



---

# **GCSE EXAMINERS' REPORTS**

---

**SCIENCE - BIOLOGY**

**SUMMER 2016**

Grade boundary information for this subject is available on the WJEC public website at:  
<https://www.wjecservices.co.uk/MarkToUMS/default.aspx?l=en>

### **Online Results Analysis**

WJEC provides information to examination centres via the WJEC secure website. This is restricted to centre staff only. Access is granted to centre staff by the Examinations Officer at the centre.

### **Annual Statistical Report**

The annual Statistical Report (issued in the second half of the Autumn Term) gives overall outcomes of all examinations administered by WJEC.

<b>Unit</b>	<b>Page</b>
Science A: Biology 1 Foundation tier	1
Science A: Biology 1 Higher tier	5
Additional Science: Biology 2 Foundation tier	10
Additional Science: Biology 2 Higher tier	14
Biology: Biology 3 Foundation tier	18
Biology: Biology 3 Higher tier	19
Science A Controlled Assessment	21
Additional Science & Separate Sciences Controlled Assessments	25

# GCSE BIOLOGY

## General Certificate of Secondary Education

Summer 2016

### SCIENCE A: BIOLOGY

#### FOUNDATION TIER

##### General Introduction

Foundation candidates generally perform well on questions or part questions where information is supplied which prompts them to give the correct answer. Candidates are also capable of drawing good quality graphs. Where foundation candidates perform less well is on questions involving recall of information. In many instances there is very little evidence that revision of topics has occurred prior to the examination. Many foundation candidates also struggle to provide sufficient detail in QWC questions for them to be awarded marks in the middle and upper bands.

On this paper many foundation candidates seemed to lack the observational skills required to extract information from charts, diagrams and graphs. Candidates do not spend enough time studying and trying to understand the information and the detail in these illustrations. Developing this skill would reward candidates with a higher overall mark in biology examinations. Question 4(b)(iii), for example, asks candidates to **use the information in the diagram** to answer the question. The vast majority of candidates gave an answer which they could not have obtained from the diagram. This demonstrated, perhaps, that the question was only given a cursory glance before the answer was written.

Phonetic spelling was accepted throughout the paper with the exception of certain technical terms. Examiners expected glycogen to be spelled correctly. Pancrease was not accepted for pancreas because the former spelling indicates an enzyme. This policy is strictly applied so that, for example, Bunson burner would be accepted for Bunsen burner but Busen burner would not.

##### Question specific comments

1. (a) Generally well answered. A few candidates named the group and this was accepted. Some seemed not to understand the meaning of the term magnification and simply answered using the figures from the question.
- (b) Most gained a mark here. The most commonly seen error was to name mosses as a group which caused decay.
- (c) A surprising number of candidates failed to gain the mark here. The use of letters was not accepted, as candidates were asked to name the groups. However error carried forward was allowed for the correct kingdom if the letters B & E were used in the first part of the question. Even if candidates recognized that insects and mammals were in the same group they often failed to correctly state Animal Kingdom.

2. (a) (i) Most candidates gained both marks. If marks were lost it was often because a ballpoint pen had been used and they were unable to erase the lines. Some line graphs were seen.
- (ii) Generally well answered.
- (b) Perhaps just over 50% of the candidates underlined age and gained the mark.
3. (a) Most gained at least one mark. A common error was to state that pesticides 'get rid of' pests or 'keep pests off' the crops. Examiners were looking for kill or destroy. The other mark was awarded for stating that pests eat or damage crops.  
A few candidates thought that pesticides acted as fertilizer and increased crop yield whilst others wrote about bioaccumulation.
- (b) Mostly well answered. The most common error was to give producer as the third answer rather than fertility.
4. (a) (i) Generally well answered although some candidates struggled with the correct answer for **X**. Tripod, clamp, test tube holder and metal rod were frequently seen.  
Test tube was the most common answer for apparatus **Y** and examiners accepted it but would have preferred to have seen boiling tube.
- (ii) Few gained marks for naming 3 pieces of apparatus. A common error here was to state a consumable as the answer, matches and wooden splints were frequently seen. The question asks for three other pieces of apparatus.  
Many different pieces of apparatus were named but in order to gain credit they had to be essential to the investigation. Answers such as measuring jug and measuring beaker were not credited.  
Bunsen and thermometer were frequently incorrectly spelled but if the spelling was phonetically 'correct' then the mark was awarded. This is the case throughout the paper although there are a few words where this rule didn't apply. These will be dealt with later.
- (b) (i) Far too many candidates incorrectly answered 1.8 here. It seems that they divided the increase in temperature per gram of Megan's sweet by the mass of Dafydd's sweet. Candidates were instructed to write the answer in the table. If, however, they left the answer in the space allowed for the calculation then the unit, °C, was required.
- (ii) Very poorly answered. Few candidates realized that this was required in order to make a fair comparison. Commonly seen incorrect answers related to fair testing and accuracy.
- (iii) Fairly well answered although it was disappointing to see that so many candidates failed to observe that, in the diagram, the two burning sweets are held at different distances from the base of the boiling tube.  
The question states – using the information in the diagram - and therefore they cannot give answers relating to the mass of the sweets as this information is not in the diagram. Reference to the mass of the sweets was incorrect and the most common answer seen.  
Very few candidates referred to energy loss.

- (c) (i)&(ii) Both parts were very well answered. Error carried forward from (c)(i) was allowed for the answer to (c)(ii).
- (d) Most answered fat or glycogen and gained the mark.
5. (a) (i) Many candidates gained the mark here. Answers, which failed to score included, muscle, hair muscle and erect muscle.
- (ii) Generally well answered. Most drew a hair emerging from the skin at a suitable angle and attached to the correct end of the muscle. Errors included attaching the hair to the wrong end of the muscle and not attaching the hair to the muscle.
- (iii) Not well answered. Constrict was frequently seen in place of contract, with the latter not often seen. Tense was not accepted.
- (iv) Poorly answered. The trapping of a layer of air was rarely seen, as was a reference to insulation. Most candidates seem to think that the hair traps a layer of warm air or traps heat.
- (b) Only the better candidates gained marks here. Many lost marks because they referred to the function of hair, shivering and sweat in their answers. Observation was also required here, candidates needed to observe that the diagram of the skin on a hot day had a layer of sweat on the surface. Some candidates thought that the sweat gland came onto the skin surface. Only the better candidates mentioned the evaporation of sweat and few referred to **more** sweat being produced on a hot day.
6. (a) (i) Better candidates did well here but many struggled with this question. One mark was awarded for the use of the correct gametes and one mark for getting the mechanics of the cross correct. If letters other than **D** and **d** used then the gametes mark was not awarded but candidates could still gain the mechanics mark if it correctly related to the gametes they had used.
- (ii) Only the better candidates did well here. This question tested the candidates' knowledge of the term 'selfing' and an understanding of a 3:1 ratio. To gain the 'selfing' mark the candidates could choose **any** two of the F1 offspring and 'mate' them together. However, in order to gain the second mark the F2 had to show a 3 purple : 1 white ratio. If the candidate chose to 'mate' two organisms that were not present in the F1 then the gametes mark could not be awarded but, if this gave rise to a 3 purple : 1 white F2 ratio then the mechanics mark was awarded.
- (b) Very poor answered. Examiners were looking for reference to repeatability or to gaining increased confidence in results. These answers were very rarely seen. Most answers incorrectly referred to getting more/better/accurate or reliable results or in order to calculate a mean/average.
- (c) Again very poorly answered. Examiners looked for reference to reproducibility or to being able to verify or confirm results. Most answers incorrectly referred to checking that Mendel's results were correct, true or right or to 'proving' his theories.

7. (a) Many candidates gained the mark for this calculation. However a number of candidates did struggle here. A commonly seen incorrect method was to divide the number of fishermen by the mass of cockles harvested i.e.  $292 \div 129$  rather than  $129 \div 292$ .
- (b) (i) Most candidates struggled to provide an acceptable answer here. Far too many candidates referred to preventing cockles becoming extinct.
- (ii) Terminology often let candidates down here because they referred to restricting the **amount** of fishermen allowed, or the **amount** of cockles harvested. If they had referred to the number of fishermen or the mass (or weight) of cockles harvested then they could have gained the mark. Some also referred to restricting the **number** of cockles harvested without thinking how these would be counted.
- (c) Lots of acceptable answers here and better candidates gained both marks. However many struggled to give such acceptable answers. Lack of care often let candidates down by making reference to  $50 \text{ m}^2$  rather than  $50 / \text{m}^2$ . Also a lack of thought and/or observation let other candidates down by stating that no cockles were harvested between 2000 and 2004 because the ‘tides weren’t suitable’. It may be that these candidates had no understanding of the seas and the tidal cycle.
- (d) Examiners were looking for a comparative answer here, that there were more cockles/ food/ prey or that there was an increase. Only the better candidates gained this mark.  
Throughout this question some candidates referred to cockles as conches, clams or, in the last part, oysters. This is difficult to understand and often makes the awarding of credit difficult.
8. (a) Better candidates did well here gaining at least two of the three marks available. However, very many candidates lacked the knowledge and or understanding to gain the marks.  
Examiners looked for answers which included reference to:
  - glucose entering or being absorbed into the blood
  - the pancreas secreting insulin
  - glucose being converted into glycogen
Candidates failed to gain the second mark if they referred to the pancreas secreting insulin. They also failed to gain credit if glycogen was spelled incorrectly i.e. phonetic spelling was not acceptable.
- (b) Another question testing the powers of observation of the candidates and many failed to score.  
Examiners looked for answers which included reference to the fact that Kate’s blood glucose:
  - is above normal before she eats
  - rises to a **very** high level
  - doesn’t fall back to her starting point
  - is always above normal
Many candidates substituted the word average for the word normal and give answers such as ‘Kate’s blood glucose is above average before she eats’. Any reference to average blood glucose levels failed to score.  
Kate’s blood glucose rising above Peter’s failed to score. The answer required reference to a very high or dangerously high level.  
Many incorrectly stated that Kate’s blood glucose level takes a long time to return to normal. In the graph it **doesn’t** return to normal.

9. Most candidates found it difficult to gain marks in the middle and top bands and far too many gained zero marks. The reasons for this are mainly a lack of knowledge and the inability to put the indicative content into any sort of sequence. There is also a lack of understanding of the term sewage with 'farmers spreading sewage onto their crops' and some candidates substituting the term fertilizer for sewage. Reference to fertilizer was not acceptable. Some candidates confuse questions on eutrophication with ones on bioaccumulation. Common errors included preventing the sun getting through and to bacteria causing disease in fish.

## HIGHER TIER

### General Introduction

Candidates generally performed well on this paper with many gaining over 75% of the marks. Some candidates were let down by their mathematical skills when answering questions 2(a) and 9(a). These two part questions constituted almost 7% of the marks on the paper and candidates needed to read these questions carefully before attempting the calculation.

Questions 3(b) and 5(a) required careful observational skills. Many candidates lost marks on these two questions because they did not spend sufficient time carefully looking at the detail in graph and the chart provided. It was observation of the detail in these illustrations which gained marks for the candidates.

The two QWC questions were generally well answered.

Phonetic spelling was accepted throughout the paper with the exception of certain technical terms. Examiners expected glycogen and species to be spelled correctly. Pancrease was not accepted for pancreas because the former spelling indicates an enzyme. This policy is strictly applied so that, for example, auksin would be accepted for auxin but ausin would not. (These spellings were seen.)

### Question specific comments

1. (a) (i) Generally well answered with many candidates gaining full marks. One mark was awarded for the use of the correct gametes and one mark for getting the mechanics of the cross correct. If letters other than **D** and **d** used then the gametes mark was not awarded but candidates could still gain the mechanics mark if it correctly related to the gametes they had used.
- (ii) Generally well answered. This question tested the candidates' knowledge of the term selfing and an understanding of a 3:1 ratio. To gain the selfing mark the candidates could choose **any** two of the F1 offspring and mate them together. But in order to gain the second mark the F2 had to show a 3 purple : 1 white ratio. If the candidate choose to mate two organisms that were not present in the F1 then the gametes mark could not be awarded but, if this gave rise to a 3 purple : 1 white F2 ratio then the mechanics mark was awarded.
- (b) Very few candidates answered repeatability or to gaining increased confidence in results. Most answers incorrectly referred to getting more/better/accurate results or in order to calculate a mean/average.

- (c) Again very few candidates answered reproducibility or referred to verification. Most answers incorrectly referred to checking that Mendel's results were correct, true or right.
2. (a) Most candidates gained the mark for this calculation. However some candidates struggled here because they divided the number of fishermen by the mass of cockles harvested i.e.  $292 \div 129$  rather than  $129 \div 292$ .
- (b) (i) Many candidates struggled to provide an acceptable answer here. Far too many candidates referred to preventing cockles becoming extinct.
- (ii) Generally well answered, although terminology let some candidates down because, even though the stem of the question refers to mass, they referred to restricting the **amount** of cockles harvested or the **amount** of fishermen allowed. If they had referred to the number of fishermen or the mass (or weight) of cockles harvested then they could have gained the mark. Some also referred to restricting the **number** of cockles harvested without thinking about how these would be counted.
- (c) Lots of acceptable answers here and many candidates gained both marks. However many struggled to give acceptable answers. Lack of care let some candidates down by making reference to  $50 \text{ m}^2$  rather than  $50 / \text{m}^2$ . Also a lack of thought and/or observation let other candidates down by stating that no cockles were harvested between 2000 and 2004 because the 'tides weren't suitable'.
- (d) Generally well answered. Examiners were looking for a comparative answer here, in that there were more cockles/ food/ prey or that there was an increase. Lack of a comparative term meant that some candidates failed to gain the mark.  
Where an organism is named to in a question it is expected that this organism is correctly referred to in the answers. Cockles were often referred to as clams, conches and even oysters. Oystercatchers were occasionally referred to as oysters.
3. (a) Generally well answered. Most candidates gained at least two of the marks available.  
Examiners looked for answers which included reference to:
- glucose entering or being absorbed into the blood
  - the pancreas secreting insulin
  - glucose being converted into glycogen
- There was rarely an explanation for the initial rise in blood sugar levels. Candidates failed to gain the second mark if they referred to the pancrease secreting insulin. They also failed to gain credit if glycogen was spelled incorrectly i.e. phonetic spelling was not acceptable.  
A few candidates missed the point of the question by referring to the effect of exercise on blood glucose levels.

- (b) Generally well answered. This question tested the powers of observation of the candidates.  
Examiners looked for answers which included reference to the fact that Kate's blood glucose:

- is above normal before she eats
- rises to a **very** high level
- doesn't fall back to her starting point
- is always above normal

Some candidates substituted the word average for the word normal and give answers such as 'Kate's blood glucose is above average before she eats'.

Any reference to average blood glucose levels failed to score.

Kate's blood glucose rising above Peter's failed to score. The answer required reference to Kate's blood glucose rising to a very high or dangerously high level.

Many incorrectly stated that Kate's blood glucose level takes a long time to return to normal. In the graph it **doesn't** return to normal.

4. This was well answered by most candidates with some excellent answers seen. There was generally a good understanding of eutrophication. The indicative content most often left out of the account was a reference to nitrates and to the fact that these are absorbed by aquatic plants/algae. This omission excluded these answers from the top band. Also many failed to refer to bacteria/decomposers increasing in number.  
Reference to fertilizer rather than sewage was unacceptable.
5. (a) (i) This was an observation question and those candidates who spent time studying the time-lapse photographs usually scored well. Answers required reference to the shape of the young root together with a reference to time. The only exception to this was an answer stating that the young root got longer. Many candidates referred to the shape or curvature of the young root without referring to time. For example, the young root curves downwards. This answer, of course, only applies from 35 minutes or after 20 minutes. Similarly an answer referring to the young root curving upwards only applies at 8 minutes. An answer stating that the young root is positively gravitropic only applies from 35 minutes or after 20 minutes.
- (ii) Well answered with most stating positively gravitropic (reference to positive geotropism was accepted).
- (b) (i) Only the better candidates gained this mark. Most answers stated that the lower surface of the root grew quicker than the upper surface. This response is difficult to understand.
- (ii) Well answered. Most knew that a hormone was involved in the curvature.
6. Most candidates found all 3 sections of this question difficult with many failing to score.
- (a) There was a lack of understanding here regarding the fact that growing plants absorb nitrates from the soil. Therefore if winter crops are sown earlier in the autumn there will be less fertilizer run-off than if the soil is left bare.

- (b) This question was not understood, because the question was about nitrate fertilizer candidates thought that aeration allowed nitrogen into the soil in order to enhance the nitrogen cycle. Only a very small number of candidates correctly referred to oxygen and the aerobic respiration of decomposers.
- (c) Very poorly answered. Few realized that straw contained proteins. The candidates' knowledge of the conversion of protein to ammonia and ammonia to nitrate is usually very good, but here they couldn't apply this knowledge to this particular scenario. If this question had referred to manure being ploughed into the soil rather than straw then it would have been more successful.
7. (a) Well answered
- (b) Better candidates understood that clones of bananas would show no variation and therefore they would not show resistance to the fungus. Some candidates incorrectly referred to resistance to the pesticide whilst others use the term immunity instead of resistance.
- (c) This was generally well answered with better candidates gaining 3 or all 4 of the marks. Bioaccumulation of pesticide was well understood as was the fact that in top consumers the build up reaches toxic or poisonous levels. The 2 marks that were most frequently missed were firstly for not recognizing that the pesticide enters the river water and secondly for a failure to understanding that the toxic level of pesticide in the caiman affects its fertility rather than directly killing the animal.  
Some candidates thought that the caiman obtained a high level of pesticide in its tissues by eating lots of bananas.  
Again it is expected that answers correctly refer to the organism named in the question. Answers often referred to crocodiles or alligators rather than caiman.
8. (a) Most candidates answered this correctly.
- (b) Most gained this mark. Genetic/DNA/gene profiling were the acceptable answers. Answers which failed to gain credit include genetic analysis, DNA testing and genetic fingerprinting. The teacher's guide to this module states that the term genetic fingerprinting should not be used as it leads to confusion with fingerprinting. However, some candidates still referred to genetic fingerprinting in their answers.
- (c) Most answered species. Correct spelling of the term was required.
- (d) Most gained this mark.
9. (a) Better candidates gained this mark but many struggled with this calculation.
- (b) Most could describe the effect of cystic fibrosis on the lungs.
- (c) Most understood that the donated lungs did not carry the cystic fibrosis or recessive allele. Some answered that the dominant allele is present in the donated lungs and gained the mark. Examiners would have preferred to see reference to the allele for cf rather than the gene for cf.

- (d)
  - (i) Most gained this mark. An answer stating that an asthma pump/inhaler is used, was not credited. However the use of an inhaler/pump **like** an asthma inhaler/pump gained the mark. Many incorrectly referred to sprays and injections.
  - (ii) Most candidates found this question difficult. Better candidates often understood the problem, but found difficulty expressing the answer sufficiently well enough to gain the mark. Examiners were looking for answers showing an understanding of the fact that lung cells, with the introduced alleles, wear out and are replaced by new lung cells carrying the cystic fibrosis alleles.
- (e) Well answered

10. Some excellent answers were seen here with many candidates gaining marks in the top band.
- Marks are most often lost because of a lack of understanding or precision about what is mutating. A mutation occurs, the organism mutates, a gene mutates, are all examples of answers which lack precision and fail to gain credit. In this question it is the gene that makes the cockroaches attracted to sugar that mutates and candidates are expected to understand this. This then gives the mutant cockroaches a selective advantage. This lack of precision now follows through to the part of the indicative content dealing with reproduction and the passing on of the mutated gene to the offspring. The gene is passed on, the mutated gene is passed on, the mutation is passed on, are all examples of answers which lack precision. It's the gene that makes the cockroaches not attracted to sugar that is passed on.
- In this question some candidates referred to the gene mutation making the cockroaches resistant or immune to the pesticide. Any reference to resistance or immunity is incorrect and such answers could not be awarded middle or upper band marks.
- Again in this question candidates are expected to use the name of the organism, given in the question, correctly. Candidates should not abbreviate the name to 'roaches'.

# GCSE BIOLOGY

## General Certificate of Secondary Education

Summer 2016

### ADDITIONAL SCIENCE: BIOLOGY 2

#### FOUNDATION TIER

##### General Introduction

Candidates at both Foundation and Higher Tiers score marks most freely on short answer questions. Most candidates at Foundation Tier are less comfortable at extended writing as was evidenced on these papers, where many candidates appeared to struggle as a result of poor language skills and an insufficient body of knowledge and understanding necessary to achieve middle band on the QWC question. A number of candidates on Higher Tier constructed excellent accounts for one or both QWC questions, though many then included irrelevant information, which limits their score to middle band, potentially denying themselves four marks from the total for the paper.

All candidates should be encouraged to pay careful attention to the study of diagrams, graphs and tables given in questions, which often provide essential information and substantial clues. Candidates should also be encouraged not to use vague terms such as amount or type when writing in a scientific context. These terms are not generally credited. Rather, candidates should seek, where appropriate, to employ a measurable physical parameter such as area or mass, or a specific qualitative term such as species.

##### Question specific comments

1. (a) This section was a comprehension exercise. The answers to parts (i) – (iii) are located directly in or derived from the text. Part (iv) requires an arithmetic calculation from given figures.
  - (i) Most candidates identified the forest as the habitat.
  - (ii) The two answers, agriculture and towns, are located in the key to the map. Many candidates failed to spot this and described activities given in the Fact File below the map.
  - (iii) Most candidates did refer correctly to the map to point out that Kawanga (was less successful) because it was surrounded by agriculture/farms.
  - (iv) It is pleasing that a number of candidates did do the correct arithmetic calculation and provided the correct answer of 650.
- (b) Section 7 (d) of the Specification refers to the role of CITES in protecting endangered species. The answer to the question is also heavily cued in the question. However only a very small proportion of the candidates scored the mark. Almost all answers were too vague (e.g. 'stop trade') or irrelevant.

2. (a) It is pleasing that, at this level, many candidates showed a good knowledge of basic cell structure and function, with no or minimal prompts.
- (i) Generally well done although without being given the actual terms from which to select, spelling becomes an issue for several candidates.
  - (ii) Many candidates recalled the function of the cell membrane, although answers were often spoiled by vague or incomplete answers such as 'decides what enters'.
- (b) (i) Many candidates gained at least one of the two available marks.
3. (a) Many candidates correctly identified the type of cell division and it is pleasing that a large proportion of those candidates gave the correct spelling of mitosis, as is required for the mark. However, very few candidates gave a clearly correct response as to how the diagram shows that mitosis has occurred. Most answers were too vague, such as 'they have the same chromosomes'.
- (b) (i)&(ii) The nature of the reduction division achieved by meiosis remains unknown to most candidates, as is the resulting number of cells that result from one cell dividing by meiosis.  
The term gamete was not frequently seen; sperm and/or egg being more common.
- (c) (i) Almost all candidates added a correct scale to the graph and, as previously reported, most candidates now demonstrate neat and accurate plotting skills.  
Almost all candidates noted that a scattergraph was required, though a few did connect the plots with a line, so losing at least one of the two plotting marks.
- (ii) Almost all candidates correctly interpreted their scattergraph to give the answer 'B'.
4. (a) Many candidates had clearly learned the equation for photosynthesis, scoring both available marks.
- (b) (i) Many candidates failed to score here. Often, only part answers were given, such as 'the rate goes up', but failed to point out the plateau. Those candidates who did identify both phases of the relationship between carbon dioxide concentration and rate, failed to use the graph to identify a particular concentration at which the plateau occurred, or where the rate started to become constant. Quite commonly, there was confusion over cause and effect.
- (ii) Many candidates read the graph correctly and did the maths to provide the answer of 14, for two marks.
- (c) Many candidates recalled that iodine is the chemical used to detect the presence of starch but very few indeed gave the colour *change*. They just stated the expected colour, thus failing to score the second mark.

5. (a) Most candidates are clearly aware that packets of cigarettes now display health warnings, but many answers such as ‘there are pictures’, or ‘you’re told’ were too vague to score, unless the candidate indicated that such warnings were ‘*on the packet*’.
- (b) (i) Many candidates scored the mark for describing the trend between tar content (of cigarettes) and the predicted rates of lung cancer, although a large proportion incorrectly stated that the data were to do with the number of cigarettes smoked, rather than their tar content. Very few candidates indeed noted the large increase in the number of predicted cases of lung cancer at a tar content of 11 mg/cigarette.
- (ii) Many candidates scored here, although some failed to use the comparative ‘higher/go up’, rather than ‘high’. Many other candidates appeared to be confused by the information and gave irrelevant answers.
- (c) Most candidates scored a mark for giving a medical condition associated with smoking cigarettes. However many then failed to secure the second mark because they did not describe the effect on the person, as required by the question. So a typical answer such as ‘emphysema damages the alveoli’ scored one mark but, ‘emphysema causes shortness of breath’ would have scored both.
6. Parts (a) to (d) are a series of single step arithmetical calculations.
- (a) Most candidates gave the correct mean.
- (b) Several candidates were not able to calculate the area of the lawn from the given dimensions, while many failed to give the unit.
- (c) Most candidates used their answers to parts (a) and (b) to calculate the estimated total number of dandelions correctly though quite a few *divided* the area by the mean number.
- (d) Many candidates went on to use the given equation to provide the correct answer.
- (e) Repeating the investigation, or throwing more quadrats were the two most commonly seen acceptable answers as ways to improve the strength of evidence in the investigation. Several candidates incorrectly suggested investigating a larger or different area.
7. Candidates are expected to have knowledge of the experimental investigation of energy release as heat during respiration by germinating peas. Overall, most candidates performed poorly on both parts of the question.
- (a) The question asks candidates to describe the results shown in the results table and to offer an explanation for the findings in **both** flasks. An acceptable answer would be simply to state that the temperature rose in flask **A** (by 7 °C) but stayed the same in flask **B**. Only a minority of candidates gave such a response. Many did give a description of the change in flask **A** but omitted to compare with flask **B**, while many others made references to the flask warming up, without referring at all to the data in the table. Explanations for the results were generally too vague or confused, often hampered by poor literacy. The idea that energy is released as heat during respiration by germinating peas (as stated in the Specification) was seen very rarely indeed. Many candidates seemed not to have had experience of the investigation.
- (b) Few candidates understood the importance of disinfection in this experiment.

8. Knowledge of stem cells is very poorly known at Foundation level. Many struggled to express their ideas.
9. (a) Only a few candidates could recall the Specification statement that there is a need to breakdown large molecules into smaller molecules so they can be absorbed. A common misconception was that large food molecules would block the intestine. The commonly seen statement that 'only small molecules could pass through the intestines' was too ambiguous to gain credit.
- (b) (i) The question was intended to test the ability of candidates to relate the term pH to the data in the graph which refers to acidic/neutral and alkaline solutions and to spot that there was a trend of increasing rate with increasing pH. However, most candidates simply referred to one or more of the bars. Again, use of the comparative was seen only rarely.
- (ii) Very few candidates have knowledge of the role of bile in the digestion of lipids.
10. Candidates at Foundation Tier generally lack the ability to score highly on QWC questions, which call for knowledge, understanding and the construction of a sequential account correctly linking the relevant points. The question presents a side view of the chest cavity before and after inspiration. Candidates were then asked to explain how the movements of the diaphragm and ribcage bring about inspiration. It was hoped that these diagrams would give candidates substantial assistance in constructing their account. There were, in fact, a number of good attempts, worthy of at least middle band. However, these were in the minority. There were two common problems. Many candidates confined themselves to describing differences in the two diagrams, while other accounts confused cause and effect. There is a widespread belief that the diaphragm is pushed down and the ribcage forced out *because* air is entering the lungs. As is usual at this level, terms such as volume, space, room and surface area are used interchangeably. Air is sucked, pulled or drawn in to the lungs, or, more passively, air simply enters the lungs. The idea of a pressure difference pushing or forcing air into the lungs was very rare indeed.

## HIGHER TIER

### General Introduction

Candidates at both Foundation and Higher Tiers score marks most freely on short answer questions. Most candidates at Foundation Tier are less comfortable at extended writing as was evidenced on these papers, where many candidates appeared to struggle as a result of poor language skills and an insufficient body of knowledge and understanding necessary to achieve middle band on the QWC question. A number of candidates on Higher Tier constructed excellent accounts for one or both QWC questions, though many then included irrelevant information, which limits their score to middle band, potentially denying themselves four marks from the total for the paper.

All candidates should be encouraged to pay careful attention to the study of diagrams, graphs and tables given in questions, which often provide essential information and substantial clues. Candidates should also be encouraged not to use vague terms such as amount or type when writing in a scientific context. These terms are not generally credited. Rather, candidates should seek, where appropriate, to employ a measurable physical parameter such as area or mass, or a specific qualitative term such as species.

1. Almost all candidates scored well in this question. Some missed the unit in (b) and others failed to multiply by 100 in part d) which thus gave an illogically low percentage. Invariably, such candidates were uncritically content to write it down as their answer.
2. Candidates are expected to have knowledge of the experimental investigation of energy release as heat during respiration by germinating peas. Overall, performance was better here than on Foundation.
  - (a) Many candidates scored a mark for the description of the results, though many lost out by making reference solely to a gain in heat, rather than a rise in temperature, or by referring to the results in one flask only. Explanations for the results were often vague or confused and very often hampered by poor ability to express ideas. Several candidates invoked bacterial action at this stage either causing the rise in temperature in flask **A** or causing it not to rise in flask **B**. Other candidates appeared to have no knowledge of the investigation. Many however, did score all three marks by stating that energy is released as heat during respiration by germinating peas and that dead peas do not respire. In a few centres, the majority of candidates gave well-written and concise accounts to what is, essentially, a factual recall question.
  - (b) Candidates who understood the investigation generally also recognised the importance of disinfection in this experiment.
3.
  - (a) Knowledge of stem cells is patchy. Examiners were looking for a knowledge that adult stem cells are undifferentiated and that they can turn into a variety of specialised cell types.
  - (b) Some answers focused on possible technical reasons as to why the use of adult stem cells might be preferred to using those from embryos, none of which were thought to be credit worthy. A number of candidates did refer, as expected, to the ethical issues surrounding use of human embryos in medical research or clinical treatment.

- (c) Rather disappointingly, only a few candidates, at either Tier, could identify the shoot and root tips as the two sources of stem cells in plants.
4. (a) Many candidates could recall the Specification statement that there is a need to breakdown large molecules into smaller molecules so they can be absorbed. The commonly seen statement that only small molecules could pass through the intestines was too ambiguous to gain credit.
- (b) (i) The question was intended to test the ability of candidates to relate the term pH to the data in the graph which refers to acidic/neutral and alkaline solutions and spot that there was a trend of increasing rate with increasing pH. However, many candidates simply referred to one or more of the bars, without discussing pH and not necessarily making comparisons so failed to gain credit.
- (ii) Several candidates do have knowledge of the role of bile in the digestion of lipids and there were many concise and cogent answers. Common failings were to assert that bile emulsifies food rather than just lipid and to omit reference to the enzyme, lipase.
5. In order to get beyond low band in QWC questions, candidates have to demonstrate knowledge, understanding and the construction of a sequential account correctly linking at least some of the relevant points.  
As reported for Foundation Tier, there is considerable confusion about how changes in the position of the diaphragm and ribcage bring about inspiration, with explanations often being further hampered by poor written communication, especially an inability to sequence points. However, many partially reasoned accounts were seen that fulfilled the criteria for middle band and, pleasingly, a good number that gave a complete, well reasoned and sequential account, with correct use of appropriate terminology.
- Concise answers are always to be encouraged. They minimise the risk of making spelling and grammatical errors and of straying into irrelevance. A number of otherwise excellent accounts added an irrelevant sentence or two, such as an account of expiration, which reduces a 6 mark answer to 4 marks.
6. (a) The majority of candidates scored both marks for the word equation for photosynthesis.
- (b) This part produced a large number of rambling accounts, often poorly sequenced. Many answers extended well beyond the six response lines provided. A common error was to omit reference to photosynthesis in plant X and/or the lack of photosynthesis in plant Y, limiting the potential score to 2 marks out of 4. Most candidates correctly pointed out that there was a lack of starch in the leaf from plant Y but few gave the correct explanation – that the starch had been (converted to glucose and) used in cell respiration.
7. (a) Almost all candidates recognised the base pairing between A and T, and C and G. Most answers were concise and to the point, though several only gave one pairing as evidence, so failed to secure both marks, while others discussed ‘results’ or ‘numbers’ being similar, rather than mass, so scoring no marks.

- (b) The Specification requires only that candidates know that DNA comprises a long chain of sugar and phosphate molecules connected by bases. Therefore, in (i) it was acceptable to label any structure, or bond, on the outer chain of the DNA, indicating the presence of sugar and phosphate. However, it was necessary to select a single base molecule (i.e. rectangle) for the mark in (ii).
- (c) Most candidates spotted that the relevant base sequence of the defective gene is shorter than that of the normal gene, but not all pointed out that there are three bases (or a triplet) missing. Some candidates are thoroughly acquainted with the role of the triplet code in protein synthesis and many have a knowledge that extends beyond GCSE. Others had only a poor grasp of this topic, confusing the roles of bases, amino acids and proteins. Many wrote loosely about bases producing or making amino acids, for example.
8. (a) This part was generally well done, with most candidates recognizing that Anjum produced a consistently lower concentration of lactic acid than Tudor, and most of those going on to point out that Anjum was able to reduce the lactic acid concentration at a faster rate than Tudor.
- (b) Very few candidates recognised that a marathon runner does not need to release energy quickly (unlike a sprinter) and so can rely on aerobic respiration.
9. (a) (i) Most candidates referred correctly to the graph and pointed out that the volume of *Paramecium caudatum* declines when in solutions of increasing salt concentrations. However, a common error was to refer to decreasing *mass*.
- (ii) This was often well done although many candidates simply stated that the line was steady/straight (at salt solutions of a concentration between 1% and 1.5%) rather than stating that the volume remained constant. Another common error was to state that the volume did not go down, which does not preclude the possibility that it might have gone up and so is an incomplete answer.
- (b) This part revealed that in fact many candidates were in some confusion about the purpose of this investigation. Suggestions as to what should be kept constant in the investigation included starting with the same mass or volume of organisms, maintaining a constant concentration of salt, measuring for the same time and using the same microscope.
- (c) Most candidates spotted the osmosis question, though several invoked active transport. As usual, the quality of explanation varied considerably, with incomplete accounts being common, or provided out of context, with no reference to the given situation.  
A surprisingly large number of candidates thought that *Paramecium* would gain water and burst, thus decreasing its volume. Also quite common was the assertion that osmosis would result in the movement of salt into/out of *Paramecium*.

10. (a) A full answer to this part of the question requires considerable analytical skills. Some candidates did point out that the concentration of the pesticide decreased over time or that the pesticide killed at least some the fish lice. Examiners were looking for an overt reference to the pesticide killing the fish lice, rather than a more general comment about the numbers of fish lice declining. A few candidates went on to point out that it would be necessary to repeat the treatment with pesticide every two weeks which was the main point of the question.
- (b) (i) Most candidates are now familiar with the term 'biological control'.
- (ii) Generally well done, although some answers were regarded as too similar to be separate points (such as, 'won't harm other species, won't become a pest'). Other answers were rather vague, such as 'will it have a disease', rather than 'will it spread disease'. Another common error was to state just one word answers such as 'predators'.
11. A top band answer to this QWC question calls for an articulate, integrated account, correctly linking some of the well-established methods of attempting to protect endangered species of animals *and* plants around the world plus a consideration of legislation to enforce protection. A reference to some of the major organisations and initiatives, such as CITES, WWF, SSSIs and seed banks was expected, together with a short comment on the purpose or methods of each. Several candidates limited their answers to little more than a list of organisations, while many other accounts were too vague, such as 'set up special areas, or stop hunting'. Some raised the idea of captive breeding, although few went on to point out that the aim would be to release the captive bred animals into the wild when conditions permitted. There were many references to the use of biological control, possibly as a result of the theme of the previous question. This was regarded as irrelevant in the context of the question. In most cases, candidates displayed either only a general awareness of the topic, with perhaps one or two vaguely described examples or a much more comprehensive knowledge. There are some candidates who clearly have a detailed knowledge and understanding of this topic and several of these wrote excellent accounts.

# GCSE BIOLOGY

## General Certificate of Secondary Education

Summer 2016

### BIOLOGY 3

#### General

The more able students tend to be entered for the separate sciences. Evidence for this is apparent in their performance on the more demanding questions in both Foundation and Higher tiers. It was pleasing to see some very good answers to the questions which assessed the quality of written communication in the Higher tier. However, the same question on the common section still proves to be a massive hurdle to foundation candidates. Many scored zero and a significant number failed to attempt the question.

Once again, those who had experienced practical work on incubating bacterial cultures using a sterile technique were at an advantage. Those who had not seen the process in a laboratory lost the majority of marks for this question. (Q5 on the Higher paper). Another observation was the general poor performance on the questions requiring knowledge and understanding of plant biology. This was particularly true in question 2 and 9 on the foundation paper but it was also seen in the higher paper in response to questions 4. It seems that most candidates prefer to learn material concerning human biology rather than plant biology.

#### Comments on individual questions

#### FOUNDATION PAPER

The first three questions required knowledge of basic facts. Those candidates who learned these facts did well. Hardly any candidates knew the function of the coronary vessels in 1 (b).

- Q.2 (b) Many did not link the correct elements or compounds with their functions in plant growth.
- Q.3 (a) This question was usually well done but part (b) required the application of knowledge and an appreciation of the ethics of using dead donors for organ transplants. The latter concept was beyond the ability of the majority.
- Q.4 (a) Candidates had the opportunity of demonstrating their mathematical skills. Many were able to do so but often neglected to state millions in the answer. These were given one out of the two available marks. In part (b) research has shown that the skills needed to plot a graph are within the ability range of most candidates who are correctly entered for the foundation tier. The responses to this question confirmed the results of this research. In part (b) (ii), Many could see the relationship between the rise in temperature and the breakdown of phthalates but few made the link between the breakdown and the increase in bacterial growth or enzyme activity with increasing temperature.

- Q.5 Candidates are expected to know and understand the principle of mycoprotein production but the actual diagram given in the question was probably outside the experience of many candidates. Part (a) required basic understanding of the process and discriminated the better candidates. The maths required for (b) (i) was within the ability of most but relatively few could calculate the percentage in part (ii). In part (iii), many did not read the data in the table correctly and did not state that there is no cholesterol in the mycoburger.
- 6 (a) (i) Plasma and one of its functions were usually given as the correct answer. Very often candidates were not accurate enough to gain the mark for measuring in part (ii). In (b) the names of the components of blood were correctly stated and the correct functions were given but in (c) only the minority gained the mark for platelets.
7. (a) (i) I saw no correct answers for the percentage increase in diameter of the pupil in all the papers that I sampled. This two stage calculation is beyond the ability of candidates who have been correctly entered for the foundation tier. A mark was given if the two measurements of the diameters were correct. Most gained this mark. (a) (ii) discriminated those who understood the link between the nerve impulse being sent from the brain to the iris muscle as the effector. Hardly any gained the two marks for this. Very few stated the retina as the answer to (b) (i) but there were more correct answers to (ii).
8. (a) Candidates often recognised that penicillin killed bacteria but none described the diffusion or movement of the penicillin from the paper disc.
- (b) Many correctly used the term, immune, for resistant. (c) The minority stated antibiotic as the answer. Often the term, fungi, was given.
9. Again, those who had been correctly entered for the foundation tier were not able to cope with the two higher level skills need to answer the question. These skills are in a linear memory of a sequential series of facts and the ability to write the facts in continuous prose. Those who had experienced practical work in relation to transpiration had a chance to gain credit. However, even these found it difficult to meet the criteria for the quality of written communication. If candidates had not seen this investigation, they were unable to gain credit.

## HIGHER TIER

- Q.1 Most were able to gain good marks for this question which tested re-call of basic facts. Many scored full marks for this but some could not link the inability of platelets to work with the anti-clotting agent.
- Q.2 (a) The correct answer to the calculation was rarely seen. Almost all candidates gained one mark for the correct measurements of the diameters of the pupils. In part (ii) It was very disappointing to see so few answers which linked the nervous impulse from the brain to the iris muscle. (b) The retina was often given as the correct answer to (b) (i) and most could state a feature of a reflex action in (ii).
- Q.3 The function of penicillin as an antibiotic was well known by most. The majority could recognise that MRSA was resistant to penicillin but some used the incorrect term, immune.

- Q.4 Although the responses to this question were usually better than those of foundation tier candidates, only the potential A and B candidates gained the top band marks. These were able to satisfy the criteria for the quality of written communication. Those who were not appropriately entered for the higher tier were clearly shown up by scoring one or zero for the question.
- Q.5 The main aim of this question was to test knowledge and understanding of the need for aseptic technique in the culture of bacteria. Knowledge of the effects of bacteria on stored food was also needed. Most candidates gained good marks for the whole question.
- Q.6 (a) Those with the necessary maths skills were able to correctly apply them to this problem set in a biological context. The better candidates scored full marks. (b) The given diagram was a more accurate representation of a Bowman's capsule than the over-simplified diagrams shown in many text books. Those who understood how ultrafiltration takes place scored high marks. In part (ii) some candidate seemed to be confused when trying to explain the role of ADH. These often mistakenly stated that ADH caused more dilute urine to be produced.
- Q.7 Answers were generally good. Most could appreciate the semi permeable nature of the membrane. Full marks were common.
- Q.8 This question, requiring re-call, was usually well done. It was the first time that the basic principles of the immune response to a vaccine had been tested in a flow chart. The responses were better than when the topic was tested in questions requiring continuous prose in previous years.
- Q.9 The better candidates had thoroughly revised this topic. It was pleasing to see good answers to (a) and (b). However, the term, effect, was often ignored in part (c) and vague incomplete answers were often given. The effect of a sensation would not be felt if X-X were damaged. Also the effector would not repsons if Y-Y were cut.
- Q.10 The question discriminated the very best from the rest. Good candidates linked the difference in the relative concentrations of oxygen and carbon dioxide in the blood vessels entering and leaving the body organs. They could express themselves with integrated accounts without irrelevant material. Their reasoning was expressed clearly with good spelling and punctuation. For those who were incorrectly entered for the higher tier, their responses were a disaster.

## **SCIENCE: BIOLOGY**

### **General Certificate of Secondary Education**

**Summer 2016**

### **SCIENCE A CONTROLLED ASSESSMENTS**

#### **Overview**

In general, the standard of the candidates' work was similar to the previous year. The candidates were well prepared and understood the controlled assessment system, but the strengths and weaknesses shown throughout the life of the specification remain largely the same. The research task continues to provide problems for a wide range of candidates.

#### **Administration and marking**

In general, samples were submitted on time and were well organised. A significant number of centres were found to be marking their candidates' work too generously. This particularly applied to those at the upper end of the mark range, but sometimes spread across the whole entry. The award of marks in the top band should indicate work of very high quality, both in the understanding of science and the communication of that understanding. Too often, very high marks were being awarded for work that was competent but showed significant weaknesses or omissions. In general, the safety task was the most accurately marked, and the main areas of marker generosity were in the research task. There were a number of instances of clerical errors by centres, but these were rare.

#### **Pupil performance**

Overall the standard appeared to be very similar to that shown in previous years. As always, there was some excellent work submitted, but the average candidates still have a weak understanding of some areas of scientific enquiry, most notably in designing investigations and in judging the strength of evidence. There are still significant gaps in their understanding of how science works in the real world, which were particularly evident in the research task.

#### **RESEARCH TASK - GENERAL ISSUES**

This task proves difficult as it combines the need for both a good understanding of the methods of scientific enquiry and good communication skills. In this task, the necessary communication skills required go further than simple spelling and grammar, although it is obvious that some candidates struggle in these areas. The best work shows a logical structure, an ability to discuss ideas and precise use of language.

The main issues in the research task are as follows.

- When judging strength of evidence, candidates focus far too heavily on the issue of bias. They do not consider the scientific methodology, e.g. sample size, confirmation by other data, significance of differences, the quality of fair testing and variability in results.
- On the issue of bias, candidates do not appreciate that data is usually correct, even in biased sources. The bias lies in the omission of data or information, and in the interpretation of the data.

- Candidates often do not seem to understand the nature and relevance of peer review. They sometimes seem to assume that ‘professional scientists’ are infallible and that media sources (especially the BBC) are inherently accurate and reliable.
- The descriptions of investigations in Part 2 are very often too vague. Candidates will sometimes ignore issues of practicality and ethics. They are far less confident about the design of a scientific study compared to that of a laboratory experiment.

## **PRACTICAL TASK – GENERAL ISSUES**

Several problems listed in previous reports were still very evident this year. They were as follows.

- Candidates do not seem to understand the relationship between variability and repeats. They still often stick to the ‘standard’ 3 repeats, which would hardly ever be enough in a real research situation (but sometimes would be, if there was a *very* high degree of repeatability). Others seem to apply an approach of ‘the more the better’ which is not always either necessary or practical.
- Some candidates erroneously believe that doing more repeats improves repeatability or improves the accuracy of results (as opposed to accuracy of the *mean*, which is improved). Occasionally, a candidate would state (correctly) that doing repeats allows the identification of anomalous results. However, in such a situation, doing just three repeats would give limited evidence for any anomaly.
- Many candidates do not really understand the concept of outliers or anomalous results. They often use the term to refer to results that are unexpected, rather than anomalous. In particular, we saw examples of ‘anomalous’ points that were means. This should rarely happen. If the repeatability of that data set is good, the point is unlikely to be anomalous. If the mean is the result of one anomalous result within the dataset, that result should have been ignored when calculating the mean. Another fault was to pick one result as anomalous when, due to limitations in the number of data points, there were several possibilities depending on where the line of best fit was drawn. On occasions, where a curved line of best fit would have gone close to the points, a straight line was drawn and a point that did not fit it was described as being anomalous.

## **SAFETY TASK – GENERAL ISSUES**

In both packs this task generally produced the best performances and the highest marks, and the quality of the risk assessments is gradually improving. Hazards were sometimes identified without stating their nature. Candidates failed to consider the precise risks brought about by the method used, and resorted to generic and largely irrelevant risks about chemicals splashing into eyes and glassware breaking without any reference to which parts of the method are likely to lead to these events, and how.

## **PACK A – RESEARCH TASK**

### **PART 1**

Most candidates produced reports that contained only relevant material, although sometimes too few sources were used, meaning that relevant material was missed out. The issues around bias, described in the general points above, were particularly evident here, where many of the sources available were from organisations which were clearly in favour or against badger culling.

Candidates seem to expect that a scientific study will always have very clear results, and therefore obvious conclusions. They struggle to draw sensible conclusions in situations like this, where the data is complex and not clear cut, and where badger culling may be appropriate in some circumstances but not in others. Some candidates with high marks gave very clear and balanced conclusions, but these were the exception rather than the rule.

## **PART 2**

Many of the scripts seen gave very vague descriptions of the proposed methodology. For example, often there was no mention of standardising the dosage given to any test groups. A number of candidates (possibly with Jenner in mind) suggested deliberately infecting cattle with bovine TB. Ethically, this could be considered acceptable in a very small trial, but not when using hundreds of cattle from farmers' herds. Such obviously unethical or impractical designs should not be credited.

## **PACK A – PRACTICAL TASK**

### **PART 1**

There were relatively few specific issues with this practical task, apart from poor lines of best fit being drawn in some cases.

### **PART 2**

No real issues with this part of the task, which was done well in many cases.

## **PACK A - SAFETY TASK**

The only issues around this task were some weak risk assessments where the nature of the hazard and/or the action in the experiment which would lead to a risk were not defined. Some candidates ignored the message on the video and included repeats as an improvement (lack of repeat data was relevant in relation to strength of evidence, but not in relation to improvements).

## **PACK B – RESEARCH TASK**

### **PART 1**

The difficulty in this task was the lack of data on the topic. Nevertheless, many candidates still came to firm conclusions despite the fact that there is no clear justification either way at the moment given the lack of information. Their 'conclusions' were basically just gut feelings, which could not be justified scientifically.

### **PART 2**

Once again the descriptions of the proposed study were very vague in many cases. Quite a number of candidates proposed deliberately exposing people to various levels of nanoparticles and seeing if they developed health conditions, which is clearly unethical and cannot be credited as a valid method.

## **PACK B - PRACTICAL TASK**

### **PART 1**

No specific issues with this part.

## **PART 2**

Many candidates misinterpreted the hypothesis, which was, “the smaller the volume of a *filled* can of water, the faster it cools down”. They suggested using different volumes of water in a can of standard volume, rather than using filled cans of different volumes. Where this occurred, the centre marking often failed to pick this up. The overall effect of such a mistake was minimal, however, provided the candidate went on to design an experiment which fitted with their own idea of the hypothesis.

### **PACK B – SAFETY TASK**

The quality of risk assessments was once again variable, but the main issue was that the candidates failed to appreciate that the experiment *was* repeated (each seed, if effect, being an experiment). Therefore, lack of repeats was not relevant either in dealing with the strength of evidence or with improvements.

## SCIENCE: BIOLOGY

### General Certificate of Secondary Education

Summer 2016

#### ADDITIONAL SCIENCE & SEPARATE SCIENCES CONTROLLED ASSESSMENTS

##### Overview

This year's controlled assessment samples were similar in quality to those of previous years. Candidates now have a better understanding of the structure of the assessment and know what they ought to include but, perhaps unexpectedly, there are still significant gaps in their understanding of scientific methodology when considering the sample as a whole.

This report covers both the Additional Science and Separate Sciences investigations, as the structures of the schemes are identical and the Additional Science investigations could also be used for Separate Biology, Chemistry or Physics.

##### Administration and marking

In general, samples were submitted on time and were well organised, with helpful annotation.

The quality of marking by centres was generally good, and consistency of marking within centres has improved over the years, indicating good quality internal moderation. Where errors occurred, these generally involved over-generous marking, particularly for candidates at the top end of the mark range.

Where marking was inaccurate, it generally related to a failure to penalise candidates for the types of fault listed in the *Pupil Performance* section, below.

##### Pupil performance

The sections below indicate common faults that occurred in the different investigations. Certain things, however, occurred in all of the investigations, such as:

- Poor explanation of the scientific knowledge used to inform the hypothesis (even amongst the more able candidates).
- Failure to properly relate numbers of repeats to the repeatability shown in the practice work.
- Mis-identification of 'anomalous' results. Results which are generally consistent yet have anomalies are actually rare, and candidates should appreciate this. It is particularly unlikely for a mean result to be anomalous. If the mean is calculated from a set of data that has good repeatability, this suggests that it is not anomalous. If the mean has been influenced by one genuinely anomalous result, that result should have been ignored when calculating the mean. Candidates also refer to results as anomalous when they actually mean 'unexpected'.

- Lines of best fit drawn inaccurately, or when the data points did not provide enough information to judge the appropriate position. Sometimes, the line was also too thick or 'fuzzy' to be fit for purpose.
- Candidates tend to be too focussed on drawing straight lines of best fit. A number of examples were seen where the points clearly formed a curve, yet a straight (and therefore inappropriate) line of best fit was drawn, and sometimes the candidate went on to indicate that the points that did not fit the straight line were anomalous.
- Underlying the last point is a basic misunderstanding of scientific methodology, which is also sometimes evident in the conclusion. Candidates seem to regard experiments as a justification of their hypothesis, not a test. They work on the basis that the hypothesis is correct, and twist the presentation and analysis of their data to fit their pre-conceived idea.
- The erroneous belief that doing more repeats improves repeatability or the accuracy of *results* (only the mean is more accurate).
- Unscientific use of the term 'accuracy/accurate' unrelated to measurements. Also, confusion between accuracy and fair testing. When candidates refer to an experiment as accurate, it often seems to mean 'free of problems' or 'generally okay'.

## **BIOLOGY INVESTIGATIONS**

### **CATALASE**

This was a fairly standard enzyme experiment, and the only common specific issue was that candidates sometimes omitted to relate the theory to the factor that they were actually investigating, i.e. the rise of the paper discs. In both their hypothesis and conclusion, they dealt with the action of the variable on the enzyme, but did not go on to explain why that would affect the rising of the discs.

### **PHOTOSYNTHESIS**

Relatively few centres used this investigation, and so it is difficult to make any generalised statements about candidate performance.

## **CHEMISTRY INVESTIGATIONS**

### **MAGNESIUM AND HYDROCHLORIC ACID**

The only recurring issue with this investigation was the plotting of a straight line of best fit when the candidate's data clearly showed that a curved line was more appropriate from the data.

### **NEUTRALISATION**

This was done less frequently than the other investigation. The theory behind the hypothesis was sometimes poorly explained, but otherwise there were no specific issues.

## **PHYSICS INVESTIGATIONS**

### **PAPER CAKE CASES**

This was a very straightforward investigation to do. It was done by many centres for Additional Science, and almost exclusively for Physics. The main problem for candidates was the scientific explanation of the effect of their chosen variable on the drop time.

### **REFRACTION**

This investigation was hardly seen during moderation and no general comment on candidate performance can be made.



WJEC  
245 Western Avenue  
Cardiff CF5 2YX  
Tel No 029 2026 5000  
Fax 029 2057 5994  
E-mail: [exams@wjec.co.uk](mailto:exams@wjec.co.uk)  
website: [www.wjec.co.uk](http://www.wjec.co.uk)