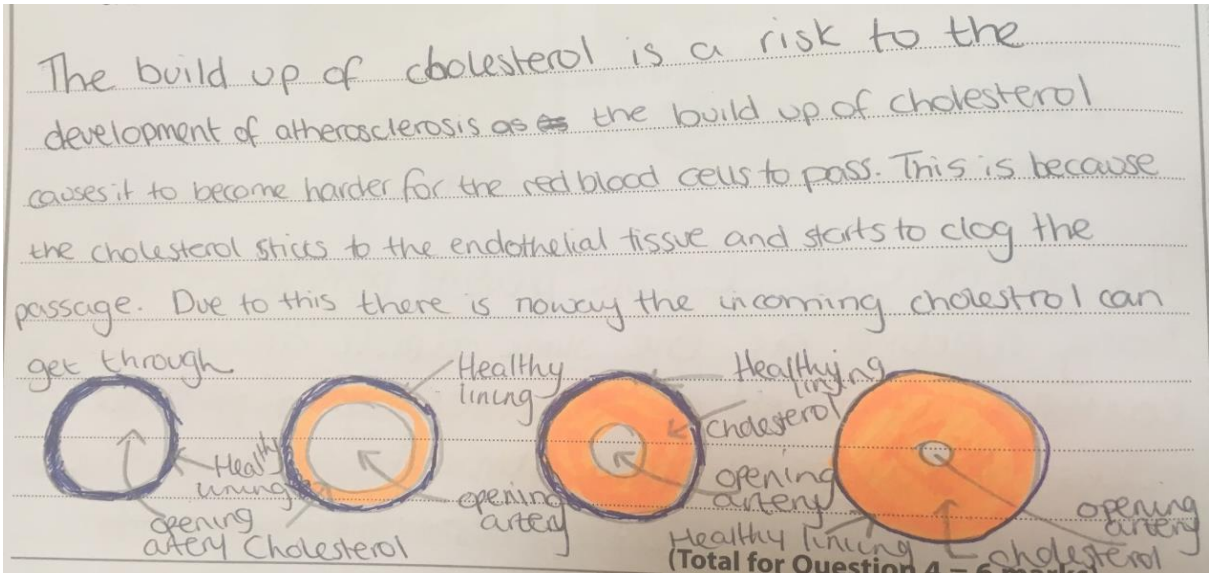
Hardly any learners discussed the idea that cholesterol combines with other substances to form plaque. Instead, most simpy repeated the question and stated that it was the cholesterol which built up. Many understood that the buildup of plaque occurs over time. Few understood the process that leads to the thickening of the artery wall but were credited for identifying that outcome. Many understood the idea of the narrowing of the lumen although many also gave answers relating to changes in blood pressure and the effect on the heart.

A lot of scientifically accurate statements were made but did not address the question, especially in regards to restricted blood flow affecting oxygen supply to

body etc. This seems to have arisen from a misunderstanding of what 'atherosclerosis' was, resulting in learners failing to concentrate on what happened in the artery and giving a much more general response.

Most of the incorrect responses seen, concerned cholesterol causing blockages in the artery/blood vessel; or, blood pressure/blood flow/blood clots /clogged up/ difficulty breathing/ lack of oxygen.

One learner gained marks through correctly labeled detailed diagrams. It is acceptable to communicate through diagrams providing they give the required level of detail for the marking point.



Question 5(a)

This question was generally well understood with the great majority of learners identifying either the cell wall or the vacuole. Many were able to identify both.

Common incorrect responses seen were upper/lower epidermis; cell membrane; mitochondria; spongy layer; chloroplast; cytoplasm; lysosomes; xylem and phloem.

Question 5(b)

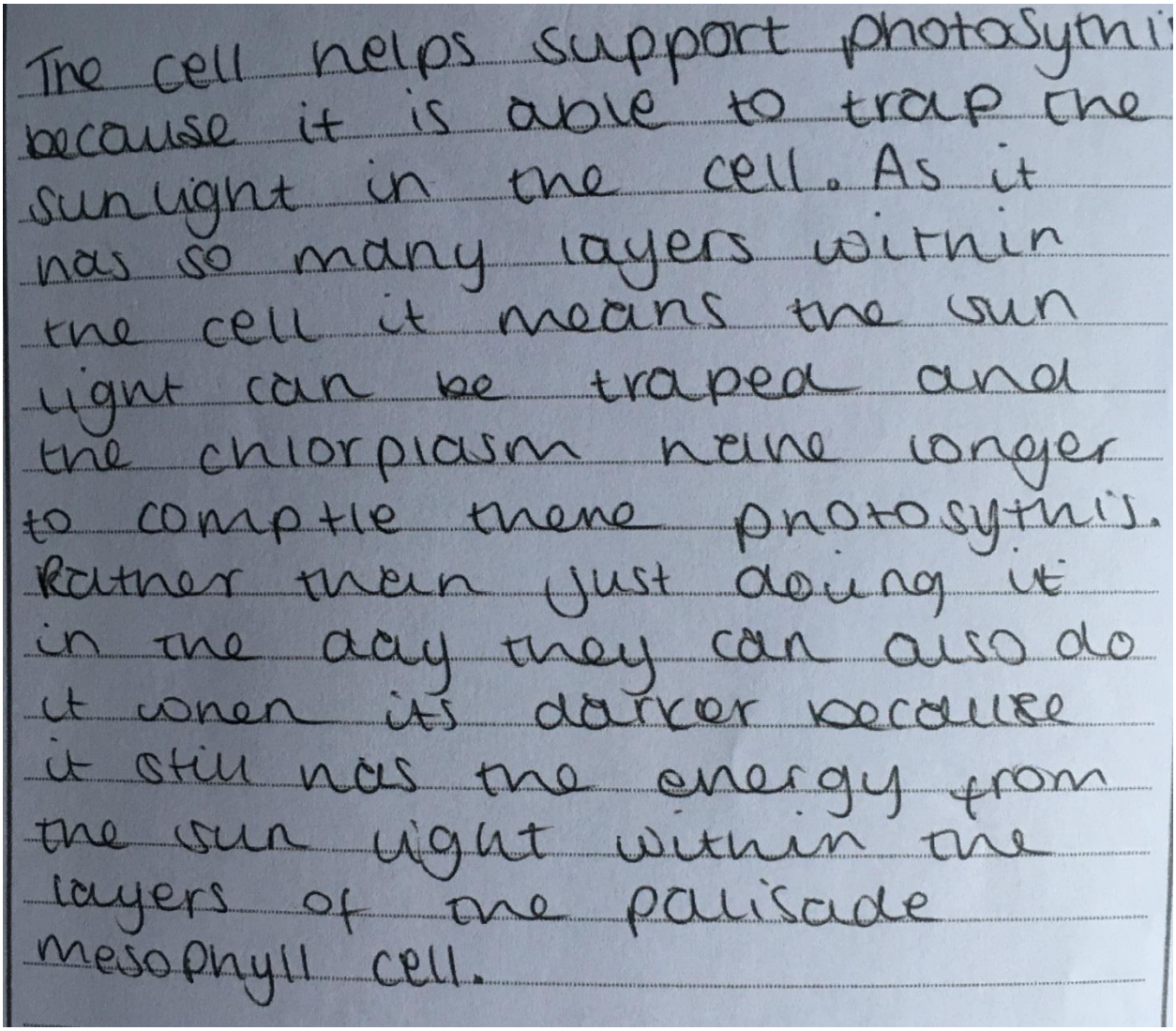
The students often scored between 1 and 4 marks for this question with 5 and 6 marks being rarely seen. There were also a lot of non-attempts on this question.

Learners generally would have scored more highly here if they had restricted their answer to the remit of the question. Some learners have misinterpreted the question and explained the structure of the leaf whereas the question is asking for the specialisations of the palisade mesophyll cell within the leaf. Therefore a lot of correct but completely irrelevant information was presented e.g. "How a leaf is adapted for photosynthesis" or "How the whole mesophyll layer is adapted". There was also much discussion of structures, organelles and processes not concerned with photosynthesis. Where considerations were restricted to the palisade mesophyll cell, by far the largest number of marks were awarded for given for adaptations to do with absorbing light (mainly more chloroplasts or larger surface areas). There was generally a lack of scientific terminology and few candidates discussed water or carbon dioxide absorption.

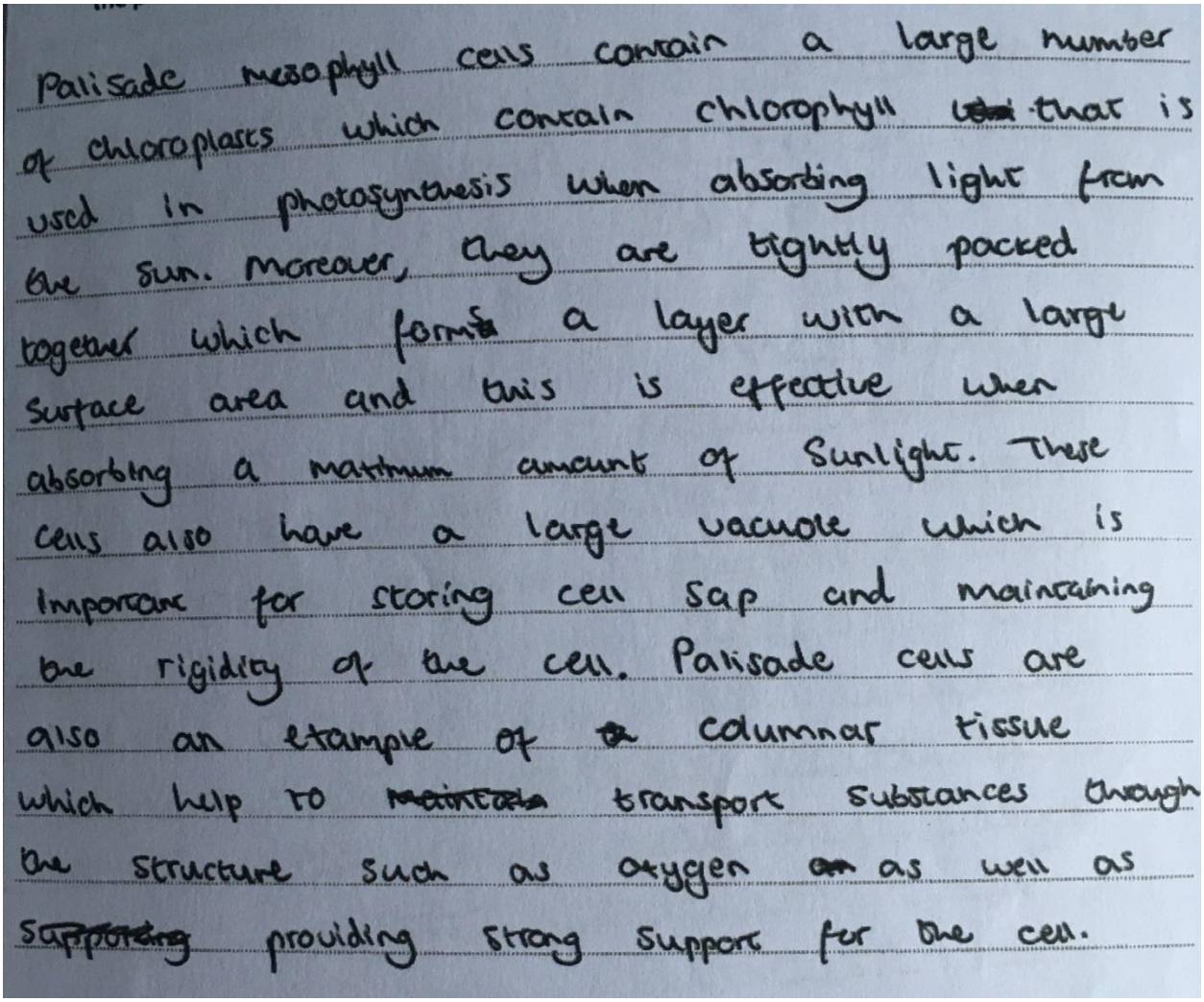
Learners have not given a fully comprehensive response by acknowledging that the cell is also specialised for gaseous exchange and have focused on light. There were minimal scripts that mentioned any gaseous exchange, some wrote about carbon dioxide in and oxygen out but not in relation to the correct area of the palisade layer.

It was an advantage to the learners if they planned their response before they started to write their answer, as then the response tended to have a more logical coherent structure. Learners did not always display clear lines of argument and need to be clear on the requirements of the command word in the question to ensure they provide a full response. Here the command word was explain and so the learners' explanations require a justification/ exemplification of a point. The answer must contain some element of reasoning/justification – this can include mathematical explanations. Definitions for the command word can be found in the unit specification.

Example Level 1 response- 1- 2 marks

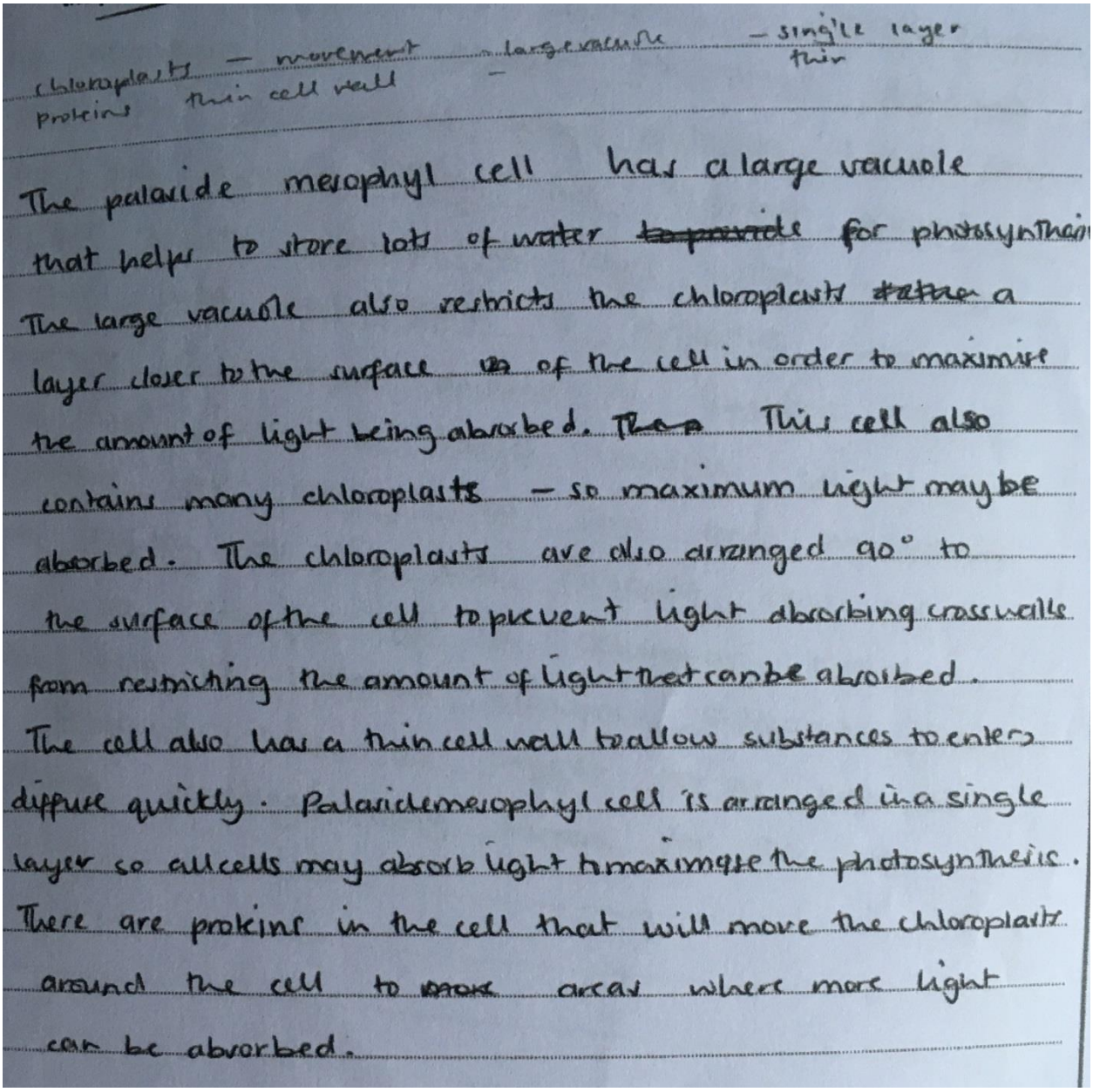

The cell helps support photosythi because it is able to trap the sunlight in the cell. As it has so many layers within the cell it means the sun light can be traped and the chlorplasm have longer to comptle there photosythis. Rather than just doing it in the day they can also do it when its darker because it still has the energy from the sun light within the layers of the palisade mesophyll cell.

Example Level 2 response- 3-4 Marks



Palisade mesophyll cells contain a large number of chloroplasts which contain chlorophyll ~~that~~ that is used in photosynthesis when absorbing light from the sun. Moreover, they are tightly packed together which forms a layer with a large surface area and this is effective when absorbing a maximum amount of sunlight. These cells also have a large vacuole which is important for storing cell sap and maintaining the rigidity of the cell. Palisade cells are also an example of a columnar tissue which help to ~~maintain~~ transport substances through the structure such as oxygen ~~or~~ as well as ~~supporting~~ providing strong support for the cell.

Example Level 3 response- 5-6 Marks



chloroplasts — movement proteins thin cell wall — large vacuole — single layer thin

The palaride merophyl cell has a large vacuole that helps to store lots of water ~~to provide~~ for photosynthesis The large vacuole also restricts the chloroplasts ~~to~~ to a layer closer to the surface ~~to~~ of the cell in order to maximise the amount of light being absorbed. ~~The~~ This cell also contains many chloroplasts — so maximum light may be absorbed. The chloroplasts are also arranged 90° to the surface of the cell to prevent light absorbing cross walls from restricting the amount of light that can be absorbed. The cell also has a thin cell wall to allow substances to enter & diffuse quickly. Palaridemerophyl cell is arranged in a single layer so all cells may absorb light to maximise the photosynthesis. There are proteins in the cell that will move the chloroplasts around the cell to ~~more~~ areas where more light can be absorbed.

Section B - Chemistry

The majority of candidates were able to calculate the relative formula mass of iron oxide in question 6(b) to gain both marks.

(b) Calculate the relative formula mass of iron oxide.

Show your working.

(2)

mass / moles x RAM

Fe 55.8 ×2 → 111.6

O 16 ×3 → 48

111.6 + 48 = 159.6

Relative formula mass = 159.6g

Some learners gave the correct method for calculating the relative formula mass of the iron oxide, but did not evaluate the calculation correctly and so did not gain the second mark. It is very important in calculations that learners are taught to show their working so that marks for working can be awarded if the final evaluation is not correct.

(b) Calculate the relative formula mass of iron oxide.

Show your working.

(2)

Fe = 55.8

O = 16

Fe_2O_3 = 2 × 55.8 + 3 × 16 = 143.6

Relative formula mass = 143.6 g/mol

It is clear that some learners had not been taught key terms such as oxidation state and therefore found question 6c very difficult with only the best learners giving the correct answer

(c) Give the oxidation state of iron in Fe_2O_3.

(1)

+3

(Total for Question 6 = 4 marks)

Some learners were confused between the oxidation state and relative formula mass and tried to give the relative formula mass for iron (II) oxide.

(c) Give the oxidation state of iron in Fe_2O_3.

(1)

71.8

(Total for Question 6 = 4 marks)

A common incorrect answer seen was for the learner to simply state that the iron was oxidized or deoxidized or reduced.

(c) Give the oxidation state of iron in Fe_2O_3.

(1)

Oxidated

Many learners were confused and tried to give a state of iron oxide rather than the oxidation state and gave the answer solid, liquid or gas.

(c) Give the oxidation state of iron in Fe_2O_3.

Solid.

(c) Give the oxidation state of iron in Fe_2O_3.

Gas

Learners found it very difficult to recall the definition of ionisation energy. Some learners had some idea of the process of ionization in terms of the particles or forces involved, but few were able to express the definition.

Only the best learners were able to recall the complete and correct definition to gain the full 2 marks available as is the following example.

7 The table shows the first ionisation energies of the first three elements in period 2 of the periodic table.

element	first ionisation energy kJ mol^{-1}
lithium	520
beryllium	900
boron	801

(a) State what is meant by the term **first ionisation energy**.

(2)

The energy required to remove one mole of electrons from one mole of atoms in a gaseous state.

Some learners were close but did not give the detail that was required to gain the marks. In this example, there is no reference to one mole of electrons and no indication that the atoms need to be in a gaseous state and so gained no marks.

7 The table shows the first ionisation energies of the first three elements in period 2 of the periodic table.

element	first ionisation energy kJ mol^{-1}
lithium	520
beryllium	900
boron	801

(a) State what is meant by the term **first ionisation energy**.

(2)

The amount of energy needed to remove an electron from an atom

Learners found questions 7bi and 7bii quite difficult.

In 7bi a good proportion were able to show an understanding that the first ionization of beryllium is higher than that of lithium stating that it has more protons or because it had a higher nuclear charge and therefore it would make the electron harder to remove.

(b) (i) Explain why the first ionisation energy of beryllium is higher than the first ionisation energy of lithium.

(2)

Beryllium has one more proton than lithium This means the nucleas has more force of attraction on the electrons making them harder to be removed so it needs more

A common answer that scored no marks was where learners incorrectly referred to the reactivity of beryllium compared to lithium

(b) (i) Explain why the first ionisation energy of beryllium is higher than the first ionisation energy of lithium.

(2)

Beryllium is higher than the first ionisation energy of lithium; this is because Beryllium is more reactive than lithium.

A large proportion of learners had the misconception that beryllium has more shells of electrons than lithium.

(b) (i) Explain why the first ionisation energy of beryllium is higher than the first ionisation energy of lithium.

(2)

As you go across the period, the first ionisation energy increases due to increase of shells, the atomic radii increases in beryllium

Fewer learners were able to score full marks in 7bii than scored full marks in 7bi.

(ii) Explain why the first ionisation energy of boron is lower than the first ionisation energy of beryllium.

(2)

Because ~~the~~ Boron has only 1 electron in the ~~first~~ first p orbital whereas beryllium has filled up $2s^2$ orbital therefore because Be only has 1 electron in ~~the~~ the orbital, it can lose ~~is more to~~ the electron easier.

(Total for Question 7 = 6 marks)

Many learners stated that the ionization energy of boron is lower than that of beryllium because there was less shielding, this was not creditworthy and so gained no marks.

(ii) Explain why the first ionisation energy of boron is lower than the first ionisation energy of beryllium.

(2)

Boron has lower first ionisation of energy than Beryllium because it has less shielding

Again, many learners referred to reactivity which was not creditworthy.

(ii) Explain why the first ionisation energy of boron is lower than the first ionisation energy of beryllium.

(2)

The ionisation energy of boron is less than beryllium because it is less reactive therefore releases less energy.

In question 8a, many learners gained both marks for correctly drawing the dot and cross diagram for chlorine.

Although told to do so in the question stem, many learners did not ignore inner shells when drawing their molecules. These were ignored whether correct or incorrect, but did cause confusion in some cases.

8 Table salt contains sodium chloride.

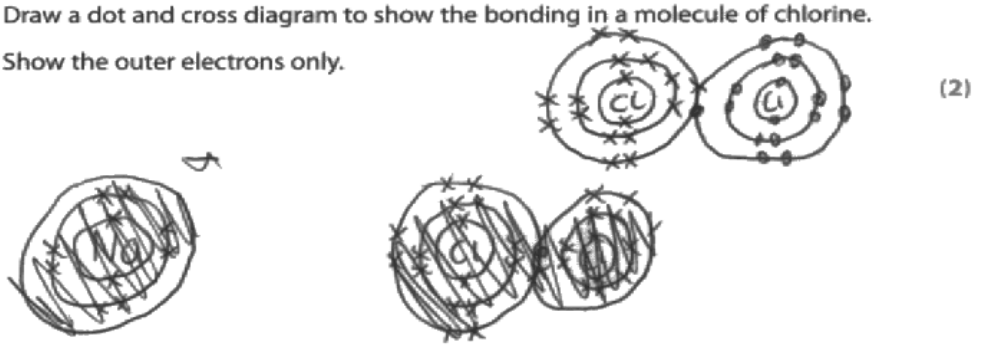
Sodium chloride can be prepared by reacting chlorine with sodium.

(a) A chlorine molecule, Cl_2, contains two covalently bonded chlorine atoms.

Draw a dot and cross diagram to show the bonding in a molecule of chlorine.

Show the outer electrons only.

(2)



Some learners did not read the question carefully and tried to draw a dot and cross diagram for sodium chloride, either as an ionic compound or covalent, neither gained credit.

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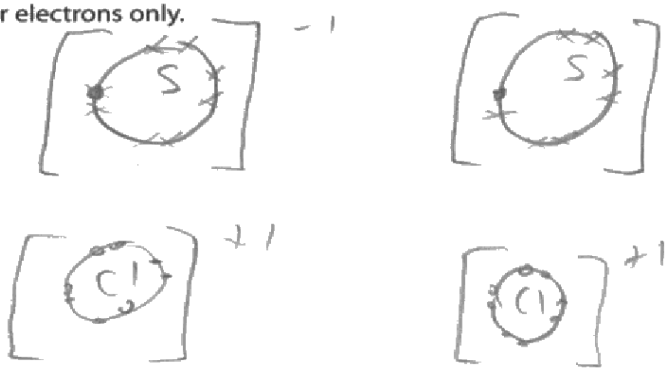
Sodium chloride can be prepared by reacting chlorine with sodium.

(a) A chlorine molecule, Cl_2, contains two covalently bonded chlorine atoms.

Draw a dot and cross diagram to show the bonding in a molecule of chlorine.

Show the outer electrons only.

(2)



Some learners knew that the covalent bond required a shared pair of electrons, but were not able to correctly complete the rest of the molecule, so scored just 1 mark.

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(a) A chlorine molecule, Cl_2, contains two covalently bonded chlorine atoms.

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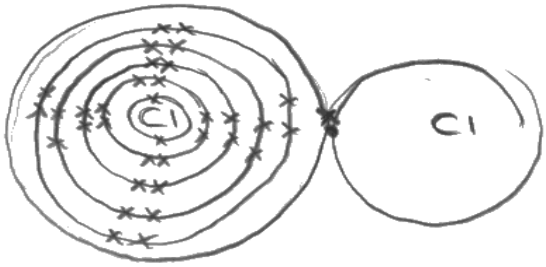

Another common error found was where learners had correctly drawn the dot and cross diagram of the molecule of chlorine, but then added a charge to the whole molecule. In these cases the learner was awarded just one mark.

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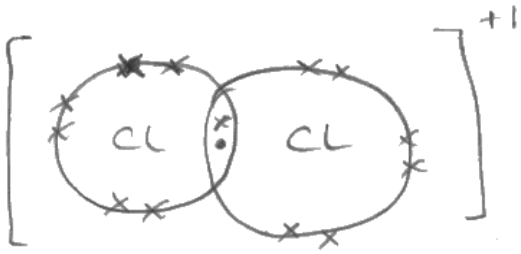
Draw a dot and cross diagram to show the bonding in a molecule of chlorine.

Show the outer electrons only.

(2)



Learners performed well in question 8bi with many scoring the full two marks available.

Good answers were seen giving more than the required level of detail

(b) (i) Describe how a chlorine atom forms a chloride ion, Cl^-.

(2)

Chlorine has 7 electrons in its outer shell and gains one electron from another atom to have a full outer shell because it has gained one electron it has a negative charge by 1- therefore becoming Cl^-

The following example shows the correct and concise answer that also gained both marks.

(b) (i) Describe how a chlorine atom forms a chloride ion, Cl^-.

(2)

because it gains an electron

Some learners did not read the question carefully and stated that the chlorine atom forms a positive charge even though the question had already stated that it forms a negative charge. The answer scored no marks.

(b) (i) Describe how a chlorine atom forms a chloride ion, Cl^-.

(2)

Chlorine atom gets electrons taken away from it as it is a positive charge forming Chloride ion

Learners found question 8bii quite difficult with only the best being able to calculate the theoretical yield of the reaction and then use that to calculate the percentage yield for the reaction.

$$2Na + Cl_2 \rightarrow 2NaCl$$

In an experiment, 4.6 g of sodium was reacted with chlorine.

The actual yield of the experiment was 7.5 g.

Calculate the percentage yield.

(relative formula mass of sodium chloride = 58.5)

Show your working.

(4)

$mol = \frac{4.6}{23} = 0.2$

mass = mol × mr

0.2 : 2

$0.2 \times 58.5 = 11.7$

$\frac{7.5}{11.7} \times 100 = 64.1\% = 64\%$

Percentage yield = 64 %

In some cases learners did not manage to complete the calculate the percentage yield correctly, but because they showed their working, partial marks were able to be awarded for some correct working such as calculating the number of moles and for showing an understanding of the ratio involved.

(ii) Sodium reacts with chlorine to form sodium chloride.

The balanced equation for the reaction is

$$2Na + Cl_2 \rightarrow 2NaCl$$

In an experiment, 4.6 g of sodium was reacted with chlorine.

The actual yield of the experiment was 7.5 g.

Calculate the percentage yield.

(relative formula mass of sodium chloride = 58.5)

Show your working.

(4)

Na=23 Cl=35.5

$\frac{4.6}{(23\times2)}$ = 0.1 moles of Na

2:2

NaCl moles = 0.1

0.1 × 58.5 = 5.85

$\frac{7.5}{5.85} = \frac{\text{Actual yield}}{\text{Predicted yield}} (\times 100)$

Percentage yield = 128 %

Many learners were aware how the percentage yield should be calculated and wrote the formula for doing so. However, they were not able to calculate the theoretical yield to correctly complete the equation. In these cases, the learner was awarded a compensatory mark for showing an understanding of how the percentage yield should be calculated.

$2Na + Cl_2 \rightarrow 2NaCl$

In an experiment, 4.6 g of sodium was reacted with chlorine.

The actual yield of the experiment was 7.5 g.

Calculate the percentage yield.

(relative formula mass of sodium chloride = 58.5)

Show your working.

(4)

$\%\ yield = \frac{Actual}{Theoretical} \times 100$

Na = 23

2Na = 46

$\frac{7.5g}{58.5} \times 100 = 12.8\ \%$

Percentage yield = 12.8% 9

Question 9a was attempted by the majority of candidates however many did not read the question carefully and gave generic properties of metals rather than properties of aluminum that would make it suitable for use as drinks cans. For example, many learners stated that the aluminum is malleable and ductile. Whilst the malleability of the metal would be an important property to make the drinks cans. Ductility, whilst still a property, would not be an important property when making drinks cans. Learners should be taught to read the question carefully and, where necessary, relate their answer to the scenario given in the question.

9 Aluminium is used to make drinks cans.

(a) Give **two** properties of aluminium that means it is a suitable material for making drinks cans.

(2)

1. It is malleable
2. It is ductile.

Many learners also thought that aluminum was a good insulator, which is not correct and would not be important when making the cans. Many learners also stated that the aluminum would not rust. It should be noted that rust is a term that is reserved for the oxidation of iron rather than all metals and therefore credit was not awarded for the aluminum not forming rust.

The following shows a good answer that gave two properties of aluminum that would make it a suitable material for making drinks cans.

9 Aluminium is used to make drinks cans.

(a) Give **two** properties of aluminium that means it is a suitable material for making drinks cans.

(2)

Aluminium is malleable so it can be easily shaped, also it is durable and does not react with water or drinks.

Many learners made a good attempt at question 9 (b), most scored at least 1 mark for stating that the bonding was metallic many made referenced to the fact that the metal had an idea of delocalised electrons.

(b) Describe the structure and bonding in alùminium metal.

(4)

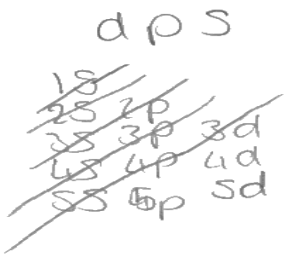
The aluminium metal has potive ~~metal~~ atoms surrounded by a sea of delocalised electrons. The aluminium metal has metallic bonding so is hard, and strong. There are strong electrostatic forces between the positive metal atoms and the negative electrons. the positive metal atoms and negative ions hold the metal in a fixed position in a 3 dimentional shape.

Some learners lost marks as they tried to describe the structure of an aluminum atom rather than the structure and bonding in the metal.

(b) Describe the structure and bonding in aluminium metal.

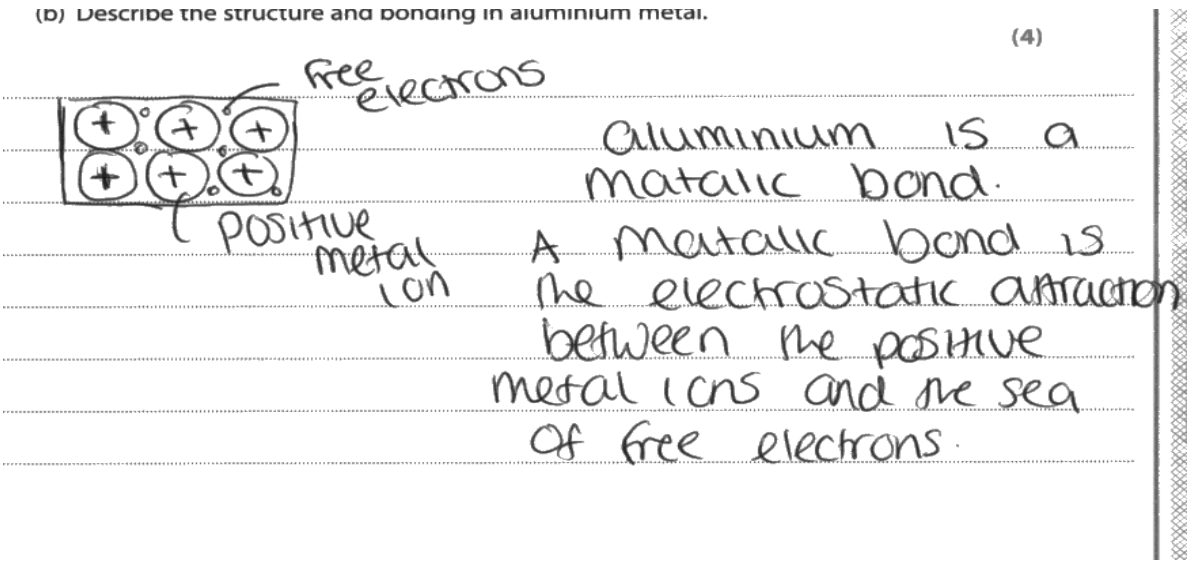
(4)

The structure in aluminium of electron shell is unstable as it doesn't have a full outer shell meaning it is very reactive but the two shells previous the 2,8 is stable and compact meaning the size is reduced and able to have enough energy to keep the 3 electrons tight.



Marks were awarded if points had been covered in a diagram.

In this example, the learner scored all 4 marks.



The levelled question in question 9c was well attempted by most. Many learners were able to score at least level 1 for stating some facts about the three metals but not being able to take this any further. Learners that could start to make links and lines of argument in their responses scored in level 2. The best learners that gave a comprehensive discussion with good lines of arguments and a well-developed structure were able to score into level 3.

Where learners lost marks, it was generally as they had not read the question carefully or simply repeated the stem of the question and gave the reactivity of the metals. Many of the less adept learners are still confused between the terms group and period. Another common error seen was to state that potassium is in period 3 and sodium and magnesium in period 2

This first example scored in Level 3 with 6 marks. The learner has given a comprehensive discussion of the relative reactivities of potassium and sodium. There are good lines of argument and a well-developed structure. There is reference to magnesium and the learner has attempted to explain its reactivity. This was deemed sufficient for level 3, 6 marks.

(c) Part of the reactivity series of metals is shown.

potassium	most reactive	
sodium	↑	
magnesium	least reactive	

Explain the difference in the reactivity of these metals with reference to their:

- position in the periodic table
- electronic configuration.

(6)

Potassium, K and sodium, Na are both group 1 metals (the alkali metals). The further down group 1 you go, the more reactive the element is. All group 1 elements have 1 electron in their outershell, which they want to lose to become stable. The higher the atomic number within a group, the more sheilding and consequently, the easier it is to loose their outer electon, making K more reactive than Na.
group 2 follows a similar pattern, but are far less reactives as they need to loose 2 electrons to gain a full outershell. Magnesium, Mg, is in group 2, the Alkaline earth metals.

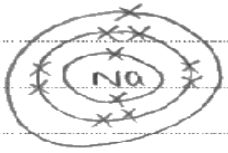
The next example scored in Level 2 with 4 marks. The learner has drawn electronic configuration diagrams for the three metals which were given credit for the electronic configuration. For each metal, they have stated how many electrons in the outer shell and linked this to reactivity. They have stated (under the sodium column) that potassium whilst still having one electron in the outer shell, has MORE shells than sodium and again relates this to reactivity. There is no explanation however, as to why more shells, means that it is more reactive. They have started to make links to reactivity in magnesium. Therefore there is some good knowledge shown with some lines of arguments and a good structure which is sufficient for Level 2 - 4 marks.

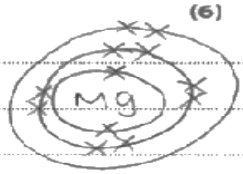
19 potassium	most reactive
11 sodium	↑
12 magnesium	least reactive

Explain the difference in the reactivity of these metals with reference to their:

- **position in the periodic table**
- **electronic configuration.**

(6)





potassium has one electron in its outer shell which makes it reactive. However, it has more shells than Na and Mg which makes it the most reactive. It is also in group 1.

Sodium has one electron in its outer shell aswell but K has more shells so is more reactive, however Na is still reactive. As well as K it is in group 1.

Mg is the least reactan out of the 3 as it is in group 2 so it has 2 electrons in the outer shell which means it isn't as reactive.

(Total for Question 9 = 12 marks)

The next example scored in Level 1 with 2 marks. The learner has given a handful of basic facts, there are no lines of argument, no explanations and no

links. Therefore, as there are no explanations or arguments or links this cannot move into level 2.

(c) Part of the reactivity series of metals is shown.

potassium	most reactive
sodium	↑
magnesium	least reactive

Explain the difference in the reactivity of these metals with reference to their:

- position in the periodic table
- electronic configuration.

(6)

Potassium is in the fourth period whereas sodium and magnesium are in the third period. Potassium and sodium ~~same~~ are in the first group whereas magnesium is in the second group. Potassium has an electronic configuration of 2.8.8.1, Sodium has an electronic configuration of 2.8.1 and magnesium has an electronic configuration of 2.8.2.

The final example has scored 0 Marks. The learner has stated that the lower you go on the periodic table, the more reactive the element gets, this is insufficient for credit as is not a true statement across the whole periodic table. They then state

that potassium has more electrons, there is no reference to what potassium has more electrons than and so there is no credit for this. They state that potassium has an incomplete outer shell, this was not sufficient for credit.

(c) Part of the reactivity series of metals is shown.

potassium	most reactive
sodium	↑
magnesium	least reactive

Explain the difference in the reactivity of these metals with reference to their:

- position in the periodic table
- electronic configuration.

(6)

The lower you go on the periodic table the more reactive an element gets. As well as this not only does potassium have more electrons but it also has an incomplete outer shell making the element unstable and more reactive

Section C – Physics

Learners found many of the Physics items a challenge; this could have been due to a number of factors. Those with good mathematical skill were able to access many of the marks associated with the skills, those with weaker skills found great difficulty with the calculations. Centres need to ensure that learners have the practice required to enable them to use simple algebra, rearrange equations, use powers of ten and read data with confidence from graphs. The Physics section was at the end of the paper, it was evident that some learners did not complete all the questions due to running out of time. Learners should be encouraged to devote sufficient time to a section, so that they have a chance of completing it and then checking what they have written. Some learners contradicted themselves in answers and appeared not to be aware of it. In many cases learners' appear not to have covered the specification areas tested in the section, it was evident that key words and concepts were not understood by many attempting the questions.

Question 10 dealt with some of the terminology relating to waves and wave motion. The question also asked learners to use the wave equation to calculate a frequency.

Q10a) this first item was relatively well answered, learners were able to give the value for the amplitude in most cases. Some learners gave an answer of 3.0cm rather than 1.5 cm as they considered the peak to trough value of displacement rather than the peak to x axis value. The weakest learners gave other values that appear to have been derived from the x axis scale.

Q10b) gave greater difficulty; learners appeared to be confused by the term 'periodic time'. The specification gives a list of terms relating to waves that should be understood. Periodic time is one of the terms specified. Some learners may well have used the term 'period' of the wave as an alternative. Learners should be taught both terms. In many cases a value from the x axis was identified but rather than the correct answer of 2.0s, answers such as 1.0s and 3.0s were incorrectly given, these corresponded to other places the wave intercepted the x axis.

Q10c) was a calculation to find the frequency of a water wave and was answered correctly by many candidates, in the instances where it was not, it was often poor algebra that was the cause. Many incorrect answers were the result to learners ending up with the equation upside down, which gave an answer of 0.67 Hz rather than the correct answer of 1.5Hz.

A fully correct three mark answer is shown below.

(c) The student investigates a different water wave.

The wavelength is 0.05 m and the wave speed is 0.075 m/s.

Calculate the frequency of the water wave.

Show your working.

(3)

frequency = v ÷ λ

$\frac{0.075}{0.05} = 1.5$

Frequency = 1.5 Hz

The learner has substituted into a rearranged equation and evaluated to give full marks.

In this example the learner has shown all the working, so if the final answer had not been evaluated intermediate marks could still be scored.

There are no marks awarded for an equation triangle, there may be useful to learner in recalling a rearrangement, but there must be clear evidence of the rearrangement, or the correct answer to score marks.

The correct answer without working would have scored full marks.

In some instances learners give two methods. In the example here the learner has multiplied the values and evaluated and then divided , correctly the values and evaluated. The answer on the answer line is the wrong one. In this example the learner is giving the examiner the choice, and this therefore scores no marks.

$0.05m \times 0.075m/s = 3.75 \times 10^{-3}$

$\frac{0.075}{0.05} = 1.5$

Frequency = 3.75×10^{-3} Hz

In calculations, learners should be clear about their answer and how it was arrived at.

Question 11 dealt with analogue and digital signals in optical fibres and the advantages and disadvantages of sending signals down optical fibres.

Q11ai) was a straightforward question asking learners to state what was meant by an analogue signal. Many learners could not do this. The term analogue and digital are in the specification as terms that should be able to be understood and used in a

variety of contexts. A few learners were able to recall the meaning of the term and gave answers such as the one below for the mark.

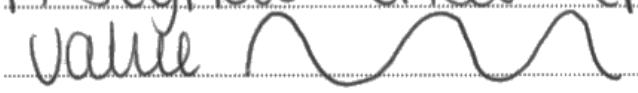
(a) (i) State what is meant by the term **analogue signal**.

(1)

has a continuous variable signal

Other learners were able to gain the mark by drawing what an analogue signal looked like, such as in the example below.

(1)

A signal that transmits any value 

Here the drawing scored the mark, not what was written.

Many learners however scored no mark, giving answers such as the one below.

(a) (i) State what is meant by the term **analogue signal**.

(1)

A signal that is not digital

This essentially is a repeat of the stem of the question.

Q11aii) was answered more successfully by learners and clearly was a better understood idea. A typical correct answer is shown below.

(ii) State what is meant by the term **digital signal**.

(1)

A signal which is identified by 1 or 0 (on or off).

The learner using the term 0 and 1 or on and off as suitable ways of stating the idea. In addition learners that stated that the digital signal was a binary signal also scored the mark. Many learners also drew the signal, which again scored the mark.

(ii) State what is meant by the term **digital signal**. 

(1)

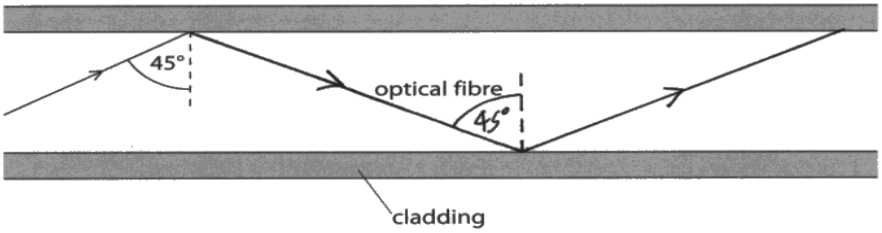
Has blocks rather than waves which are easier to see and analyse and a lot clearer.

In the example above the drawing scored the mark, the writing was ignored.

Q11b) was a question requiring learners to continue a light ray represented by a continuous line through an optical fibre. There were two marks awarded, one for the first reflection at the bottom of the fibre and a second for getting the angles of reflection correct. It was expected that the lines would be carefully drawn and that the angles were. A good answer is shown below.

Complete the path of the red light through the optical fibre.

(2)

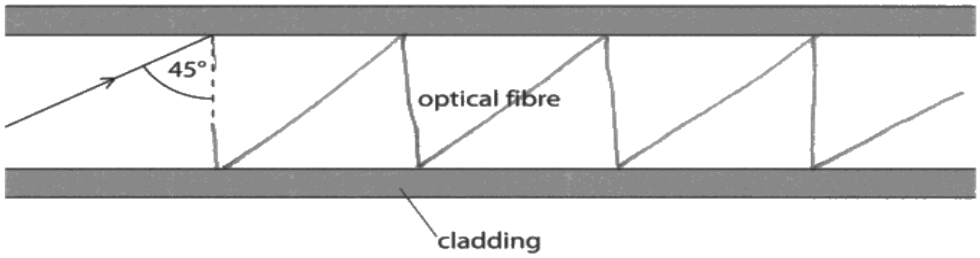


The learner has drawn a good reflection and the angles of incidence and reflection are approximately the same.

In this example the learner has not drawn a continuous line and the angles are incorrect.

Complete the path of the red light through the optical fibre.

(2)



This response scores 0 marks.

Q11c) this was the first question that required a more extended answer. The question asks learners to explain two advantages of using digital signals instead of analogue signals to transmit television programmes. Learners were expected to give an advantage and justify it; the two had to be linked together. In almost every case, where learners scored marks on this question, an advantage or two were given, but they were rarely explained. This limited the mark to a maximum of two. Some learners gave more than two advantages, but without any linked justification, the mark was therefore restricted to two. Learners could have done so much better on this question if they had written an answer that considered the command 'explain', in many cases the answer related more to the word 'list'.

A typical response by learners is below.

Explain **two** advantages of using digital signals instead of analogue signals to transmit television programmes.

(4)

1. There is less attenuation in digital signals so there is less need for the signal to be 'boosted' as frequently as analogue signals.

2. Digital signals can transmit more data quickly & the quality of the message (or television programme) is clearer and better.

In this example which was awarded two marks there are no linked pairs. The first statement can be given a mark for the second part of the first linked pair in the mark scheme. Being only one part of the pair means just one mark can be scored.

In the second part there are two further parts of a linked pair, but they are not complete. So throughout what appears to be a good answer there are no linked pairs of advantage and explanation, just some related statements.

Many learners found difficulty in giving any relevant advantages.

Question 12 was a about the differences between light and sound waves and the inverse square law for electromagnetic radiation.

Q12a asked learners to give two differences between visible light and sound waves. The question does not ask learners to describe light or soundwaves. Many learners answered the question by describing transverse and longitudinal waves, which was not required.

(a) Give **two** other differences between visible light waves and sound waves.

(2)

Light waves do not require a medium to travel through, sound waves do.

Light waves travel at a right angle to the direction of oscillation, sound waves travel in the same direction.

This kind of answer was seen quite frequently. The learner has given a difference in the first line and scores one mark for this. In the second line the learner has described the waves.

In this example, the learner has given a description in the first line and in the second line has stated a fact about light, but not made clear the difference as there is no comparative to sound. This answer therefore scores 0 marks.

(a) Give **two** other differences between visible light waves and sound waves.

(2)

Sound travels parallel to from the source.
Light can travel through a vacuum.

This is a good example of the type of question where learners have to be very clear that they have read the question carefully and given the answer required. Many learners gave correct facts, but they were not relevant to the question.

Q12b) was a very difficult question, with very few correct responses. The question was targeted at the higher end of the grade range, so the expectation was that a restricted number of learners would be able to gain all the marks. It was expected that many more learners would be able to identify the equation and make a start on the calculation. Poor algebra was again an issue for many learners. Dealing with a square root seemed to be a particular challenge.

A fully correct three mark answer is given below.

Show your working.

(3)

$I = \frac{K}{r^2}$

$\frac{I}{K} = \frac{1}{r^2}$

$\frac{100}{30^2} = 3.3$

$\sqrt{3.3} = 1.82$

Minimum distance = 1.82 m

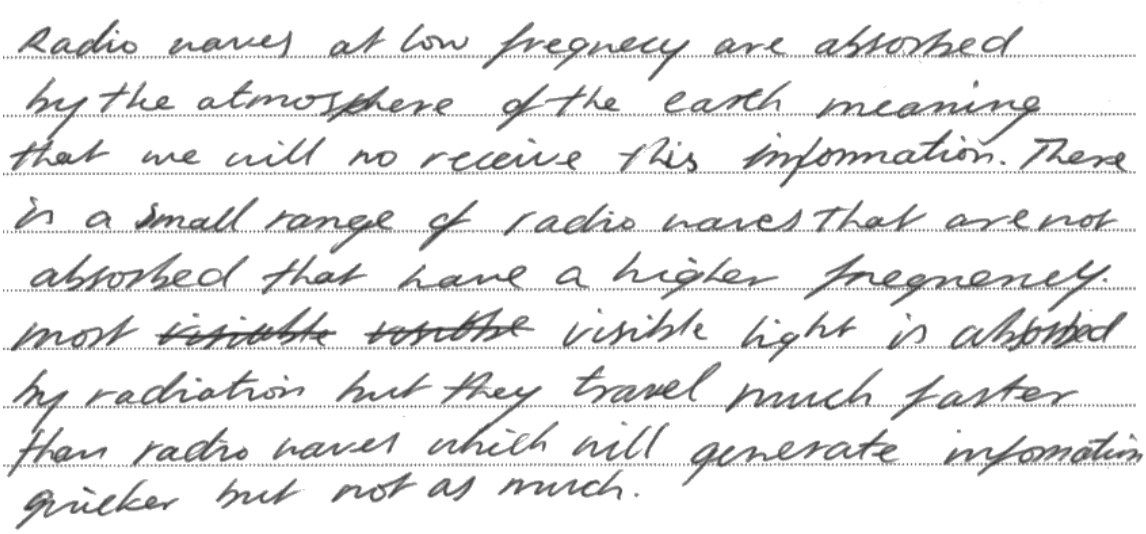
The learner has correctly rearranged, substituted into the calculation and evaluated the answer.

The working out is exemplary. Learners should be encouraged to set out their working so that it can be followed in a form such as this.

Most learners could not get beyond the initial equation. There was one mark available for the rearrangement, however few learners got this far.

Question 13 was about using different forms of electromagnetic radiation in communication and in the final question, evaluating the strengths and weaknesses of the electromagnetic radiation used in two common forms of communication control devices.

Q13a) asked learners to interpret data from a graph. This was a question that required a longer answer and was worth four marks. Answers required a linked pair of statement and justification. Many learners were not able to access this question. The command word was 'explain', yet many learners described the data. In many cases learners repeated the stem of the question or diagram, this never scores marks.


Radio waves at low fregnecy are absorbed by the atmosphere of the earth meaning that we will no receive this information. There is a small range of radio waves that are not absorbed that have a higher fregnency. most ~~visible~~ ~~to the~~ visible light is absorbed by radiation but they travel much faster than radio waves which will generate infomation quicker but not as much.

This response was typical of the answers seen. The first sentence is a repeat of information from the graph. There is a mark awarded for the statement that a small range of radio waves are not absorbed as it is the equivalent to the first part of the first linked pair, however without the justification no further mark can be awarded.

Many learners suggested that one type of E-M radiation travelled faster than another, this is wrong. In addition some learners wrote about the radio waves absorbing radiation, and were clearly confusing the ideas with those associated with ionising radiation. It was clear that learners had struggled to interpret the data provided.

Q12b) was designed to be a simple explain question testing the idea that all electromagnetic waves travel at the same speed in a vacuum. Many learners thought that were required to calculate a value and this was not the case. The answer to the question was simply that the both types of radiation would arrive at the same time as they both travel at the same speed in a vacuum.

This response below is what we were looking for, for two marks.

Explain how much time is taken for Signal B to travel between the two satellites.

(2)

Electromagnetic Waves travel at the same speed, so the same time is taken for Signal A and Signal B to travel between the two satellites

Stating the answer 1.28 seconds scored one mark if there was no justification. Many learners seemed to think that the different forms of electromagnetic radiation travel at different speeds.

Q13c) was the last question in the section. This was a levelled six mark item. In order to gain a distinction mark, learners had to give strengths and weaknesses of both types of devices in a clear and logical way that needed to be linked together to make a conclusion based on the evidence.

Evaluate the strengths and weaknesses of using:

- an infrared remote control
- a Bluetooth© remote control

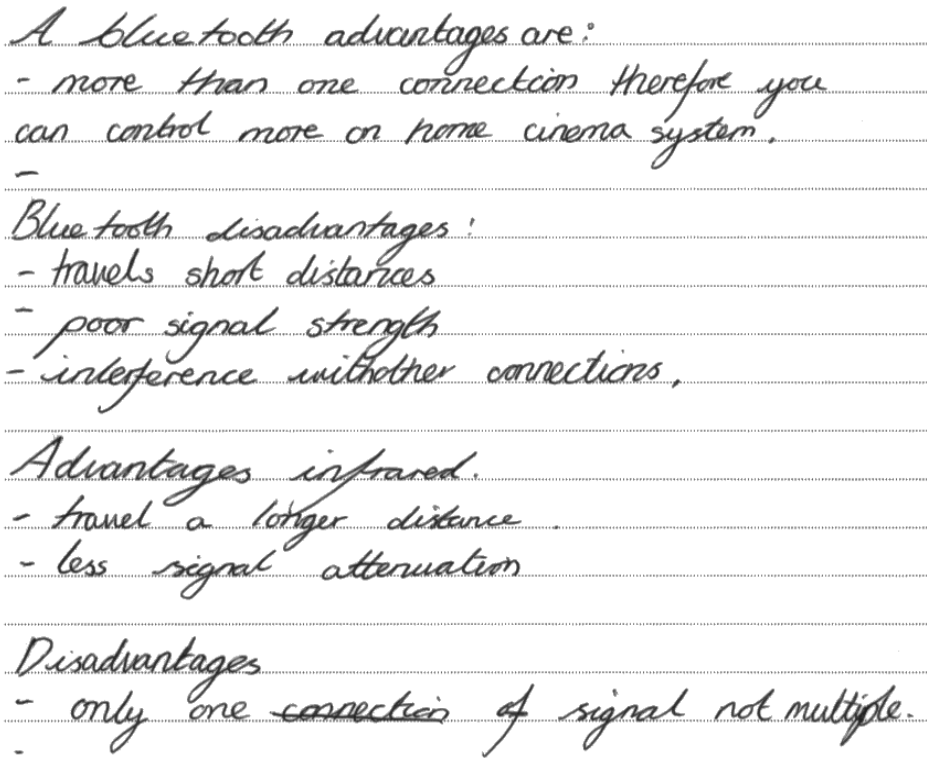
to control the home cinema system.

(6)

~~an infrared remote control~~ the strength of a Bluetooth remote control is that it can be used anywhere in the house and not have to be pointing at it however the weakness is it can easily get interference from other ~~blue tooth~~ bluetooth controlers. However infrade controllers strengths is that it does not get interference and is very accurate however it needs to be pointing or attached to the system in order & for it to work the best.

This answer gives some strengths and weaknesses of both in a clear and logical way, but there is no conclusion made. This scores 4 marks and is a Merit level response.

Many learners were not able to give strengths and weaknesses, instead they gave isolated facts.



In this example, the learner has given one strength and weakness for Bluetooth. The learner has presented the information as a series of points not linked together and so no more than a Pass mark can be awarded. This answer scored two marks.

Generic points

Understand the demand of the command word, e.g. explain make a point and add an explanation to reach full marks.

Show all working before giving answer on answer line for mathematical marks.

Plan 6 mark question answer in bullet points before writing in full. This could be creditworthy if you run out of time to write prose. Gives logical coherent response and helps to focus.

Consider the context of the question and apply your knowledge within the context of the question

Biology Specific points

Learners should be able to recognise cell organelles from diagrams and electromicrographs. They should also know the function of each organelle.

Learners should be able to give full level 3 definitions of key terms, such as tissue for example.

Learner should focus on the causes of conditions such as depression, Parkinson's disease and Atherosclerosis, rather than the effects on the person.

Learner should be able to discuss the specialisations of the cells listed in the specification with logical lines of argument for the advantages of the specialisations.