GCSE EXAMINERS' REPORTS

GCSE
SCIENCE (DOUBLE AWARD)

SUMMER 2019

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SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 1: BIOLOGY 1 – FOUNDATION TIER

General Comments

All seven questions on the paper were attempted by a large proportion of the entry. However, the number of questions that were not attempted was larger than that seen in 2018.

Poor basic literacy severely limited the quality of responses of many candidates. At Foundation Tier, many struggled with extended writing as was evidenced on this paper. Candidates often appeared hampered as a result of poor language skills and an insufficient body of knowledge and understanding necessary to answer direct questioning or to construct comprehensible, coherent and comprehensive answers. Many answers or part answers were partly or wholly illegible, making it very challenging for markers to interpret. Spelling was often poor. With some exceptions (e.g. meiosis/mitosis), a misspelt biological term is accepted as long as it is phonetically accurate. However, often this was not the case. Vocabulary was generally very limited, with candidates appearing to struggle to express their ideas. It is difficult to score marks on scientific questions if knowledge of the terminology is lacking.

Candidates often seemed not to have read the question fully and did not consider diagrams given in questions, which often provide substantial clues to the answer. As a result, their ability to analyse data, make inferences or draw conclusions was severely hampered.

Failure to use the comparative term (e.g. 'more/ less', 'higher/highest') frequently resulted in lost marks. Candidates would be well advised to avoid using the term 'amount' when answers require reference to a specific measurable quantity, such as volume, number, concentration or mass. Poor basic numeracy, including simple arithmetic, severely handicapped a substantial proportion of the entry.

Comments on individual questions/sections

Q.1 (a) (i) On the diagram of the thorax, only a few candidates gave the correct name for structure X - intercostal muscles, while most scored a mark for structure Y- ribs/ribcage.

(ii) The alveoli as being the site of gas exchange in the lungs was not well known. The commonly seen 'aveoli' was not allowed.

(iii) The action of the diaphragm and the resulting change in pressure in the thorax during exhalation were poorly known. All four words from the given list were seen in each of the two spaces.

(iv) The most common answer for the pathway for air from the lungs when we exhale was letter B - bronchus, trachea, bronchiole.

(b) The introduction to this question explained the term vital capacity and showed apparatus that could be used to measure vital capacity in a 'before and after' diagram.

Candidates were asked to describe how a student used the apparatus to measure her vital capacity. Many candidates spotted the labelled mouthpiece and the arrow from the label to the opening of the tube and were then able to suggest that the student breathed out through the tube. Many answers however were spoilt by the idea that the student breathed in *and* out through the tube, or in several cases that the student sucked water out of the bell jar. Commonly, answers were too vague, such as the student 'blew into the jar'. The second available mark proved to be more difficult to score. It was hoped that candidates would spot that the level of the water had dropped, allowing a reading to be taken of the volume (of air, or water expelled). However, most answers were limited to the point that the water level had dropped, or that having blown into the jar, she could measure her vital capacity without stating how.

(c) **(i)** Many candidates constructed a neat and accurate bar chart. A common error however, was a failure consistently to remember that there were two small squares to be allotted per student on the y-axis, resulting in a loss of one, sometimes both marks.

(ii) It was hoped that candidates would spot the bi-modal distribution in the vital capacities, suggesting that the variation was the result of age and gender differences, and some candidates did indeed get at least one of the two. A wide variety of other suggestions was also accepted, such as fitness, smoking, or named lung conditions. Vague suggestions such as 'health issues' or of being 'sporty' were not credited. A large number of responses suggested that the variation was due to errors in the method, or inaccurate measurements.

Q.2 **(a)** Many candidates performed well on the table recalling the name and function of the two labelled cell components. The cell membrane *controls* entry/exit, not 'allows', as was seen commonly.

(b) The candidates were asked to select from a short list the organ and cell that belonged to the circulatory system. Responses here were disappointing. All combinations were seen. A very popular suggestion for the blood cell being palisade, instead of phagocyte.

(c) **(i)** **I** Candidates were then asked to calculate the surface area of one side of an image of a red blood cell. The calculation was set up to be done in two stages, in order to assist candidates to arrive at the correct answer. In part I, the radius is given (4). Candidates were then asked to square the radius. This proved to be problematic. Many candidates appear to have multiplied the radius by the diameter (i.e. 4×8) to give an answer of 32 (instead of 16).

II Part II requires the candidates to multiply their answer to part I by 3.14 and give their answer to the **nearest whole number.** This instruction was given in order to take into account the large variety of errors expected in part I and thus to facilitate marking an error carried forward. Unfortunately, many answers included decimal numbers and thus failed to score.

(ii) Many candidates gave the correct function for the red blood cell (carry oxygen) and some scored the second mark for adding the prefix 'more'.

(iii) Very few candidates know the meaning of the word 'specialised'. Answers such as 'important' or 'special' were common.

Q.3 **(a)** The question stated that students were investigating the movement of molecules through small pores in a membrane, using Benedict's reagent to test for the presence of glucose. It was hoped that this information would aid candidates in interpreting the results of the investigation and to provide correct answers.

(i) While several candidates stated that there was no glucose in the water at the start, many thought that the blue colour of the reagent showed the *presence* of glucose, or starch, or that 'nothing had happened'.

(ii) While many did point out that glucose had appeared in the water at 15 minutes, most failed to use the cue given to them in the stem of the question and so lost the second mark by not adding that the molecules had passed through the pores. Vague comments such as the glucose had leaked out, or left the tube were not credited.

(b) The true/false table concerning the processes that occurred during the investigation proved to be very challenging to most candidates. However, it was pleasing that some candidates did score all three available marks showing a good understanding.

Q.4 The use of lichens as indicators of air pollution is required knowledge, but many candidates seemed unaware of this. However, all the information required to answer the three parts of this question is presented to candidates in the form of a table, a diagram and the text.

(a) A number of candidates did analyse the information provided and gave the correct answer of low (pollution). However, all other pollution levels were seen, as well as many that were not in the table, such as 'not much'.

(b) **(i)** Many candidates correctly pointed out that the usual wind direction was from East to West, or to wood B as the evidence for why air pollution in wood B would be higher than in wood A. Many answers were too vague, such as 'the usual wind direction' or that 'the smoke/pollution/air goes that way'.

(ii) The candidates were asked to use lichens on trees as indicators to design an investigation to test Sharon's hypothesis. The information given in the stem of part (a) states that: Sharon examined several trees in her school grounds and identified each type of lichen.

A candidate who wrote one sentence that stated: 'Examine trees in woods A and B, identify each type of lichen, then compare the results' would have covered six points of indicative content, and most probably scored 5 marks. Unfortunately, a large proportion of the entry ignored the question entirely, instead writing (often at length) an account of why they would or would not support Sharon's hypothesis, thus scoring no marks at all. The mean mark of 1.7 (out of 6) indicates the extent of the problem. Candidates should be encouraged to read and consider questions carefully.

Q.5 **(a)** Many candidates correctly identified the aorta in (i) but almost no correct answers were seen for the function of the coronary artery in (ii) which is an item of recall from the specification.

(b) **(i)** In part I, most candidates gave the correct relationship between increasing intensity and increasing heart rate. Part I, was designed to help candidates focus on why the increasing heart rate would be important for respiring muscle tissue (part II). The stem of (a)(i) reminds candidates that the aorta carries oxygenated blood. Thus 'more oxygen for more respiration' would score both marks. Unfortunately, most candidates ignored the prompts to oxygen and respiration. Many answers asserted that the increased heart rate was to do with repairing the muscle. A large number did not attempt this part.

(ii) Many candidates gave at least one acceptable way in which a fair comparison could be made between the three boys. Candidates should be encouraged strongly to avoid using the word amount here - as in the 'same amount of steps', for example, which is meaningless, whereas 'number' would be more appropriate. A common error was to state that the experiment should be repeated, or extended in some way.

(iii) Most candidates scored the mark here, usually for the idea of testing more people or both genders, as a way of making the investigation more representative of the population.

Q.6 **(a)** Pleasingly, many candidates scored at least one of the two marks available for this unscaffolded equation for photosynthesis.

(b) Very few candidates were able to express 20 as a percentage of 25.

(c) Many candidates picked up on the diagram showing that leaf A has more chlorophyll, or that it reflected less light (than B), but rarely both and a few referred to the graph as asked in the question to spot that leaf A had a greater rate of photosynthesis. Common errors were to state that leaf A was bigger, or had a greater surface error, or indeed that it reflected *more* light.

Q.7 **(a)** **(i)** Very few candidates could recall that amino acids are the products of protein digestion. Popular answers included various food items such as meat or protease.

(ii) A few candidates correctly stated that digested food is absorbed in the small intestine.

(b) **(i)** Candidates were asked to make a conclusion from the results but where attempted, most answers were to do with the contents of the tubes.

(ii) and (iii)

These parts were too challenging for almost all candidates at this level and many left both parts blank, although a few did spot that the stomach liquid must be acidic.

(iv) Pleasingly, a number of candidates persisted with this question and some made the point that lipase (only) digests fat (and not protein). However, there were very few references to the specificity of the active site, though a few mentioned the lock and key model, which did not score.

(v) Very few candidates scored the mark for temperature being the further variable that should be controlled.

Summary of key points

- Questions often involve a comparison between two or more sets of information such as in tables, graphs or diagrams. When answering, candidates should be careful to useful *comparative* terms (more/higher/faster etc).

- The stem, or introduction to questions usually include a number of substantial prompts, key terms or named processes that candidates should then use in their answers. These introductions should be studied carefully before attempting an answer.

- Candidates should keep their answers as concise as possible to reduce the risk of making a contradictory or erroneous point which might negate a correct one.

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GCSE

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UNIT 1: BIOLOGY – HIGHER TIER

General Comments

The lack of GCSE exam maturity was quite obvious for a number of candidates. For example, the quality of the written responses, were much lower, as was the ability to read and **take in** the information in the question. Some candidates often seemed to skim through questions quickly picking out a few key words and then writing what they know about these few key words. This resulted in the answers lacking the detail necessary in order to score well on this paper.

Comments on individual questions/sections

Q.1 **(a)** Generally well answered with many candidates gaining 1 or 2 marks. The equations were often spoiled by poor placement of terms such as light, chlorophyll and energy. These terms were not required in the answer. A word equation was asked for but for those candidates who gave chemical formulae they had to be correct, e.g. superscript numbers were not acceptable. Far too many candidates gave the equation for respiration.

(b) Many candidates gave the correct answer. If the answer was incorrect then 1 mark was awarded for the correct method of calculation i.e. $\left(\frac{20}{25}\right) \times 100$.

(c) Better candidates understood what the diagram showed and gained 2 marks. However, there were far too many incorrect answers such as – leaf A is bigger, leaf A has a larger surface area, leaf A has more light energy falling on it

Q.2 **(a)** **(i)** Almost every chemical named in the specification appeared as answers here. Better candidates named amino acids and gained the mark. Hedging their bets by listing a number of chemicals in the hope that one of them was correct did not gain credit.

(ii) Again all parts of the digestive system appeared as answers in this question. Small intestine was the only answer accepted. (Credit was given for duodenum and ileum if seen.)

(b) **(i)** Although the candidates were asked to make a comparison between **Tubes A** and **D** the comparison did not need to be written in the answer. Many wrote extensively about the contents of the two tubes when all that was needed was a simple statement saying that protease is needed (for the digestion of protein). It was insufficient to say that protease digested protein in **Tube A** i.e. just to give the result. They had to draw a conclusion i.e. protease is needed to digest protein.

(ii) Again, a conclusion was required and not just a statement of results. Protease is present gained 1 mark and the fact that it is acidic or at pH 2 or low pH gained the other mark. Candidates generally found this question difficult. Some implied that the acid was responsible for the digestion of protein whilst others stated that there was "no pH present". Some candidates spent far too much time trying to explain the 100 % digestion of protein in Tube A compared to the 98 % digestion in Tube D.

(iii) Few candidates could recall that enzymes are proteins. It seems that the – enzymes are proteins and protease is an enzyme - link was just one step too far for them. Most thought that amino acids are proteins.

(iv) A few good answers were seen here. Many realised that protease only digests proteins and that lipase only digests lipids/fats/oils. Or that lipase doesn't digest proteins. Fewer gave creditworthy answers relating to the specificity of enzymes or to their active sites - this was the 2nd marking point. Candidates must use correct or acceptable terms when describing the action of enzymes. Protease digests or breaksdown (or hydrolyses) lipids is what was looked for. Protease 'dissolves', 'absorbs', 'destroys' or 'gets rid of' proteins are unacceptable. Answers such as "the lock and key" doesn't work are not creditworthy.

(v) Generally poorly answered. Temperature was the only acceptable answer. Many candidates didn't understand that they couldn't select a given variable from the diagram. The question asked for one further variable.

Q.3 **(a)** Candidates were asked for two other organs (other than the lungs) which occupy the space of the thoracic cavity. They were given a diagram that clearly labelled the thoracic cavity so why candidates gave the names of organs or structures outside the thoracic cavity is puzzling. Acceptable answers included the heart, trachea, oesophagus, bronchi and blood vessels or named blood vessels. Very few candidates gained both marks here.

(b) Some excellent answers here with many candidates gaining all 5 marks. The mechanism bringing about inspiration was well known by some. However, the quality of response was not consistent across the candidature.

(c) **(i)** The calculation caused problems for many candidates especially those that failed to register the request to give their answer to two decimal places. The correct answer of 0.09 % gained two marks. For those candidates who calculated the volume of one balloon only then 0.04 % gained one mark. The correct method of calculation with an incorrect answer also gained one mark, as did an answer with incorrect rounding or more that two decimal places.

(ii) Most candidates managed to gain one mark usually by referring to the fact that the chest/thoracic wall/ribs move whilst the wall of the bell jar is rigid. The 2nd mark was harder to obtain.

Examiners were looking for a comparison of diaphragm/rubber sheet position/shape, relative volumes of the space around the lungs/balloons or the relative sizes of the lungs/balloons. 'The rubber sheet is pulled downwards by a hand but the diaphragm was not', was not creditworthy.

Q.4 **(a)** Generally well answered. Many candidates realised the relationship between available light and photosynthesis – those candidates gained the mark. However far too many failed to make the link, giving unacceptable answers such as 'light is needed for the kelp to grow". The only place in the biology specification where light is mentioned is in relation to its role in photosynthesis. It should therefore be almost a 'knee jerk reflex' for candidates to think of photosynthesis whenever light is referred to in a question.

(b) This was very poorly answered. Candidates are informed in the question that kelp can grow at the rate of 0.5 m/day. To repeat this in the answer did not gain credit. They had to state that if the kelp is harvested at ≤ 0.5 m/day then harvesting can be maintained. It was quite evident from some of the answers that many of the candidates have trouble with the meaning of the term harvest/harvesting. They should be instructed in its meaning in relation to both crops and natural resources.

(c) **(i)** A well answered question. The graph presented very little difficulty to the majority of candidates. Where marks were lost it was for not joining the plots with a ruler, creating a poor scale or failing to include the units on the axis labels.

(ii) Generally well answered. No effect/stay the same/stays at 780 mg/kg were the answers examiners looked for. It is not good enough to say that it doesn't rise any further because that answer doesn't preclude the fact that the readings couldn't fall.

(iii) Very poorly answered. They failed to understand the significance in the results being given as mg/kg rather than mg/plant.

(iv) Some good answers although many candidates struggled with the calculation and with expressing the answer in standard form. 1.229091×10^4 , any correct rounding of this number was awarded the two marks. One mark could be gained for incorrect rounding. Answers not given in standard form could still gain a mark. As could the correct method but the wrong answer, i.e. $\left(\frac{676}{0.055}\right)$ gained a mark.

(v) Many candidates gained one mark for referring to active transport, some also gained a second mark for stating that active transport requires energy. Very few gained the mark for stating that the source of the energy was respiration. Far too many candidates gave answers that were a confused compilation of statements about diffusion, osmosis and active transport.

(d) Quite well answered for those candidates who understood the meaning of the term controlled variable. Many came up with an acceptable answer although far too many answered temperature or oxygen concentration – the values of which were given in the question.

Q.5 Candidates found most of this question difficult. The working and structure of the heart were not well understood, neither were the function of arteries and veins or the significance of the different pressures in the different parts of the circulatory system. Throughout this question no credit was given for statements referring to arteries and veins pumping blood.

(a) **(i)** This question was about the difference in the distance that blood has to travel when it's coming out of the atria and the ventricles. From the atria the blood travels to the ventricles – a very short distance and therefore the blood doesn't need to be pumped by a thick-walled muscular chamber. The opposite is the case for blood that has to be pumped all around the body. Some candidates read this question as one requiring an answer referring to the difference in pressure between the left and right ventricles.

(ii) Few candidates realised that the blood passing through the lungs would experience a drop in pressure and that this would account for the difference in pressure between the pulmonary artery and vein.

(iii) This question was not very well answered. This is another question about different strength pumps being needed because blood has to be pumped different distances in the two circulations. The different distances are not obtainable from the diagram where the lungs and rest of body are shown equidistant from the heart. Knowledge and recall are required here. Answers required reference to the relative thicknesses of the walls of the left and right ventricles, the different pressures these two chambers could create and the distances the blood has to travel in the two circulations.

(b) This question is about the essence of understanding the need for a double circulation in homoeothermic vertebrates. That after the blood has passed through the organs and tissues of the body it doesn't have sufficient pressure to go through the lungs and therefore, has to go back to the heart to receive sufficient pressure to get it through the lungs. Then after passing through the lungs it doesn't have sufficient pressure to go around the body and therefore it has to go back to the heart etc, etc. Candidates had very little understanding of why humans have a double circulation.

(c) Generally well known. Most candidates understood the role of valves in preventing the backflow of blood.

Q.6 Some good answers where candidates showed an understanding of the role of mucus and cilia in the cleaning mechanism of the lungs. The harmful effect that tobacco smoke has on the cilia and mucus was also understood by some candidates. Reference to diseases of the respiratory system was not required. Occasionally reference was made to cilia working in the oesophagus.

Q.7 **(a)** **(i)** A very mixed response here. Better candidates could calculate the energy release /g of food - 552 J but, far too many candidates had difficulty converting this into kJ.

They just weren't sure how to carry out the conversion. This was disappointing. However, the incorrect kJ reading could be carried forward to part (ii) as an error carried forward (ecf).

(ii) Having obtained a kJ reading in part (a)(i) many candidates did not know what to do with it. Many had forgotten that Carwyn only wanted one third of his energy intake to come from carbohydrate. But, they didn't know where to get this one third reading from. Total energy intake $\left(\frac{8\,400\,\text{kJ}}{3}\right)$ = 2 800 kJ. Those that got a reading of 2 800 weren't quite sure what to do with it. They needed to divide it by the kJ reading for part (a)(i) to obtain the answer.

(iii) Generally poorly answered. Only a few candidates realised that much of the energy from the burning pasta was lost to the air/environment/surroundings/lost as light.

(b) Candidates found this difficult. Better candidates referred to the maintenance of the shape of the active site and gained a mark. Hardly any candidates referred to the fact that these two enzymes were made up of different amino acids or amino acids arranged in a different sequence.

Summary of key points

- Candidates must read the question carefully rather than skim quickly through it. Once read, they must follow any instructions given. Question 1 is a good example. Here the candidates are instructed to write the **word** equation for photosynthesis. So why would some of them include chemical formulae in their answers? It's as if they are attempting to show the examiner that they have more knowledge than is asked for, so they write H20 or CO2 or CO^2 getting the chemical symbol wrong and score zero marks. If candidates are asked to give the answer of a calculation to two decimal places then that is what's expected. If they fail to follow this instruction they lose marks.

- They must look carefully at diagrams, charts, tables, photographs and graphs. They must develop the skills necessary to absorb and interpret the information contained in them. In Question 1(b)/1(c) a very frequently seen incorrect answer was that ***'…the surface area of leaf B is less than leaf A…'***. It isn't, the surface areas are exactly the same. If there were any doubt in the candidate's mind then a quick use of a ruler would demonstrate this.
  In the chart in question 2(b) there's a lot of information to absorb. In 2(b)(i) they are asked to compare the results for Tubes A and D and draw a conclusion. Why do candidates think that they are going to get any marks for writing the list of contents in Tube A followed by the list of contents in Tube D? It seems for many that the word conclusion is beyond their understanding. Some candidates compared Tubes A and B or A and E.

- In questions where candidates are asked to give one **other** variable that should be controlled in an experiment, candidates do not seem to understand that **other** here means a variable not mentioned in the question. Question 2(b)(v) - commonly seen incorrect answers here were pH, concentration of protein and concentration of protease – all given in the question.

- The candidates' demonstration of the recall of learned facts is not good. 40 % of the questions on the paper involve recall. Thorough revision is essential if high marks are to be obtained on recall questions.

- Far too many candidates find simple mathematical calculations difficult. The calculation of a simple percentage still troubles far too many candidates. They should also at this stage be able to convert, for example, grams into kilograms or J into kilojoules. In question 4(c)(iv) candidates were asked to give the answer to a calculation in standard form. Many candidates failed to do this and lost marks. It was obvious that some candidates didn't understand the use of standard form.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 2: CHEMISTRY 1 – FOUNDATION TIER

General Comments

Most candidates found the first five questions accessible. Question 5 was a PISA-style question and it is pleasing to report that it was well answered. Question 6 was the QER question which was poorly answered. Candidates found it difficult to explain practical methods in questions 7 and 8. The final two questions were poorly answered.

Comments on individual questions/sections

Q.1 Most candidates gained two or three marks, mainly for identifying **A**/hydrogen as the element making the 'pop' noise and **D**/chlorine as the element that produces lithium chloride on reacting with lithium. Very few candidates failed to score any marks.

Q.2 **(a)** **(i)** Many candidates identified the correct diagram for an element however, the reason for their choice was vague e.g. 'same element', 'the only element', 'it has one atom'.

(ii) and (iii)

These were well answered.

(b) The M_r calculation for (i) was well done although some candidates multiplied the A_r values rather than adding them. The percentage calculation was well done. The most common error was to divide 64 by 32 rather than 32 by 64.

(c) This was thought to be an accessible question (testing quite a difficult skill) but it was poorly answered.

Q.3 **(a)** Only a minority of candidates gained the mark, mainly because not **all** the pure substances were given. Those that correctly identified all three gave a correct reason.

(b) Many gained one mark whilst a minority got both marks. Candidates did not read the question which asked for **two** conclusions. Some only ticked one box.

(c) This was well answered with most candidates correctly calculating the R_f value.

(d) On the other hand this part was poorly answered. Many candidates referred to the substance not reacting rather than the solubility whilst many did not attempt an answer.

Q.4 **(a)** Many candidates gained both marks. Weaker candidates referred to the mantle or sea levels rising or stated that earthquakes/tsunamis would arise due to the movement of plates.

(b) Part (i) was well answered, however part (ii) was disappointing. Candidates referred to volcanoes/earthquakes rather than stating what happens to the oceanic plate as required. Part (iii) was poorly answered.

(c) The calculation was very pleasing with many getting both marks. The only common error was incorrectly rounding 0.895 to 0.89.

Q.5 With the exception of part (d), the whole question was well answered. Many candidates scored at least one mark for part (c). Part (d) was very poorly answered and many did not attempt it. The question gives the name of the salt formed but many candidates did not read carefully enough to realise this. The skill of writing a chemical formula is a very important one and allows access to several marks on each chemistry paper. Centres are encouraged to work on developing and practising this skill from KS3 and throughout the GCSE course.

Q.6 The majority of candidates gained a lower-band mark for the QER question, stating the benefit of adding fluoride into the water and some possible side-effects.

Fewer candidates achieved the middle band by providing the ethical argument or expanding on the side-effects. Very few top band answers were seen. Several candidates included irrelevant information referring to treatment of the water supply or hard water. Several candidates answered exclusively in the context of chlorine rather than fluoride.

Q.7 **(a)** Many gained one mark by stating that the mass would decrease, however few candidates related the loss to the release of gas from the container.

(b) Both parts were well answered, although the common error for (i) was to give the last time recorded on the graph rather than the time at which the line becomes horizontal.

(c) This was well answered with the majority gaining both marks. The most common error was to use the mass rather than the *decrease* in mass as required.

(d) This was the most poorly answered part of the question. Many candidates drew the graph to the right of the original as required but very few showed an understanding that the same mass would eventually be lost. Several candidates did not attempt the question.

Q.8 **(a)** This was well answered and many candidates got 1 or 2 marks.

(b) **(i)** Many candidates stated that 'hydrogen gas is formed' rather than giving an observation such as 'bubbling' or 'fizzing'.

(ii) General laboratory rules such as 'tie long hair back' and 'stand well back' were not credited.

(iii) Many candidates gave the name of the product rather than the formula as required. Very few correct answers were seen on the foundation tier paper. Large numbers did not attempt the question.

(iv) A wide range of numbers were given with many candidates clearly not knowing that solution **A** is alkaline.

(v) The majority of candidates gave an acceptable answer which was pleasing.

Q.9 This question was poorly answered at foundation tier.

(a) **(i)** Candidates mainly referred to the decrease in volcanic eruptions rather than the decrease in temperature of the Earth. The second mark for the formation of the oceans was more accessible.

(ii) Some candidates misinterpreted the question and gave answers relating to an increase in carbon dioxide. Many gained a mark for reference to photosynthesis but few included the absorption of carbon dioxide by the oceans or by rocks.

(b) The majority gained one mark for stating a cause for the increase in carbon dioxide or a reason why global warming is a concern. Some explanations were too vague to gain credit e.g. causes – factories, more cars, volcanic eruptions; concerns – ice caps melting (no mention of faster rate), animals dying (no mention of loss of habitat).

(c) This part was very disappointing. Many candidates did not attempt the question and others just wrote 2 in both boxes with little thought.

Summary of key points

Good points

- Mathematical skills have improved.
- PISA-style question was well answered.

Areas to improve

- Writing chemical formulae of compounds.
- Balancing chemical equations.
- Practical skills and explanations relating to practical work.

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GCSE

Summer 2019

UNIT 2: CHEMISTRY 1 – HIGHER TIER

General Comments

The first two questions were well answered and were accessible to most candidates. In question 3 very few candidates identified the compounds with most only identifying the metal or halide ions. The symbol equation in question 3 was very poorly done. Question 4 was not accessible to the majority of candidates – only the graph was accessible to most. The distillation question was well answered in question 5, however, the majority of candidates could not rearrange the mathematical equation to calculate the M_r for the second part. The QER question was poorly answered with many candidates only being awarded lower-band marks. The displacement of halogens and the calculation were poorly answered in question 7. In question 8 very few candidates correctly calculated the rate at 2 minutes whilst the particle theory explanation for the difference in rate between S and T was again poorly answered.

Comments on individual questions/sections

Q.1 Many areas of the question were well answered.

(a) This was well answered and many candidates scored 2 or 3 marks.

(b) Many candidates gave the 'lilac flame' although a minority gave an answer of 'hydrogen gas is formed' instead of 'bubbling' or 'fizzing'. As on the foundation tier paper, general laboratory rules such as 'tie long hair back' were often seen. Many candidates gave the name of the product for (iii) but only a minority gave the correct formula. The most common incorrect formula given was KH_2O. Again, a wide range of numbers were given for (iv) and the majority of candidates gave an acceptable answer for (v).

Q.2 This question was well answered.

(a) Many candidates gained full marks for parts (i) and (ii). In (i), some candidates had clearly not read the question carefully enough and referred to the combustion of fuels and a temperature increase! Most gained a mark for the formation of oceans. For (ii), a minority of candidates misinterpreted the question and gave answers relating to an increase in carbon dioxide as was the case on the foundation tier paper. Most referred to photosynthesis and a good number stated that carbon dioxide had been absorbed by the oceans or by rocks.

(b) Many gained one mark. Some explanations were too vague to gain credit e.g. causes – factories, more cars, volcanic eruptions; concerns – ice caps melting (no mention of faster rate), animals dying (no mention of loss of habitat).

(c) This was well answered on the whole by higher tier candidates. Some showed an understanding of the balancing process but just fell short of ensuring equal numbers of all atoms on both sides e.g.
6NH_3 + $3O_2$ → **3**N_2 + $6H_2O$
A near miss with the number of hydrogens not balanced.

Q.3 **(a)** Many candidates gained one mark for either correctly identifying some of the metal ions or the correct halide ions. Few gained full marks for combining the two. Those who did not get credit stated the name of the halogens rather than the halide ions. Some candidates gave the metals calcium and potassium showing poor recall of flame test colours.

(b) This was very poorly answered. As on the foundation tier paper, many candidates were unable to write chemical formulae. Common errors were $AgCl_2$, $MgNO_3$.

(c) The majority of candidates scored 1 mark for finding M_r for silver nitrate and many gave the correct answer in standard form which was good to see. Some multiplied the mass by M_r rather than dividing it. ECF was applied when candidates calculated M_r using only one oxygen atom.

Q.4 This was a poorly answered question with very few candidates gaining credit other than for the graph in part (b)(i). Few candidates realised that the temperatures were below room temperature in part (a). The graph was well done and the majority of candidates scored 2 or 3 marks. The line of best fit was drawn well, although some drew a line from the origin to the first point or joined the points using a ruler. Those candidates lost a mark. In part (b)(ii), candidates found it difficult to give a reason for their answer, even though they showed this on the graph. In part (c), the vast majority of candidates had no knowledge of the method detailed on page 38 of the Guidance for Teaching document.

Q.5 **(a)** This was well answered and many candidates scored 1 or 2 marks, usually for the different boiling points and the collection of the two liquids in separate containers. Several candidates remembered to state that the vapour condenses, rather than saying that it turns into a liquid, which is too vague.

(b) Candidates found it difficult to re-arrange the equation, hence only a minority of candidates gained full marks. Many included the mass of only one oxygen atom rather than two as stated in the question.

Q.6 Answers here were disappointing with many candidates scoring only 1 or 2 marks. Some gained middle-band marks but very few included the detail required for a top-band mark. Several candidates recognised boiling as a method of softening temporary hard water and that permanent hard water is softened by adding washing soda. Some correctly identified washing soda as sodium carbonate. A correct description of the methods and the naming of the ions present in both temporary and permanent hard water was rarely seen. Some answers did include the hydrogencarbonate ion present in temporary hard water. Very few candidates attempted an equation to illustrate how the methods work. When an equation was attempted, the by-products were often incorrect. Several candidates compared the washing soda method and the ion exchange technique, whilst many described an experiment to test the amount of hardness in water using washing soda as an alternative to soap solution!

Q.7 **(a)** Candidates gained one mark in part (i) for stating that chlorine is more reactive than iodine. However, the explanation was very poor where only the best candidates correctly stated that the iod**ide** is displaced by chlorine. The equation for part (ii) was very poorly answered. Incorrect formulae such as KI_2, KCl_2 and 2I were often seen.

(b) A wide range of numeracy skills and methods were seen. The majority of candidates gained 1 mark for finding the relative masses of 2Fe and $3Cl_2$ (112 and 213). Very few candidates scored all three marks.

(c) Both parts were very well answered. In (ii), weaker candidates showed a lack of understanding by using 7.00 g in their calculation.

Q.8 **(a)** Most candidates gained credit for this part.

(b) This was not as well answered because many failed to identify **all** the correct statements. Many candidates ticked only one box – usually the low concentration of hydrogen peroxide.

(c) Only the stronger candidates suggested that a catalyst/enzyme may be present in stain remover **D**. Many candidates referred to other factors that could alter the rate although the question stated that they were kept constant.

(d) Most candidates failed to calculate the **change** in mass and time to calculate the rate in (i). The scales on both axes were also commonly misread. Part (ii) was poorly answered as candidates failed to mention that **S** was **half** as concentrated/**half** as many particles in a given volume/**half** as likely to collide successfully than **T**, which was necessary to gain full marks. Those who gained credit stated that **T** was more concentrated and that successful collisions were more frequent with **T** but, did not state that there were more particles **in a given volume**. Weaker candidates referred to more collisions, without reference to chance or frequency.

Summary of key points

Good points

- Higher tier candidates performed better in the common questions than foundation candidates.
- Balancing given symbol equations.
- Converting answers into standard form.

Areas to improve

- Practical skills and explanations relating to the practical work - especially in relation to solubility.
- Calculation methods.
- Writing full chemical equations.

- Rearranging given mathematical equations.
- Displacement of halogens.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 3: PHYSICS 1 – FOUNDATION TIER

General Comments

Not one question part was attempted by all candidates, ranging from 59 % for question 5 (QER) to 99% for question 3b (a tick box exercise).

Candidates are generally more successful in completing calculations, especially ones involving a single stage, with limited data to select from and given an equation. They are less successful when required to write a description or explanation of any length.
Knowledge of the electromagnetic spectrum was poor. Evaluation of data to respond to claims in question 7 was not completed well.

Comments on individual questions/sections

Q.1 **(a)** Many candidates completed the table correctly however a significant proportion decided that the volume of the bone was 68 cm^3. They obviously either didn't read the information above the measuring cylinders or didn't understand what it meant. The answer for volume was carried forward into the calculation that followed. Most candidates selected the correct equation and used it correctly to arrive at the correct answer. In the instances where an ecf was applied, it was disappointing that some candidates rounded their answer for density incorrectly to lose the answer mark. Also answers such as 0.47058824 were seen.

(b) This was generally not well answered. Many answers simply repeated the information in the question or stated that bone is denser because it is a solid.

Q.2 **(a)** Labelling of the diagram was poor with very few correct answers seen. A common answer was a transformer. Most candidates gained at least one mark for linking the parts of the power station to the correct energy change. Some candidates ignored the instruction to 'Draw **one** line from each part…' so attracted a penalty.

(b) This was an exercise testing candidates' understanding and application of data about energy. They were required to substitute 2 of the 3 values into the given equation. Few candidates successfully achieved this. There was little understanding that electrical energy was usefully transferred. Some candidates even added all the given values together presumably because the denominator stated total energy supplied. Approximately 11 % of candidates did not attempt it.

Q.3 **(a)** The term refraction was not well known. Answers such as ripple effect and osmosis were seen. Almost 35 % of candidates did not attempt to write anything down.

(b) Most candidates earned at least one mark for ticking a correct box which was usually the fourth one down. This selection led many to also incorrectly choose the first box stating frequency is higher in shallow water.

(c) This was a straightforward calculation using the wave speed equation from page 2 and most candidates earned both marks. Despite this, approximately 7 % of candidates did not attempt it. The question only gave two pieces of data so candidates were not required to select values for substitution. However, another number appeared in the question i.e. (page) 2, which very surprisingly made an appearance in the calculations of a few candidates.

Q.4 Success in this question was dependent on the ability of candidates to select and use data from the given table of information.

(a) **(i)** About half of candidates noted that if this choice was made then there would be zero carbon dioxide produced. Others decided that the choice depended on the distance travelled on one charge, but this didn't answer the question.

(ii) Credit was given for the selection of 7 000. Most candidates succeeded to attain this mark. However, less multiplied this by 2.5 to arrive at the correct answer.

(b) **(i)** The calculation required the multiplication of three values ($4 \times 6 \times 0.4$) to arrive at an answer of 9.6 kg. A minority of candidates achieved this. Most multiplied two of the values to arrive at answers of 24 or 1.6 or 2.4 so gaining one mark only.

(ii) This followed the question where candidates had just calculated the mass of carbon dioxide produced when the Voltsa is fully charged. The majority of candidates did not take this into account when answering the question and as a result failed to earn credit.

(c) Space was left for the expected two calculations. Very few candidates attempted these. Even those that tried, frequently obtained the incorrect answer for the petrol car due to the omission of the factor of 7. This was the first question on the paper that required a concluding remark to enable full credit to be given.

Q.5 It was anticipated that this QER based on the electromagnetic spectrum would allow all candidates to write something relevant. It was shocking to discover that about 40 % did not even attempt it. Of those that did give an answer, about half could name all regions. They then proceeded to describe uses of one or more of the regions. Few described differences in terms of wavelength, frequency or energy. Even fewer described similarities. As a result, most responses gained a bottom band mark with some entering the middle band.

It is doubtful whether some candidates understand what the em spectrum is referring to. Some of the stranger responses included references to:

- The need for regular charging
- Regions including coal, gas, sound and kinetic energy which is used to drive wind turbines
- The inclusion of the electricity supplies of France, America and Australia
- The magnets of the em spectrum and what each can attract

- Detecting ghosts
- Extra violet, ultra-violent and grammar rays
- A.C. and D.C. uses
- Microwave batteries used in mobile phones.

Q.6 **(a)** The most common reason for a mark was due to the placement of the ammeter. However, knowledge of circuit symbols, especially that of a thermistor, was poor. Also, quite often, the voltmeter was placed in series.

(b) **(i)** Most candidates earned at least one mark for accurate plotting. The most common errors were plotting the 2 500 point at 3 000 and the 5 400 point at 5 800. A minority of candidates drew a smooth curve through their points.

(ii) Most candidates stated that the resistance decreased to earn a mark but few went on to describe this happened at a decreasing rate.

(c) **(i)** Most candidates read from their graph to state the resistance value.

(ii) Most selected the correct equation, substituted correctly but then wrote down an answer of, for example, 3 instead of 0.003. A significant minority of candidates did not substitute a value of 12 V into the equation but used the value 50 which was a temperature. If they had written down the circuit equation for current then they would have received the first mark otherwise no credit was given for this.

(d) This is another example of a style of question that must include a concluding statement to earn full marks. Some perfect responses were seen but these were in the small minority of instances. The majority of candidates noted that it was suitable because its resistance reached 5 400 Ω without taking into account the initial resistance.

Q.7 This question required evaluation of data from the four labels and extracting relevant values to complete calculations. Two of the question parts also required a concluding remark. Apart from ticking boxes candidates had limited success in this question.

(a) Most candidates selected at least two correct statements.

(b) Few candidates extracted appropriate information about power and screen sizes and calculated ratios to make the comparison. A variety of methods would have been acceptable, and they are illustrated in the marking scheme. Not all candidates took notice of the information in the question which instructed them to use data for televisions 1 and 2. A concluding remark was required to earn both marks, but this only applied to very few candidates.

(c) **(i)** Most candidates earned some credit here. A very common error was not converting the power of the television into kilowatts, so credit was limited to a substitution mark. Another error, but not so common, was substituting the values upside down with no attention being given to the units of values on the label and the units in the given equation.

(ii) Most candidates earned a mark here for substitution into the cost equation. Not all converted the answer into £ despite the instruction in the question and the unit on the answer line.

The total number of units used per year was already given on the label, so candidates did not need to calculate it however some attempted it and were unsuccessful.

(iii) Few candidates gained any credit for this part of the question. Those that did usually worked out and compared the running costs but did not take into account the difference in purchase cost. This resulted in an incorrect conclusion.

(iv) A range of responses was seen to this question part.

Summary of key points

- Encourage candidates to read each question part carefully so they follow the instructions.
- Use assessment for learning methods to develop candidates' skills in producing and assessing each other's explanations of scientific theory.
- Provide further practice in graph plotting, in particular to construct linear scales from non-linear data and interpreting scales when each 1 cm square is 2, 20 200 etc.
- Provide more opportunities for candidates to select values for substituting into equations that require careful attention to units.
- Further develop calculator use – practice rounding and not copying all numbers down to 6 or more decimal places.
- Further practice the drawing of circuit diagrams especially how voltmeters are added in parallel across a component.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 3: PHYSICS 1 – HIGHER TIER

General Comments

Only one question part had a 100 % attempt rate and one must question whether there were candidates for this examination who would have been more successful if entered for the foundation tier paper. The knowledge of resistance in parallel circuits and refraction of water waves were both particularly poor. There was, once again, much evidence of candidates not reading questions carefully and they are generally more secure when completing calculations than when offering explanations.

The least successfully answered questions on the paper invariably demanded that candidates read and interpret information so that they understood what was being asked of them. This was very evident in multi-stage calculations, where it was common to simply see two random numbers from the stem of the question inappropriately substituted into one equation to generate an answer. The quality of the written responses was poor in many cases and basic recall was weak. The quality of extended response question demanded that candidates described a method from a specified practical; the structure of the writing was generally poor as was knowledge of this experiment. It is disappointing that this question had almost the lowest attempt rate on the paper. Knowledge of units and prefixes was very poor.

Comments on individual questions/sections

Q.1 **(a)** This was designed to ensure that candidates had read the labels carefully to assist with later question parts. Candidates most commonly obtained two marks here and interacted well with the information presented.

(b) Where candidates understood what was meant by the term proportional, they were able to handle the data well and make valid conclusions. It was evident, however, that most candidates did not have a secure understanding of proportionality, often just subtracting numbers or making vague statements about bigger televisions having greater power.

(c) **(i)** Units proved to be problematic here and it was rare to see a correct conversion from watts into kilowatts.

(ii) This was a straightforward calculation of cost which yielded many correct responses although the conversion from pence into pounds was lost on many. Candidates should be encouraged to consider whether their answers are sensible; one would like to hope that candidates recognise that £1 772 is not a realistic running cost for a television for one year.

(iii) Most candidates did not take the purchase cost of the televisions into account and some struggled to complete any sensible calculations. It was pleasing to see that candidates are more frequently completing their answers with a conclusion.

(iv) This was a familiar question but many answers were vague and references to these appliances being better for the environment with no explanation as to why were commonly seen.

Q.2 **(a)** The quality of the candidates' diagrams was generally very poor and few gained marks.

(b) This was very poorly done with most candidates simply taking the two numbers in the stem and multiplying them together. Very few measured the wavelength despite being told to use a measurement from the diagram. Determining the frequency from the information given was rarely seen. It was evident that many candidates did not read the question carefully.

(c) The majority of the candidates did not know that frequency remains constant as the water depth changes. Answers to this question were often poorly expressed, limiting the marks awarded.

Q.3 It was disappointing that so many candidates did not attempt this question, which was a straightforward description of specified practical work. It was not always evident from the responses that candidates had any experience of undertaking this experiment. Although it was pleasing to see some very clear and concise answers many candidates did not relate their answer to the density equation provided in the examination paper and it was not uncommon to see candidates mixing up density and volume.

Q.4 **(a)** **(i)** Candidates should be encouraged to label the values at the origin on their graphs, to avoid losing the scale mark. Whilst many could plot the points accurately the quality of the curves drawn was usually poor.

(ii) Most candidates were able to describe the trend and gained one mark but very few went on to state that the resistance was decreasing at a decreasing rate.

(b) **(i)** This was a multi-stage calculation with 5 marks allocated and reference in the stem to using both the graph and equations from page 2. Despite all of that information most simply took the two values for power and voltage from the stem and substituted into the equation for current. It was rare to see the parallel resistance equation used. Candidates should be encouraged to consider the mark allocation and read the stem carefully.

(ii) This was a challenging AO3 question testing candidates' knowledge of parallel circuits. It was poorly answered as most did not discuss the components separately and poor expression often cost candidates marks.

Q.5 **(a)** This was a straightforward AO1 recall question testing knowledge of fossil fuel power stations but responses were disappointing and many answers were not well written.

(b) The responses here were often poor and candidates struggled to handle percentages.

(c) This was a standard calculation of current, testing the ability to rearrange an equation and handle the SI prefixes provided on page 2 of the paper. It was surprising to see many candidates select and use the resistance equation, ignoring the MW unit totally. Most ignores the prefixes altogether and where conversions were attempted they were more often than not incorrect.

Q.6 **(a)** The knowledge of the differences and similarities was not well known. Poor expression let candidates down here as well, with many incorrectly stating that geosynchronous satellites stay in the same position, rather than in the same position above the earth.

(b) **(i)** It was surprising how many could not select a correct answer in this part of the question, even if they had previously identified that both types of satellites orbit in 24 hours.

(ii) This part of the question was handled well by most of the candidates, with occasional errors in the use of standard form.

(iii) Many candidates correctly identified that station C would receive the signal but did not show their workings. Again, candidates must be encouraged to read the stem of each question very carefully.

Summary of key points

- Encourage candidates to read each question part carefully and to consider the mark allocation.
- Ensure that candidates undertake all of the specified practical work and have sufficient practice in method writing.
- Provide plenty of practice in determining the total resistance of parallel circuits.
- Allow sufficient practice in the use of prefixes and encourage candidates to learn units.
- Check that candidates understand the significance of a dot above a digit on their calculator screens as these are often misinterpreted leading to penalties for incorrect rounding.
- Develop confidence in extended writing by allowing sufficient practice in and assessment of this skill.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 4: BIOLOGY 2 – FOUNDATION TIER

General Comments

All eight questions on the paper were attempted by at least 99 % of the entry. Throughout the paper, there was evidence of poor basic literacy. This severely limited the quality of responses. Most candidates at foundation tier struggle with extended writing as was evidenced on this paper, where many candidates often appeared hampered as a result of poor language skills and an insufficient body of knowledge and the understanding necessary to answer direct questioning or to construct comprehensible, coherent and comprehensive answers. Vocabulary was generally very limited, with candidates appearing to struggle to express their ideas. It is difficult to score marks on technical questions if knowledge of the terms is lacking.

Candidates often seem not to have read the question fully and do not consider diagrams given in questions, which often provide substantial clues to the answer. Failure to use the comparative term (e.g. 'more/ less', 'higher/highest') frequently resulted in lost marks. Candidates would be well advised to avoid using the term 'amount' when answers require reference to a specific measurable quantity, such as volume, concentration or mass. Poor basic numeracy, including simple arithmetic, severely handicapped a substantial proportion of the entry.

Many candidates failed to engage fully with the question, lacked the ability to analyse data, could not make inferences or draw conclusions. They seemed to be insufficiently prepared for the demands of the examination.

Comments on individual questions/sections

Q.1 **(a)** Only a few candidates gave the correct genus name (*Alhagi*) which is the only acceptable answer. The most common error was to give the full binomial.

(b) Candidates were asked to choose two labelled features of the plant and explain how each is an adaptation to living in dry deserts where there are herbivores. Most candidates picked out at least one adaptation (usually sharp spines), a few gave two. The explanations were often confounded however by errors, such as 'to deter *predators*' (for the spines) or irrelevance, such as the seed case 'produces seeds'.

(c) The candidates were asked to compare root growth in plants A and B. Several candidates referred only to growth of the plants above the ground and ignored the roots. Many candidates did make a fair comparison of root growth but only a few went on to explain how this might help the plant obtain water from deep in the soil.

Q.2 **(a)** Very few candidates could explain that the term differentiate involves a change, or growth into (another type of cell). Many simply restated the term differentiate.

(b) The table in which the candidates had to pick out features relating to mitosis was regarded as quite challenging but it was pleasing that a good number of candidates scored at least one of the available three marks.

(c) Very few candidates were able to recall more than one of the specification statements concerning the advantages of using stem cells taken from a patient rather than from an embryo. Most answers were too vague to score at all.

Q.3 **(a)** **(i)** Only a few candidates correctly identified the pathogen in the diagram as being a virus.

(ii) The term mutation was rarely seen.

(b) Almost all candidates were able to state one way in which pathogens are spread between people. Contact, sneezing and coughing, being the most popular. Vague answers such as 'not washing your hands' were not credited.

(c) It was pleasing that many candidates scored all three marks for correctly sequencing the responses by the body having been invaded by pathogens.

Q.4 **(a)** Many candidates scored at least one mark for correctly naming one of the two structures in the skin diagram (most commonly for sweat gland). Only very few scored both.

(b) **(i)** Graphical skills are generally good, with many producing neat and accurate plots, joined by a neatly drawn straight line. It is important that candidates take care to ensure that their line is drawn precisely through the centre of each plot as there is no tolerance for this skill.

(ii) The cooling effect of sweat, which is essentially pure recall, is challenging for candidates at this level. The question was designed to provide cues to assist candidates in the explanation of 'the effect of sweat on human body temperature'. In the event, many candidates ignored the question and concentrated solely on the results of the experiment. Many thought that the point of the experiment was to show that the body cools more rapidly if it is draped in a wet towel. Most candidates scored at least one mark however, usually for referring to cooling in the flask with the wet towel.

(iii) Many candidates scored one mark for pointing out that the flask with the dry towel cooled more slowly. A few pointed out that without sufficient fluid intake, sweating would be inhibited.

Q.5 **(a)** Many candidates correctly identified the definition of biodiversity from a choice of three statements.

(b) **(i)** Most candidates drew a correctly placed horizontal line on the graph. However, some seemed to have missed the question entirely.

(ii) **I** Some candidates picked out the correct reading from the graph (400 000) and subtracted the given safe stock (150 000) to give an answer of 250 000. This answer alone scored one mark. To score both marks, candidates had to realise that they then had to divide that answer by 1 000. Only a few did that.

II The calculation required the multiplication of the two given figures (i.e. 150 000 × 120). Very few candidates could do this.

(iii) The three sections of this question required reference to the graph.

I The evidence for overfishing is the trend of decline in the stock of adult fish which then fell below the safe stock. Most candidates referred only to the line showing the total annual *catch*, which in isolation, is irrelevant.

II This section required candidates to extrapolate the line for the remaining stock, which would then show a zero stock in 2015 (as predicted by the scientists). Very few candidates did this.

III Many candidates did score a mark here for spotting that the stock began to rise after the introduction of the quota in 2005.

(c) A few candidates could recall a benefit to humans of maintaining biodiversity, most usually for (potential) medicines. However, a large proportion of the answers referred to food supply, which is specifically ruled out by the question.

Q.6 Candidates were asked to describe how they would test the effect of drinking coffee with caffeine or without caffeine on the reaction time of a class of 20 Year 11 students. They were asked to base their plan on the method given in the specified investigation and included in the stem of the question. Unfortunately, many candidates produced no plan but rather focused on an account of how caffeine would affect reaction time, mental state or heart rate. These answers received no marks.

However, some candidates did exhibit a grasp of the principles of experimental design, such as:

- splitting the class into two groups (of 10)
- testing reaction time before drinking coffee
- giving one group a drink of coffee with caffeine and the other a drink of decaffeinated coffee
- performing the tests (often with repeats)
- including fair testing
- finding mean scores and comparing the results.

Very pleasingly, a few candidates introduced the idea of the blind test.

A common error was to make fair test references that were very vague, such as:

- 'dropping the ruler from the same height' without stating that this should be the same height *above the hand/fingers*
- stating that the drinks should be the same *amount* for each student, rather than the same concentration or volume.

Overall there were many well-structured and sequenced accounts that achieved at least middle band marks.

Q.7 **(a)** Very few candidates showed any understanding at all of the term gene and still fewer of the term allele.

(b) **(i)** Many candidates at foundation tier can now correctly complete a Punnett square. The most common error was to enter the incorrect genotypes of the gametes, in which case the mechanics mark is still available for credit.

(ii) Some candidates gave the correct genotype (nn) of the affected individual 9 and a few offered an explanation for their choice. Answers here were generally to restate the information in the key - i.e. 'because she is affected' rather than to point out that a heterozygous or homozygous dominant individual would *not* be affected.

(iii) Some candidates gave one possible genotype (either Nn or NN) but only a few gave both, as required by the question.

(c) The concept of multiple genes is almost unknown at foundation tier. Some candidates may have had the correct idea but their answers were generally too vague, such as to state that 'we have many genes' or irrelevant, such as 'we get one gene from each parent'. The effect of the environment on the phenotype was seen a few times.

Q.8 **(a)** Many candidates scored at least one of the three available marks for the basic structures of the bacterium and several scored all three. Many candidates reversed the labels for the cell membrane and cell wall which places the cell wall *inside* the cell membrane. This seems illogical perhaps but was a common error.

(b) **(i)** A few candidates scored here, usually for stating that there had been no bacterial growth, which shows that they had read the information in the stem of the question. The commonly seen 'there were no bacteria' did not score but 'the bacteria were killed' did.

(ii) Many candidates scored a mark for stating a number greater than 1 and up to and including 2 but a range of other numbers was also seen.

(iii) Some candidates did seem to have an idea for how to obtain a more accurate value for the minimum concentration to be effective but vague comments, such as include a bigger range often spoilt the answer. Many answers were solely to do with improving confidence or extending the investigation with ideas such as do a repeat, leave it for a longer time or use extra tubes.

Summary of key points

- Questions often involve a comparison between two or more sets of information such as in tables, graphs or diagrams. When answering, candidates should be careful to useful *comparative* terms (more/higher/faster etc).

- The stem, or introduction to questions usually includes a number of substantial prompts, key terms or named processes that candidates can then use to great advantage. These introductions (including diagrams) should be studied carefully before attempting an answer.

- Candidates should keep their answers as concise as possible to reduce the risk of making a contradictory or erroneous point which might negate a correct one.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 4: BIOLOGY 2 – HIGHER TIER

General Comments

Many responses to questions showed a clear understanding of Biology. Many candidates demonstrated their ability to apply knowledge in questions. Quality of written communication was an issue for some candidates, in a number of cases candidates lost marks because their answers lacked detail or clarity. Most questions were attempted indicating that time did not appear to be an issue. As expected, the mean marks obtained by higher tier candidates on questions 7/1 and 8/2 were higher than foundation tier candidates.

Comments on individual questions/sections

Q.1 (a) (i) and (ii)

Very few candidates gave correct definitions of the terms ‘gene’ and ‘allele'. It was very clear that few understood that a gene is a section of DNA that codes for a particular characteristic whereas an allele is an alternative form of a gene.

(b) (i) Many candidates correctly completed the Punnett square. Candidates are reminded that if they make an error they should cross out their mistake and rewrite the letter for their gamete or genotype. Examiners cannot guess hybrid letters. In addition, if candidates are given letters to use to represent gametes it is important that they use the letters provided.

(ii) While most candidates could correctly identify the genotype of individual 9. Very few could explain their answer.

(iii) A large number of candidates only listed one genotype, despite the question asking for genotypes.

(c) This was answered well, with many candidates gaining credit.

Q.2 (a) Many candidates gained three marks, correctly labelling the parts of the bacterial cell.

(b) (i) A number of candidates incorrectly referred to bacteria being removed and therefore did not gain credit.

(ii) There was a large variability in the answers seen. Some candidates incorrectly suggested various values below 1.00 $\mu g/cm^3$. A very common error was an answer of 1.00 $\mu g/cm^3$. The diagram shows there is still bacterial growth at this concentration so candidates did not gain credit.

(iii) Many correctly suggested that Carys should test smaller intervals but less correctly identified the range. Answers such as between tubes 3 and 4 did not gain credit as candidates were required to state the range of concentrations.

Q.3 **(i)** Many correctly identified the types of cell division. As in previous years candidates are required to spell mitosis and meiosis correctly.

(ii) The most common error seen was candidates using the diploid and haploid chromosome number for humans.

(iii) A large number of correct responses were seen, although a number of responses referred to the number of daughter cells produced or restated the difference in chromosome number.

Q.4 **(a)** There was a huge range in quality of line graphs seen. The origins had been provided and in most cases candidates used these for their scale. Axis labels were often incorrect or without units. Plots were generally accurate to within ± 1 small square. Most candidates joined the points, if candidates chose to do this they needed to ensure the line drawn went through the centre of each point. Curves of best fit were also acceptable. A few candidates plotted all four plants. They were not penalised for this, but they lost time plotting unnecessary lines.

(b) **(i)** This was answered correctly by many candidates, although incorrect answers commonly seen included biodiversity and intraspecific competition.

(ii) Many failed to note percentage/coverage/ cover and / or along the transect/ into the wood. The second mark was more accessible as candidates gained credit for suggesting any sensible reason for the difference in percentage cover of the two plants.

(c) **(i)** This was well answered, with many giving clear statements.

(ii) Many gained the mark and could suggest an improvement to the method. Common errors included longer transect and repeat.

(d) This was answered very well, candidates had clearly learned the statements provided in the teacher's guide.

Q.5 **(a)** This calculation was answered correctly by many candidates. The most commonly seen error was an incorrect answer as a result of candidates using the number of false positives somewhere in the calculation.

(b) **(i)** A large number of candidates stated that 'animals are good predictors of how humans will respond to drugs' and 'animal tests cannot predict how humans will respond to a drug' without using the information to corroborate these statements, consequently they did not gain credit.

(ii) This was well answered.

(iii) Generally well answered, although there were some responses referring to thalidomide helping bone cancer as opposed to treating it.

Q.6 **(a)** **(i)** This was the most challenging question on the paper with very few candidates gaining full credit. There were many vague answers seen and a number which gave a definition of homeostasis which did not gain credit. There were also a number of candidates who referred to specific examples (usually glucose) as opposed to giving a general definition of negative feedback.

(ii) This was answered well, with many candidates giving three suitable factors that need to be controlled within the body. A number of candidates gave more than three factors, presumably wanting the examiner to pick which ones to mark. In a question such as this, it is suggested candidates only provide the number of factors requested. Heat and hydration are not acceptable alternatives to temperature and water.

(b) **(i)** While many candidates were able to apply their knowledge of homeostasis to give two reasons why the blood glucose level of an individual with insulin dependent diabetes may fall below the normal range there were a large number of candidates who incorrectly stated that not enough insulin had been injected.

(ii) Many were able to give a clear explanation of the effect of a glucagon injection and gained three marks. Misspelling (or hedging of bets) on the spelling of glucagon and glycogen was an issue. The most commonly awarded mark was the third mark point referring to the increase in blood glucose levels.

Q.7 Some excellent answered were seen, with many candidates writing clear, concise accounts demonstrating a sound understanding of natural selection. As a result, there were many candidates who gained marks in the top band. Conversely, there were a number of answers that showed a lack of understanding of this concept. A common error seen was reference to rats becoming immune to warfarin.

Q.8 **(a)** **(i)** This was answered well.

(ii) Many candidates gained full credit.

(b) **(i)** Many failed to make it clear that it is amino acids that join together to form proteins for the third marking point, but triplet/three bases code was well known, as well as this coding for one amino acid.

(ii) Some very good answers were seen, where candidates applied their knowledge of protein synthesis to conclude why mutation 1 may affect an organism more than mutation 2. Vague statements such as mutation one has two parts different did not gain credit.

Summary of key points

- There was evidence that information provided to candidates to use in their answers had not always been utilised. Candidates are advised to take a highlighter into their exam to highlight key points of information provided.

- The specification outlines the mathematical skills which can be assessed. It is recommended that candidates are given opportunities to develop these skills throughout the course. It is also advised that candidates always show their working when completing calculations as if they fail to get the correct answer they may be awarded marks for their working.

- Responses to questions that required candidates to provide a definition such as 1a(i) and (ii) and 6a(i) were disappointing. It was clear that candidates had not taken the time to learn them. Definitions are outlined in the teacher's guide and it is important that they are included when teaching topics.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 5: CHEMISTRY 2 – FOUNDATION TIER

General Comments

This paper proved to be more accessible than last year's and the mean mark of 20 was an increase of just over a mark from that seen in 2018. The weakest candidates fared better and far fewer candidates scored single figure marks. More candidates scored marks in the thirties than last year and the highest mark was 48.

Performance in certain areas was a little disappointing. Candidates showed a lack of recall of basic knowledge e.g. the pH scale and testing for gases. Many candidates lost marks because they did not copy the formulae of ions correctly from the table inside the back page of the examination paper.

Candidates performed relatively well on the PISA-style question 4 and most made a good attempt at the QER question.

Questions based on practical work continue to show that many candidates do not fully understand the procedures they carry out in lessons.

Comments on individual questions/sections

Q.1 **(a)** Attempted by nearly all candidates and generally answered well. The majority of responses achieved 1 or 2 marks for correctly identifying that ions in a metallic structure are tightly packed and that electrons are free to move. Fewer candidates showed knowledge of the meaning of 'malleable'. There were also a very small number of candidates who did not read the question properly and used their own terms to answer the question rather than choosing them from the box.

(b) **(i)** Attempted by nearly all candidates. However, only a minority of responses gained the full 2 marks for getting both answers correct. The majority of candidates gained 1 mark. Approximately equal numbers gained the first mark as gained the second mark. A small number of candidates scored no marks despite underlining two answers.

(ii) Attempted by nearly all candidates but very poorly answered. Very few responses were awarded the mark. The majority of those credited gave 'anti-bacterial' as the property. The majority of incorrect answers were bulk properties of a metal e.g. hard, malleable or conducts heat/electricity.

Q.2 **(a)** **(i)** Attempted by nearly all candidates and generally answered well. The majority of responses were awarded 1 or 2 marks, usually for identifying errors 1 and 2. Only a minority of candidates gained the full 3 marks. Some suggested $NaCO_2$ as the correct formula for sodium carbonate.

(ii) Attempted by most candidates but poorly answered. Common mistakes included circling the pH of sulfuric acid, the formula of ethanoic acid, the colour of universal indicator in water and the word 'neutral' in the row for water. There were a small number of candidates who did not attempt the question.

(b) (i) Attempted by most candidates but generally poorly answered. Very few responses were awarded both marks for this question. A minority of candidates achieved 1 mark with approximately equal numbers correctly answering either 'carbon dioxide' or 'barium chloride'. The majority of candidates scored no marks. Common mistakes included 'silver nitrate' or 'universal indicator' instead of barium chloride. All the given gases were suggested in place of carbon dioxide suggesting that random guesswork was the basis of many answers.

(ii) Attempted by most candidates but very poorly answered. Very few responses were awarded the mark. Most wanted to use a lit splint or a glowing splint for this test. There were a small number of candidates who did not attempt this question.

(c) (i) I Attempted by nearly all candidates with most responses being awarded the mark. The most common incorrect answer was **B**.

II Attempted by nearly all candidates but poorly answered in general. Only a minority of responses gave the correct answer of 33 °C. Most candidates incorrectly gave an answer of 53 °C.

(ii) Attempted by nearly all candidates with only a minority of responses being awarded the mark for correctly giving exothermic as the answer. Common incorrect answers included 'endothermic' or generic terms such as 'reactive' or 'strong' or descriptions referring to the solution becoming hot or warm.

(d) (i) Attempted by nearly all candidates, with only a minority of responses being awarded the mark for correctly naming the salt as magnesium sulfate. Common mistakes included magnesium sulfide, MgS, MgSO and 'magnesium sulfuric'.

(ii) Attempted by nearly all candidates and generally answered very well. The majority of responses correctly referenced a flame and a squeaky pop. Common errors included vague answers such as 'squeaky pop test' (with no description), no reference to a flame (e.g. use a splint to make a squeaky pop) or the use of a 'glowing splint' to relight.

(iii) Attempted by most candidates but very poorly answered in general. Very few responses were awarded any of the marks for this question. Common mistakes were giving no charges on the ions, giving the charge of the zinc ion as Zn^{+} and giving the *names* of the ions. Common incorrect formulae included ZnCl and Zn_2Cl.

Q.3 (a) (i) I Attempted by nearly all candidates with the majority of responses correctly identifying the correct structure of methane. The most common mistake was ticking the structure consisting of one hydrogen atom and four carbon atoms.

II Attempted by nearly all candidates with around half of all responses correctly naming the bonding type as covalent. Incorrect answers were evenly spread between the possible wrong answers suggesting more guesswork.

(ii) **I** Attempted by nearly all candidates with only a minority of responses awarded the mark for correctly identifying all three structures. The range of incorrect answers varied significantly, due to the different number of possible combinations. However, the most common errors were naming **B** as giant covalent, **A** as metallic and **C** as ionic.

II Attempted by nearly all candidates with only a minority of responses awarded the mark for correctly identifying **B** as methane. Incorrect answers were evenly spread between **A** and **C**, again suggesting that some candidates were guessing randomly.

(b) Attempted by the majority of candidates but poorly answered in general. Only a minority of responses gained the full 2 marks. A significant number of candidates gained 1 mark for calculating M_r for the compound. Common errors included an incorrect calculation of M_r and using an incorrect total mass of hydrogen.

Q.4 **(a)** Attempted by nearly all candidates but poorly answered. Only a minority of responses were awarded the mark for correctly identifying 4 metals. The most common incorrect answers were 3 and 5.

(b) Attempted by nearly all candidates with the majority of responses being awarded the mark for correctly identifying 1-19 %. The most common incorrect answer was 19-25 %.

(c) Attempted by nearly all candidates but poorly answered. Only a minority of responses were awarded the mark for correctly identifying that all of the alloys contained at least three metals. The most common incorrect answers were that the alloys contained at least one or at least two metals.

(d) Attempted by nearly all candidates with the majority gaining the mark for correctly identifying that all of the alloys of gold were used for decorative purposes. The incorrect answers were distributed evenly across the other possible options, suggesting once more that some candidates were guessing randomly.

(e) Attempted by the majority of candidates but answered poorly in general. Only a few responses were awarded both marks for correctly calculating the mass of tin in the solder joint. The most common mistakes were multiplying 0.00011 by 90 or 0.00011 by 5. There were also a significant number of candidates who did not attempt this question.

Q.5 **(a)** **(i)** Attempted by nearly all candidates but poorly answered. Only a few were awarded the mark for identifying 10 atoms in the compound. The most common incorrect answers were 3, 6 and 9.

(ii) Attempted by nearly all candidates but poorly answered. Only a minority of responses were awarded the mark for correctly identifying salt petre. Incorrect responses were evenly distributed across the table, suggesting that candidates did not know how to approach this question and that much guesswork was involved.

(b) **(i)** Attempted by nearly all candidates but poorly answered. Only a very few responses were awarded the mark for correctly recognising that ions are free to move when lead chloride is in a molten state. Common errors included explanations involving free electrons and free atoms.

(ii) Attempted by nearly all candidates with the majority of responses awarded 1 mark for either recognising the chloride as a negative ion or that opposite charges attract. Only a very few candidates gave complete answers and gained both marks.

(iii) Attempted by nearly all candidates but poorly answered in general. Only a very few responses were awarded the mark for reference to gaining electrons. Common mistakes included answers referring to becoming smaller, losing oxygen or losing the charge.

(iv) Attempted by nearly all candidates but very poorly answered. Only a very few responses identified the correct ionic equation. Once again, it was evident that most candidates were guessing randomly.

(c) Attempted by the majority of candidates with the majority of responses being awarded either lower-band or middle-band marks. Very few gained top band marks. Common weaknesses included giving lists of the different factors without any explanation of their significance, stating that the sea/river between the plant and housing areas would reduce noise/pollution and reference to people being able to buy and use aluminium/power more easily due to the proximity of the plants. Very few candidates correctly explained the significance of the power plant in supplying the vast quantities of energy required by the works or the dock for importing the aluminium ore. This was an accessible QER question and only a minority of candidates did not attempt it.

Q.6 **(a)** Attempted by most candidates with the majority of responses being awarded 1 mark for stating how the burning got more difficult as the molecules got bigger. Very few candidates achieved 2 marks for correctly linking both the ease of burning and cleanliness of the flame to the size of the molecule. Some candidates referred to trends in boiling points and the colour of the fractions.

(b) **(i)** Attempted by nearly all candidates with approximately half of responses awarded both marks. There were a significant number of candidates who gained 1 mark for 3 or 4 correct bars drawn onto the graph. The vertical scale proved difficult for some candidates as did plotting negative values for the first two bars.

(ii) Attempted by most candidates but poorly answered in general. Only a minority of all responses were awarded both marks for this question. A significant number of candidates were awarded one mark for estimating the boiling point without drawing the trend line.

Common weaknesses included drawing an incorrect trend line that did not fit the data and incorrectly reading the value indicated by the trend line drawn.

(c) **(i)** Attempted by most candidates and generally answered well. The majority of responses were awarded the mark for correctly explaining a suitable method. Common mistakes included choosing water as the method and not linking the method to removal of oxygen. No credit was awarded for 'fire extinguisher' without reference to foam or carbon dioxide.

(ii) Attempted by most candidates but very poorly answered. Very few responses gained any marks for this question. Most did not know that the combustion of hydrocarbons produces carbon dioxide and water. Nearly all candidates who gained the first mark also gained the second mark for correct balancing.

(iii) Attempted by most candidates with around half of responses being awarded 2 marks. Nearly all of the correct responses referred to carbon dioxide and global warming. A significant number of candidates achieved 1 mark for either referring to carbon dioxide or global warming. Reference to the greenhouse effect rather than global warming was not credited.

(d) **(i)** Attempted by nearly all candidates but poorly answered in general. Only a very few responses were awarded both marks for this question. A number of candidates achieved 1 mark for answers involving measurements of one of the factors before and after heating. Temperature **rise** and mass of fuel **used** were not credited. No credit was given for keeping a control variable the same e.g. distance between the flame and the beaker.

(ii) Attempted by nearly all candidates with the majority of responses gaining the mark. The majority of correct answers referred to the distance between the flame and the beaker. Practically every other variable was suggested showing a poor understanding of the equation and of this familiar experiment.

(iii) Answered by nearly all candidates but poorly answered in general. Only a minority of responses were awarded the mark. Incorrect responses varied between all of the other choices, suggesting that many candidates were again simply guessing.

Summary of key points

- Learn subject content thoroughly to be able to answer recall (AO1) questions. These are very poorly answered in general, showing a lack of knowledge/revision.

- Be able to write chemical formulae and balance symbol equations correctly.

- Look at the number of marks allocated to each question. This will give some indication of how many points are needed within an answer.

- Attempt all questions. There is still a significant number of candidates who do not attempt many parts of questions, even those that are interpretation or evaluation type questions.

- Attempt as many past paper questions as possible before sitting exams. This will ensure candidates are familiar with the various styles and demands of questions.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 5: CHEMISTRY 2 – HIGHER TIER

General Comments

This paper proved to be more accessible than last year's and the mean mark of 20 was an increase of over two marks from that seen in 2018. Fewer candidates scored less than 15 marks but performance overall was disappointing with most candidates scoring between 15 and 30. The highest mark was 56.

Performance in certain areas was a little disappointing. Candidates showed a lack of recall of basic knowledge e.g. testing for ions. Skills in writing chemical formulae and equations were poor. A total of 7 marks were awarded for these skills on this paper.

Candidates performed relatively well on the data response elements of question 3 and most made a good attempt at the QER question.

Questions based on practical work continue to show that many candidates do not fully understand the procedures they carry out in lessons. This was particularly evident in question 4.

Comments on individual questions/sections

Q.1 **(a)** Attempted by nearly all candidates with the majority of responses being awarded 1 mark for stating that the burning got more difficult as the molecules got bigger. Very few candidates achieved 2 marks for correctly linking both ease of burning and cleanliness of the flame to the size of the molecule. Common errors included reference to boiling point and to the colour of the fraction. Some candidates also chose more than two properties.

(b) **(i)** Attempted by nearly all candidates with the majority of responses awarded both marks. There were a number of candidates who gained 1 mark for 3 or 4 correct bars drawn onto the graph. The vertical scale proved difficult for a minority of candidates as did plotting negative values for the first two bars.

(ii) Attempted by nearly all candidates with the majority of responses being awarded both marks. A number of candidates were awarded one mark for estimating the boiling point without drawing the trend line. Common weaknesses included drawing an incorrect trend line that did not fit the data and incorrectly reading the value indicated by the trend line drawn.

(c) **(i)** Attempted by nearly all candidates with the majority of responses awarded the mark. Common mistakes included choosing water as the method and not linking the method to removal of oxygen. No credit was awarded for 'fire extinguisher' without reference to foam or carbon dioxide.

(ii) Attempted by nearly all candidates but very poorly answered. Very few were awarded any marks for this question, since they did not know that the combustion of hydrocarbons produces carbon dioxide and water. Nearly all candidates who gained the first mark also gained the second mark for correct balancing.

(iii) Attempted by nearly all candidates with around half of all responses being awarded both marks. Nearly all of the correct responses referred to carbon dioxide and global warming. A significant number of candidates achieved 1 mark for either referring to carbon dioxide or global warming. Reference to the greenhouse effect rather than global warming was not credited.

(d) **(i)** Attempted by nearly all candidates with around half of responses being awarded 2 marks. A significant number gained 1 mark for answers involving measurements of one of the factors before and after heating. Temperature **rise** and mass of fuel **used** were not credited. No credit was given for keeping a control variable the same e.g. distance between the flame and the beaker.

(ii) Attempted by nearly all candidates with the majority of responses gaining the mark. The majority of correct answers referred to the distance between the flame and the beaker.

(iii) Answered by nearly all candidates but poorly answered in general. Only a minority of responses were awarded the mark. The most common error was choosing the endothermic reaction profile.

Q.2 **(a)** Attempted by nearly all candidates with only a minority of responses being awarded 3 marks. The majority of candidates gained either 1 or 2 marks for incomplete diagrams. Common mistakes included no arrows to show the transfer of electrons, unclear arrows, drawing two oxygen atoms and missing the charges/electronic structures on the ions.

(b) Attempted by nearly all candidates with only a very few responses awarded 2 marks. A minority of candidates achieved 1 mark for saying that magnesium oxide has stronger bonds than sodium chloride. Direct comparison of the size of the charges is essential in this question.

(c) Attempted by nearly all candidates with only a minority of responses being awarded 2 marks. A significant number of candidates achieved 1 mark for correctly overlapping the outer shells and drawing electrons in the shared area. Common mistakes included only one pair of shared electrons being drawn in each overlap, no lone pairs being drawn on the oxygen atoms and some atoms having too many electrons.

Q.3 **(a)** Attempted by nearly all candidates with approximately half of responses being awarded both marks. A number of candidates achieved 1 mark for getting the correct letters above and below copper but in the wrong order.

(b) **(i)** Attempted by nearly all candidates with most responses being awarded the mark.

(ii) Attempted by nearly all candidates but not well answered. This was very different to any question previously asked and only the strongest candidates were able to use mathematical reasoning to work out the correct answer of 0.1 V.

(c) Attempted by nearly all candidates with only a few responses being awarded both marks. A minority of candidates achieved 1 mark for the correct general definition of oxidation and reduction. Common mistakes included reference to zinc gaining electrons/copper losing electrons and attempted explanations in terms of gain/loss of oxygen rather than gain/loss of electrons.

Q.4 **(a)** Attempted by most candidates with only a minority of responses being awarded both marks. A significant number of candidates performed the correct calculation but then failed to round the answer correctly.

(b) **(i)** **I** Attempted by nearly all candidates but poorly answered. Only a minority of responses were awarded the mark for the idea of a rough result or estimate in a short time. Common errors included references to increasing accuracy and calculating a mean value.

II Answered by nearly all candidates with approximately half of responses being awarded the mark.

(ii) Attempted by nearly all candidates but poorly answered in general. Most responses were awarded 1 mark for some explanation of crystallisation at the end. A few candidates were also awarded the mark for reference to repeating the titration without an indicator. Very few gained the marks for the exact volumes of acid and alkali needed, although slightly more gained the mark for the mean volume of 27.65 cm^3. Omission of these volumes was the main weakness.

(c) **(i)** Attempted by most candidates but very poorly answered in general. Very few responses were awarded full marks for this question. A significant number of candidates achieved 1 mark for giving the correct formulae of the reactants. Very few gained the second mark for the correct formulae of the products and therefore could not access the third mark for correct balancing. $CuOH_2$ was often given as the formula of copper(II) hydroxide and additional incorrect products such as H_2O and CO_2 were sometimes included.

(ii) Attempted by most candidates but poorly answered. Only a few responses were awarded both marks for this question. Approximately half of candidates achieved 1 mark for correctly giving one of the tests – this was split evenly between the barium ion test and the flame test. There were also a small number of candidates who achieved 1 mark for correctly giving both tests without the correct observations. The flame test colour for sodium was not well known and the halide ion test was often incorrectly suggested.

(d) Few candidates achieved both marks for this question. Approximately half of the candidates achieved 1 mark for the correct formula of magnesium carbonate.

A minority of candidates did not attempt this question. Some used an incorrect formula for carbonate ions and others gave magnesium and carbon dioxide as the reactants. Understanding of ionic equations is generally poor.

Q.5 **(a)** Attempted by nearly all candidates with approximately half of responses being awarded both marks. A minority of candidates achieved 1 mark for either not ticking enough responses or ticking too many. Common errors included not ticking 'allotrope of carbon' and incorrectly ticking 'smart material' and 'hydrocarbon compound'.

(b) **(i)** Attempted by nearly all candidates with approximately half of responses being awarded both marks. A minority of gained 1 mark for calculating the total number of sides on all pentagons or all hexagons. The most common incorrect answers were 16 and 32.

(ii) Attempted by most candidates. However, only a few responses were awarded full marks. There were a significant number of candidates who gained 2 marks for completing the calculation using an incorrect radius or for not correctly converting into metres. A significant number of candidates gained 1 mark for calculating the radius of 0.55 nm or for completing the calculation but using an incorrect radius in the formula and without conversion into meters.

(c) Attempted by most candidates but poorly answered in general. Very few responses were awarded the mark. Common incorrect answers included high melting point, high boiling point, conducts electricity and very small.

(d) Attempted by most candidates but poorly answered in general. Very few responses were awarded the mark. Common answers not credited include 'nanoparticles can easily enter the body' and 'nanoparticles are harmful'. Reference was required to there being uncertainty about the **long-term** effects of nano-particles.

(e) Attempted by most candidates but poorly answered generally. Very few responses were awarded both marks for this question. A small number of candidates were awarded 1 mark for reference to delocalised electrons or comparing Buckyballs to graphite. Common errors included reference to Buckyballs not having delocalised electrons and to moving 'atoms' or 'ions' rather than electrons.

Q.6 Attempted by most candidates with the majority of responses being awarded marks in the lower band. A minority of candidates were awarded marks in the middle band with only very few awarded top-band marks. Most candidates gained their marks for a correct definition of isomerism or correct drawings of chain isomers. Candidates often drew two diagrams which showed exactly the same isomer with different bond angles. They must remember to ensure that all carbon atoms have four bonds and that all structures have the correct number of hydrogen atoms.

Summary of key points

- Learn subject content thoroughly to be able to answer recall (AO1) questions. These are very poorly answered in general, showing a lack of knowledge/revision.

- Be able to write chemical formulae and symbol equations correctly. This type of question is still very poorly answered generally, despite being a core part of all papers.

- Have a better understanding of the command words in questions and what they are asking for in responses, e.g. the difference between state, describe and explain.

- Look at the number of marks allocated to each question. This will give some indication of how many points are needed within an answer.

- Attempt all questions. There are still a significant number of candidates who still do not attempt many parts of questions, even those that are interpretation or evaluation type questions.

- Attempt as many past paper questions as possible before sitting exams. This will ensure candidates are familiar with the various styles and demands of questions.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 6: PHYSICS 2 – FOUNDATION TIER

General Comments

The three question parts which had the lowest percentage of attempts were 2 (b), 6(b) and 6(e). It was disappointing that a large proportion (approximately 20 %) of candidates didn't attempt the QER question, especially as it was practically based.

Generally, candidates seemed to be more confident with numerically driven questions and they displayed an ability to choose the appropriate equation from page 2, and then use it successfully. Many candidates showed their calculations and were able to record their answer in the space provided. However, a few candidates were unable to carry out correct rounding of their final answer and were penalised a mark. Assessment Objective 1 (AO1) type of questions was an area that many candidates lost marks on. A large number of candidates couldn't recall basic definitions or physics facts which are clearly identified in the specification. Frequently candidates decided that they would just miss out answering questions of this type and it seemed they were not concerned about losing marks. As a consequence their total score for the paper was significantly reduced. On occasions, the poor quality of some candidate's handwriting made answers difficult to read, numerical workings hard to follow and assessment of graph work challenging.

Comments on individual questions/sections

Q.1 **(a)** Almost all candidates attempted this part of the question and attained marks. A few used alternative words or phrases that were not present in the box. An example being 'red super giant' which gained no credit.

(b) Although the instruction in the stem of the question was to underline the correct word or phrase many candidates chose an alternative method. These were still credited, unless more than one selection had been made. Many thought, incorrectly, that stars generate their energy by the burning of increasingly heavier elements.

Q.2 **(a)** Again, the majority of candidates attempted this question part. They showed a secure understanding of linking the type of radiation to its description.

(b) The QER demanded the application of some basic knowledge of alpha and beta radiation interacting with paper. It was evident that many candidates had not observed this type of experiment as they were confused, thinking that the ruler, tongs and A4 paper were the radioactive sources. The mean mark was less than 1 out of 6. This was disappointing but I hope the question will make a good teaching or revision resource for candidates in the future.

Q.3 **(a)** The majority of candidates successfully linked the Segway acceleration to the correct part of the graph.

(b) The numerical part was carried out to a high standard by most. However, very few could recall the units of acceleration. Frequently m/s was recorded instead of m/s^2.

(c) This was reasonably well answered by candidates. Some failed to bring down the acceleration calculated in part (b) and used, incorrectly, 6 m/s from the graph or 3 seconds from the question stem.

(d) Many correctly identified 9 seconds from the graph but failed to subtract 0.6 s from it.

(e) The application of Newton's first law to the Segway training session was not done well. Many were unable to identify or link a change in velocity to unbalanced forces.

(f) Identifying that the Segway would take a longer time or distance to stop was generally completed well but linking this to an explanation based around friction was not.

Q.4 **(a)** Some candidates showed confusion as they identified "height" as the controlled variable. The majority of candidates did select the correct answer of "distance travelled".

(b) **(i)** This was a relatively straightforward calculation and generally candidates coped well with it. It was unfortunate to witness some using "10 cm" from the stem of the question as the distance travelled. Candidates who read the stem carefully did not make this mistake as it is clearly labelled within the table of data.

(ii) **I** Frequently candidates correctly identified that the time decreased but failed to comment about the decreasing rate.

II It was noted that a few candidates were unable to apply common sense to this question. They had correctly stated that the time was going to decrease in the previous part and then proceeded to describe how the mean speed of the car would decrease too.

(c) **(i)** It was encouraging that most candidates were able to write a similar correct statement as instructed. However, it was evident that candidates had selected 10 cm as there were two identical readings present in the row rather than the range in the data being the smallest.

(ii) Candidates showed a good awareness of using the 'more accurate' term correctly. Some were able to give an explanation by referring to human error or reaction times.

Q.5 **(a)** Candidates generally scored well on this question part.

(b) **(i)** A variety of conversion attempts were observed. Some, not many, were correct. It seemed as though candidates were not aware of, or unable to use, the SI multipliers given on page 2.

(ii) It was pleasing to observe most candidates being able to substitute kinetic energy and the correct distance into the equation. Many benefitted from an error carried forward from (i).

(iii) A poorly answered question part. It was evident that candidates were confused about the reduction in stopping distance as they incorrectly thought the woman was falling a smaller distance. Many candidates thought that falling on the bag full of water would be safer.

Q.6 **(a)** **(i)** Some candidates failed to fill in the table as they had not followed the instruction. Those who did, generally attained the mark.

(ii) and (iii)

A variety of answers were observed. Some candidates correctly applied their knowledge of probability and gained both marks.

(b) Frequently this was omitted by candidates. Those who did attempt filling in the numbers were successful with mass number but not with atomic number.

(c) **(i) and (ii)**

It was encouraging that only a few candidates missed out this question part. Most were able to fill in the table with reasonable success. When plotting points, candidates need to take more time to use neat crosses so that the accuracy of their plots can be checked and credited appropriately. The quality of curves was generally poor and lines that were too thick, disjointed or 'sketchy' could not be credited.

(d) **(i)** Very few candidates attained marks here as they were unable to recall the meaning.

(ii) Some were able to use the graph to good effect and obtain a correct half-life. Some points had already been plotted on the original graph grid to assist candidates.

(e) All foundation tier candidates struggled interacting with the information in the stem. They were unable to answer this question part.

Summary of key points

It was felt that the vast majority of questions in this paper were accessed by all candidates. Practically based questions were, on the whole, attempted with confidence and most candidates were able to apply their knowledge successfully. Mathematically based questions seemed to be the most popular, with candidates gaining many of their marks on this question type. The literacy-based questions were least popular and generally produced the lowest facility factors.

On reflection, for candidates to improve in the future the following may be considered.

- To encourage candidates to learn AO1 physics content prior to the examination.
- Check at the end of the examination that all questions have been attempted.

- Take care with rounding of a number that is recorded for their final answer.
- Practise doing conversions using the multipliers located on page 2.
- To take care reading and recording the correct number displayed from their calculator screen. Some incorrect use of the “recurring” notation was observed on some answers.
- Accurately plot points and take more care drawing their best fit curves.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 6: PHYSICS 2 – HIGHER TIER

General Comments

The mean mark obtained on the paper was well below 50 %, raising questions about suitability of candidates for a higher tier paper. Performance on the very first question was decidedly weak, a question that contained plenty of opportunities for genuine higher tier candidates to earn a good number of marks. From there the standard of attainment went further downhill with subsequent questions being rewarded with 30 % of their marks at best. The negative experience that candidates have in being entered for an examination tier above that which is suited to their abilities can do nothing for their confidence and self-esteem. There were many opportunities on the paper for candidates to demonstrate their abilities, many re-entry point opportunities within questions and a wide variety of question styles, ranging from the mathematical through graph construction, analytical and involving extended prose but the candidature failed to grasp the breadth of chances to obtain success.

Comments on individual questions/sections

Q.1 **(a)** The vast majority of candidates succeeded at gaining the first mark but often not the second or third.

(b) There was a frequent failure to complete the nuclear equation correctly which only demanded that 14 = **14** + 0 and 6 = **7** + (-1). This should surely be within the grasp of higher tier candidates.

(c) **(i)** Completion of the table was often incorrect for the total number of nuclei. The answer to this is easily obtained from the pattern in the first three rows.

(ii) For those who did achieve the correct numbers of carbon nuclei remaining, the majority were able to plot the points and attempt to draw the line. Far too many joined point to point with a series of disjointed straight lines instead of drawing a smooth flowing curve.

(d) **(i)** A chance to refresh and restart was presented with the request for the definition of half-life, which was well answered by many – a question that is frequently asked.

(ii) The determination of the half-life of carbon-14 was not well done with answers ranging from 5 years to many millions of years.

(e) The demand of the last part of the question was beyond the abilities of the vast majority of candidates!

Q.2 The content of this question, ranging as it did in covering the basic statement of a law and its application, mathematical calculations and demonstration of understanding and back to a bit of basic bookwork at the end, covered a wide variety of skills but candidates managed to gain fewer than a third of the marks on this question.

Q.3 **(a)** The QER part of this question was based on pure recall of the life cycle of a high mass star but it showed that entrants do not learn basic bookwork. Less than a quarter of the marks were awarded overall on this part.

(b) The answers that inner planets are rocky and outer planets are comprised of gases would have earned two of the three marks, but the mean to be awarded was two out of the possible three!

Q.4 This question was written in a pisa style again with plenty of opportunity for entry at a number of points through the question.

(a) This part questioned the understanding of dangers to health from the three types of radiation from sources that are external to the body but answers often included coverage of what happens when alpha sources are inhaled! The difference in ionisation effects of beta as opposed to gamma radiations is not well understood.

(b) In this part a wide range of information was presented to the candidates for them to interrogate and from which to select the relevant material from which to base their answers. Despite the first part of the question referring to the U.K. and France, far too many answers included the U.S.A. in their responses. Those who did access the relevant data often did not know how to handle it to answer the question. This pattern persisted through part (ii) of the question. The last part was often well answered.

Q.5 The problems encountered in this question became evident from the beginning.

(a) **(i)** This part asked for the spring that could…. And had a maximum extension close to 14 mm, so candidates looked down the maximum length column and found 14.016 and gave that (spring E) as their answer showing no attempt to subtract the unstretched length to find the suitable spring!

(ii) This was often answered with 0.17 or 0.0…17 with however many zeros imaginable. It was beyond their capabilities to realise that 0.17 N is needed to stretch the spring by 1 mm so it would need a force that is a thousand times bigger (conversion on page 2) to make the spring stretch a full metre. The answer of 170 N/m was very rarely seen.

(b) **(i)** Finding the force of 1.284 N needed to stretch the spring was about as far as most candidates got in answering the question. Fortunately, by multiplying the given value of the spring constant in units of N/mm by the extension in mm gives the same answer as working in standard SI units, giving the same answer. Very, very few used that force to calculate the energy stored, thinking instead that the force value was the energy required.

(ii) Very few managed to arrive at the correct answer even with the ecf principle being applied. Genuine higher ability candidates knew that the area under a velocity-time graph gives the distance travelled and they could find the area of a triangle (half $\times$ base $\times$ height) and they could read the intercepts as 0.9 and 0.09 to arrive at their answer. A very small part of the cohort achieved the desired answer to this part.

Summary of key points

- It cannot be overstated that candidates are being entered for this paper that are ill-prepared to cope with its demands.

- The poor standard of mathematical aptitude was highlighted in the last question in particular but was demonstrated in many other examples throughout the paper.

- Graph plotting skills are generally satisfactory but much practice is required in drawing curved lines.

- The candidates do not take kindly to writing in continuous prose either in the analysis of information given to them (in tabular or written form) or in regurgitating basic items of knowledge. The performance on this paper highlights the need for consolidation of more structured basic learning and application exercises and practice in writing at length.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2019

UNIT 7: PRACTICAL ASSESSMENT

General Comments

It was pleasing that there was again a good spread of marks with the vast majority of candidates attempting most questions. Some positive achievement was seen from candidates across all qualifications and abilities. However, explanations requiring demonstration of scientific knowledge were often poor.

SECTION A

Risk assessment

The nature of the hazard was not always clearly identified (e.g. acid is an irritant) and the risk often lacked an action (e.g. acid splashes on skin whilst pouring into beaker). Where candidates accessed the provided student safety sheets, they did not always select information which was relevant to the task.

Table of results

The majority of tables were well structured and logically organised although candidates tended to lose marks for incorrect units or putting units in the body of the table.

SECTION B

Graphs

Many candidates were able to plot graphs correctly, although lines of best fit were often poor or not attempted. Many candidates did not start their scale at the origin and should be encouraged to do so.

Variables

Generally, candidates are confident in identifying the independent and dependent variables in different investigations indicating that these terms are well understood.
Candidates were usually able to identify controlled variables but stating how they were controlled referencing both instrumentation and the value measured was not done well.

Evaluation of quality of data

Repeatability and reproducibility were generally well understood; however, the terms accuracy and precision are still poorly understood. The idea of random error was not well known. Calculating uncertainty from a given equation proved very difficult. Suggesting improvements however was often well done.

Comments on individual questions/sections

INVESTIGATING THE EFFECT OF LIPASE CONCENTRATION ON MILK

SECTION A

In the risk assessment, the hazard was poorly described and, as has been the case throughout, the risk was poorly expressed as candidates were unable to correctly describe an action which would constitute a risk in the procedure.
The table of results was generally laid out well but the conversion of minutes into seconds proved to be a challenge for a number of candidates.

SECTION B

(a) The independent variables and dependent variables were well answered as was the range.

(b) The usual problems were seen with this graph question in terms of the correct scale on the y-axis, candidates struggled with the high values for time.

(c) The majority of candidates correctly described the relationship between the independent and dependent variables.

(d) Candidates often identified inaccuracies but were less strong on describing the corresponding improvement.

(e) This was very poorly answered with very few candidates able to state the need to include the denatured enzyme.

(f) Although it was apparent that most candidates understood why the experiment was not suitable for investigating pH but many had trouble explaining this effectively.

(g) This was well answered.

(h) Most candidates succeeded in recognising the fact that the enzyme would be denatured but fewer were able to correctly relate this to active site shape and the inability for the enzyme substrate complex to form.

INVESTIGATING THE HEAT ENERGY RELEASED BY BURNING DIFFERENT FUELS

This practical was very popular with many centres.

SECTION A

The risk assessment in this investigation was completed to a slightly better standard than was seen across the suite of investigations. Many candidates used the student safety sheets effectively. However, a few candidates extracted information without considering the actual practical being performed and used inappropriate safety guidelines. The table of results was completed well.

SECTION B

(a) The control variables were identified by the majority of candidates. However, there were still some who used 'amount' instead of volume. Marks were also lost due to candidates not referring to the correct instrument or stating the value of control variable i.e. 100 cm^3 of water using a measuring cylinder.

(b) Most candidates correctly identified how to check repeatability and reproducibility, although some candidates did not seem to realise that the experiment was not repeated.

(c) (i) The graph was drawn with varying degrees of success. The scale was drawn better than many of the suite due to the assistance of the point labelled at the beginning of the graph. However, many candidates used this as a point and consequently lost the line of best fit mark.

(ii) As was the case with most of these types of questions, the relationship was correctly stated but the description of the graph was poorly answered with candidates unable to describe the decreasing rate of the gradient.

(d) The numerical questions here were well answered.

(e) Candidates correctly identified heat loss as a factor but many candidates were unable to communicate clearly two improvements or explain how one of the improvements would improve the results.

INVESTIGATING THE EFFECT OF TEMPERATURE ON THE REBOUND HEIGHT OF A SQUASH BALL

This proved to be a very popular task both with double award and separate science candidates.

SECTION A

(a) This was usually done well although the risk often lacked an action and many failed to suggest drying the floor as a suitable control instead giving vague responses such as take care and do not run.

(b) This was a simple table and many candidates scored highly. Where candidates lost marks, it was often for missing or incorrect units, with C^o often seen.

SECTION B

(a) Most candidates are secure in their knowledge of independent, dependent and controlled variables. A large number did not read the question carefully however and rather than explaining why a variable was controlled they answered with how.

(b) (i) Many were able to correctly identify the resolution of the ruler used.

(ii) It is disappointing that after carrying out the experiment candidates were unable to identify that measuring a moving object is very difficult and cannot be done accurately.

(c) Most candidates scored well. The most common errors were failing to label values at the origin on both axes, having a y-axis scale which was too small and joining point-to-point.

(d) It was common here for candidates to score one mark for describing the relationship between the variables, few developed their answer to describe the relationship numerically.

(e) (i) The equation for determining uncertainty was given and candidates had to select the correct data to substitute using their data for the lowest temperature. Many were not able to do this correctly and selected their overall highest and lowest values.

(ii) Although most understood the term repeatable, being able to discuss repeatability clearly in reference to data proved challenging.

(f) This was done well by many.

(g) Many were able to calculate the potential energy but explaining why it differed to the initial value often yielded vague responses which did not gain credit.

Summary of key points

- Encourage candidates to identify the nature of any hazard and to always link a risk with an action in the method.
- Allow plenty of opportunity for candidates to plot graphs. They should have suitable practice in determining their own scales which include values at the origin and they should develop a clearer understanding of what constitutes a good line of best fit.
- Practice method writing to ensure that candidates write concisely and clearly in a suitable style.
- When undertaking practical work, encourage candidates to draw links between the results collected and scientific theory.
- Give candidates experience of judging the reproducibility and repeatability of given data.
- Ensure that candidates understand the significance of a dot above a digit on their calculator screens so that they do not make errors in rounding.

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