GCSE EXAMINERS' REPORTS

**GCSE (NEW)
APPLIED SCIENCE (DOUBLE AWARD)**

SUMMER 2019

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APPLIED SCIENCE (DOUBLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 1 FOUNDATION TIER

General Comments

This is the third year that this paper has been available. There were over 2220 entries for this tier paper. The majority of candidates sat this paper through the medium of English (1850) compared to Welsh (375).

Most of the candidates attempted every question. Question 1, 2 & 3 had the highest attempt rate at over 97%, no question had a 100% attempt rate. Question 1 had the highest mean mark of 7.4 out of 13 marks and the highest facility factor at 56.8. Question 7 had the lowest mean of 0.8, lowest attempt rate at 80% and the lowest facility factor of 9.6.

Question 6 and 7 were common to the higher tier paper.

Comments on individual questions/sections

Q1. Mean mark 7.4/13. The attempt rate for this question was 99.8%.

(a) The majority of the candidates scored well on this first question, correctly identifying the 3 pieces of evidence that supported Wegner's theory.

(b) In part (i) most candidates were able to plot the graph using the data given and gain the two plotting marks. Many candidates lost one mark on drawing the suitable line. A straight line should be drawn with a ruler between the points plotted. For part (ii) and (iii) most candidates were able to read off the graph and describe the trend shown gaining the marks available.

(c) Most candidates chose the correct terms from the list of words to describe how tectonic plates move.

(d) Nearly all candidates could name at least one natural disaster and so gained some marks here.

Q2. Mean mark 2.0/8. The attempt rate for this question was 97.4 %.

(a) Most candidates were able to identify the correct type of heat transfer shown by the experiments.

(b) In the table of the results the mean was usually correctly calculated and the anomalous results identified.

(c) Most candidates were able to use the results of the experiment and place the metals in order from the 'best' metal for transferring heat to the 'worst' metal.

(d) It was rare to award the 3 marks here. Many candidates failed to explain why the experiment showed heat transfer by radiation. If candidates gained any marks it was for describing that conduction was not occurring as there was no contact between the plates and the heater.

Q3. Mean mark 3.9/16. The attempt rate for this question was 98.7 %.

(a) Most candidates could place most of the water treatment steps in the correct order and gained the 3 marks available here.

(b) In this QER question very few candidates were awarded marks in the middle band. Those candidates who were awarded marks in the lower band simply described some of the main principles of the experiment, including adding a mass of salt and changing the temperature. Many candidates did not attempt this part of the question.

(c) Candidates usually gained credit for identifying the most soluble salt however in part (ii) many candidates failed to read off the graph and then calculate the difference in solubility between the two salts. In part (iii) most candidates recognised that the solubility of potassium nitrate increased with temperature and sodium sulfate decreased and therefore gained 2 of the 3 marks available.

(d) To gain the marks in this part of the question candidates needed to use the data in the table and solubility graph for potassium nitrate. Only a few candidates managed to answer this correctly using the data from the graph to explain that the technician was incorrect.

Q4. Mean mark 1.7/7. The attempt rate for this question was 91.5 %.

(a) Many candidates seemed to miss part (i) and did not label the circuit. If a candidate attempted this part, they usually gained at least one mark for labelling the ammeter correctly. In part (ii) most candidates could use the equation to calculate the current. In part (iii) the candidates needed to use the data in the table to explain that Dafydd's claim was incorrect.

(b) Many candidates managed to choose the correct term from the choice.

Q5. Mean mark 3.4 /12. The attempt rate for this question was 92.9 %.

(a) The majority of candidates were able to label at least one part of the blast furnace correctly.

(b) When completing the table most candidates could give the correct chemical formula for carbon and identified the type of material.

(c) Only a few candidates could balance and then complete the chemical equations for the extraction of iron.

(d) In this part of the question most candidates could use the information in the table to calculate the cost of iron ore and total cost to produce one tonne of iron. If a candidate incorrectly calculated the cost of iron ore an error carried forward mark was given for the total cost.

(e) Only a few candidates recognised that aluminium was more reactive than carbon and so its ore could not be reduced in a blast furnace.

Q6. Mean mark 2.0 /11. The attempt rate for this question was 89.9 %.
This question was common with the higher tier paper.

    (a) Many of the candidates could select the appropriate information and calculate the payback time of the biogas generator gaining all 3 marks available.

    (b) Nearly all the candidates could give at least one disadvantage to using wind power.

    (c) Many candidates could not select the correct data from the stem of the question and use the efficiency equation.

    (d) In this calculation there were a number of ways to show the farmer was incorrect in his assumption. Many candidates could show that the farmer did not have enough cows or that the energy produced by his cows would not provide enough power to satisfy his needs. Some marks were gained by candidates for correctly calculating the mass of waste and/or energy produced per cow.

Q7. Mean mark 0.8 /8 The attempt rate for this question was 80.0 %. This question was common with the higher tier paper.

    (a) Most of the candidates could not use the equations given to calculate the volume and surface area of different cubes.

    (b) Very few candidates gained marks in this part of the question. Candidates could not explain that Sarah was incorrect. The rate of diffusion is the same for all the cubes and the times relate to the fact that the acid must diffuse further and so the time is greater.

    (c) It was rare to see a candidate that could explain why the surface area:volume ratio makes red blood cells suitable for their function. Candidates gained one mark for quoting the ratio given, approximately 3:2. It was very rare to see this developed as to allow the red blood cell a faster rate and so allow faster gas exchange.

Summary of key points

Many candidates continue to lack scientific literacy and often it is clear from the answers given that the candidate has not read the question carefully.

In this paper candidates found the following topics challenging; describing how to determine the solubility of a salt, using equations to calculate efficiency and the power output, diffusion of substances into a cell.

Candidates continue to find the following difficult:
- Applying knowledge and understanding to novel situations.
- Using equations and substituting values correctly.
- Reading the questions carefully and extracting the most relevant parts.
- Drawing a straight line with a ruler.

APPLIED SCIENCE (DOUBLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 1 HIGHER TIER

General Comments

This is the third year that this paper has been available. There were only 123 entries for this higher tier paper. The majority of candidates sat this paper through the medium of English (88) compared to Welsh (35).

Most of the candidates attempted every question. Question 4 had the lowest attempt rate of 95.1%. All the other questions had attempt rates of over 97%. Question 1 had the highest mean mark of 4.6 out of 11 marks and the highest facility factor of 41.9. Question 7 had the lowest mean of 1.5 and lowest facility factor of 9.6.

Question 1 and 2 were common to the foundation tier paper.

As stated in previous reports, a significant number of the candidates found the paper challenging and would be better suited to the foundation tier.

Comments on individual questions/sections

Q1. Mean mark 4.6 /11. 100 % of candidates answered this question which was common with the foundation tier paper.

    (a) Many of the candidates could select the appropriate information and calculate the payback time of the biogas generator gaining all 3 marks available.

    (b) Nearly all the candidates could give at least one disadvantage of using wind power.

    (c) Many candidates could not select the correct data from the stem of the question and use the efficiency equation.

    (d) In this calculation there were several ways to show the farmer was incorrect in his assumption. Many candidates could show that the farmer did not have enough cows or that the energy produced by his cows would not provide enough power to satisfy his needs. Some marks were gained by candidates for correctly calculating the mass of waste and/or energy produced per cow.

Q2. Mean mark 2.2 /8. 97.6 % of candidates answered this question which was common with the foundation tier paper.

    (a) Most of the candidates could use the equations given to calculate the volume and surface area of different cubes.

(b) Very few candidates gained marks in this part of the question. Candidates could not explain that Sarah was incorrect. The rate of diffusion is the same for all the cubes and the times relate to the fact that the acid must diffuse further and so the time is greater.

(c) It was rare to see a candidate that could explain why the surface area:volume ratio makes red blood cells suitable for their function. Candidates gained one mark for quoting the ratio given, approximately 3:2. It was very rare to see this developed as to allow the red blood cell a faster rate and so allow faster gas exchange.

Q3. Mean mark 4.2 /11. The attempt rate for this question was 98.4%.

(a) In part (i) most of the candidates gained at least one mark here for describing at least one piece of evidence to support Wegner's hypothesis. In part (ii) only a few candidates gained the 3 marks available here. Many stated that the tectonic plates move but few gave further explanation of why.

(b) In part (i) only a few candidates labelled the map correctly however in part (ii) a number of candidates could correctly describe the difference between destructive and constructive boundaries with suitable consequences of their movement.

Q4. Mean mark 2.4 /11. 95.1% of candidates answered this question.

(a) Only some candidates were able to correctly describe the purpose of haematite and limestone in the blast furnace.

(b) Only a few candidates were able to complete the balanced symbol equation in part (i). In part (ii) it was very rare to see the candidates correctly identify the substances that were reduced or oxidized.

(c) Only some candidates were able to calculate the monthly raw material cost using the information given in the table and gain the 3 marks available. 2 marks were awarded if the candidate just used the cost per tonne as a basis for their calculation.

Q5. Mean mark 2.1 /6. The attempt rate for this question was 98.4%.

(a) In this QER question many of the candidates described some of the trends/changes shown on the graph without linking the types of respiration, aerobic and anaerobic. This limited them to the 1-2 marks. Only a few candidates described the graph linking the type of respiration occurring at each stage. Very few candidates were awarded marks in the top band.

Q6. Mean mark 3.5/12. 99.2% of candidates answered this question.

(a) Only a few candidates were able to explain how digestion provides nutrition. In part (ii) a number of candidates could describe the process of peristalsis.

(b)   In part **(i)** many of the candidates could use the information on the graph to describe the effect of temperature on an enzyme (the rate of digestion increases and decreases), however in nearly all the candidates' work there was little explanation of why this occurred. In part **(ii)** many candidates recognized that the enzyme could be different or denatured and in part **(iii)** it was very rare to see the correct control stated for this experiment. In part **(iv)** candidates could describe some of the differences between the enzymes but again it was rare to give more than 1 mark.

Q7.   Mean mark 1.5/16. 99.2% of candidates answered this question.

(a)   Very few candidates were able to sketch on the graph how the resistance of a thermistor changes with temperature. In part (ii) many of the candidates could simply describe the changes in ammeter and voltage readings. It was very rare to see a complete explanation referring to the voltage across R and the thermistor's resistance.

(b)   Some candidates could state the independent and dependent variable from the information given. In part (ii) it was very rare to see candidates use the given equations to calculate the ammeter and voltmeter reading. If the candidate did not perform a conversion only 1 mark was lost. In part (iv) it was very rare to see any correct responses. Candidates found this very challenging and could not describe the suitable modifications that would be needed to investigate the I-V characteristics of the LDR.

Summary of key points

The candidates still do not demonstrate scientific literacy and many of the candidates still find it difficult to distinguish between the terms 'describe' and 'explain'.
Candidates also found the following areas quite difficult; extraction of iron in a blast furnace, respiration and investigation of the properties of an LDR.

Candidates continue to find the following difficult:

• Applying knowledge and understanding to novel situations.
• Using equations and substituting values correctly.
• Reading the questions carefully and extracting the most relevant parts.
• Giving clear explanations.

Completing past papers as a revision tool is essential and centres should be encouraged to use the WJEC past paper section and the OER's available on the website.

APPLIED SCIENCE (DOUBLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 2 FOUNDATION TIER

General Comments

There were about 2 100 entries for this tier paper, similar to last year. Not one question was attempted by 100% of candidates. Most questions were attempted by 92% upwards except for question 4 (QER).

Candidates appeared to interact better with the information in the pre-release article on question 7 than the common question 8.

Candidates did well when using physics equations and graph plotting in question 6.
Four topics were not applied very well in the context given in the paper. These were drug treatments, use of quadrats, vaccines, and the em spectrum used for images of parts of the Universe.

There is more information provided on the exam paper but there is an additional 15 minutes allowed for reading time. There is plenty of evidence to suggest that not all candidates used this to their advantage. Schools need to further develop the scientific literacy of their learners. They need to be able to evaluate which information is required for a question part.

Candidates had difficulty in:

- applying knowledge and understanding to novel situations.
- reading questions carefully so consequently often miss information contained within the question.
- interpreting some of the data.
- giving clear explanations

Comments on individual questions/sections

Q.1   Mean mark – 2.3

    (a)   (i)&(ii)

        More candidates were able to identify the herbivore than the producer.

        (iii)   Most candidates earned at least 1 mark here for stating the effects on the food web.

    (b)   Few candidates could describe the effects of bioaccumulation.

Q.2   Mean mark – 1.6

    (a)   (i)   Most candidates earned their marks in this part of the question for stating animal testing and/or human testing.

(ii) A minority of candidates stated that drug testing could be harmful to gain 1 mark.

(b) The uses and harmful side effects of aspirin were not known.

Q.3 **Mean mark** – 1.5

(a) **(i) & (ii)**

Most marks were awarded for correct answers to parts (i) and (ii).

(iii) Candidates were unsure how to complete the calculation. Some used the total number of snails of species C rather than the mean, others subtracted numbers from 15.

(iv) Few candidates stated that more quadrat samples should be taken.

(b) Few correct responses seen.

Q.4 **Mean mark** – 0.9

Over 50% of candidates failed to attempt this QER question. It was anticipated that responses would at least include the names of the regions of the em spectrum but this was not the case. A minority of candidates could name all 7 regions and even less could continue to describe the types of images that could be obtained.

As a result most marks awarded were in the bottom band or below and more likely to be 1 than 2.

Strangely, it was clear that some candidates did not realise that a new question had started because they continued to write about snails.

Q.5 **Mean mark** – 2.0

(a) **(i)** Few candidates ticked any correct boxes.

(ii) Candidates failed to recognise the flu virus mutates.

(b) A few excellent responses were seen. Most candidates did not understand the significance of the dark circles around each disc. These were mistaken for regions of bacterial colonies.

Q.6 **Mean mark** – 7.4
Candidates generally obtained at least a third of their marks on this question.

(a) **(i)** Nearly all candidates gained 2 marks for their calculations.

(ii) Candidates were able to identify the anomalous result but then made mistakes when calculating the mean. Some candidates included the anomaly in their calculation while others multiplied the remaining times and then divided by 4.

(iii) An ecf for the answer in part **(ii)** was allowed and as a result mostly correct answers were seen.

(b) (i) Very few candidates could identify variables that needed to be controlled.

(ii) Most candidates plotted the points accurately. Not all managed to draw a straight line of best fit for 3 reasons:
- all points off the line lay on one side
- the line failed to go through the origin
- a series of point to point lines were drawn.

(iii) Most candidates could read from their graph to find the required acceleration.

(c) (i) Even with a list of labels to choose from, labelling of the diagram was poor with most candidates scoring 1 mark.

(ii) The correct type of break was usually underlined.

Section B

The following questions were based on the pre-release material. Candidates should be familiar with its contents and should have interacted with it by the time they sit the exam. It is meant to provide a teaching resource upon which questions will be based. An obvious learner task would be for them to come up with their own questions based on its contents together with their own marking scheme. It is disappointing that 97% attempted question 7 and 94% attempted question 8.

Past Science B pre-release articles and associated questions are available on the WJEC website and are useful teaching resources.

Q.7   Mean mark – 2.6

(a) Most candidates achieved both marks in this part.

(b) (i) Mostly correct answers seen.

(ii) A minority of candidates came up with an acceptable reason.

(iii) Very rare that a mark was awarded.

Q.8   Mean mark – 3.9

(a) **(i)** A minority of candidates calculated the correct number of units. Some added the volumes of the drinks.

(ii) A few candidates were able to determine whether it would be safe to drive. Others could not work out how many hours elapse between 11pm and 1pm.

(b) **(i)** A few candidates recognised that the packs of cereal were different masses, but they could not explain why this would be a problem when comparing them.

(ii) This part was not answered very well.

(c) It was rare to see a correct calculation. Errors were made in calculating the BER and EER although if they could be added together correctly then under ecf allowance a mark was gained.

(d) **(i)** The correct answer was seen occasionally.

(ii) This was not answered well. Candidates should have been able to reach a conclusion by looking at the data in figure 7. Alternatively, the equation for BMI given on page 6 of the resource booklet clearly shows that the statement is true. It is unlikely candidates could recognise the relationships between quantities in an equation.

(iii) Less than half of candidates calculated the correct value for the BMI. Others failed to square the height.

(e) **(i)** A minority of candidates completed Punnett squares correctly. Others wrote incorrect parental alleles into the square, a few wrote pairs of alleles in each parental box and some only showed 1 allele in each of the cross boxes.

(ii) The answer needed to be consistent with the results of the Punnett square for any credit to be awarded and this usually was not the case.

Summary of key points

Recommendations

- Encourage candidates to read each question part carefully.
- Use assessment for learning methods to develop candidates' skills in producing and assessing each other's explanations of scientific theory.
- Provide further practice in graph plotting, in particular drawing best fit lines.
- Provide more examples where candidates decide the relationship between quantities in an equation e.g. proportional or inversely proportional.
- Provide further opportunities for candidates to work through calculations especially selecting values to be substituted into equations.
- Provide further practice in identifying anomalies and calculations of mean values.

General Comments

There were 106 entries for this tier paper. A significant number of candidates found the demands of the paper too difficult and hence scored low total marks. These would have been better suited to the foundation tier paper.

Candidates appeared to interact well with most of the information in the pre-release article. Four topics were not applied very well in the context given in the paper. These were use of quadrats, vaccines, nitrogen cycle and evidence for the origin of the Universe.

There is more information provided on the exam paper but there is an additional 15 minutes allowed for reading time. There is plenty of evidence to suggest that not all candidates used this to their advantage. Schools need to further develop the scientific literacy of their learners. They need to be able to evaluate which information is required for a question part.

Candidates had difficulty in:

* applying knowledge and understanding to novel situations.
* reading questions carefully so consequently often miss information contained within the question.
* interpreting some of the data.
* giving clear explanations.

Comments on individual questions/sections

Section A

The following questions were based on the pre-release material. Candidates should be familiar with its contents and have interacted with it by the time they sit the exam. It is meant to provide a teaching resource upon which questions will be based. An obvious learner task would be for them to come up with their own questions based on its contents together with their own marking scheme. It is pleasing that 99% attempted question 1 and 100% attempted question 2. For a significant percentage of candidates, marks achieved in question 1 contributed approximately 40% of their total mark for the paper. Past Science B pre-release articles and associated questions are available on the WJEC website and are useful teaching resources.

Q.1 **Mean mark** – 10

    (a) **(i)** Most candidates calculated the correct number of units.

        (ii) The majority of candidates were able to determine whether it would be safe to drive. Others could not work out how many hours elapse between 11pm and 1pm.

    (b) **(i)** Most candidates recognised that the packs of cereal were different masses, but they could not explain why this would be a problem when comparing them.

(ii) This part was not answered very well.

(c) Most calculations were correct.

(d) **(i)** Nearly everyone gave the correct answer.

(ii) This was not answered well. Candidates should have been able to reach a conclusion by looking at the data in figure 7. Alternatively, the equation for BMI given on page 6 of the resource booklet clearly shows that the statement is true. It is unlikely candidates could recognise the relationships between quantities in an equation.

(iii) The majority of candidates calculated the correct value for the BMI. Others failed to square the height.

(e) **(i)** The majority of candidates completed Punnett squares that were correct. Others wrote incorrect parental alleles into the square, a few wrote pairs of alleles in each parental box and some only showed 1 allele in each of the cross boxes.

(ii) The answer needed to be consistent with the results of the Punnett square for any credit to be awarded.

Q.2 **Mean mark** – 2.1

(a) Candidates were expected to recognise which information in figure 1 was relevant to the cardiovascular system. A minority achieved this but often failed to link each improvement with a period of time so limiting their mark. The majority of candidates included every improvement whether relevant to the question or not. Answers such as this scored zero.

(b) Firstly, candidates needed to decide which of the data in figure 2 was relevant to the question. The majority of candidates did this and could describe the trend including recognising drops but failed to mention that the increase was inconsistent. The remaining candidates did not limit themselves to the smokers who have quit column of data and often went outside the time period referred to in the question.

Section B

Q.3 **Mean mark** – 1.8

(a) Most descriptions failed to describe how the area to be investigated would be marked out in some way and how dice (or some other random number generator) would be used to determine the coordinates for random placement of the quadrat. As a result the first 2 marks were lost.

(c) **(i)** The question asked for a comparison of snail species in both habitats. Candidates should have included in their descriptions which species were being referred to and in which habitat. Candidates often failed to do either. They tended to compare a count of the snails in the habitats rather than how they were distributed.

(ii) Responses here were poor. Candidates failed to appreciate that for the data shown, the quadrat area is a constant and the area of the habitat is irrelevant.

Q.4   Mean mark – 7.0

(a) Nearly all candidates gained 3 marks for their calculations. The failure to convert 45 cm to 0.45 m was the reason for the loss of the fourth mark.

(b)   (i) Most candidates constructed correct scales with labelled axes and plotted the points accurately. Not all managed to draw a straight line of best fit for 3 reasons:
- all points off the line lay on one side
- the line failed to go through the origin
- a series of point to point lines were drawn.

There are instances where non-linear scales are produced. This is treated more harshly when occurring on the y-axis. In this instance, no marks would have been awarded.

(ii) Most candidates could read from their graph to find the required height.

(iii) Few candidates could describe how to extend the experiment.

(c)   (i) Labelling of the diagram was poor with a minority of candidates scoring any marks.

(ii) It was sometimes difficult to decide from answers whether candidates were referring to the two bones in one leg rubbing together at the joint or two knees rubbing together.

(iii) The correct term for this break was seen on a minority of scripts. Actual answers seen include 'splinting fracture' and 'a break (a bad one)'.

Q.5   Mean mark – 2.5

(a) Knowledge of the nitrogen cycle was very poor.

(b) Most candidates scored 2 or 3 marks for explaining the harm that can be caused by the use of artificial fertilisers. They could describe how they enter rivers causing algal bloom. The role played by bacteria was often omitted.

Q.6   Mean mark – 2.6

(a)   (i) Candidates either referred to antigens or antibodies but not both so scoring 1 mark.

(ii) A few excellent responses were seen which scored full marks but these were rare. The most common marks were 1, for recognising the flu virus mutates, or 0.

(b) **(i)** Again a few excellent responses seen. Most candidates did not understand the significance of the dark circles around each disc. These were mistaken for regions of bacterial colonies.

(ii) The purpose of a control disc was not known.

Q.7 **Mean mark** – 1.5

(a) Only a minority of responses were correct. Just about every region of the em spectrum made an appearance except microwaves.

(b) Candidates were unable to describe the Steady State theory. Recall of CMBR and cosmological red shift was very poor. As a result, most marks awarded were in the bottom band and more likely to be 1 than 2.

Summary of key points

Recommendations

- Encourage candidates to read each question part carefully.
- Use assessment for learning methods to develop candidates' skills in producing and assessing each other's explanations of scientific theory.
- Provide further practice in graph plotting, in particular to construct linear scales from non-linear data and drawing best fit lines.
- Provide more examples where learners decide the relationship between quantities in an equation e.g. proportional or inversely proportional.
- Provide further opportunities for candidates to work through multi-stage calculations.
- Provide further practice in completing calculations with mixed units that require conversions.

APPLIED SCIENCE (DOUBLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 3 FOUNDATION TIER

General Comments

There were approximately 1 440 entries for this tier paper, a smaller number than last year. The mean mark was higher than last year by approximately 4 marks. Not one question was attempted by 100% of candidates. Most questions were attempted by 94% upwards except for questions 5 (QER) and 8.

Candidates responded well to questions including graph work. Two topics were not applied very well in the context given in the paper. These were nuclear fission and a chemistry question on carbon and its forms.

Some questions require candidates to make a concluding comment to earn full marks e.g. **1(b)(iii), 2(c)(iii)** and **3d**.

There is more information provided on the exam paper but there is an additional 15 minutes allowed for reading time. There is plenty of evidence to suggest that not all candidates used this to their advantage. Schools need to further develop the scientific literacy of their learners. They need to be able to evaluate which information is required for a question part.

Candidates had difficulty in:
- applying knowledge and understanding to novel situations.
- reading questions carefully so consequently often miss information contained within the question.
- interpreting some of the data.
- giving clear explanations.

Comments on individual questions/sections

Q.1   Mean mark – 3.4
There were some very straightforward parts to this question which did not require recall. Even so, about 60 candidates did not attempt any of it.

    (a)   A minority of candidates identified an error.

    (c)   **(i)**   Most candidates correctly identified the correct colouring. An answer of E10 did not earn credit and was due to carelessness by the candidates.

            (ii)   The majority of candidates identified the 3 colourings. Others just stated one.

            (iii)   About half of candidates were able to argue that the prediction was incorrect. Most responses included a concluding remark.

(iv) The value of the distance travelled by the solvent front was usually correct as was the R_f value of E102.

Q.2   Mean mark – 4.2

(a) Knowledge of the formula for water was not well known. Even when the correct formula was used candidates made errors in balancing the equation.

(b) Most candidates answered correctly by stating increase the temperature.

(c)   (i) & (ii)

Readings from the graph were usually correct.

(iii) Candidates were unable to provide a correct explanation here.

(d) Few candidates stated the correct answer. Some chose a final volume at the end of one of the graphs and added this value to 1.2. The fact that they were adding a volume to a mass did not prevent them. Others thought the catalyst was used up and stated an answer of 0.

(e) Nearly all candidates calculated the correct temperature change but few were successful in finding the time milk takes to sour in the refrigerator.

Q.3   Mean mark – 4.0
This was the best answered question on the paper. This is not surprising since it involved a straightforward plotting exercise and questions based on the graph. No recall was required. It is surprising that about 40 candidates did not attempt any part of it.

(a) Most candidates earned full marks for plotting points correctly and joining them with a suitable straight line.

(b) The trend was usually described correctly.

(c) Mostly correct answers seen. However, due to carelessness, an answer of 0.6 was sometimes seen.

(d) Few candidates were able to use the data to explain whether the statement was correct or not.

Q.4   Mean mark – 1.2
This was the least well answered question on the paper.

(a) The structure of the reactor was not well known. Very few marks were awarded.

(b)   (i) About half of candidates recognised that the number of neutrons doubled from one generation to another.

(ii) Some excellent explanations were seen but in a minority of instances. Most candidates did not appear to be aware of the role of control rods.

(iii) Acceptable answers were meltdown or overheat. Few candidates quoted these.

Q.5   **Mean mark** – 1.6

Approximately 400 candidates did not attempt the question. This QER question is based on a specified practical but candidates did not appear to be aware of the procedure. Some obvious safety precautions were usually included so some marks were awarded. Marks were limited to bottom band due to lack of detail. Some candidates described timing how long it would take for a cross on the white paper to disappear.

Q.6   **Mean mark** – 4.4

(a)   Most candidates identified at least two correct statements about the advantages of organic farming.

(b)   It was clear that many candidates did not understand how to interpret stacked bar charts. However, a minority did understand this and some clear descriptions were seen.

(c)   The majority of answers were correct but in other cases, the following errors were seen:
- calculating the total for 2016 and stating that value as the change.
- calculating the total for 2016, adding it to the three other totals and finding a mean.

(d)   These two parts were not answered well. Ethical arguments were not well known. Candidates could not interpret the data to explain whether ethics had an impact on farming practices.

Q.7   **Mean mark** – 1.7

(a)   **(i)**   Most candidates selected the correct cross and dot diagram and it became clear why when answers to part (ii) were read.

(ii)   The most common reason given was that it is shaped like a diamond.

(iii)   A minority of candidates could recall the type of bond. Others stated metallic or strong.

(b)   Hardly any marks were awarded for answers to both parts in this section. There were clues in the labelling of the diagram, but candidates ignored them.

Q.8   **Mean mark** – 2.2
Approximately 160 candidates did not attempt the question.

(a)   Most candidates could complete the word equation for photosynthesis.

(b)   Few candidates could state a use of glucose.

(c)   Some excellent answers were seen earning candidates 2 or 3 marks. These were in a minority of instances.

Q.9   **Mean mark** – 3.0

(a)   **(i)**   The role of bacteria in causing food poisoning was not well known.

(ii) Symptoms of food poisoning are well known.

(iii) The majority of candidates could state at least one precaution to be taken when preparing food.

(b) Candidates were expected to interact with over a page of information. No recall was required. Performance was mixed and the average mark was about 1 out of 7.

(i) The fact that notifications had dropped was recognised but the reason that less hens would be infected was not.

(ii) The fact that the highest percentage of food poisoning cases occur during the summer months was sometimes stated but the explanation for this increase was not. Some candidates misunderstood the question and described how the percentage in a quarter changed from year to year.

(iii) Candidates were expected to notice that the scale on the y-axis for males and females were different. Generally this part was not answered well.

Summary of key points

Recommendations

- Encourage candidates to read each question part carefully.
- Use assessment for learning methods to develop candidates' skills in producing and assessing each other's explanations of scientific theory.
- Further experience is needed in writing balanced chemical equations.
- Provide further opportunities for data interpretation.

General Comments

There were 91 entries for this tier paper, a similar number to last year. The mean mark was slightly lower than last year.

A significant number of candidates found the demands of the paper too difficult and hence scored low total marks. These would have been better suited to the foundation tier paper.

Candidates responded well to questions on photosynthesis and one including calculating means and graph work.

Two topics were not applied very well in the context given in the paper. These were gas chromatography and another chemistry question on energy changes. Candidates also found drawing a tangent to a curve very difficult. Additionally, explanations in terms of particles or molecules are not particularly good e.g. **5(c)(ii)** and **6(b)**.

Some questions require candidates to make a concluding comment to earn full marks e.g. **2(b)(iii)** and **5(d)(ii)**.

There is more information provided on the exam paper but there is an additional 15 minutes allowed for reading time. There is plenty of evidence to suggest that not all candidates used this to their advantage. Schools need to further develop the scientific literacy of their learners. They need to be able to evaluate which information is required for a question part.

Candidates had difficulty in:
- applying knowledge and understanding to novel situations.
- reading questions carefully so consequently often miss information contained within the question.
- interpreting some of the data.
- giving clear explanations.

Comments on individual questions/sections

Q.1   Mean mark – 4.4
This was the best answered question on the paper.

   (a)   Most candidates could complete the word equation for photosynthesis.

   (b)   Most candidates knew the glucose would be stored as starch or used for respiration, but few knew it could produce proteins. Many answers referred to making food which was not accepted.

   (c)   Most candidates scored well in this part with many earning 2 or 3 marks.

Q.2 **Mean mark** – 5.0

    (a) **(i)** The role of bacteria in causing food poisoning was not well known.

          (ii) Symptoms of food poisoning are well known.

          (iii) The majority of candidates could state at least one precaution to be taken when preparing food.

    (b) Candidates were expected to interact with over a page of information. No recall was required. Performance was mixed and the average mark was about 3 out of 7.

          (i) The fact that notifications had dropped was recognised but the reason that less hens would be infected was not.

          (ii) The fact that the highest percentage of food poisoning cases occur during the summer months was often stated but the explanation for this increase was not. Some candidates misunderstood the question and described how the percentage in a quarter changed from year to year.

          (iii) Candidates were expected to notice that the scale on the y-axis for males and females were different. Generally this part was not answered well.

Q.3 **Mean mark** – 2.2

The full range of marks were awarded for candidates' responses. This paper coincided with a series about Chernobyl and there were references to this event so maybe it was helpful to candidates who watched it.
The best responses included details about the role of control rods and pump and what would happen in the event of a nuclear accident.
Some candidates omitted any mention of the pump. Others wrote everything about reactors including the role of the moderator which was irrelevant on this occasion.

Q.4 **Mean mark** – 6.6

    (a) Nearly all candidates did as instructed and showed both calculations and stated the correct conclusion.

    (b) **(i)** The majority of candidates constructed correct scales with labelled axes and plotted the points accurately. Not all managed to draw a straight line of best fit for 3 reasons:
- all points off the line lay on one side
- the line failed to go through the origin
- a series of point to point lines were drawn.

          There are instances where non-linear scales are produced. This is treated more harshly when occurring on the y-axis. In this instance, no marks would have been awarded.

(ii) Most candidates earned a mark for recognising the trend, but few mentioned the proportional relationship.

(c) **(i)** One mark was awarded for writing all the atomic masses down from the Periodic Table. Not all candidates showed this step, so it was difficult to give any credit in the event of an incorrect answer.

(ii) An ecf from the previous part was allowed here but few candidates knew how to make the calculation.

Q.5 **Mean mark** – 3.3
This question was not answered well.

(a) Knowledge of the formula for oxygen (O_2) was not well known. As a result a minority of candidates earned any credit here. Even when the correct formula was used candidates made errors in balancing the equation.

(b) The variables to be controlled in this experiment were not identified in all but a few responses.

(c) **(i)** Attempts at drawing a tangent were poor and in many instances it was not even attempted.

(ii) Candidates were unable to use particle theory to give an explanation.

(iii) Attempts at drawing a line at the higher temperature were unsuccessful in most instances.

(d) **(i)** It was thought to be a 50/50 decision in stating the type of reaction but answers included thermal runway and even an electromagnetic reaction. Even when exothermic was stated, candidates could not use the diagram to explain why.

(ii) Rarely did a response state that the activation energy would be lowered. ΔH remaining constant was not mentioned.

(e) Most candidates were unable to make the required calculation. Some even obtained an incorrect temperature change.

Q.6 **Mean mark –** 0.7
This was the least well answered question on the paper.

It is doubtful that candidates have any experience in interpreting gas chromatograms and providing explanations in terms of molecules.

Q.7 **Mean mark** – 4.5

(a) Only a minority of responses were creditworthy. Candidates had more success in explaining the difference in conduction properties between graphite and diamond than their differences in terms of hardness. However, candidates needed to explain about both diamond and graphite each time and this generally was not done.

(b)   A few candidates completed a correct calculation. Others managed to calculate the mass or volume to earn some credit. Most candidates did not know how to find the volume of a cube.

(c)   Most candidates could use the data to explain the advantages of using carbon nanotubes.

Summary of key points

Recommendations

- Encourage candidates to read each question part carefully.
- Use assessment for learning methods to develop candidates' skills in producing and assessing each other's explanations of scientific theory.
- Provide further practice in graph plotting, in particular to construct linear scales from non-linear data and drawing best fit lines.
- Provide further practice in drawing tangents to the curved line on a graph.
- Further experience is needed in writing balanced chemical equations especially when including oxygen.
- Emphasise explanations in terms of particles or molecules at every opportunity.
- Provide further opportunities for candidates to work through multi stage calculations.

APPLIED SCIENCE (DOUBLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 4 FOUNDATION TIER

General Comments

- Most centres opted for Pack B.
- Some candidates are still confused by the terms: independent; dependent and controlled variables.
- The quality of candidates' SPaG is improving.
- Candidates still find constructing a risk assessment difficult.
- Some candidates still need practice with listing units on tables and using the correct (consistent) number of decimal places on columns of numbers, particularly when calculating means.
- Candidates found producing accurate graphs/charts challenging.
- Evaluations are still low scoring sections on all papers, at all levels.
- Candidates are quite good at extracting information from text or from tables, but many find accessing information on graphs more difficult.

Comments on individual questions/sections

Pack A

Pack A Activity 1 Task A

Most candidates were able to state the independent variable as 'the type of pen', although as with last year a significant minority were confused between all three types of variable. It is suggested that centres direct their candidates to read and re-read the 'Background' information at the start of Activity 1 as this gives valuable information to candidates about the variables involved with the experiments.

Generally, of those candidates who stated controlled variables, the same pencil line was the most common correct response. Few candidates identified two controlled variables. A majority of candidates stated the dependent variable in this case is the distance moved by each colour.

The vast majority of candidates were able to produce an equipment list and a simple method.

The quality of the methods produced by candidates was extremely variable. The examining team were particularly looking to see if the candidates were identifying a suitable way of measuring the dependent variable (the distances moved by each colour), and the distance moved by the solvent front and that the suggested method would actually work in practice. This is where a significant number of candidates lost marks.

The quality of candidates writing was assessed here. We were particularly looking for the correct use of the key terminology (keywords) for this method, and SPaG was assessed.

Examiners were looking for the correct spelling of the scientific keywords and the correct, consistent use of capital letters and full stops. Centres are encouraged to remind candidates about this.

Pack A Activity 1 Task B

Most candidates managed to draw a good sketch of their chromatograms and included the distance moved by the solvent front as stated in the instructions.
Most candidates were then able to take suitable measurements from the supplied chromatogram, and produced their own table of results, although a number of candidates did not measure the distances accurately. A significant number of candidates found organising the table quite challenging, as it required both colours to be recorded clearly for each pen. A significant number of candidates did not clearly label the column headers.
Better candidates managed to clearly record the distance moved by the solvent front.
Most candidates managed to include cm or mm as the unit of distance, but many included the units in the rows of the table, which is not accepted.
Many candidates recorded the distance to an inconsistent number of decimal places.

Pack A Activity 1 Task C

Most candidates were able to calculate the retention factors correctly, although there were a number of instances of error carried forward, and a majority of candidates were inconsistent with the number of decimal places of their calculated values.
Most candidates found it difficult to give a clearly explained conclusion. Many could give a simple statement of what happened, but few could link their observations to their calculated values of R_f.

Pack A Activity 1 Task D

Candidates have found the evaluation tasks quite hard, and it is clear that they need more support from centres prior to the exams.
Candidates were first asked to comment on the suitability of their method. This requires an answer (suitable or unsuitable) plus a plausible reason why. Many candidates simply stated what happened during the experiment.

A majority of candidates were able to identify a source of inaccuracy, with most opting to suggest difficulties deciding where to measure the position of the spot.
The suggested improvements did not need to link to the suggested source of inaccuracy. Candidates generally suggested 'repeating the experiment'.
The final section required candidates to assess the suitability of the experiment to decide if their technique could be used to identify ink used in a forged document. Candidates did not do this well and generally failed to make a comment with a (correct) explanation, but a minority of the better candidates did make a comment about the quality of the data, generally suggesting the difficulty in accurately measuring the distance moved by the coloured spots as an issue.

Pack A Activity 2 Task A

    (a)   **(i)**   Most candidates could describe the pattern shown in Graph 1, but a significant majority did not use any data from the graph.

            (ii)   Most candidates could state the two temperatures, but many did not then explain which temperature would be better to use in terms of energy use.

(b) **(i)** Most candidates were able to identify the correct anomalous result.

(ii) Many candidates were also able to calculate the missing mean values.

(c) Few candidates were able to explain how the resolution of the graph was better than the values shown in the table and so would be better for determining the unknown volume of carbon dioxide.

Pack A Activity 2 Task B

A significant number of candidates identified the method as valid.
Many candidates managed to suggest a suitable improvement, with 'more repeats' being the most common suggestion, and reducing the temperature interval as a common alternative. Few candidates were able to correctly state if there was enough data to determine the ideal combination of concentration and temperature and then state what additional information would be needed to get the cider to the required fizziness. They did not link the temperature data in Graph 2 with the concentration data given in Graph 1.

Pack A Activity 3

The Risk Assessment was again, the least successful part of the examination across all the Packs, both Higher and Foundation and Single and Double Award, although the standard of candidates' answers are improving across the board.

Many candidates at foundation level struggled to identify the specific nature of a hazard and identifying the risks with the actions causing the risk. For example, whilst many candidates could identify that the 5 mol/dm^3 sulfuric acid is a hazard, some did not state that it was corrosive, and even fewer identified that the acid could cause a corrosive burn when handling and pouring the acid. This ensures parity with the Risk Assessment elements of the other GCSE Sciences.
Candidates did have more success with identifying suitable control measures.
Centres are strongly recommended to revisit this with their candidates frequently.

Pack B

The overwhelming majority of centres chose this Pack.

Pack B Activity 1 Task A

Most candidates were able to state the independent variable as 'the number of bands', although a few candidates were confused between all three types of variable. It is suggested that centres direct their candidates to read and re-read the 'Background' information at the start of Activity 1 as this gives valuable information to candidates about the variables involved with the experiments.

Generally, of those candidates who stated controlled variables, the 'number of weights' was the most common correct response. A few candidates identified two controlled variables, with the type/length/width of the bands being the most popular choices. Please note that 'amount' is not an acceptable term for weight (or number of bands). Can centres please discourage candidates from use of this word and to be more precise with their scientific language?

The dependent variable in this case is the extension of the bands (or stretched length of the bands), which was given in the guidance 'Background' to the candidates.

The vast majority of candidates were able to produce an equipment list and a simple method.

Although slightly better than last year, the quality of the Methods produced by candidates continues to be extremely variable. The examining team were particularly looking to see if the candidates were identifying a suitable way of measuring the dependent variable (the extension), and that the suggested method would actually work in practice, including changing the number of bands and repeating the measurements. This is where a number of candidates lost marks.

The quality of candidates writing was assessed here. We were particularly looking for the correct use of the key terminology (keywords) for this method, and SPaG was assessed. Examiners were looking for the correct spelling of the scientific keywords and the correct, consistent use of capital letters and full stops. Use of key scientific terms, such as extension, given in the Background should be evident in candidates' responses. Centres are encouraged to remind candidates about this.

Pack B Activity 1 Task B

The vast majority of candidates managed to take a good set of repeatable results for this experiment, although some candidates struggled if they were given rubber bands with differing dimensions.

Most candidates were able to produce their own table and tested each of the five band combinations and repeated them three times. A significant minority of candidates failed to record initial length of the rubber bands, but candidates were not penalised for this if they made it clear in their method that they were measuring extension directly.
Some candidates were able to spot anomalies in their data and dealt with them accordingly, and most calculated a mean extension, or a mean stretched length (although a high proportion of candidates who did this method, then failed to subtract the initial length of the bands, which then caused them problems in **Task C**). Marks in this section were generally lost for inconsistent use of decimal places and inappropriate use of units in the body of the table. Centres should encourage candidates to keep units in the headers. Examiners accepted any suitable units.

Pack B Activity 1 Task C

Very few candidates failed to calculate some form of mean. The majority managed to calculate mean extensions, but a proportion only calculated a stretched length.

Many candidates lost marks plotting the graph. Inappropriate labelling of the origin seemed the main loss, and only a few candidates lost marks for inaccurate point plotting – we accept a tolerance of $\pm <1$ small square.

Most candidates could calculate the mean stiffness using the given equation, although there were quite a few instances of error carried forward from the mean calculations. Candidates also lost marks here for inappropriate use of decimal places. This needs revisiting by centres.

Only the best candidates were able to explain why the action of rubber bands and real, human muscles are different in terms of contraction and stretching and therefore why the model arm would need two sets of rubber bands to mimic the action of an elbow joint.

Pack B Activity 1 Task D

Candidates continue to find any evaluation tasks quite hard, and it is clear that they still need more support from centres prior to the exams.

Candidates were first asked to evaluate their method. This requires an answer (suitable/valid or unsuitable/invalid) plus a plausible reason why. Many candidates simply stated what they did, or what they found difficult.

The suggested improvements do not need to link to the suggested source of inaccuracy. Most candidates, who got marks, suggested more repeats, but any sensible suggestions were given credit. Quite a few candidates from a range of centres suggested, words to the effect of, 'use more detail', without qualifying what they actually meant.

Pack B Activity 2 Task A

Q.1 **(a)** **(i)** Most candidates were able to correctly identify the solubilities and the missing salt, but some candidates read the graph incorrectly, and identified the values at 0 °C rather than 10 °C.

(ii) Very few candidates were unable to give the order of solubility for the six given salts.

(b) Many candidates were able to state the pattern in the solubility of potassium chloride, and it was good to see so many using data from the graph to do so.

(c) Candidates found comparing the patterns of solubility of potassium chromate and cerium sulfate more difficult. Most could state the patterns, but only the better candidates used correct data from the graph to qualify their patterns.

Q.2 **(a)** **(i)** Most candidates could identify the anomaly.

(ii) Many candidates were able to calculate the mean values with far fewer errors this year.

(b) Most higher candidates were able to answer this question well, but not on the foundation tier paper. They were confused by the unusual shape of the sodium sulfate solubility graph.

Pack B Activity 2 Task B

Evaluations continue to be done poorly by a high proportion of candidates.

Only a minority of candidates identified the method outlined in the Resource Pack as explicitly suitable, although more candidates could talk about reasons why it was suitable or unsuitable.

Most candidates could identify a suitable suggested improvement, with a significant minority identifying the measurement intervals as unsuitable.

Fewer candidates could then identify the method as being unsuitable for operating at temperatures of 30 °C and 60 °C and justify their answer.

Pack B Activity 3

The Risk Assessment was again, the least successful part of the examination across all the Packs, both Higher and Foundation and Single and Double Award, although the standard of candidates' answers are improving across the board.

Many candidates at foundation level struggled to identify the specific nature of a hazard and identifying the risks with the actions causing the risk. For example, whilst many candidates could identify that the inoculating loop is a hazard, some did not state that it was hot, and even fewer identified that the heat could cause a burn when cleaning the loop with the flame.

Please note that when suggesting suitable protective equipment for handling hot objects **heat proof** gloves are required, not just 'gloves'.

Candidates did have more success with identifying suitable control measures.
Candidates do not have to write risks and control measures for hazards that are blanked out.

Centres are strongly recommended to revisit this with their candidates frequently.

Summary of key points

Centres should give candidates opportunities to:

- regularly identify independent, dependent and controlled variables.
- write methods using a good level of SPaG.
- construct Risk Assessments and use Student Safety Sheets.
- practice listing units on tables and use the correct (consistent) number of decimal places on columns of numbers, particularly when calculating means.
- frequently plot a range of accurate graphs and charts.
- evaluate methods.
- read and access information presented on graphs and charts.

APPLIED SCIENCE (DOUBLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 4 HIGHER TIER

General Comments

- Most centres opted for Pack B.
- It is clear that most Higher Tier candidates have been well trained to include most items needed in a plan.
- The quality of candidates SPaG is good on the Higher Tier.
- Candidates still find constructing a comprehensive Risk Assessment difficult.
- Some candidates still need practice with listing units on tables and using the correct (consistent) number of decimal places on columns of numbers, particularly when calculating means.
- Higher Tier candidates can generally produce good graphs/charts but they need to be a little more careful with the scales that they choose.
- Evaluations are still low scoring sections on all papers, at all levels.

Comments on individual questions/sections

Pack A

Pack A Activity 1 Task A

Most candidates were able to state the independent variable as 'the type of pen', although as with last year, a few higher tier candidates were confused between all three types of variable. It is suggested that centres direct their candidates to read and re-read the 'Background' information at the start of **Activity 1** as this gives valuable information to candidates about the variables involved with the experiments.

Generally, most higher tier candidates were able to state at least one controlled variable, and the same pencil line was the most common correct response. A minority of candidates identified two controlled variables.

A majority of candidates stated the dependent variable in this case is the distance moved by each colour.

The vast majority of candidates were able to produce an equipment list and a simple method.

The quality of the methods produced by candidates was extremely variable. The examining team were particularly looking to see if the candidates were identifying a suitable way of measuring the dependent variable (the distances moved by each colour), and the distance moved by the solvent front and that the suggested method would actually work in practice. This is where a significant number of candidates lost marks.

The quality of candidates writing was assessed here. We were particularly looking for the correct use of the key terminology (keywords) for this method, and SPaG was assessed.

Examiners were looking for the correct spelling of the scientific keywords and the correct, consistent use of capital letters and full stops. Centres are encouraged to remind candidates about this.

Pack A Activity 1 Task B

The vast majority of candidates managed to draw a good sketch of their chromatograms and included the distance moved by the solvent front as stated in the instructions.
Most candidates were then able to take suitable measurements from the supplied chromatogram, and produced their own table of results, although a number of candidates did not measure the distances accurately. A number of candidates found organising the table challenging, as it required both colours to be recorded clearly for each pen. A significant number of candidates did not clearly label the column headers.

Most higher tier candidates managed to clearly record the distance moved by the solvent front.

Most candidates managed to include cm or mm as the unit of distance, but a significant number included the units in the rows of the table, which is not accepted.
Some candidates recorded the distance to an inconsistent number of decimal places.

Pack A Activity 1 Task C

A majority of higher tier candidates were able to use the supplied data to either calculate the retention factors of each of the colours in each of the pens correctly with a consistent number of decimal places, or used the data to determine the distances travelled by each of the colours in the forgery.

The candidates that correctly determined the retention factors of the pens or the distances travelled by the colours in the forgeries and were generally able to correctly identify that none of the pens were used in the forgery.

Pack A Activity 1 Task D

Candidates have found the evaluation tasks quite hard, and it is clear that they need more support from centres prior to the exams.

Candidates were first asked to comment on the suitability of their method. This requires an answer (suitable or unsuitable) plus a plausible reason why. Some candidates simply stated what happened during the experiment.

A majority of candidates were able to identify a source of inaccuracy, with most opting to suggest difficulties deciding where to measure the position of the spot.

The suggested improvements did not need to link to the suggested source of inaccuracy. Candidates generally suggested 'repeating the experiment'.

The final section required candidates to assess the suitability of the experiment to decide if their technique could be used to identify ink used in a forged document. Some candidates did not do this well and generally failed to make a comment with a (correct) explanation, but a minority of the better candidates did make a comment about the quality of the data, generally suggesting the difficulty in accurately measuring the distance moved by the coloured spots as an issue.

Pack A Activity 2 Task A

    (a) **(i)** Most candidates could describe the pattern shown in Graph 1, but a significant majority did not use any data from the graph.

        (ii) Most candidates could state the two temperatures, but many did not then explain which temperature would be better to use in terms of energy use.

    (b) **(i)** Most candidates were able to identify the correct anomalous result.

        (ii) Many candidates were also able to calculate the missing mean values, although some candidates included the anomaly in their calculations.

        (iii) Most candidates could plot the graph, but some candidates lost marks for not plotting the scale correctly with a correct origin.

        (iv) A few candidates found determining the concentration producing 20 cm^3 if gas in 10 minutes challenging and failed to do this accurately.

Pack A Activity 2 Task B

Most higher tier candidates identified the method as valid.
Many candidates managed to suggest a suitable improvement, with 'more repeats' being the most common suggestion, and reducing the temperature interval as a common alternative. Few candidates were able to correctly state if there was enough data to determine the ideal combination of concentration and temperature and then state what additional information would be needed to get the cider to the required fizziness. They did not link the temperature data in Graph 2 with the concentration data given in Graph 1.

Pack A Activity 3

The Risk Assessment was again, the least successful part of the examination across all the Packs, both Higher and Foundation and Single and Double Award, although the standard of candidates' answers are improving across the board.

Only a minority of candidates at Higher level identified the specific nature of a hazard and then the risks with the actions causing the risk. For example, whilst many candidates could identify that the 5 mol/dm^3 acid is a hazard, not many stated that it is because it is corrosive and even fewer identified that the acid could cause a corrosive burn when handling and pouring.

Candidates did have more success with identifying suitable control measures.

Centres are strongly recommended to revisit this with their candidates frequently.

Pack B

The overwhelming majority of centres chose this Pack.

Pack B Activity 1 Task A

Most candidates were able to state the independent variable as 'the number of bands', although a significant minority were confused between all three types of variable. It is suggested that centres direct their candidates to read and re-read the 'Background' information at the start of Activity 1 as this gives valuable information to candidates about the variables involved with the experiments.

Generally, of those candidates who stated controlled variables, the 'number of weights' was the most common correct response. A few candidates identified two controlled variables, with the type/length/width of the bands being the most popular choices. Please note that 'amount' is not an acceptable term for weight (or number of bands). Can centres please discourage candidates from using this word and to be more precise with their scientific language?

The dependent variable in this case is the extension of the bands (or stretched length of the bands), which was given in the guidance Background to the candidates.

The vast majority of candidates were able to produce an equipment list and a simple method.

Although slightly better than last year, the quality of the methods produced by candidates continues to be extremely variable. The examining team were particularly looking to see if the candidates were identifying a suitable way of measuring the dependent variable (the extension), and that the suggested method would actually work in practice, including changing the number of bands and repeating the measurements. This is where a significant number of candidates lost marks.

The quality of candidates writing was assessed here. We were particularly looking for the correct use of the key terminology (keywords) for this Method, and SPaG was assessed. Examiners were looking for the correct spelling of the scientific keywords and the correct, consistent use of capital letters and full stops. Use of key scientific terms, such as extension, given in the Background should be evident in candidates' responses. Centres are encouraged to remind candidates about this.

Pack B Activity 1 Task B

The vast majority of candidates managed to take a good set of repeatable results in this experiment, although some candidates struggled if they were given rubber bands with differing dimensions.

Most candidates were able to produce their own table and tested each of the five band combinations and repeated them three times. A significant minority of candidates failed to record initial length of the rubber bands, but candidates were not penalised for this if they made it clear in their method that they were measuring extension directly.

Some candidates were able to spot anomalies in their data and dealt with them accordingly, and most calculated a mean extension, or a mean stretched length (although a high proportion of candidates who did this method, then failed to subtract the initial length of the bands, which then caused them problems in **Task C**). Marks in this section were generally lost for inconsistent use of decimal places and inappropriate use of units in the body of the table. Centres should encourage candidates to keep units in the headers. Examiners accepted any suitable units.

Pack B Activity 1 Task C

Very few candidates failed to calculate some form of mean. The majority managed to calculate mean extensions, but a proportion only calculated a stretched length. Some candidates lost a mark for inconsistent use of decimal places.

Many candidates lost marks plotting the graph. Inappropriate labelling of the origin seemed the main loss, although a high proportion lost marks for poor best fit lines (we accepted 'join-the-dots' in this instance as the variable is categoric).

Most candidates were able to use their graph to suggest a suitable band number that would have an extension between 5 cm and 10 cm, but it was here that candidates were penalised if they did not use extension.

Only the best candidates were able to explain why a model arm would need two sets of rubber bands to model a forearm, with many candidates simply stating that there were two muscles.

Pack B Activity 1 Task D

Candidates continue to find any evaluation tasks quite hard, and it is clear that they still need more support from centres prior to the exams.

Candidates were first asked to comment on the suitability of their method. This requires an answer (suitable or unsuitable) plus a plausible reason why. Many candidates simply stated what they did, or what they found difficult.

Some candidates were able to identify a source of inaccuracy, with most opting to suggest difficulties associated with positions of the ruler or moving weights during measuring. The suggested improvements do not need to link to the suggested source of inaccuracy. Most candidates, who got marks, suggested more repeats, but any sensible suggestions were given credit. Quite a few candidates from a range of centres suggested, words to the effect of, 'use more detail', without qualifying what they meant.

Some candidates were able to discuss the repeatability of their results and in this case, they had to assess the repeatability and give reasons why. This was the highest scoring part of **Task D**.

Pack B Activity 2 Task A

Q.1 **(a)** Most candidates were able to correctly identify the order of the solubilities, but some candidates read the graph incorrectly, and identified the values at 0 °C rather than 10 °C.

(b) Many candidates were able to state the pattern in the solubility of potassium chloride, and it was good to see so many using data from the graph to do so.

(c) Candidates found comparing the patterns of solubility of potassium chromate and cerium sulfate more difficult. Some could state the patterns, but only the better candidates used correct data from the graph to qualify their patterns.

Q.2 **(a)** **(i)** Most candidates could identify the anomaly, but a significant minority obviously did not understand the meaning of the term 'anomaly'. This needs reinforcement by centres.

(ii) Many candidates were able to calculate the mean values with far fewer errors this year.

(b) A high proportion of candidates found this question hard. They found describing the solubility of sodium sulfate difficult and were obviously confused by the unusual shape of the graph.

(c) Most candidates either got this question correct, or simply left it out. There are a proportion of candidates who find any questions involving numbers quite daunting.

Pack B Activity 2 Task B

Evaluations continue to be done poorly by a high proportion of candidates.

Only a minority of candidates identified the method outlined in the Resource Pack as explicitly suitable, although more candidates could talk about reasons why it was suitable or unsuitable.

Most candidates could identify a suitable suggested improvement, with a significant minority identifying the measurement intervals as unsuitable.

Fewer candidates could then identify the method as being unsuitable for operating at temperatures of 30 ℃ and 60 ℃ and justify their answer.

Pack B Activity 3

The Risk Assessment was again, the least successful part of the examination across all the Packs, both Higher and Foundation and Single and Double Award, although the standard of candidates' answers are improving across the board.

Only a minority of candidates at Higher level identified the specific nature of a hazard and then the risks with the actions causing the risk. For example, whilst many candidates could identify that the inoculating loop is a hazard, not many stated that it is because it is hot and even fewer identified that the heat could cause a burn when cleaning the loop with the flame. This ensures parity with the Risk Assessment elements of the other GCSE Sciences. Please note that when suggesting suitable protective equipment for handling hot objects heatproof gloves are required, not just 'gloves'.

Candidates did have more success with identifying suitable control measures.

Candidates do not have to write risks and control measures for hazards that are blanked out.

Centres are strongly recommended to revisit this with their candidates frequently.

Summary of key points

Centres should give candidates opportunities to:
- regularly identify independent, dependent and controlled variables.
- write methods using a good level of SPaG.
- construct Risk Assessments and use Student Safety Sheets.

- practice listing units on tables and use the correct (consistent) number of decimal places on columns of numbers, particularly when calculating means.
- frequently plot a range of accurate graphs and charts.
- evaluate methods.
- read and access information presented on graphs and charts.

APPLIED SCIENCE (DOUBLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 5 – PRACTICAL ASSESSMENT

General Comments

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

Section A: Risk Assessment

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

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

Section B: Graphs

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

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

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

Comments on individual questions/sections

Investigating the effectiveness of different thicknesses of loft insulation
This was a reasonably popular choice for Double Award Applied Science candidates.

Section A

    (a)   Many struggled to form a coherent hypothesis and there was much confusion over the terms heat and temperature.

(b) Whilst the risk and control measure were often completed well the nature of the hazard was often missing.

(c) Many struggled to organise the data into a logical table and this meant that often units or headings were missing.

Section B

(a) **(i) and (ii)**

Identification of the independent variable proved challenging in this investigation although most were able to identify the dependent variable.

(iii) Many correct responses seen.

(b) **(i) and (ii)**

Many candidates were able to demonstrate knowledge of repeatability and reproducibility, although the clarity of the responses seen was often poor and candidates did not always convey the idea of checking the similarity of results to judge repeatability or reproducibility.

(c) This was usually poorly done.

(d) Comparing results to their initial hypothesis proved very challenging for most candidates and the clarity of the responses seen was poor.

(e) **(i)** Candidates did not have to plot their own data and this helped many of them to score reasonably well here, especially as a value was already given on the origin for the y axis to assist with scaling sensibly. The line of best fit mark was frequently withheld for thick or whispy lines or dot-to-dot.

(ii) Processing the data to determine the mean temperature rise per minute was only correctly done by a few.

(iii) and **(iv)** and **(f)**

This section of the paper dealt with the principles of heat transfer and was not well-understood by candidates. If marks were attained, it was for adding a line to the graph but it was rare to see a sensible explanation of why the line was in that position.

(g) Although the quality of method writing was frequently poor many candidates were able to attain marks for identifying controlled variables.

Investigating the effect of practice on reaction time.

This experiment was only available to Double Award Applied Science candidates.

Section A

(a) Candidates found it difficult to write a clear hypothesis for this investigation and poor use of language was often seen with comments such as reaction time gets 'faster'.

(b) Most candidates here gave spurious risks which earned no credit.

(c) The table was difficult to structure well, causing many to lose marks.

Section B

(a) **(i) (ii) and (iii)**

Many failed to identify the dependent variable and its range. The term stimulus was not widely understood.

(b) Most candidates were able to complete the table by reading a value from the graph.

(c) Graph plotting was challenging for many who struggled to produce a sensible scale.

(d) Candidates were confident at describing the relationship between variables from the graph and most gave a correct response.

(e) **(i)** and **(ii)**

Many candidates could identify the role of 'the experimenter' in the investigation but the idea of experimenter bias was generally not understood.

(f) Most candidates struggled to identify inaccuracies and improvements.

(g) **(i) and (ii)**

In the final section of the data candidates examined data and were asked to draw conclusions. Many struggled to identify the relationship shown in the data.

(iii) and (iv)

Many candidates were able to state the meaning of the terms repeatability and reproducibility although linking this to the data shown was challenging.

(v) It was pleasing to see some good attempts at this question.

Investigating the heat energy released by burning different fuels

This practical was very popular with many centres.

Section A

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

Section B

Q.2 **(a)**   The controlled variables were identified by the majority of candidates. However, there were still some who used the word 'amount' instead of 'volume'. Marks were also lost due to candidates not referring to the correct instrument or stating the value of controlled variable i.e. 100 cm^3 of water using a measuring cylinder.

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

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

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

      (d)   The numerical questions here were well answered.

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

Summary of key points

Encourage candidates to identify the nature of any hazard and to always link a risk with an action in the method.

Allow plenty of opportunity for candidates to plot graphs. They should have suitable practice in determining their own scales which include values at the origin, and they should develop a clearer understanding of what constitutes a good line of best fit.

Practice method writing to ensure that candidates write concisely and clearly in a suitable style.

When undertaking practical work, encourage candidates to make links between the results collected and scientific theory.

Give candidates experience of judging the reproducibility and repeatability of given data.

Ensure that candidates understand the significance of a dot above a digit on their calculator screens so that they do not make errors in rounding.