



GCSE EXAMINERS' REPORTS

**GCSE
SCIENCE (DOUBLE AWARD)
SUMMER 2022**

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UNIT 1: BIOLOGY 1 – FOUNDATION TIER

General Comments

All seven questions on the paper were attempted by a large proportion of the entry. However, weak basic literacy severely limited the quality of responses of many candidates. At Foundation Tier, many struggled with even short passages of extended writing as was evidenced on this paper, where many candidates appeared hampered as a result of weak language skills. Once again, many candidates had an insufficient body of knowledge and understanding necessary to answer direct questioning or to construct comprehensible and cogent answers. Many answers or part answers were partly or wholly illegible, making it very challenging for examiners to interpret. Spelling was often weak. With some exceptions (e.g. meiosis/mitosis), a misspelt biological term is accepted as long as it is phonetically accurate.

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

Plotting points on graph paper and joining the plots with a neat and accurate line are now generally very well done. However, weak basic numeracy, including simple arithmetic, severely handicapped a substantial proportion of the entry.

Comments on individual questions/sections

- Q.1** **(a)** **(i)** Perhaps as many as 25% of the entry missed this part, despite the entire question being in **bold**. Those candidates who did attempt the question often produced neat, carefully drawn cell walls in one continuous line as required.
- (ii)** **I** Most candidates correctly identified organelle X as a chloroplast, though mitochondrion was a close second choice.
- II** Again, a small majority scored here, this time for recognising the associated process as photosynthesis.
- (b)** **(i)(ii)** In each case, all three terms were seen commonly in the responses. One very common misconception was that a group of specialised cells is an organism.
- Q.2** **(a)** The use of the bell jar model as an aid to understanding inspiration is required by the specification [section 1.2(f)]. However, many candidates were very confused about the processes involved. Common errors were to think that as the rubber sheet is pulled down, the volume of the space inside the bell jar *decreases* and the air pressure *increases*.

- (b) Knowledge of the main structures involved in the human respiratory system was patchy and only a minority of candidates achieved all three marks, sometimes with correct spelling.
- Q.3 (a) Almost all candidates selected a correct food chain for three marks.
- (b) (i) Candidates must read questions carefully. This part asks for the **source** of the energy entering plant plankton, so the answer must refer to the sun. Many candidates, including some of the most able, just gave 'light' as their answer.
- (ii) Any characteristic of living things would have scored here.
- (c) This Pisa-style question tests comprehension skills.
- (i) The answer 'rats are predators' would have scored. Many candidates overlooked this reference in the text and gave vague answers such as 'rats harm the puffins', or 'rats stop them breeding'.
- (ii) Most candidates scored at least two of the four marks in this True / False table. Common errors were a) to believe that puffin numbers were generally *rising* and b) the result of not understanding percentage changes, a limitation also pointed out in the 2019 P.E. report for Unit 1.
- Q.4 (a) (i) I The majority of candidates scored at least two of the three marks available for calculating the correct mean i.e. 63.4. The third mark was often lost because the candidate did not give their answer to the nearest whole number, despite that instruction being in **bold**.
- Candidates should be encouraged to show their working, when given the space, as an incorrect calculation might well score 1 mark for evidence of the correct method having been used.
- II Many candidates compared the two means and correctly concluded that the girls had a higher resting heart rate than the boys. However, a large proportion simply gave their *inferences*, such as 'the boys are fitter than the girls'.
- (ii) The question supplies four examples of a fair test, from which one must be picked. The fact that there are equal numbers of girls and boys, while desirable, does not constitute an example of a fair test. A large proportion of responses limited their answer to just that one comment.
- (b) (i) The vast majority of candidates performed well on plotting the four points, accurately and neatly. Candidates should be encouraged to follow the convention of plotting 'x's. Most candidates appeared to have had a ruler, but often, if the third mark did not score it was due to an inaccurate line.

- (b) (ii) This was the least well answered of the Low Demand questions. Bethan's investigation discovered that females have a higher resting heart rate than males. The same is the case in the large-scale data shown in graph 4.3. This, evidently challenging question, was tackled by a relatively low 81% of the entry.
- (iii) Interpreting graphs at Foundation Tier generally offers two marks. Often, the graph line will show a rise, followed by a fall, or a plateau and most candidates typically score the line mark. The second mark is for noting the critical value on the graph, the point at which the trend changes. Typically, several will miss that mark. In the present case, many candidates ignored the question and simply offered *opinions* as to why resting heart rate changes with age in men, often along the lines of old men being less active.
- (c) The candidates were provided with the answers to this question in the text above Table 4.2. Many candidates perhaps did not pick up on those cues, instead giving their own ideas, some of which were acceptable. However, often, responses were too vague or simply missed the point.
- Q.5** Part (a) was intended to provide cues to aid in tackling part (b), viz the digestion of starch, enzymes and absorption of food molecules into the blood.
- (a) Knowledge of the role of the main organs of digestion and absorption [specification 1.3(f)] was very patchy. Many candidates scored 0 marks.
- (b) At Foundation Tier, QER questions generally require little or no knowledge of Biology *per se* but rather are designed to test the ability to write clear, logical and relevant answers centred around observational and deductive skills, or experimental design. The topic for this question references 1.3(a) and (i) of the specification. A candidate could access middle band marks by simply extracting the answer from the given information. An answer such as 'In stage 1 there is starch. An enzyme is added and glucose appears, which is small enough to pass through the holes in the Visking tubing into the water', would constitute a good middle band answer, most probably attracting 4 marks. Examiners saw several good middle band answers and a few which achieved top band. Unfortunately, most candidates failed to make use of the information provided and did not exhibit the required skills. Most responses were highly confused.
- Q.6** (a) (i) Many candidates seemed not to realise that the mass of unsaturated fats is a subset of the total mass of fat.
- (ii) Very few candidates knew that starch makes up most of the carbohydrate in pasta; the two most popular answers being 'fibre' and 'protein'.

- Q.6**
- (a)**
 - (iii)** Answers here were often too vague such as ‘keep you healthy’ or ‘good for your heart’.
 - (b)**
 - (i)** Several candidates scored both marks for the correct calculation, while a few others gained 1 mark for showing the correct method in their working, even though reaching an incorrect answer.
 - (ii)**
 - I** Very few candidates realised that the energy value in Table 6.1 refers to kJ per 100 g, while that in the experiment (Table 6.3) refers to kJ per g.
 - (ii) II&(iii)** Very few candidates could offer any plausible answers to these two parts. The most common answers in II centred on there perhaps being different types, or masses of pasta and in (iii), a range of safety concerns. A few answers in (iii) had the right idea and scored the mark but many did not mention that the closeness of the Bunsen burner might affect the temperature *of the water/ thermometer*.
- Q.7**
- (a)** Only a few candidates could accurately label the bronchiole and / or blood plasma as required by specification section 1.2 (g). The most common label line for blood plasma identified a red blood cell.
 - (b)**
 - (i)** Only a very few candidates made any impression in response to this part, which called for a comparison of the walls / tissues of the two alveoli in image 7.2 and a reference to reduced surface area for gas exchange in the damaged alveolus.
 - (ii)** Many candidates gave answers here that were too vague, such as ‘struggle / harder to breathe’ rather than, for example ‘increased breathing rate’ or ‘shortness of breath’.
 - (iii)** Most candidates gave ‘smoking’ as a correct answer for a cause of emphysema.

Summary of key points

- The stem, or introduction to questions usually include a number of substantial prompts, key terms or named processes that candidates should then use, often by extracting *verbatim*, in their answers. These introductions should be studied carefully before attempting an answer. Use of a highlighter pen or underlining key words might be helpful in this regard.
- QER questions are often based around designing an investigation, allowing candidates to demonstrate a grasp of basic investigative principles. In some QER questions, candidates may be given a set of information and / or a diagram to comment on and to draw conclusions from. In all cases, only a minimum of recall will be required to access top band.
- Candidates should keep their answers to **all** questions as concise as possible to reduce the risk of making a contradictory or erroneous point which might negate a correct one. This is especially the case in questions calling for **one** point and in all QER questions. If candidates choose to express their ideas in bullet points when answering on QER, they should still write in full sentences, with capital letters and full stops.

SCIENCE (DOUBLE AWARD)

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UNIT 1: BIOLOGY – HIGHER TIER

General Comments

The performance on this paper is indicative of a Year 10 cohort of candidates whose education has been severely disrupted over the last 2 years or so. Through no fault of their own the knowledge required to achieve a good performance at GCSE level in this subject is lacking in many of the topics outlined in the specification. However, in a written report like this Principal Examiners can only comment on what is seen in the candidates' responses to questions.

Comments on individual questions/sections

- Q.1 (a) (i)** A surprising number of candidates got this answer wrong. It seems that most of these candidates did not know which figures to use in the calculation.
- (ii)** Most candidates got the answer wrong. Flour, fibre, sugars and proteins all appeared as incorrect responses.
- (iii)** Many of the answers were non-specific, e.g. salt is bad for your health and many referred to the clogging of arteries, causing heart attacks or diabetes and dehydration.
- (b) (i)** Generally well answered. If candidates didn't have the correct answer they could still gain one mark for using the correct figures in the calculation. A number of candidates cubed 20 in the calculation because its unit was cm^3 .
- (ii) I** Many candidates had difficulty with this question because their answers compared the energy content of 100 g of pasta in Table 1.1 with the energy content of 1 g of pasta in Table 1.3. In order to gain full marks 100 g of pasta in Table 1.1 had to be compared with 100 g of pasta in Table 1.3 or 1 g against 1 g. Some candidates stated that the energy content in Table 1.3 was for 1.6 g of pasta. They failed to realise that the calculation converted the energy content to 1 g even though the column heading in the table stated per gram.
- II** Many found this question difficult. If the candidates mentioned energy being 'lost' they had to state where the 'lost' energy had gone. For example, into the air, atmosphere, surroundings or to the mounted needle. Or, that there was incomplete combustion of the pasta.
Many gave the reason for the difference as: in Table 1.1 100 g of pasta is burned but in Table 1.3 only 1.6 g is burned. Or that in Table 1.1 a whole packet of pasta is burned.

- (b) (iii) Answers stating that the Bunsen burner was too close to the boiling tube had to specify what effect this would have on the results. That is, that the Bunsen flame would heat the water or affect the reading on the thermometer.
- Q.2** (a) The bronchiole arrow had to land on or in the diagram at a point above the 'pinch' between the 2nd and 3rd bronchiole / alveolar wall cells (counting from the top of the bronchiole). More often than not the bronchiole arrow landed anywhere on or around the diagram except on the bronchiole. The plasma arrow usually landed in or on the blood capillary but this was often on the wall or on a red blood cell.
- (b) (i) It is difficult to understand why so few candidates used the difference between the diagram of the healthy lung and the lung with emphysema to help to answer the question. Very few candidates mentioned the damage to the alveolar walls in the emphysema lung and the effect this would have on the surface area available for the exchange of gases. Most candidates answered the question by turning the data in the table into sentences and therefore gained no marks.
- (ii) Examiners were looking for answers referring to the increased rate of breathing or the shortage of oxygen absorbed or the shortness of breath. Answers which failed to score referred to the limited distance emphysema sufferers could walk or to the fact that they had difficulty walking upstairs.
- (iii) Generally well answered.
- Q.3** (a) (i) Sun, sunlight or solar energy were the only acceptable answers. Food and Trophic Level 1 were commonly seen incorrect answers.
- (ii) Well answered.
- (iii) Well answered.
- (b) (i) Well answered.
- (ii) Fairly well answered. The word energy had to appear in the answer and this was not always the case.
- (iii) Quite well answered. Respiration / heat energy from respiration were the most commonly seen correct answers.
- (c) Quite well answered. Difficult to understand why some candidates did not attempt the question.
- Q.4** (a) One mark was awarded for the correct reactants and one for the correct products. If light, chlorophyll or energy appeared as a reactant or a product then no mark was awarded on that side of the equation.
- If chemical notation was used then it had to be correct. E.g. – Co_2 , CO^2 and cO_2 all failed to score. The same rule applied to water and oxygen chemical notation.

- (b) (i) I Generally most candidates recognised that **A** had more carbon dioxide than **C**. Few candidates referred to carbon dioxide as **the** limiting factor. It is very difficult to understand why some candidates stated that **A** had a higher temperature than **C** or that **A** had more light than **C**.
- II Generally well answered. Most recognised that **C** had a higher temperature than **D**. Few candidates referred to temperature as being **the** limiting factor. It is again very difficult to understand why some candidates stated that **C** had more light than **D** or that there was a difference in the carbon dioxide concentration between **C** and **D**.
- (ii) Many referred to increasing carbon dioxide concentration or increasing temperature and gained the mark. Increasing light intensity failed to score. An answer such as 'increase the amount of oxygen given to the plant' showed a lack of understanding of the topic.
- (iii) Fairly well answered
- (iv) I Most candidates found this question difficult. Photosynthesis would stop was the answer that was looked for. Many candidates seem to have little concept of just how hot 80 °C is – stating that the rate of photosynthesis would increase. 'The hotter it is the higher the rate of photosynthesis'. Many referred to the high temperature denaturing enzymes. But, in order to gain the mark candidates had to specify that the enzymes controlling photosynthesis would be denatured,
- II Only a few candidates realised that it was the concentration of carbon dioxide in air.
- (c) Well answered.

Q.5 This was the QER question.
Some very good answers were seen here with many candidates being awarded 5 or 6 marks. These candidates showed a very good understanding of the double circulatory system.
Unfortunately, many of the answers seen were very confused. These candidates often confused the right and left sides of the heart, the bicuspid and tricuspid valves and the direction of blood flow within the heart – blood flowing from ventricles to atria.

- Q.6** (a) (i) Enzyme-substrate complex was known by some candidates.
- (ii) Glycerol was known by some candidates.
- (b) (i) Quite well answered. All the rate of reaction readings are given to two decimal places and candidates were not expected to present their answer to the nearest whole number. Therefore, an answer of 0.1 failed to score.

- (ii) Some well drawn and accurately plotted graphs were seen. Two marks were awarded for five correctly plotted points. One error resulted in one mark being awarded and more than one error resulted in zero marks for the plots. The plotted points needed to be neatly drawn and within < 1 small square. Unfortunately some plotted points were indicated with large, thickly drawn Xs or very large 'blobs'. These often lost marks.
One mark was awarded for a neat line, drawn with a ruler, passing through the centre of each plotted point. Again a tolerance of < 1 small square was allowed. Thick clumsily drawn lines could easily lose the line mark as could any indication of a double line.
The fourth mark was awarded for having suitably correct axis scales together with the Y – axis label. (The unit was not required.)
Candidates were expected to use **over** half the graph paper in their plotting otherwise one mark was lost. Often the dimensions of the graph paper given in a question are carefully worked out to allow the candidate to draw a clearly plotted graph of maximum size. Candidates need to know this.
- (iii) Increase and decrease were both needed together with the temperature at which the change occurred.
- (iv) Many candidates found this very difficult mainly because they struggle with the differences between the request to **describe** and the request to **explain**. Question 6(b)(iii) was an explain question and many candidates repeated their answer to that question again in this question.
Few candidates attempted to answer this question by referring to kinetic energy and its effect on the collisions between substrate and enzyme molecules.
- (c) There was a lack of understanding of experimental procedure here. Candidates did not understand that, for example, if a reaction between enzyme and milk-fat molecules is to take place at 80 °C then the reactants need to reach 80 °C before being mixed together. That is they need to acclimatise or equilibrate prior to mixing. Answers here ranged from 'killing germs' to 'controlling pH'.
- (d) Quite well answered although many candidates seemed to lack an understanding of the nature of skimmed milk – that it has had its fat removed.

- Q.7 (a) Many disappointing responses were seen here. The understanding of active transport, osmosis and diffusion was vague at best.
The instruction at the start of the question was to place a tick (✓) or a cross (✗) in **each** box. Many candidates failed to carry out this instruction. They considered that leaving a space blank was the same as inserting a ✗. This was not acceptable and these candidates lost marks.
- (b) Some very good answers were seen here. However, many candidates had little, or a confused, understanding of osmosis.
A straightforward definition of osmosis was not accepted unless the detail within the definition was applied to the actual circumstances of the question.

Summary of key points

- If candidates are asked to conduct a comparison in a question then they must compare like with like, i.e. the comparison must be fair. (See comments on question 1(b)(ii).)
- Diagrams are provided in questions to help a candidate or to test a candidate's understanding. They need to be studied very carefully. Often the answer to a question will be found within the diagram. (See comments on questions 1(b)(iii) and 2(b)(i).)
- When asked to label a drawing / diagram then arrows must not fall short of the structure being labelled.
- Candidates must understand the differences between the terms describe and explain. (See questions 6(b)(iii) and 6(b)(iv).)
- In questions where there is a choice of answers and candidates are asked to underline the correct answer don't leave it blank – have a go! There is no penalty for underlining the wrong answer.
- When drawing a graph use the maximum amount of graph paper possible. At the very least the graph should occupy over half of the graph paper available.
- Follow instructions! (See comments on question 7(a).)

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UNIT 2: CHEMISTRY – FOUNDATION TIER

General Comments

Due to the increased use of objective questioning styles on the foundation only questions, this section was generally accessible and well attempted. The PISA-style question was very well attempted but it was not well answered. Foundation Tier candidates struggled on the common section, especially questions 8(b)(i), 8(c)(ii) and 9(a)(i)&(ii) where they were required to recall descriptions and/or explanations.

Mathematical questions on the foundation tier were generally well attempted and well answered. However, they struggled with writing chemical formulae and writing and balancing symbol equations.

The QER question was better answered than in previous years with far fewer candidates not attempting it at all.

Comments on individual questions/sections

- Q.1**
- (a)** Many candidates scored all the marks. The majority who did not forgot to add water to the rock salt before filtering the solution.
 - (b)**
 - (i)** Many candidates gained 1 mark here for identifying that a pen should not be used to draw a line on chromatography paper. A number however did not recognise that the water level should be below the sample.
 - (ii)** Many candidates gained the marks for correct calculation of the R_f value. Some did not use the distance to the solvent front and others divided the distance travelled by pigment 2 with that travelled by pigment 1.
- Q.2**
- (a)**
 - (i)** This question was well answered with candidates correctly identifying copper and the lack of either a temperature rise or bubbling as evidence of no reaction.
 - (ii)** This question was well answered.
 - (b)** Many gained this mark. Those who did not often opted for 'combustion' rather than 'exothermic'.
 - (c)**
 - (i)** Many candidates gained 2 of the 3 marks for plotting a line graph. Many continue to connect the plots using a ruler rather than drawing a smooth curve of best fit. This was the most common error.

- (c) (ii) This question was well answered.
- (iii) Poorly answered. Many candidates did not identify that the rate of a reaction slows as reactant particles are used up during a reaction. Many chose option 1 or option 2 which were both linked to changes in the temperature of a reaction rather than concentration.
- (iv) Many candidates scored 1 mark here for correctly stating that the temperature of the acid could be increased. Very few suggested changing the concentration of the acid. The most common error was stating that the volume of acid could be increased. Many of the candidates had clearly not recognised that the changes must relate to the acid.
- (v) Only a minority of candidates gave the correct formula for magnesium chloride. The most common incorrect answers were MgCl and Mg_2Cl .
- Q.3** (a) The majority of pupils scored 2 marks in this question for giving the correct atomic number and mass number for beryllium. These could be found on the element symbol at the start of the question and using the Periodic Table key would have been useful. Very many failed to give the correct number of protons and neutrons.
- (b) This question was well answered.
- (c) Most candidates counted the correct number of atoms in the formula. The most common incorrect answer was 2.
- Q.4** (a) This question was well answered.
- (b) The majority of candidates recognised that green plants produced oxygen in the early atmosphere for 1 mark. Fewer correctly named the process as photosynthesis to gain the second mark.
- (c) Poorly answered. Many candidates failed to match the properties stated with those of argon. Many named elements not in Group 0. Hydrogen and carbon dioxide were common incorrect answers.
- (d) Poorly answered.
- Q.5** (a) Poorly answered. The most common error was selecting location **D** as this had the highest concentration of F^- ions.
- (b) This was well answered.
- (c) Poorly answered. Many candidates failed to make a link between the ions listed in the table and the names of the compounds given in the question.
- (d) (i) A large number of candidates gave the correct M_r . Those who did not mostly gave an answer of 88 (A_r of oxygen not multiplied by 4).

- (d) (ii) Poorly answered. Many candidates did not recognise that there are two atoms of fluorine in the formula of calcium fluoride and gave the incorrect answer of 24.4%.
- Q.6** (a) Many candidates scored one of the two marks available. A large number gave the correct flame colour for sodium. Fewer were able to correctly identify the precipitate colour of silver iodide.
- (b) (i) Some gained credit for the formula of silver iodide but most were unable to give the correct formula for sodium nitrate.
- (ii) This question was well answered. The most common incorrect answers were 'evaporation' and 'distillation'.
- Q.7** Most candidates scored marks in the lower band in this QER. The majority correctly identified some advantages and disadvantages of hard water. However, most candidates did not give the detailed descriptions of the advantages / disadvantages required to access the middle and upper band marks. Some confused hard water with fluoridation and those who wrote about fluoridation only gained no credit.
- Q.8** (a) (i) The majority of candidates answered this correctly.
- (ii) At Foundation Tier level many candidates were able to describe in simple terms how the appearance of sodium changes on oxidation. The most common unacceptable answers were 'gets darker', 'rusts' and 'changes colour'.
- (iii) Poorly answered. Only a minority were able to give the correct formula for sodium oxide. Many candidates named the compound rather than giving its formula.
- (b) (i) Poorly answered. Most candidates did not clearly identify chlorine gas as the toxic substance in the reaction.
- (ii) A number of candidates were able to give the correct formula of sodium chloride. The most common incorrect answer was NaCl_2 . Very few were able to correctly balance the equation.
- (c) (i) Some candidates identified the correct boiling point from the list. The most common error was following the trend in increasing boiling points down the group and selecting 100°C but not recognising that this value is lower than the melting point of 117°C .
- (ii) Many candidates were able to give a valid prediction for the reactivity of astatine. Some did not gain the second mark because they failed to describe the trend in reactivity. A minority incorrectly identified the trend in Group 7, stating that reactivity increased down the group.

- Q.9 (a) (i)** Some candidates achieved credit for stating that the continents fitted like a jigsaw. Many were unable to mention similar rocks and fossils being found on different continents to gain further credit. Common errors included reference to 'countries' as opposed to 'continents' and to plant and animal 'species' rather than 'fossils'.
- (ii)** A minority of candidates gained credit in this question. Many stated that 'he could not explain his theory' rather the fact that he was unable to suggest how the continents moved. Very few candidates gained credit for stating the evidence that we have today to support Wegener's theory, such as knowledge of convection currents in the mantle or the existence of tectonic plates.
- (b)** This question was well answered by the majority of candidates.

Summary of key points

- A total of 7 marks were awarded for chemical formulae and equations on this paper. Understanding this 'language' is important in chemistry and skills should be practised regularly throughout the course.
- Basic numerical skills such as addition, subtraction, multiplication and graphical skills are essential. A total of 12 marks were awarded for these skills on this paper.
- The importance of learning the key facts within each topic should be emphasised to candidates. Recalling prior knowledge (AO1) makes up 40% of the marks on this paper.

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UNIT 2: CHEMISTRY – HIGHER TIER

General Comments

Higher Tier candidates performed better on the common questions than the Foundation Tier candidates. This section was generally very well attempted. The PISA-style question was also very well attempted and very well answered on the Higher Tier paper.

As on the foundation paper, many candidates struggled to answer questions where they were required to write descriptions and / or explanations that required recalled knowledge. However, the quality of written communication and scientific explanation was better on the Higher Tier paper.

The mathematical questions on the Higher Tier were not very well answered in general and again candidates struggled with writing slightly more complex chemical formulae and balanced symbol equations.

The QER question was better answered than in previous years with far fewer candidates not attempting it at all.

Comments on individual questions/sections

- Q.1**
- (a)**
 - (i)** Very well answered.
 - (ii)** Well answered by the majority of candidates.
 - (iii)** Very well answered.
 - (b)**
 - (i)** Poorly answered. The majority of candidates did not clearly identify chlorine gas as the toxic substance in the reaction. No credit was awarded for vague statements such as 'to prevent a toxic substance from escaping' or 'toxic fumes are produced'.
 - (ii)** Well answered. The majority were able to give the correct formula and balance this simple equation.
 - (c)**
 - (i)** Very well answered. A small number of candidates selected 100 °C but did not recognise that this value is lower than the melting point of 117 °C.
 - (ii)** Very well answered. The vast majority of candidates gave a suitable prediction for the reaction of astatine with iron wool. No credit was awarded for 'slow reaction' which is a repeat of the description for iodine.

- Q.2** (a) (i) Most candidates gained credit for stating that the continents fitted like a jigsaw. Many were unable to mention similar rocks and fossils being found on different continents to gain further credit. Common errors included reference to 'countries' as opposed to 'continents' and to plant and animal 'species' rather than 'fossils'.
- (ii) Many candidates gained credit in this question for stating that 'he could not explain how the continents moved' for one mark. Fewer scored the second mark for giving the evidence that we have today to support Wegener's theory such as knowledge of convection currents in the mantle or the existence of tectonic plates.
- (b) This question was very well answered.
- Q.3** (a) The majority of candidates correctly identified the element as F to gain credit. Many used the electronic structure correctly linking group number to the number of electrons in the valence shell and the period number to the number of shells. Some used the atomic number to identify the element. This did not gain credit.
- (b) This question was well answered by many candidates. A small number only identified one element as being inert. The most common error was not recognising that element A with only 2 electrons also has a full outer shell.
- (c) Poorly answered with only a small number of candidates gaining both marks. The majority of candidates who gained 1 mark correctly determined the atomic numbers. Determining the mass numbers was poorly done with 18 and 20 the most common incorrect answers.
- Q.4** (a) This question was very well answered despite many candidates recalculating the mean time for the 0.6 g/dm^3 of thiosulfate using all three time values to obtain a mean of 45 s which they then used when plotting the graph in part (b). There was no penalty for this.
- (b) The majority of candidates correctly plotted the graph gaining all three marks. A number of candidates continue to connect points using a ruler rather than drawing a smooth curve of best fit. These were not awarded the third mark.
- (c) The majority of candidates gained credit in this question for stating that 'the higher the concentration, the higher the rate'. Fewer candidates were able to explain why increasing the concentration increased the rate. Many did not state that increasing the concentration adds more reacting particles in the same volume of solution.
- (d) Many candidates gained credit here for identifying that increasing the temperature increases the rate of the reaction and sketching a curve anywhere below the original curve.
- (e) Many candidates correctly calculated the number of moles in sodium thiosulfate. The two most common errors were incorrect calculation of the relative formula mass and not giving the final answer to two significant figures. A number gave the answer to two decimal places.

- Q.5** Most candidates scored 2 or 3 marks in this QER question on hard water. The majority gained credit by describing a method for testing for temporary and permanent hardness in water. Very few candidates were able to identify the anions responsible for temporary and permanent hardness. Many incorrectly stated that the type of hardness depends on the relative concentrations of magnesium and calcium ions. Many made no reference to hydrogencarbonate ions. Only a very small number of candidates were able to link boiling temporary hard water to thermal decomposition and the formation of carbonate ions as the reason for removal of temporary hardness.
- Q.6**
- (a)** The majority were awarded two marks out of the possible three for this question. Candidates were able to identify and provide detail of photosynthesis and respiration as the processes responsible for maintaining the balance of oxygen and carbon dioxide in today's atmosphere. Very few recognised that both processes must occur at the same rate to ensure the balance is maintained.
 - (b)** Many candidates gained 1 mark for identifying that the emissions of carbon dioxide in both India and the USA increased at a steady rate for the majority of the time period. Fewer scored the second mark for stating that from 2005, carbon dioxide emission decreased in the USA but more than doubled in India.
 - (c)** Fewer than half the candidates were able to balance the combustion equation.
- Q.7**
- (a)** The majority of candidates correctly identified silicon as the metalloid in the table. Candidates who did not gain both marks, did not identify the non-metallic and metallic properties of silicon given in the table.
 - (b)** Very well answered.
 - (c)** Well answered.
 - (d)**
 - (i)** Many candidates were able to determine that phosphorus is a liquid at 60 °C. Fewer were able to explain why this was the case using the melting and boiling point data provided. Many candidates simply stated that 60 °C was above the melting point, making no reference to the boiling point in their answer.
 - (ii)** Fewer than half the candidates successfully balanced the equation.
- Q.8**
- (a)**
 - (i)** The majority of candidates were able to recall that reactivity increases down Group 1. Fewer were able to explain this in terms of the change in electronic structure. A large number of candidates recognised that there was an increase in the number of electron shells / distance from the nucleus, but they did not link this to the attraction between the nucleus and the outer electron. For this reason, many scored one out of the two marks available.

- (a) (ii) A number of candidates recognised that the difference in reactivity between the elements of groups 1 and 2 is to do with the number of electrons lost from the outer shell when they react. The candidates who did recall this scored full marks in this question. Many did not make this link, often attempting to describe the trend in reactivity down Group 2. The most common incorrect answer was candidates stating that Group 2 elements were more reactive than Group 1 elements because they have more electrons in the outer shell 'to react'. This is a significant misconception.
- (b) This reacting masses calculation was very poorly done and most candidates scored no marks. Calculations such as this will need to be revised and practised over the coming year as they can also appear in the Unit 5 paper.
- (c) This question was extremely poorly answered with barely any candidates able to write the formulae of the reactants and products. Calcium hydroxide was often given as CaOH and hydrogen as H.

Summary of key points

- A total of 7 marks were awarded for chemical formulae and equations on this paper. Understanding this 'language' is important in chemistry and skills should be practised regularly throughout the course.
- Mathematical skills, including chemistry specific calculations and graphical skills, are essential. A total of around 11 marks were awarded for these skills on this paper.
- The importance of learning the key facts within each topic should be emphasised to candidates. Recalling prior knowledge (AO1) makes up 40% of the marks on this paper.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2022

UNIT 3: PHYSICS – FOUNDATION TIER

General Comments

Many candidates for this unit 3 foundation paper had not prepared well. There were many sections of the paper left blank by a large number of candidates. The quality and legibility of candidates' handwriting was weaker than in previous years. Reading values from graphs proved problematic for many. Knowledge of circuit symbols, *I-V* characteristics and heat transfer was particularly poor. Determining the circumference of a circle, despite being given the equation, was beyond many candidates.

Comments on individual questions/sections

- Q.1 (a)** This was an easy introduction to the paper which yielded a large number of correct responses.
- (b)**
- (i)** Most candidates gained at least some credit, often attaining 2 or 3 marks.
 - (ii)** This was often done poorly by many candidates with many giving vague answers rather than preventing electric shocks. A surprising number of candidates did not attempt this question part.
- Q.2 (a)**
- (i)** This was a very simple graph to plot, designed to be accessible for the weakest Foundation Tier candidates. Most candidates were able to plot the points although a minority did not use a ruler so lost the line of best fit mark.
 - (ii)** Determining the relationship between $\frac{1}{\text{frequency}}$ and wavelength and frequency and wavelength could easily be determined from the table. Many candidates selected increases for both, perhaps describing what they could see on the graph rather than carefully looking at the information given in the question.
 - (iii)** Candidates were directed to the table in part I to state the wavelength at 10 Hz. It was surprising to see many incorrect responses, again this could be explained by candidates not reading the question carefully. Part II was a very simple calculation, multiplying the stated value of the wavelength by the given frequency of 10 Hz. It was reasonably common to see candidates dividing the frequency by 10 leading to them gaining no marks.

- (b) (i) Candidates had to select the words to correctly complete 4 sentences about satellite communications. It was rare to award 4 marks. Equator seemed to be the response more infrequently chosen although it was difficult to discern patterns. Certainly candidates' knowledge here was often limited.
- (ii) It was relatively uncommon in part I to see correct responses despite candidates being given the equation for circumference with terms defined. Part II was also poorly done by many. Lots of candidates failed to realise that the distance travelled by the satellite was the circumference of the orbit so did not bring their answer through from I, instead using the radius of the orbit as the distance travelled. Incorrect rounding was frequently seen causing candidates to lose the answer mark.
- (iii) This was very poorly answered and candidates rarely attained marks. Candidates did not realise that the satellite would have to travel further in the same time so must be faster.

Q.3 This question was in the context of heat transfer which historically has not been done well. This proved to be no exception.

- (a) (i) A mixture of responses was seen here, with conduction and convection both being common responses.
- (ii) Few candidates in part I were able to either describe seeing a convection current or to show this on the diagram. It was rare to see a correct response in part II, the idea that hot water is less dense and rises was rarely communicated.
- (b) Most candidates were able to order the metals but many got the order totally reversed, giving answers in order of longest to shortest time perhaps from not reading what the question asked for.

Q.4 (a) This QER question proved quite accessible for some Foundation Tier candidates although many revealed a disappointing lack of knowledge of this simple topic. Many were able to provide some advantages and disadvantages although they should be discouraged from making vague and unqualified references to cost. However, the quality of writing was poor. Candidates often failed to use punctuation and spelling was problematic for many. The legibility of handwriting was also an issue in many cases.

- (b) (i) Most were able to determine the wasted energy from the Sankey diagram.
- (ii) Many incorrect responses were seen here with candidates selecting the wrong energy values or substituting incorrectly. Candidates should recognise that efficiencies of greater than 100% cannot be correct.

- Q.5**
- (a)**
 - (i) and (ii)** This simple numerical work proved to be much more accessible to candidates than previous questions requiring a descriptive answer. Many candidates were able to determine the units saved and the saving per week although errors were often seen with candidates attempting conversions that were not required.
 - (iii)** Many candidates gained credit in part I, often with ecf. It was not uncommon in part II to see the conversion from weeks to years incorrectly done.
 - (b)**
 - (i)** Many correct responses seen.
 - (ii)** This simple numerical calculation to determine the number of cows required proved to be difficult for many Foundation Tier candidates. Reading the question carefully to check what they are asked for would benefit all candidates.
 - (c)** This was very poorly answered with many vague responses. The information required to answer the question was given in the table and a simple comparison of the global warming potential of CO₂ compared to methane would have allowed candidates to gain both marks. The responses given were usually too vague and did not answer the question.
- Q.6** This common section proved beyond the reach of many Foundation Tier candidates who lacked the level of knowledge and problem-solving required. The latter sections of this question were frequently left blank.
- (a)** The symbol for the variable resistor was not known by many candidates. The symbol for a voltmeter was more commonly seen but usually connected in series not parallel.
 - (b)**
 - (i)** This is a familiar style of question where candidates evaluate the relationship between pairs of values. This was poorly done with candidates often not selecting relevant data. Many candidates did not know how to determine ratios for comparisons.
 - (ii)** Candidates were given the power equation and required to determine the maximum current and voltage from the graph to determine the maximum power. This was correctly done by many although some errors were seen in reading the scale causing many to lose marks.
 - (c)**
 - (i)** Another straightforward numerical calculation requiring values from the graph to determine the resistance of the resistor. Despite this being simple many failed to select the correct values.
 - (ii)** Candidates were required here to demonstrate that they knew the current-voltage characteristic for a resistor by adding a line to the graph. If the correct point was identified then the line usually mirrored the curve of the lamp scoring no credit.

- (d) (i) Most Foundation Tier candidates were not able to give a sensible response here and knowledge of the behaviour of a diode was very weak.
- (ii) Few candidates could sketch an I - V characteristic for a diode and it was rare to award marks.

Summary of key points

- Encourage candidates to read the questions carefully.
- Remind candidates to write as legibly as possible and to use appropriate punctuation.
- Encourage candidates to attempt all questions.
- Practise drawing circuits with appropriate symbols.
- Build in opportunities to use simple equations from Maths such as circumference and volume so that candidates are confident in using them in Science.
- Allow plenty of opportunities to read values from graphs.
- Practise different revision methods with candidates to build confidence and knowledge.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2022

UNIT 3: PHYSICS – HIGHER TIER

General Comments

There were approximately 4150 entries for this tier paper. Not a single question had a 100% attempt rate but lots of parts exceeded 90%. Only in two parts of questions did this drop slightly below 80%. Generally, questions requiring calculations (1(b)(ii), 1(c)(i), 4(c) and 6(a)(i)) or data analysis (6(b)) were answered better than those requiring recall of information (1(a), 2(c)(i), 3 and 4(a)).

Candidates often seemed not to have read the question carefully. This was evident in 1(b)(i) and 1(b)(ii). Some candidates had difficulty in substituting into equations correctly, converting between units and handling indices.

Comments on individual questions/sections

- Q.1 (a)** Less than half of candidates gained a mark here. Voltmeters were usually connected in series. Some were connected in parallel to a length of connecting wire. The symbol for a variable resistor was not well known and often the symbol for a thermistor was added to the diagram. Just over 5% of candidates did not attempt the question.
- (b) (i)** This was answered well by many candidates although answers were not always well presented. It was common to see expressions such as $0.5 = 0.9$ and $1 = 2.4$ which in the context of the question were understood to mean a pair of currents showing doubling and the corresponding values of voltage read from the graph. This was sufficient for 2 marks. A concluding remark was required for the third mark. A tolerance of ± 0.1 was allowed on graph voltage values. Some candidates ignored the instruction to select pairs of data in the range 0.5 A to 2.0 A so were penalised. Others misread the voltage scale on the graph by taking each small square as 0.1 and not 0.2. The attempt rate was just under 94%.
- (ii)** The question asked for maximum power so this required taking values from the graph for the largest current and voltage shown. The voltage value fell on a given major scale line of 12 V but the current point fell half way between two given scale values of 2.0 and 2.5 so should be read as 2.25 A. A tolerance of ± 0.05 was allowed. Most candidates calculated the correct answer to earn 3 marks. However, some read the current as 2.5 A so only achieved 1 mark if a voltage of 12 was used. Others ignored the instruction to calculate maximum power so did not gain a mark. The attempt rate was over 99%.

- (c) (i) This was a straightforward calculation and most candidates obtained 2 marks. It was surprising that just over 2% of candidates did not attempt it.
- (ii) The attempt rate fell to just below 84%. Few correct answers were seen. The expected straight line should have extended from the origin through the point (12,2) (ecf allowed) but this was rarely seen. Many curves were drawn to the correct point and also straight lines from the origin to join to the end of the curve for the lamp.
- (d) (i) The attempt rate fell to just below 80%. This question was assessing whether candidates could adapt the circuit in (a) to include the sealed box and also knowledge about a diode allowing current one way but not the other. Very few credit worthy answers seen. Candidates had problems describing how the circuit could be adapted and there was confusion about a diode. Some thought its resistance changed with light intensity. One candidate suggested 'open the box' and others said to check the symbol to see if it's a triangle with a line.
- (ii) The attempt rate rose slightly here to just under 83%. This was a recall question and about 30% of candidates sketched the graph correctly. Otherwise a large variety of shapes of lines in some or all of the quadrants were seen.
- Q.2** (a) (i) Less than half of candidates gave the correct answer for wavelength. Common errors included answers of 3 and 12 cm.
- (ii) An ecf was allowed here for wavelength. About a third of candidates obtained the correct answer. Errors included manipulating incorrectly and failing to convert from cm to m. In some instances, candidates ignored the terminology in the equation and the units of the given values and just multiplied them.
- (b) The difficulty of this question was intentionally reduced by providing the wave direction after the boundary. Despite this a minority of answers earned credit and about 14% of candidates did not attempt it. In some instances, the diagram was completed very well but usually errors were seen which limited the marks obtained, such as adding extra wavefronts in between those that were joined at the boundary or the added wavefronts were not perpendicular to the direction. However, it was more common to see wavefronts heading in any direction except to that shown by the arrowed line.
- (c) (i) This was a recall question and it was not answered well with only about 10% of candidates earning any credit. Common errors include the satellite and Earth move at the same speed and the satellite and Earth both orbit in 24 hours.
- (ii) The question helpfully showed the first and last parts of the path taken by the signal. Candidates had to deduce there were another 2 parts to be included. Therefore, the total distance travelled by the signal should have been $4 \times 3.6 \times 10^7$ m. Lots of methods included distances of $2 \times 3.6 \times 10^7$ m or 3.6×10^7 m. Some candidates skipped showing the substitution step and instead manipulated first.

- Q.2 (c) (ii)** This was fine if manipulation is correct but if not then the substitution mark was lost. Some candidates experienced difficulty with dividing indices. Other errors included using the wave speed formula which does not include time and also not indicating which equation had been selected and just showing $3.6 \times 10^7 \times 3 \times 10^8$.
- (iii)** This was not answered well and just over 10% did not attempt it. About 20% gained the mark. Many answers were too vague or just stated the time is the same.
- Q.3 (a)** This was a recall question. Answers were weak. The functions of each wire were not well known. Where candidates earned credit it was usually for the function of the earth wire to protect from electric shock.
- (b)** This was another recall question with a lower facility factor than part (a). Almost 21% of candidates did not attempt it. There was a lot of confusion between mcb and rccb. Very few creditworthy answers were seen with an occasional 3 marks awarded.
- Q.4 (a)** This question tested knowledge of conduction through metals and it was not well answered. Unless the answer specified electrons it was assumed the particles referred to atoms. So, references to particles moving did not earn credit. Many candidates thought that particles start to vibrate instead of vibrate more as the temperature rose. Some answers mentioned free electrons but no description of their role. There were also descriptions of the particles in water so the question must have been misread.
- (b)** This was slightly better answered than part (a) but generally still poor responses. Few candidates could state it was an example of convection and that hot liquids rise or are less dense. Some candidates just described the direction of circulation. Errors included: heat rises, cold water is less dense, particles are less dense and descriptions of convection of air.
- (c)** This question did not depend on recall and was much better answered. Many candidates gained both marks. Others answered 320 or 1920 J and omitted the second step in the calculation so earned 1 mark.
- Q.5** This was the QER question with an attempt rate of just over 90%. The full range of marks was awarded. Some candidates spoke about burning coal but if the account was clear about the processes involved then they were not penalised on this occasion. It was very pleasing to see the number of candidates earning top band marks and especially 6 marks. The mean mark is just in the middle band. Some candidates gave detailed descriptions of electricity generation by gas, how efficiency is increased and how safety is achieved. These were usually well written and presented. Answers were lacking in detail in some instances, for example, there was no mention of generators at the power station or the efficiency or safety aspects were omitted. There was some confusion with step-up and step-down transformers and their function so answers included statements that step-up transformers increase current. Some candidates were not sure of the term transformers so some referred to step-up pylons, turbines, and even step-up consumers. Other errors included: heat loss is prevented by raising the voltage, energy is created at the power station and gas fired power stations operate by wind or solar power.

- Q.6**
- (a)**
 - (i)** This was well answered with most candidates extracting the required information to complete the calculation with many of them earning full marks. However, some either failed to convert p into £ or converted incorrectly to arrive at answers of 2.4×10^n where n is not 3, so gaining 2 marks.
 - (ii)** An ecf was allowed from part (a)(i). Just over half of candidates calculated correctly to earn the mark. It is surprising that about 8% fewer candidates attempted this question than (a)(i).
 - (b)** There was a lot of data included in the introduction to this part. It was incumbent upon candidates to read this information and the questions carefully. Many obviously did this.
 - (i)** It was intended that this part be an easier introduction to use of the data leading to the more difficult part (ii). However, candidates generally did not do as well here as in the next part. Many candidates calculated $\frac{1.9}{5.3} \times 100$ to earn the first mark but lost the answer mark due to incorrect rounding. Some calculated the inverse $\frac{5.3}{1.9}$ or forgot to multiply by 100. Candidates should be aware that if their answer is greater than 100% then they have done something wrong and should look again at their method. Some of the workings shown here were not expected until part (ii) however could be used to find the efficiency also.
 - (ii)** The mean here was about half marks. Many candidates handled the data well to come up with some imaginative methods of solving the problem and full marks were awarded, albeit to a minority of candidates. Other candidates gained 2, 3 or 4 marks for a partial solution or because they had made an error or errors somewhere along the line. Some candidates left this blank (about 12%) but had included some of the steps in their answer to part (i). It was decided in cases such as these, that credit could be awarded here for relevant calculations seen in part (i). In this question the conclusion was not required to earn full marks however most candidates gave it anyway.
 - (c)** Few creditworthy responses were seen. A minority of candidates recognised that when comparing carbon dioxide with methane then it's a matter of the lesser of two evils. Answers were often too vague and it was not clear whether candidates were referring to methane or carbon dioxide in their answers.

Summary of key points

Candidates must be encouraged to:

- read questions carefully and follow the instructions given.
- develop the skills required to read graph scales especially where each small square is 0.2 or 0.05.
- show substitutions into formulae in the spaces allocated for workings.
- develop strategies to retain information since 40% of the marks are allocated to recall.
- improve their ability in handling indices, such as when multiplying or dividing.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2022

UNIT 4: BIOLOGY – FOUNDATION TIER

General Comments

Most questions have been attempted by most candidates. Candidates found the paper to be more challenging as they progressed through it. Throughout the paper, there was evidence of poor basic literacy. This severely limited the quality of responses. However, it was pleasing to see so many candidates attempt the QER question. Many candidates wrote lengthy answers showing that they found the question accessible. However, many candidates often appeared hampered as a result of poor language skills. Their answers were often difficult to read as the result of poor handwriting coupled with sentences that were incoherent.

Candidates often seem not to have read the question fully and do not consider diagrams or graphs given in questions, which often provide substantial clues to the answer. Candidates should use the axes labels on graphs when asked to describe or explain a graph. Recall of basic facts has proven to be challenging for most candidates. These types of question have had the lowest scores in this paper. This points to improvements needed by candidates in their revision.

Failure to use the comparative term (e.g. 'more / less', 'higher / highest') 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. Often candidates lost marks by not showing their workings. It was disappointing that so many candidates could not use a given formula

Comments on individual questions/sections

- Q.1 (a)** This question was answered very well by almost all candidates. All candidates attempted the question and most obtained full marks.
- (b)** Almost all candidates attempted this question. Candidates read the instructions and used words from the box provided.
- Q.2 (a)** Again almost all candidates attempted this question. Words were used from those provided. Most candidates were credited for the hair label. Some got confused with at least one of the other labels. Some candidates lost a mark by not copying the given labels from the box correctly, e.g. writing muscle instead of erector muscle.

- (b) Most candidates attempted this question. There were multiple options to gain the mark. Most candidates went for sweating. Some candidates chose to answer in terms of vasodilation. Very few gave the word vasodilation and many lost the mark due to giving an incorrect description, e.g. stating that blood vessels moved closer to the surface of the skin. This is incorrect.
- Q.3** (a) Unfortunately not all candidates attempted this question. Some candidates missed this due to there not being a line to give your answer on, instead the answer had to be added to the diagram. In order to gain the mark here a line had to be drawn that was in contact with the nucleus. When labelling a diagram it is the end of the label line that will be marked. Some lines fell just short of the nucleus and were therefore deemed to be labelling the cytoplasm. These types of answer did not gain credit.
- (b) A number of candidates did not attempt this question. Of those that did, just over half gained the mark. This was slightly more challenging than previous questions as it required recall of a specific term – double helix.
- (c) Most candidates attempted this although appeared to have missed it. Most obtained the mark.
- (d) Most candidates attempted this question.
- Q.4** (a) This is a fairly common type of question and it was disappointing not to see more candidates attempt to answer it. Of those who attempted it approximately half got it correct. There is still confusion over genus and species with many candidates. Also some wrote *Rattus* with a lower case 'r'. This did not get credit.
- (b) Again, this is a common type of exam question. Only half the candidates gained the mark. The most common incorrect answer was 'animals with a spine'. The answer that was needed was 'animals with a spinal column/backbone'.
- (c) Almost all candidates attempted this question.
- (d) This was well answered by most candidates.
- Q.5** (a) This was well answered by most candidates.
- (b) This was well answered by most candidates.
- (c) (i) Most candidates gained a mark here.
- (ii) Very few candidates were able to gain a mark here as they did not comment on whether the vaccination programme was successful or not. They could have gained a mark either way, as long as they backed up their conclusion with evidence from the graph.
- (iii) Most candidates gained a mark here by stating that parents were concerned that the report might be true and there was a link with autism.

- Q.6**
- (a)**
 - (i)** Most candidates attempted this question. A number of candidates struggled to use the formula provided. Many forgot to multiply by 100, as stated in the formula. There seemed to be a general lack of confidence when tackling a basic numeracy question. Some candidates lost a mark due to incorrect rounding. On the other hand, there were many excellent responses, with workings being shown and answers correctly rounded.
 - (ii)** This was generally well answered with most candidates picking up at least 1 mark out of the 2 possible marks.
 - (b)** Most candidates attempted this. With the command word being suggest, we accepted that kestrels nest on the coast for them to catch fish. This was a plausible answer and the candidates were not to know that kestrels do not eat fish.
 - (c)** Many attempted this question. Some candidates got confused with genus and species again which cost the mark, e.g. 'they both have the same species'.
- Q.7**
- (a)**
 - (i)** Many candidates answered this question well. They stated that blood glucose levels increased up to 4 pm and then decreased.
 - (ii)** There were two ways of answering this correctly, either stating the number 50 a.u. or actually giving the range of 80-130 a.u. Many candidates gave one or both answers. Some attempted to do this but read the graph incorrectly.
 - (iii)** Many candidates failed to get a mark here. Many answers stated that a diabetic would have a higher blood glucose level. This was not enough to gain credit. They needed to say that the blood glucose levels would be higher than the maximum normal blood glucose level. There were other ways to gain credit (please see the mark scheme).
 - (b)**
 - (i)** Many candidates attempted this question but very few obtained any marks. Many candidates got confused with the chemical tests. Of those that mentioned Benedict's reagent, only some included the need to heat / boil.
 - (ii)** Multiple types of answer would have gained credit here. Common examples were 'stayed blue and negative'.
 - (c)** Only 69% of candidates attempted this question. Recall of specific fact needed here.
- Q.8** It was very pleasing to see 97% of candidates attempt this QER question. Most candidates made use of the differences and similarities given in the diagrams. Many candidates found the similarities easier to identify than the differences. Many candidates were hampered by poor literacy skills when it came to communicating the differences. The best answers kept it simple, e.g. a bacterium has a cell wall and a virus does not.
A small number of candidates drew a table to compare the bacterium with the virus. This is not advised as this is a QER question and drawing tables often stifles the extended response.

- Q.9**
- (a)** This is the first of the overlap questions. It was attempted by over 90% of candidates but many answers did not gain credit. This is a basic recall question that candidates either knew or did not know.
 - (b)** Again this was a recall question. 80% attempted the question but it was not well answered. Candidates found this question very difficult.
 - (c)**
 - (i)** This was generally well done. Some candidates failed to read the question properly and used letters other than N and n. This cost them a mark immediately. There were still some candidates that used double letters for gametes. This loses both marks straight away.
 - (ii)** A probability was needed here. Many candidates gave a ratio. This did not receive credit. Also, the answer needed to be consistent with the Punnett square. Some candidates seemed to have memorised 25% as an answer, even when this did not correspond to their incorrect Punnett square.
 - (d)** Again this was a recall question. Many candidates could not remember the answers.
- Q.10**
- (a)** Most candidates attempted this question. Many circled the anomalous result correctly. Many correctly worked out the mean. Some included the anomalous point even though it stated in bold not to. Some candidates are still struggling on basic numeracy such as means.
 - (b)** This was the most difficult question on the paper with very few candidates gaining credit. Most answers were about the answer being a decimal. This did not gain credit. The answer that was wanted was that there were not enough quadrats done.
 - (c)** Some candidates understood that they had to multiply their mean by the area of the school field. More than half the candidates did not grasp this concept. Some showed their workings but many did not. This often prevents marks being awarded.
 - (d)** This was another recall question and again it was found to be difficult for most candidates. Only 65% of candidates attempted this question and very few got it correct.

Summary of key points

- Candidates would benefit from reading all parts of all questions very carefully. This would prevent questions being missed and candidates making silly errors such as using the incorrect letters in the Punnett square.
- In numeracy questions it would be advantageous to show all workings. This allows marks to be awarded even if the correct answer has not been obtained.
- When writing about differences, candidates should keep their sentences simple and concise, e.g. viruses have a protein coat and bacteria do not.
- Label lines should touch the structure they are labelling.
- Many candidates seemed to be confused by scientific names of organisms.
- Recall of basic facts has proven to be a weakness for many candidates. Candidates would benefit from more thorough revision.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2022

UNIT 4: BIOLOGY – HIGHER TIER

General Comments

It was good to see so many excellent responses on the QER question with many candidates gaining 5 or 6 marks. The mean mark was in the middle band. The facility factor was one of the highest on the paper.

Marks were lost on some questions because candidates either failed to read the question carefully enough or they did not register an instruction which is written into the question. In question 2(a)(ii) candidates are asked to calculate a mean from a set of data and they were instructed to omit the anomalous result from the calculation. Many candidates lost marks because they included the anomalous result in the calculation.

In question 7(a)(i) candidates were given a formula to use in the calculation of population size. They were instructed to give the answer to the nearest whole number. Many candidates failed to follow this instruction. It is always good practice to re-read a question after the answer has been written. This would help candidates pick up instructions which they have failed to register.

The legibility of handwriting is a problem for some candidates. The script is sometimes extremely difficult to decipher. Such candidates may benefit from the use of a word processor during examinations. The use of a word processor by such learners must be normal practice during school / college lessons and mock examinations before it can be used during external examinations.

Comments on individual questions/sections

- Q.1**
- (a)** Many candidates stated a change in a gene or DNA. However, there were far too many vague answers such as 'a change in something'.
 - (b)** Radiation was the most common correct answer seen. There were many incorrect responses relating to pollution, climate change, temperature and global warming.
 - (c)**
 - (i)** Most candidates gained at least one of the two marks available for the Punnett square. Errors seen included not using gametes from two heterozygotes, introducing completely different letters to represent the alleles and using dihybrid gametes. It was possible to gain the mechanics of the cross mark even if the gametes were incorrect.
 - (ii)** Candidates who gained full marks on the Punnett square usually gained the probability mark. This mark could still be obtained if it correctly matched the contents of the Punnett square. Ratios were not credited.

- (d) (i) Many answered gene therapy and gained the mark. Incorrect answers seen included stem cell treatment and genetic engineering.
 - (ii) Examiners were looking for inhaler or aerosol as an answer. Inhaling, inhalation and breathing-in did not gain credit. By injection was another frequently seen incorrect answer. Many candidates left the question unanswered.
 - (iii) Many candidates struggled with this question. The most commonly seen correct answer related to the temporary nature of the treatment. The ethical nature of the sourcing of the dominant allele did not form part of this question.
- Q.2**
- (a) (i) 15 dandelions was the only acceptable answer here. Other numbers were often circled and answers where no number was circled were also seen.
 - (ii) Candidates were asked to omit the anomalous result in the calculation of the mean. Many candidates failed to follow this instruction. However, one mark was still available if the calculation of the mean was mathematically correct using the anomalous result. If candidates circled the incorrect anomalous result, error carried forward (ecf) was applied so that they could still gain the two marks for the calculation.
 - (b) Candidates found this question very difficult. Very few referred to the use of more quadrats or increasing the number of samples. The most common answer by far related to the mean being a decimal or 'you can't have 0.6 of a dandelion'. Other incorrect responses related to the fact that the results contained an anomaly.
 - (c) Many candidates scored well on this question. Ecf from (a)(ii) was allowed here as was the use of correctly rounded mean values. However, credit could only be given if the mean used came from their answer in (a)(ii).
 - (d) Transect was not well known.
- Q.3**
- (a) (i) Not many candidates gained the full 3 marks here.
 - (ii) Most candidates recognised that 'something was being kept the same' but many failed to refer to the internal environment or internal conditions of the body.
 - (iii) Well answered.
 - (iv) Many knew negative feedback.

- Q.3 (b) (i) I** Candidates found this question difficult with very few gaining the three marks available. The glucose–insulin metabolism was not well understood. Many candidates failed to follow the key and seemed to confuse the graph lines. Some candidates wrote Anwen and Rhys on the graph lines and this seemed to pay dividends. A frequently seen misconception was that Anwen and Rhys drank both glucose and insulin. Examiners were looking for answers that recognised
- the low level of insulin in Anwen's blood
 - the slow fall in her blood glucose level
 - the fact that her blood glucose doesn't fall to the starting level
 - and that her blood glucose level at the start was high.
- Any three of these gained full marks.
Careful observation of the graph shows that statements such as 'Anwen's glucose level is constant' and 'Anwen's insulin level doesn't rise' are incorrect.
- II** Far more candidates answered Type 1 than Type 2. These candidates failed to realise that Type 2 diabetics, like Anwen, produce insulin but that Type 1 diabetics don't produce any.
- (ii)** Many candidates gained at least one mark. Most recognised that insulin was involved in the treatment of diabetics but often failed to answer that it needed to be injected. Insulin administered via an insulin pump is injected via a permanently placed needle. Answers such as 'take insulin' failed to score.
Any reference to diet needed to be specific – low fat / low carbohydrate / low sugar / low calorie.
An answer referring to exercise needed to specify regular or daily. Any reference to oral medication needed to specify the name of the medication.
Answers referring to transplant surgery needed to specify pancreas or pancreatic tissue.
- Q.4 (a) (i)** The only acceptable answer here was 1 : 1 and 1 : 1 and many gained this mark. 33 : 33 and 17 : 17 failed to score.
- (ii)** Many candidates referred to the base pairing correctly and gained one mark. Few gained the mark for referring to the complementary nature of the bases.
- (iii)** Candidates found this question very difficult. Two values are mentioned in question 4 – percentage and ratio. Examiners were looking for an answer which referenced the fact that the ratio of the base pairs would be the same in bananas and strawberries but the percentage of the base pairs would be different.
Most answers incorrectly referred to the DNA in the two species being different.
- (b)** Many candidates referred to three bases or a triplet of bases or a codon and gained one mark. But there was confusion with regard to the involvement of amino acids with many incorrectly stating that the base triplet made amino acids. Correct answers for the second mark needed to refer to amino acids being coded for or arranged in sequence to form a protein.

- Q.5**
- (a)**
 - (i)** Many correctly named phagocyte.
 - (ii)** Quite well answered. Answers such as 'they are ingested', 'killed' or 'die' failed to gain the mark.
 - (b)**
 - (i)** Few candidates gained full marks here. Examiners were looking for answers which referred to the vaccine containing antigens which stimulated the lymphocytes to produce antibodies. Many candidates confuse antibodies and antigens and some think that the antibodies are present in the vaccine.
 - (ii)** Many candidates gained one mark here for recognising that a second or booster vaccine had been given. The second mark was awarded for stating that the disease causing virus may have entered the body. This answer was less often seen.
 - (iii)** Not well known with many different types of cells appearing as an answer.
 - (iv)** Immunity or immune was often seen but unfortunately so were resistant and cured.
 - (c)**
 - (i)** Most candidates recognised a decrease here.
 - (ii)** One mark was awarded for the sketched line extending fully from one vertical axis to the other. Many gained this mark. The second mark was awarded for the shape of the line being reciprocal to the shape of the top of the bar graph. This mark was more rarely seen. The line could appear anywhere within the vertical frame of the chart.

Q.6 Some very good answers were seen here with many gaining five or six marks. Marks were lost for giving insufficient information about the two types of cell division or for giving incorrect information.

Mitosis and meiosis indicative content were occasionally swapped over. In this situation it is often impossible to gain any credit.

Candidates often made statements such as – 'mitosis is 46 chromosomes and meiosis is 23'; 'meiosis occurs in the gametes'; 'meiosis is sexual reproduction and mitosis is asexual reproduction'; 'mitosis is for repair of cells'. Such statements show a lack of understanding and are not creditworthy.

Candidates often refer to daughter cells as being identical or different rather than genetically identical or genetically different.

Candidates should be advised not to answer a QER question by using a table. This question evaluates the Quality of Extended Response and such a response is difficult to demonstrate in a table.

Finally, care should be taken in the spelling of meiosis and mitosis. When they are spelled as 'meiotis' or 'meitosis' it is difficult to award any credit.

- Q.7 (a) (i)** The candidates were instructed to give the answer to the nearest whole number. The correct answer of 25 gained two marks. Otherwise, one mark was awarded for 24.5.
- (ii)** Quite well answered. Ecf from (a)(i) was allowed.
- (iii)** Quite well answered with many candidates gaining at least one of the two marks available.
- (b)** Many good answers were seen here.
No deaths / births were alternative answers as were no Immigration / emigration.

Summary of key points

- In genetics questions candidates must use the letters to represent alleles that they are instructed to use.
- Read the questions carefully and always follow instructions. (See question 2(a)(ii).)
- In graph questions where candidates are given a key to identify the components of the graph it is important that they study the key carefully and follow it precisely.
- If candidates are asked to provide a ratio from given data they must reduce the ratio to its lowest form. Eg $33 : 33 = 1 : 1$. $33 : 33$ would not gain a mark.
- The QER question should not be answered using a table. It is the Quality of Extended Response which is being tested i.e. the quality of writing – grammar, spelling, punctuation etc. It is difficult to express this in a table.
- Candidates must follow given instructions or risk losing marks. (See question 7(a)(i).)

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2022

UNIT 5: CHEMISTRY – FOUNDATION TIER

General Comments

Most candidates found this paper accessible and many made a good attempt at the Foundation Tier only section. This was due to the style of the questions where candidates were given multiple choice answers. Similarly, the PISA-style question was also very well attempted and well answered.

Foundation Tier candidates struggled on the common section, especially on questions where they were required to write descriptions and / or explanations. They also struggled on questions which required direct recall of knowledge.

The mathematical questions on the Foundation Tier were generally well attempted and answered well. However, they struggled with writing chemical formulae, symbol and ionic equations and in questions where they were required to apply the knowledge taught in year 10.

The QER question was better answered than in previous years with far fewer candidates not attempting the question at all.

Comments on individual questions/sections

- Q.1**
- (a)**
- (i)** Most candidates were able to correctly label the locations of at least one of the chemicals entering or leaving the furnace. Many were able to locate two or three. The location of the iron ore (A) and removal of slag (D) were more commonly given than the location of waste gases (B).
 - (ii)** Responses were evenly split between option 1 and option 2. Fewer candidates gave option 3.
 - (iii)** Responses were evenly split between all four option choices.
 - (iv)** Generally well answered, with a majority of candidates identifying the correct diagram.
- (b)**
- (i)** Most candidates were able to correctly match up at least one of the terms to its definition. Many were able to match up two terms; fewer were able to match up all three. The definitions of the anode and electrolysis were the most common correct ones.
 - (ii)** Similarly to part (i), most candidates were able to correctly choose at least one of the terms from the list of options. Many candidates were able to choose two terms; fewer were able to choose all three. Recognising aluminium as being a liquid at the operating temperature was the most common correct response, whereas cryolite lowering the melting point was the least common correct response.

- (iii) The majority of responses were evenly split between 2 and 4. Fewer candidates gave 6.
- Q.2 (a)**
- (i) This was very well answered with nearly all candidates correctly choosing the measuring cylinder and thermometer as the pieces of apparatus to measure the volume of liquid and temperature respectively. The most common incorrect response was to use a beaker instead of a measuring cylinder.
- (ii) This was answered well with the majority of candidates recognising the need to repeat the experiment (or words to that effect). Incorrect responses included reference to fair testing or ensuring the same starting temperature.
- (b)**
- (i) This was generally answered well with the majority of candidates correctly showing how the value of 679 kJ is calculated. Some used the values from the table to show this whereas others listed the bonds from the diagram. A number of candidates overcomplicated the question and went on to do more than was required.
- (ii) This was also generally answered well with many candidates correctly calculating the value of 864 kJ. Some lost a mark for incorrectly calculating the total energy (even though they had correctly listed the bond energies). A number of candidates went on to calculate the overall energy change and were therefore penalised one mark.
- (iii) The majority of candidates were able to correctly match at least one of the descriptions to the letters in the diagram. Fewer candidates were able to match both descriptions. More candidates were able to identify the activation energy (C) than were able to identify the overall energy change (D).
- Q.3 (a)**
- (i) This was generally well answered with the majority of candidates correctly naming oxygen as the gas needed for combustion. Common incorrect responses included carbon dioxide, hydrogen and methane.
- (ii) This was not answered as well as expected and responses were varied. Few candidates correctly identified both X and Y as water and carbon dioxide. Common incorrect responses included limewater for liquid X and methane or oxygen for gas Y.
- (iii) Responses were evenly split between all four options.
- (b)**
- (i) This was generally well attempted with the majority of candidates awarded at least one mark for correctly showing the arrangement of the carbon and hydrogen atoms within a methane molecule. Fewer were able to correctly show the pairing of the electrons between the atoms to gain the second mark.
- (ii) This was answered well with the majority of candidates correctly identifying covalent bonding. The most common incorrect responses were ionic bonding and reference to single bonds.

- (c) This question was poorly answered with very few candidates awarded any marks. Very few candidates correctly identified both errors in the table. Even fewer were able to give a suitable correction for the identified errors. For the chip pan fire – many candidates identified the tea towel as the error rather than the fact that it would remove oxygen. For the bonfire – many candidates correctly identified the fire blanket as the error but went on to say that it would either remove the oxygen or that it would be too small to put out the fire.
- Q.4**
- (a) (i) This was very well answered with nearly all candidates achieving two or three marks. The most common error was incorrectly identifying the second statement as being true.
- (ii) This was well attempted with the majority of candidates awarded one mark for calculating the difference in usage in one year (115 bags). Fewer candidates were awarded the second mark for calculating the difference over five years (575 bags). The most common incorrect response was 125 from for simply multiplying the current usage (25 bags) by 5.
- (b) This was very well attempted and the majority of candidates were able to correctly calculate the number of consumers (81). A minority of candidates were awarded one mark for showing a correct method but making an arithmetic error.
- (c) This was very well answered with the majority of candidates recognising that plastics are non-biodegradable (or words to that effect). Incorrect responses commonly referred to the impact of plastic waste, such as litter and landfill problems, or killing marine life.
- Q.5** This was better attempted than in previous years. Nearly all responses were at least awarded bottom band marks (1-2 marks) for correctly describing the reactions within the table and / or giving the order of reactivity of the metals. The majority of responses were awarded middle band marks of 3 or 4 for correctly describing the reactions within the table and giving the order of reactivity of the metals. Few responses built on this in terms of referencing displacement or explaining in terms of the products formed during the reactions. Very few candidates gave correct equations for the displacement reactions taking place. The most common error was to describe the reactivity of the nitrates rather than the metals themselves – often limiting these responses to bottom band marks.
- Q.6**
- (a) (i) This was not well answered by nearly all candidates. The most common answer was 98%, using both the 4.048 and 4.0 values at 2 hours. This demonstrated that candidates could work out percentages correctly and that the problem was extracting the information from the table. There were also a few candidates who, having carried out the correct calculation, did not give their final answer to the nearest whole number.
- (ii) This was also not well answered by nearly all candidates. Insufficient responses stated that the beads absorb a 'lot of water' or that the beads are 'very absorbent'. They were unable to recall that they absorb 'many times their own volume of water' which is the property described in the specification.

- (b) (i) This was well attempted by the majority of candidates. Most were able to plot the results correctly, however fewer candidates scored the mark for the line of best fit. Some joined their points with a ruler whilst others drew poor quality lines e.g. a line that went well above 8.1 between 10 and 12 hours.
- (ii) This was well attempted by candidates who had attempted to plot the graph. Many candidates were awarded one mark for recognising the difference in absorption of the beads at 10 °C and 40 °C. However, fewer candidates were awarded the second mark for recognising that the bead at 40 °C stops absorbing within 10 hours.
- Q.7** (a) (i) This was attempted by the majority of candidates but poorly answered in general. Whilst many were able to identify substance **A** as magnesium, fewer correctly identified substance **B** as carbon dioxide. The most common incorrect responses saw candidates naming the salts produced during the reactions or hydrogen or water.
- (ii) This was not well answered by nearly all candidates with only a very few giving the correct formulae for both substances. Many named the products instead of giving the formulae and were therefore not awarded any marks. Common incorrect responses were CuCl for copper chloride and KOH instead of H₂O.
- (b) This was attempted by nearly all candidates. Most were awarded one mark for correctly balancing. However, very few were awarded the mark for the formula of sodium carbonate. The most common incorrect responses were NaCO₃, NaCO and NaCl.
- (c) (i) This was not well answered by nearly all candidates. Very few were able to recall the test for a chloride ion, using silver nitrate (as this is year 10 content that carries through to year 11). The most common incorrect responses were 'it fizzes' and 'there is a colour change'.
- (ii) This was attempted by the majority of candidates. However only a minority were awarded the mark. Responses were evenly split between all five options.

Summary of key points

- Understanding chemical formulae and equations are important skills in chemistry and should be practised regularly throughout the course. A total of around 8 marks were awarded for these skills on this paper.
- Basic numerical skills such as addition, subtraction and multiplication and graphical skills are essential. A total of around 11 marks were awarded for these skills on this paper.
- Recalling prior knowledge (AO1) makes up 40% of the marks on this paper. The importance of learning the key facts within each topic should be stressed.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2022

UNIT 5: CHEMISTRY – HIGHER TIER

General Comments

The common questions were generally well attempted and Higher Tier candidates performed better on these than the Foundation Tier candidates.

Similarly to the Foundation Tier, the PISA-style question was also very well attempted and very well answered on the Higher Tier paper.

Whilst the quality of written communication and scientific explanation was better on the Higher Tier paper, many candidates struggled to answer questions where they were required to write descriptions and / or explanations. Many also struggled on questions which required direct recall of knowledge.

The mathematical questions on the Higher Tier were not very well answered in general and, similarly to the Foundation Tier, candidates struggled with writing chemical formulae, symbol and ionic equations and in questions where they were required to apply the basic knowledge taught in year 10.

The QER question was better answered than in previous years with far fewer candidates not attempting the question at all.

Comments on individual questions/sections

- Q.1**
- | | | |
|------------|-------------|--|
| (a) | (i) | This was not well answered by nearly all candidates. The most common answer was 98%, using both the 4.048 and 4.0 values at 2 hours. This demonstrated that candidates could work out percentages correctly and that the problem was extracting the information from the table. There were also a few candidates who, having carried out the correct calculation, did not give their final answer to the nearest whole number. |
| | (ii) | This was not well answered by nearly all candidates. Insufficient responses stated that the beads absorb a 'lot of water' or that the beads are 'very absorbent'. They were unable to recall that they absorb 'many times their own volume of water' which is the property described in the specification. |
| (b) | (i) | This was well attempted by the majority of candidates with many being awarded all four marks. However, there were a significant number who were not awarded the mark for the line of best fit. Some joined their points with a ruler whilst others drew poor quality lines that went above 8.1 between 10 and 12 hours. |

- Q.1 (b) (ii)** This was attempted by nearly all candidates. The majority were awarded one mark for recognising the difference in absorption of the beads at 10 °C and 40 °C. However, fewer candidates were awarded the second mark for recognising that the bead at 40 °C stops absorbing within 10 hours.
- Q.2 (a) (i)** This was attempted by nearly all candidates. The majority were able to identify substance **A** as magnesium, however fewer correctly identified substance **B** as carbon dioxide. The most common incorrect responses saw candidates naming the salts produced during the reactions or hydrogen or water.
- (ii)** This was attempted by nearly all candidates. However, only a minority of responses were awarded two marks for giving the correct formulae for both substances. More candidates gave the correct formula for water than for copper(II) chloride. The most common incorrect responses were CuCl for copper chloride and KOH instead of H₂O.
- (b)** This was attempted by nearly all candidates. Most candidates were awarded one mark for correctly balancing. However, very few were awarded the mark for the formula of sodium carbonate. The most common incorrect responses were NaCO₃, NaCO and NaCl.
- (c) (i)** This was not well answered by nearly all candidates. Very few were able to recall the test for a chloride ion, using silver nitrate (as this is year 10 content that carries through to year 11). The most common incorrect responses were 'it fizzes' and 'there is a colour change'.
- (ii)** This was attempted by all candidates. However only a minority were awarded the mark. Responses were evenly split between all five options.
- Q.3 (a) (i)** This was very well answered by the majority, who correctly identified the type of bonding as ionic.
- (ii)** This was well attempted by nearly all candidates. However few candidates were awarded both marks. Many responses gained one mark for recognising that sodium oxide needed to be melted or dissolved to conduct electricity. However, very few responses made reference to the 'ions' being free to move. The most common incorrect response referred to free or delocalised electrons.
- (b) (i)** This was well attempted by nearly all candidates and well answered in the majority of cases. Many were able to correctly show the bonding between the carbon and fluorine atoms and were awarded two marks. However, there was a significant number of candidates who were only awarded one mark. This was usually for correctly overlapping electron shells but failing to show octets for all atoms. A surprising number of candidates attempted to show ion formation.
- (ii)** This was attempted by nearly all candidates but responses were surprisingly poor considering this question has been asked many times previously. Better candidates were awarded both marks for correctly recognising weak forces between the molecules and that little energy is required to break them. However, common incorrect responses included reference to the covalent bonds between atoms being weak.

- (c) This was attempted by nearly all candidates but was not well answered by the majority. Very few candidates were awarded two marks for correctly recalling the properties of the nanoparticles in both sunscreen and self-cleaning windows. Those for sunscreen were better known. References to protecting the skin and to 'light' rather than UV rays were not credited. No credit was awarded for reference to bacteria being removed from self-cleaning windows.
- Q.4**
- (a)
- (i) This was attempted by nearly all candidates. The majority were awarded one mark for recognising that aluminium is more reactive than iron. Fewer candidates were awarded the second mark for referencing the reduction of iron(III) oxide (or words to that effect). Common unacceptable responses were that the aluminium was more reactive (with no reference to iron), reference to the loss of oxide (rather than oxygen) and that the iron was reduced.
 - (ii) This was attempted by nearly all candidates. However, only a minority were awarded both marks. Nearly all of the candidates who gave the correct formulae of both products were also awarded the mark for balancing. The most common incorrect formulae were Fe_2 and AlO .
 - (iii) This was very well answered by the majority. Where marks were not awarded, candidates had usually incorrectly calculated the M_r for Fe_2O_3 as 72.
- (b)
- (i) This was generally answered well with the majority of candidates able to correctly identify the tests that did not need to be carried out in the dropping tile and explain their choice. Common incorrect responses made reference to the metals having the 'same reactivity' without going on to state that they would therefore not react.
 - (ii) This was not well answered by the majority of candidates who attempted the question. Very few correctly calculated the mass of copper as 0.381 to gain all three marks. A significant number of candidates were awarded one mark for correctly calculating the mass of 2Fe and 3Cu (112 and 190.5). Nearly all candidates who were awarded the second mark went on to give the correct final answer. The majority used the reacting mass method with very few using moles. A significant number of candidates did not attempt the question or had no understanding of the calculation.
- (c)
- (i) This was attempted by the majority of candidates and many were awarded one mark for either balancing the equation or for explaining that oxidation is a loss of electrons. Only a minority were awarded both marks. Incorrect responses usually referred to a gain of electrons or loss of oxygen.
 - (ii)
 - I This was attempted by nearly all candidates but very poorly answered. The most common incorrect responses referred to human error, incomplete reaction or inaccurate weighing.
 - II This was attempted by nearly all candidates but very poorly answered. The most common incorrect response referred to the charge on the electrode not attracting chloride ions.

- Q.5 (a) (i)** This was attempted by nearly all candidates but surprisingly not well done considering that similar questions have been set previously. Only a minority of candidates were awarded both marks for correctly describing the difference in supply and demand of the fractions up to and then beyond C_{16} . Many candidates were awarded one mark for describing the general trend in supply and demand as chain length changes. Responses that failed to reference chain length and both supply and demand gained no credit.
- (ii)**
- I** This was attempted by nearly all candidates with the majority being awarded one mark for either the correct definition of cracking or stating the conditions for the process. Only a minority were awarded both marks. Common incorrect responses included 'separating' rather than splitting or breaking and reference to distillation.
 - II** This was attempted by nearly all candidates and generally well answered. The most common incorrect response was $C_{12}H_{26}$ given when only one ethene molecule was counted.
- (b) (i)** This was attempted by nearly all candidates but generally poorly answered. Responses not credited included reference to 'different formulas' and 'different arrangement of molecules'. Some confused isomers and isotopes.
- (ii)** This was attempted by nearly all candidates and generally well answered. The majority were awarded one mark for correctly giving the structure of the straight-chain isomer (butane). Fewer correctly gave the structure of the branched-chain isomer (methylpropane). The most common response not credited was a bent or 'L-shaped' straight chain rather than the methylpropane structure. Some lost credit for not including the bonds between carbon atoms in their structures.
- Q.6 (a)** This was attempted by nearly all candidates and generally answered very well. Many candidates were awarded both marks for correctly comparing the mass of waste and volume of litter. Common unacceptable responses saw candidates relating both the mass of waste and volume litter to one type of bag, and references to the production of bags, recycling and energy costs.
- (b)** This was attempted by nearly all candidates and very well answered in most cases. Many candidates were awarded full marks for correctly indicating whether each factor supports or opposed the use of paper bags. The factors most commonly put in the wrong bracket were 'carbon footprint generated in production' and 'energy used in recycling'.
- (c)** This was attempted by nearly all candidates, however only a minority of responses were awarded the mark. Whilst many candidates correctly recognised paper as the type of bag, only a few correctly linked atmospheric acidification from the text to acid rain.

- Q.7 (a)** This was better attempted than QER questions in previous years with fewer non-attempts.
Nearly all responses were awarded at least bottom band marks (1-2 marks) for correctly describing the relationship between the volume of acid and the temperature change.
A good number were awarded middle band marks (3-4 marks) for describing the graph and correctly relating the highest temperature to the point of neutralisation.
Only a few candidates were awarded top band marks (5-6 marks) for describing changes in pH as the acid was added before and after the point of neutralisation, as well as explaining the decrease in temperature when the reaction was complete and the acid was in excess.
- (b)** This was attempted by most candidates but not well answered in general. Only a very few were able to recall the ionic equation to show how water is formed. A full symbol equation was given by some candidates but that gained no credit in this case.

Summary of key points

- Understanding chemical formulae and equations are important skills in chemistry and should be practised regularly throughout the course. A total of around 10 marks were awarded for these skills on this paper.
- Mathematical skills, including chemistry specific calculations and graphical skills are essential. A total of around 11 marks were awarded for these skills on this paper.
- Recalling prior knowledge (AO1) makes up 40% of the marks on this paper. The importance of learning the key facts within each topic should be stressed.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2022

UNIT 6: PHYSICS – FOUNDATION TIER

General Comments

Data on this paper shows that there was not one question (or part of) that was attempted by every entrant. In general, the take up with questions was good to very good and performance on some of the standard processes was very good e.g. the graph drawing, basic application of number, interpreting a pie chart and making calculations on data taken from a table. Other aspects were handled poorly, such as suggesting ideas for improving the method of carrying out an experiment, the effect on a pie chart of making one change to the data and identifying energy losses in mechanical systems. Number work was generally well done but the standard of writing from some of the entrants made for difficulty in assessing questions that involved extended prose.

Comments on individual questions/sections

- Q.1** As indicated above, the identification of dependent and independent variables was not well handled and the purpose of allowing a cake case to drop 30 cm or so before timing its fall was not understood. Less than half of the papers showed that entrants knew that an anomalous result should be discounted when calculating a mean from 5 readings but the graph plotting and curved line drawing was well done in part (c)(i).
- Q.2** This question was well done in many cases.
- (a) Roughly two thirds got the answers correct.
 - (b) The success rate in this part was even better.
 - (c) This was well done but in too many answers there was a failure to point out the relevance of the number work, by simply writing $9.1 + 13.9 = 23$ for example.
- Q.3**
- (a) The majority of candidates showed that they could identify the order in which the statements should be given to carry out the experiment.
 - (b) However, they failed to state two improvements that could be made to improve the measurements.
 - (c) The numerical work was well done in the first two parts of (c) but weak use of language and inability to explain themselves cost marks for a significant number of candidates on the last part.
- Q.4** Half marks were gained in general on the QER question showing the overall performance to be at the lower end of the middle band of attainment. There were some good scripts in which the basic motion of the car was described along with data on timings and values of velocity quoted but far too many are ill inclined to spend the necessary time on answering the question fully.

- Q.5**
- (a)**
- (i)** This part was straightforward and was well answered.
 - (ii)** The demand of this part proved to be excessive for many of the entrants. It was sometimes read that the SECTION of the pie chart for radon gas would be smaller for the Mid Wales region than for Cornwall but there were very few that identified the knock-on effect that the size of the other sections would be reduced as a result. The answers in many cases failed to mention that it was the sections of the pie chart that was being considered with statements like “the radon would be smaller” – a fact that was given in the question!
- (b)**
- (i)** This part resulted in low marks, with not many showing that they knew any of the quantities given in the mark scheme would be halved during the half-life of polonium.
 - (ii)** Repeated halving was done correctly by many.
 - (iii)** Stating the numbers of nucleons, neutrons and protons in polonium-210 was not well answered.
- Q.6**
- (a)**
- (i)** The mark scheme shows two approaches that could have been taken in answering this part of the question and the candidates made use of both options to equal effect, depending on whether the work done on lifting a distance of 0.8 m was calculated initially or whether the distance was doubled initially. The answers obtained by both approaches were achieved to good effect with about half marks being awarded over all.
 - (ii)** There was little success achieved, once a move away from pure number work was introduced into the question. In this part all that was required for a single mark was recognition that the gain in PE is equal to the work done in lifting the crate. The physics of the situation was lost on most candidates.
 - (iii)** This part produced very few correct answers showing a failure to recognise the part that friction would have in such a situation.
- (b)**
- This part required a calculation again and was better answered. Around half of the candidates showed that they could find the mass of the 450 N crate and subtract from it the mass of the empty crate, or alternatively, find the weight of the apples, subtract that from 450 N and then convert that to a mass giving 33 kg.

Q.7 With the exception of parts (a)(ii) and (iii), the performance on this question, that was common with the Higher Tier paper, was remarkably encouraging. Having said that, many failed to read the instruction that only information from the table should be used to answer the questions.

- (a) (i) Around a third of candidates failed to recognise the features of negative temperatures, namely that -139 is a higher number than -171 and that Europa was not the answer to the question.
- (ii) A small percentage of answers displayed an understanding that Jupiter is not a star and does not have a significant heat radiation emission but it is the Sun that is responsible for the temperature on Jupiter's moons and they are all (about) the same distance away from the Sun.
- (iii) There was an abject failure to interrogate the table of information to assess any relationship between diameter of the moons and their orbit times in answer to this part. Not many recognised that although Callisto has the longest orbit time, it is Gannymede that has the largest mean diameter of those in the table.
- (iv) The greater demand of part (iv) when compared to part (iii) was overcome by candidates who often showed that they could double the orbit radius of Europa and show that it is not equal to the orbit radius of Gannymede. This part was noticeably better answered than the previous one.
- (b) (i) About half the answers wrongly indicated that a light year is a measurement of time!
- (ii) Roughly half of the answers to the last part were correct, calculating that 1 AU is equal to 150 000 000 km.

Summary of key points

- Candidates should be taught the meaning of command words in questions.
- Candidates should be given to instruction to read the information in questions carefully.
- Rote learning of principles of physics should be undertaken on a regular basis.
- Greater opportunities should be found for candidates to exercise their skills in writing at length, especially in QER type responses.
- Give plenty of opportunities for candidates to interrogate information in tables and to justify claims that are made about the conclusions that are drawn therefrom.
- The consequences of making a change to the data relating to one sector of a pie chart should be considered and exercised.
- Opportunities to develop understanding the relationship between work and energy should be made available to candidates.

SCIENCE (DOUBLE AWARD)

GCSE

Summer 2022

UNIT 6: PHYSICS – HIGHER TIER

General Comments

A large number of blank question parts and weak responses were seen indicating that many candidates were incorrectly entered for the Higher Tier paper. Many candidates showed poor recall of basic facts. In many questions it was evident that candidates had not read the stem of the question or other information presented in diagrams or tables carefully enough. Numerical work was usually better than written responses although in many cases rearranging equations was not correct. The quality of extended writing was often weak.

Comments on individual questions/sections

- Q.1 (a) (i)** Candidates were familiar with the equation and the majority were able to gain credit here for a calculation of work done. However, many failed to recognise that they would have to double the height given in the stem, despite the very clear diagram shown.
- (ii)** In this section candidates were asked to 'state' the gain in potential energy. A straightforward question which only required them to repeat their answer from (i). Few recognised this application of the work - energy relationship and it was rare to see the same answer as previously determined. Many candidates decided to do a calculation despite the command word in the stem.
- (iii)** This was one of the least well answered questions on the paper. The majority of candidates did not consider additional energy transfers and the most common answer was that the box would have to be lifted higher than shown.
- (b)** There were a reasonable number of correct answers here although one would expect almost all Higher Tier candidates to be able to cope with this sort of question. Candidates were required to determine the mass of the crate then subtract the mass of the apples. Many candidates were able to determine the mass of the crate but did not go on to do anything sensible with their answer.
- Q.2 (a) (i)** The majority of candidates were able to identify that Callisto had the highest temperature of the moons given in the table although a small number selected the coldest moon, failing to order the negative numbers. It was surprising to see some candidates give the temperature rather than the name of the moon as requested.
- (ii)** This question was not well understood by candidates and it was rare to award both marks. The idea that these planets are all roughly the same distance from the Sun was not understood.

- Q.2 (a) (iii)** This section required candidates to compare mean diameter and orbit time for the moons in the table. Many answers were too vague to gain credit and did not attempt to make comparisons between Callisto and the others.
- (iv)** This is a familiar style of question and it was well answered by many.
- (b) (i)** Many candidates were unable to identify the correct definition of a light minute, it was quite common to see 'light minute is a unit of time' selected.
- (ii)** Many correct responses were seen here for this simple conversion from AU to m.
- Q.3 (a)** This was a very low scoring section of the paper. Most responses were too vague to gain credit and the instruction to discuss in terms of numbers of particles was ignored by many. Candidates often discussed electrons and outer shells rather than considering the number of protons and neutrons in each nucleus.
- (b)** This was a purely recall based section considering the symbols and description of alpha, beta and gamma radiation. It was evident that most candidates were not secure in their knowledge and few gained all 4 marks.
- Q.4 (a)** This QER question required candidates to consider a velocity-time graph presented on a grid without numbers. The question demanded a comparison of distances and accelerations for the regions shown, which could be simply determined from the gradient and the areas under the line. The majority of responses seen were bottom band or lower middle band. Many candidates' responses were poorly written and lacked any meaningful comparisons.
- (b) (i)** Most were able to state Newton's second law.
- (ii)** Many correct calculations were seen in part I. Candidates however often forgot the $\times 10^5$ factor shown in the column heading of the table. Part II was poorly done. Candidates were given the maximum velocity of the train and asked to calculate the time taken to accelerate from rest to the maximum velocity. In some cases candidates subtracted an acceleration from the velocity to determine change in velocity. Rearranging was often weak and many candidates lost both marks by attempting to rearrange first and then losing the substitution mark by substituting into an incorrect equation.
- (iii)** Candidates were expected to identify that doubling a mass of 2.3×10^5 kg gives 4.6×10^5 kg which is approximately 4.4×10^5 kg. Candidates either missed the word approximately so stated that this was untrue or they didn't complete the numerical doubling and simply stated that it is approximately double. The idea that trains with the same deceleration and maximum velocity will take the same time to stop irrespective of mass was lost on almost all candidates.

- Q.5**
- (a)**
 - (i)** Usually well done but a significant number were unable to calculate the mean correctly.
 - (ii)** Most candidates were able to determine the uncertainty.
 - (iii)** The equation was given so most were able to determine the percentage uncertainty.
 - (b)**
 - (i)** Most candidates were able to make sensible comments here about the accuracy of light gates compared to stopwatches.
 - (ii)** There were a disappointing number of blank responses here. Candidates were required to determine the velocity of the cake cases at 1.60 m and 0.20 m in order to determine and compare kinetic energy values. It was surprising, but not uncommon, to see distances substituted into the kinetic energy equation. Many candidates forgot to square their velocity values.
 - (c)**
 - (i)** Most candidates were able to state that the mean speed increases as drop height increases but few stated that the increase was at a decreasing rate despite the two mark allocation for this question part.
 - (ii)** Those who attempted this were usually correct but it was disappointing to see blank scripts here.
 - (iii)** It was uncommon to see a correct response in I here. Many candidates incorrectly identified the downwards force as gravity rather than weight. More were able to describe that the forces were balanced at terminal speed but this was still not well answered by many.
- Q.6**
- (a)** Not well answered. Many simply repeated the wording from the question and did not really understand the context of monitoring radiation arriving from abroad, clearly stated in the stem.
 - (b)** Many candidates did not attempt this section. Knowledge of how to determine a background count from the apparatus listed was weak.
 - (c)**
 - (i)** In common with previous examinations many candidates have difficulty in clearly expressing the meaning of half-life.
 - (ii)** Again it was disappointing to see a number of candidates not attempting this question although those who did were usually correct.
 - (d)** Half-life calculations often prove problematic for candidates and this was no exception. Many had no idea how to approach this and gained no marks.
 - (e)** Responses here were often too vague to credit with no meaningful comparison of the time taken to reach safe levels or half-lives.

Summary of key points

- Ensure that candidates are familiar with all of the command words in questions.
- Encourage candidates to read questions carefully including information given in diagrams.
- Encourage candidates to read all of the options in the tick list before deciding on the correct response.
- Remind candidates to substitute before they attempt to rearrange equations.
- Remember to show simple numerical proofs when considering claims, even if they seem obvious.
- Provide plenty of opportunity for candidates to complete different types of half-life calculations.



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