GCSE EXAMINERS' REPORTS

GCSE (NEW)
APPLIED SCIENCE (SINGLE AWARD)

SUMMER 2019

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APPLIED SCIENCE (SINGLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 1 FOUNDATION TIER

General Comments

There were approximately 1 400 entries for this tier paper which is a large increase on last year's entry of about 500. The majority of candidates attempted nearly every question, however there was not a single question with a 100% attempt rate. Within attempted questions some sections were left blank. It was disappointing that so many attempted questions resulted in zero marks. The number of scripts with a single figure total mark was alarming. Also, some candidates failed to attempt any question at all.

Overall impressions were that performance on this paper was of a similar standard to last year with the mean mark slightly greater.

There is more information provided on the exam paper but there is an additional 15 minutes allowed for reading time. Schools need to further develop the scientific literacy of their learners. Candidates need to be able to evaluate which information is required for a question part e.g. **2**, **3** and **8**.

Candidates gave inappropriate time to revision and so exhibited gaps in their knowledge and understanding e.g. question **4 (water hardness**), **5 (heat transfer)** and **7 (preparation of zinc sulfate).**

Some questions ask candidates to evaluate whether a suggestion or claim is correct e.g. **2(b)(iii)** and **8(b)(ii)**. A concluding statement about the validity of the claim is required for full marks.

Comments on individual questions/sections

Q.1 **Mean mark** – 1.8

(a) About half of candidates were able to state an advantage to earn a mark.

(b) **(i)** There was confusion about whether the transformer was step up or step down and also between which part was the power station and transformer.

(ii) The most common answers were either that the current flows faster or to ensure there is enough voltage to share around the country.

Q.2 **Mean mark** – 2.2

(a) Most candidates gained a mark for either stating the meaning of renewable energy or giving an advantage of increasing its use. It was rare to see more than 1 mark awarded and this was due to the vagueness of answers, such as, better for the environment or reduces pollution. More detail was required.

(b) **(i)** The origin of some of the numerical answers remain unclear. Some of the more obvious reasons for an incorrect answer were:

- Finding the sum of a row
- Finding the sum of a different year
- Not including all the energy sources in the addition even though the heading of the first column clearly stated 'Renewable energy source'

(ii) A minority of candidates calculated a correct answer even after allowing an ecf. Rounding errors in the final answer meant the final mark was withheld. Often the question was not attempted.

(iii) Most commonly, either the question was not attempted or the instruction to use data was ignored. The outcome was zero marks.

Q.3 **Mean mark** – 1.9

(a) Most candidates were able to interpret the diagram to obtain correct answers for parts (i) and (ii). The answers to part (iii) were usually given as a range rather than one number.

(iv) & (v) Very few correct answers were seen in either of these parts.

(b) If a creditworthy answer was given it usually referred to the safety aspect due to the risk of explosions.

(c) In total, very few marks were awarded in either question part.

Q.4 **Mean mark** – 2.3

(a) **(i)** The method to find the amount of hardness in a water sample was not well known. It was rare for any marks to be awarded.

(ii) Many candidates were able to select at least two correct statements.

(b) A majority of candidates gained a mark for stating hard water is good for bones or teeth.

Q.5 **Mean mark** – 3.0

(a) The terms conduction, convection and radiation were not well known. Even if they made an appearance, they very rarely completed the sentences correctly. All sorts of answers appeared, such as evaporation, friction, melting and boiling.

(b) **(i)** Most candidates earned 2 marks for correctly plotting the points but less drew an acceptable line of best fit. Frequently either they didn't begin at 0,16 or they were drawn as a series of point to point lines.

(ii) The majority of candidates were able to interpret the graphs to arrive at a correct answer.

(c) Few candidates knew that black is a better absorber of heat. There were references to black being a better conductor.

Q.6 **Mean mark** – 1.6
The question included less information than the version on the higher tier. The questions were also less demanding.

(a) Usually hydrogen was identified as an element but oxygen was the named compound.

(b) It was rare to award a mark. The formulae for oxygen and water were not well known and if these were incorrect then the balancing mark was forfeited.

(c) Candidates did not take note of information in the question. It clearly stated that the car was 4-wheel drive and each wheel contained a 4 kW motor. The correct answer was only provided by a minority of candidates.

(d) Information about the efficiency of energy recovery was deliberately stated in the last sentence of the initial information about the car. Few candidates scored any marks here. It was common to see a 50/50 split of the kinetic energy. Also candidates should be aware that the sum of the heat and electrical energies is equivalent to the initial kinetic energy.

Q.7 **Mean mark** – 0.7
Approximately 60% of candidates failed to make an attempt at an answer.

This QER question required recall of a specified practical and the method was not known. Some credit was usually given for references to basic safety but rarely was more than 1 mark awarded.

Q.8 **Mean mark** – 1.9
The page of information at the start of question 1 was necessary to familiarise candidates with the two methods used to monitor air pollution. Some of the 15 minutes reading time should have been used here. Responses suggest that this was not the case. About 15% of candidates did not attempt any part of the question.

(a) Few candidates successfully identified the dependent variable and a variable that needed to be controlled.

(b) **(i)** Most candidates completed the total column in the table correctly but few calculated correct means.

(ii) A few candidates earned at least 2 marks for calculating the lichen indicator score from tree trunk data. Not all of these went on to interpret the graph correctly and/or failed to provide a concluding remark. Despite the space for working, most candidates who attempted this question part did not show any use of data.

(c) Hardly any credit was awarded in this last part of the question. Quite often it was left blank.

Q.9 **Mean mark** – 0.9

This question required use of data provided in the table. The only necessary recall was the relative position of the asteroid belt in relation to the planets.
About 20% of candidates did not attempt any part of the question.

(a) **(i)** It is doubtful candidates know where the asteroid belt is in relation to the named planets. Very few candidates could use the data to estimate a circumference within the allowed range. Usually it was left blank.

(ii) Most candidates could state at least 1 reason for Saturn's longer orbit time.

(iii) Few candidates completed this calculation correctly.

(b) It was rare for any credit to be given here. Again, this part was frequently left blank.

Summary of key points

Recommendations

- Encourage candidates to make use of reading time and 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 the drawing of best fit lines.
- Provide more opportunities for writing balanced symbol equations which include the use of H_2 and O_2.
- Further practice is required in the rounding of final answer.

APPLIED SCIENCE (SINGLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 1 HIGHER TIER

General Comments

There were only 19 entries for this tier paper.

There was a 100% attempt rate for 5 questions. The exceptions were questions **3**, **5** and **8**, where 1 candidate failed to attempt them. Overall impressions were that performance on this paper was of a similar standard to last year. A few 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.

There is more information provided on the exam paper but there is an additional 15 minutes allowed for reading time. Schools need to further develop the scientific literacy of their learners. Candidates need to be able to evaluate which information is required for a question part e.g. **2a**, **8b** and **c**.

Candidates gave inappropriate time to revision and so exhibited gaps in their knowledge and understanding e.g. questions **3**, **4(a)(i)**. Question **1**, which was written in the context of using living indicators to monitor pollution, was answered well. It only contained 1 mark requiring recall. Questions **5** (salt preparation and precipitation reactions) and **6** (hydrocarbons) were not answered well.

Some questions ask candidates to evaluate whether a suggestion or claim is correct e.g. **1(b)(ii)**, **7(b)(ii)** and **8(b)**. A concluding statement about the validity of the claim is required for full marks.

Comments on individual questions/sections

Q.1 **Mean mark** – 6.8

This was the best answered question on the paper.
The page of information at the start of question 1 was necessary to familiarise candidates with the two methods used to monitor air pollution. Some of the 15 minutes reading time should have been used here. Responses suggest that this was the case.

(a) Most candidates successfully identified the dependent variable and two variables that needed to be controlled.

(b) **(i)** Most candidates completed the table correctly.

(ii) Most candidates earned at least 2 marks for calculating the lichen indicator score from tree trunk data. Not all went on to interpret the graph correctly and/or failed to provide a concluding remark.

(c) **(i)** About half of candidates knew how the system of scientific names helps scientists across the world.

(ii) Again, about half of candidates used the scientific classification information to make an acceptable suggestion.

Q.2 **Mean mark** – 3.6

This question required use of data provided in the table. The only necessary recall was the relative position of the asteroid belt in relation to the planets. It was the second best answered question.

(a) **(i)** About half of candidates could use the data to estimate a circumference within the allowed range.

(ii) Most candidates could state at least 1 reason for Saturn's longer orbit time.

(iii) About half of candidates completed this calculation correctly. Others arrived at an answer double the actual one because they used the radius of the Earth instead of its diameter.

(b) **(i)** The majority of candidates found the time until the alignment would occur again.

(ii) Most candidates determined the positions of Earth, Mars and Jupiter after the elapsed time but less were successful in the positioning of Saturn.

Q.3 **Mean mark** – 1.9

This QER question required recall of the large scale structure of the Earth and an explanation of the movement of tectonic plates. Answers exposed gaps in the knowledge of candidates. Additionally, some candidates answered a question of their own making and described the evidence for continental drift.

Descriptions of the structure of the Earth in terms of a solid iron core, molten iron outer core, mantle and crust were often incomplete. Some candidates were confused about which part of the core is molten.

Few candidates described the process occurring at tectonic plate boundaries where plates slide past one another, move towards one another and move apart. Even fewer could explain that the cause of the movement was due to convection currents in molten rock in the mantle. As a result, most candidates earned a mark in the bottom band with a few entering the middle band.

Q.4 **Mean mark** – 3.9

(a) **(i)** Few marks were awarded here. Candidates were unable to explain the difference between elements and compounds.

(ii) It was rare to award more than 1 mark and this was usually for writing down the formula of water. The formulae of hydrogen and oxygen were not well known and if these were incorrect then the balancing mark was forfeited.

(b) Information about the efficiency of energy recovery was deliberately stated in the initial information about the car. Higher tier candidates are expected to read questions carefully and take note of data as and when it appears. Candidates would benefit from highlighting such information as they read through the question. Few candidates scored full marks here.

(c) Candidates did not appear to be aware of a reduction in circuit resistance when components or devices are connected in parallel.

(d) Most candidates earned credit here for recognising that less carbon dioxide would be produced but they failed to get the second mark because they stated that this will stop global warming instead of explaining that there will be less additions to the greenhouse effect.

Q.5 Mean mark – 1.4

At least one candidate scored full marks in this question.

(a) Very few candidates earned any credit here. The preparation of zinc sulfate was not known. Most candidates described dissolving zinc oxide in water and then evaporating the solution which miraculously produced zinc sulfate. The use of sulfuric acid was not known.

(b) Few candidates earned credit and even then, it was usually just 1 mark for identifying one of the salts.

Q.6 Mean mark – 1.5

This was the least-well answered question on the paper.

(a) At least one perfect answer was seen but most candidates were unable to list the three stages involved let alone provide any explanation.

(b) Most candidates gained this mark for recognising alkanes are saturated or using words to that effect.

(c) Diagrams of the structural formula were poor, and few candidates stated a correct molecular formula.

(d) Hardly any marks were awarded in this part.

Q.7 Mean mark – 2.8

(a) Candidates could usually provide one of the explanations but not both.

(b) **(i)** Most candidates knew that black is a better absorber of heat. They were also expected to refer to IR radiation but very few did.

(ii) About half of candidates were able to calculate both rates of temperature increase but some then gave an incorrect conclusion.

Q.8 Mean mark – 5.9

This question produced a wide range of marks from 13 at the top end to 3 at the bottom.

(a) **(i)** Most candidates could state the meaning of the term base load.

(ii) Most candidates could name the two types of transformer i.e. step up and step down, and the majority knew which increased voltage and which decreased voltage to make it safer for consumers. The reason for the increase in voltage was not well known. Some candidates think it is necessary so that there is enough electricity to go around or to make it flow faster through wires. A few candidates described how the transformers step up and step down power so failed to get any credit.

(b) There were a number of routes through this question. Firstly, use of data was required. Some candidates made no use of the space to make any calculations so did not gain any credit. A minority of candidates either calculated the number of nuclear power stations needed or the equivalent number of one of the renewable sources to meet the output of a nuclear plant, to earn partial credit. However, no answer covered both of these calculations. Nearly all candidates made a concluding remark, but it was not based on collaborating calculations.

(c) **(i)** Most candidates earned credit for plotting points. Some lost the scale mark for the following errors:

- Failure to label the y-axis including units
- Not including 0 on the y-axis
- Producing non-linear scales

Curves of best fit were not good.

(ii) There was no guidance as to how to tackle this calculation but there were at least two superb responses with logical and clear workings shown which scored full marks. Both completed the question in slightly different ways. Other candidates were able to earn some credit for a correct part method, usually failing to arrive at a correct outcome but then by applying ecf they were able to find a payback time.

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.
- Provide more opportunities for writing balanced symbol equations which include the use of H_2 and O_2.
- Target extra activities of interpreting chemical data such as information about solubility of salts and how this can be used.
- Provide further opportunities for candidates to work through multi stage calculations.
- Provide further practice in completing calculations with mixed units that require conversions.
- Provide further examples of open-ended calculations where candidates must decide on the appropriate method to be used

APPLIED SCIENCE (SINGLE AWARD)

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Summer 2019

UNIT 2 FOUNDATION TIER

General Comments

There were 935 entries for this tier paper, up on the previous year. The majority of candidates appeared to be appropriately entered for this tier. Apart from question 8 and the common question 9, the vast majority attempted every question. There were some topics such as the structure of the knee, penetration of ionising radiations, and the typical nuclear reactor where candidates appeared to lack the expected background knowledge.

Candidates had difficulty in:

- applying their scientific knowledge to novel situations.
- reading questions carefully so as not to miss information and to be aware of the different command words used.
- interpreting some of the data and being able to apply it in calculations.
- Understanding the term reproducibility.
- QER: Organisation, punctuation, spelling and grammar caused problems for many.

Comments on individual questions/sections

Q.1 **Mean mark** - 2.8
A quite well attempted question.

(a) most candidates could read from graph.

(b) a significant minority could not explain that Seren had increased speed.

(c) and **(d)**

were generally well done

(e) mistakes were common in this question, either by not reading Seren's finishing time from the graph or by incorrect division.

Q.2 **Mean mark** - 4.1
This was the best answered question on the paper

(a) was generally well answered with candidates knowing what a double blind trial was.

(b) most candidates could extract the correct information from the table.

Q.3 **Mean mark** - 0.8

This question assessed AO1 knowledge and showed that the majority of candidates did not know the structure of the knee and the role of synovial fluid.

Q.4 **Mean mark** - 1.6
Although this question was well attempted, most of the marks obtained came from **(b)(i)**.

(a) It was common for a significant majority of candidates to wrongly assume that the purpose of the control rods was to control flow of the coolant gases and that a greater flow of the coolant gas was needed to stop the nuclear reaction.

(b) **(i)** Candidates generally scored 1 or 2 marks here.

(ii) Most candidates could not complete this decay equation.

Q.5 **Mean mark** - 2.0

(a) Candidates generally could not give a reason for the increase in MRSA but did know that use of handwashing and use of antiseptics could control it.

(b) **(i)** Candidates could generally plot the graph although it was common to see incorrect plotting due to a scale using two small squares being equal to 1.

(ii) Candidates could score the first mark for the idea of cases decreasing with time but did not score the second mark for the idea of decreasing rate/non-linearity.

Q.6 **Mean mark** - 2.5
This contained the QER question

(a) **(i)** only a minority of candidates could give two reasons for the fall in the number of smokers.

(ii) Candidates' poor organisation led to confused answers that failed to link the idea of long- or short-term to the effect candidates identified. This resulted in a number of candidates failing to get out of the bottom band.

(b) most candidates could work out the number of units that Alex drank but then failed to give the advice asked for in the question.

Q.7 **Mean mark** - 0.9
Candidates showed little understanding of thermal runaway reactions in the context of Lithium ion batteries.

(a) only a small minority could define what a thermal runaway reaction was and generally these candidates got a mark for describing the diagram. Even less candidates could suggest ways of preventing it.

(b) **(i)** The use of negative numbers seemed to confuse some candidates who failed to spot that D was a temperature rise and thus exothermic.

(ii) was surprisingly not always attempted, and when it was it was generally incorrect.

Q.8 **Mean mark** - 0.1

Candidates found this the most difficult question on the paper and so was only attempted by 76% of candidates. Those that did attempt the question did not seem to have experience of this standard physics experiment or an understanding of how the penetrating powers of alpha, beta and gamma changes count rate as they pass through different materials.

Q9 Mean mark - 1.7

This was a common question with the Higher tier paper.

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

Most candidates could not do these calculations, either leaving them blank, inverting the numbers, or multiplying rather than dividing the numbers.

(iii) The reason for comparing per 100 g was not well understood.

(iv) it was generally understood that exceeding the RDA increased the chance of obesity and diabetes.

(b) Candidates found identifying variables difficult and quite often quoted a piece of apparatus as a controlled variable.

(c) **(i)** candidates could not explain how results were reproducible.

(ii), (iii) and **(iv)**

calculations were generally left out or poorly attempted.

Summary of key points

Recommendations

- Encourage candidates to read each question part carefully and maybe underline key words. For QER, plan a structure before attempting to answer.
- Develop candidates' skills in extracting information for calculations.
- Practice applying basic physical properties such as penetration of ionising radiations to practical problems.
- Emphasize the importance of understanding the required practicals, particularly being able to state and explain independent, dependent and controlled variables.
- Further experience is needed in writing balanced nuclear fission equations.

APPLIED SCIENCE (SINGLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 2 HIGHER TIER

General Comments

There were 15 entries for this tier paper, down on the previous year. All of the candidates responded well to questions and were appropriately entered for the correct tier. The vast majority attempted every question.

Candidates had difficulty with the following:

- applying knowledge to novel situations.
- understanding what is meant by the terms dependent and controlled variable.
- Correctly interpreting command words contained within the question.
- Understanding how reproducible results are obtained.

Comments on individual questions/sections

Q.1 **Mean mark** - 9.1

This was a common question with the foundation tier and was the best answered question on the paper,

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

Most candidates could do these calculations.

(iii) The reason for comparing per 100 g was not well understood.

(iv) It was generally understood that exceeding RDA increased the chance of obesity and diabetes.

(b) Surprisingly, candidates found identifying variables difficult.

(c) **(i)** Candidates could not explain how results are reproducible.

(ii) and **(iii)**

Calculations were generally done well. However some candidates found it difficult to compare energy of different masses in (iv).

Q.2 **Mean mark** - 2.7

Candidates made good attempts at this question but tended to miss that synovial fluid was produced by the membrane and that loss of this fluid could lead to osteoarthritis.

Q.3 **Mean mark** - 3.1

(a) Candidates failed to apply the command word to discuss, so only gave one side of the argument.

(b) Most candidates knew what a double-blind trial was but could not explain why a large number of people were needed.

(c) Candidates found the mathematical conversions difficult.

Q.4 **Mean mark** - 1.4 QER

Most candidates could not fully describe either disease and generally only gave one control method and so the vast majority ended up with marks in the bottom band.

Q.5 **Mean mark** - 1.9

This question was not well answered and had the lowest facility factor on the paper.

(a) Candidates showed little understanding of writing the decay equation.

(b) The exponential growth in energy was poorly explained.

(c) The marks that were scored were generally from this part of the question.

Q.6 **Mean mark** - 2.6

(a) Candidates found applying an understanding of types of radiation into this setting challenging.

(b) Candidates were required to read and interpret information from two diagrams and although most could extract some relevant information. They found difficultly in explaining their findings.

Q.7 **Mean mark** - 4.0

(a) Candidates could generally plot and add lines to graphs although some struggled with getting the plateau at the same height as the original graph. Many could relate a higher rate of reaction to greater kinetic energy but failed to link this to a greater number of successful collisions.

(b) Candidates realised that a catalyst speeds up a reaction but could not explain how.

Q.8 Mean mark - 1.1

Candidates found this the most difficult question on the paper with very few marks awarded in part (a). Few candidates showed any knowledge of using gradients to calculate speed. Although they made a better attempt at part (b), many wrote about speed rather than acceleration which was the requirement of the question.

Summary of key points

- Encourage candidates to read each question part carefully and underline key words.
- Develop candidates' skills in producing clear explanations when answering questions and make sure they understand command words such as 'discuss'.
- Provide further practice in interpreting distance:time graphs, in particular finding gradients to calculate speed.
- Emphasize the importance of understanding the required practicals, in particular being able to state and explain independent, dependent and controlled variables.
- Further experience is needed in writing balanced nuclear fission equations.
- Provide further opportunities for candidates to work through multi-stage calculations.

GCSE (NEW)

Summer 2019

UNIT 3 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 of the candidates were able to state the independent variable as 'the type of catalyst' and many were able to state at least one of the controlled variables, with the same volume of hydrogen peroxide the most popular choice, although a significant minority used the word 'amount' rather than 'volume' – please note that 'amount' is not an acceptable term for any measured quantity. Fewer candidates could state two controlled variables.

The dependent variable in this case is the 'time to produce 100 cm^3 of froth', which was given in the guidance to the candidates. Many candidates managed to identify this.
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, 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 again encouraged to remind candidates about this.
The Risk Assessment was still the least successful part of the examination across all the Packs, both Higher and Foundation and Single and Double Award, although the quality was slightly higher this year.

Very few candidates at foundation level identified a fourth hazard and that the hydrogen peroxide is an irritant. Many candidates could identify injuries caused by the hazards, but fewer could state the actions that might bring them about. This still needs emphasising as it ensures parity with the Risk Assessment elements of the other GCSE Sciences.
Candidates did have more success with identifying suitable control measures.
Centres are again, strongly recommended to revisit this with their candidates.

Pack A Activity 1 Task B

The vast majority of candidates managed to take a decent set of repeatable results in this experiment, but a significant proportion were confused about recording times in minutes and seconds, which caused problems for some candidates in Task C.
Most candidates were able to produce their own table, and tested all three catalysts, repeated three times.
Many candidates were less able to accurately indicate the correct units, but a significant proportion included the units in the rows of the table as well, which is not accepted. Many candidates recorded their times with an inconsistent number of decimal places. 'Mins' and 'secs' are not acceptable as units for time.

Pack A Activity 1 Task C

Most candidates were able to calculate some form of mean, but some candidates were confused about times recorded in minutes and seconds, and then found keeping consistent decimal places difficult.

The bar chart scale proved to be quite challenging for some candidates, particularly if their means were confused by times in minutes and seconds. Many candidates lost marks for not adding a correctly written origin on their mean time scale.
Most candidates could calculate the volume of froth produced per second, although there were many cases of error carried forward. Some candidates were unable to keep the number of decimal places consistent.

The majority of candidates identified manganese(IV) dioxide as their best choice to propel the drone and then justified their choice in terms of the shortest time to produce a fixed volume of gas.

Pack A Activity 1 Task D

Candidates have still found the evaluation tasks quite hard, and it is clear that they need even 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 were unable to give an answer, let alone a plausible reason.

Some candidates were able to suggest a source of inaccuracy, mostly in terms of it being difficult to determine when the volume of the froth reached 100 cm^3.
The suggested improvements did not need to link to the suggested source of inaccuracy.
Most candidates suggested more repeats as a possibility. Any sensible suggestions were given credit.

Some candidates were able to discuss the repeatability of their results, candidates needed to state if their results were or were not repeatable, and then needed to qualify their statement.

Pack A Activity 2 Task A

(a) (i) The majority of candidates were able to correctly determine the missing test levels.

(ii) Most candidates could use the values from **(a) (i)** to state why the water is unsuitable for fish.

(iii) Most candidates also stated that water conditioner could be added to the water to make it suitable for fish.

(b) (i) Candidates found this question quite challenging. Most were able to give a simple description of how the levels changed, but very few were able to use the day data on the graph to quantify the change.

(ii) Most candidates could state the relationship between the three different nitrogen compounds, but some candidates repeated 'nitrate'.

(iii) Unsurprisingly, a significant minority of candidates were unable to calculate the rate of change of total nitrogen, and many candidates simply left this question out.

Pack A Activity 2 Task B

Many candidates were able to suggest if the method detailed in the Resource folder was suitable or unsuitable, with most opting for suitable and then qualifying this by stating how easy it was to do the tests. A minority of candidates simply described what the test was.

A good number of candidates were able to suggest an improvement, with many stating 'repeat the test' and some suggesting to 'use a digital meter'. Both of these were acceptable answers.

Only a minority of candidates were able to suggest and explain why the test alone is unsuitable for testing water from a water butt, although those that did, managed to talk about potential micro-organisms or other pollutants in the water.

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 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 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.

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 rubber bands are a hazard, some did not state that it was when they snap, and even fewer identified that the risk was eye/facial injuries occurring when the weights were added. 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 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.

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.

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.

Most candidates at higher tier were able to evaluate the quality of their data, and generally discussed repeatability and sources of inaccuracy.

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 ^{o}C rather than 10 ^{o}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 candidates were confused by the unusual shape of the sodium sulfate solubility graph.

(c) Most candidates got this question correct but a few simply left it out.

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 ^{o}C and 60 ^{o}C and justify their answer.

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 (SINGLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 3 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 a good graph/chart 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 catalyst', 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 'volume of hydrogen peroxide' was the most common correct response, closely followed by the volume of froth needed. A few candidates identified two controlled variables, with the number of detergent drops being the most popular choice. Please note that 'amount' is not an acceptable term for volumes. 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 'time to produce 100 cm^3 of froth', 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 time to produce 100 cm^3 of froth), and that the suggested method would actually work in practice, including 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.

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.

Most candidates at higher level can identify the specific nature of a hazard but then struggle to identify the risks with the actions causing the risk. For example, whilst many candidates could identify that the dilute hydrogen peroxide is an irritant, not many identified that this could cause eye/skin rashes whilst pouring it into the measuring cylinder. 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 A Activity 1 Task B

The vast majority of candidates managed to take a decent set of repeatable results on this experiment, but a small proportion were confused about recording times in minutes and seconds, which caused problems for some candidates in Task C.
Most candidates were able to produce their own table, and tested all three catalysts, repeated three times.
Many candidates were less able to accurately indicate the correct units, but a number of candidates included the units in the rows of the table as well, which is not accepted. Many candidates recorded their times with an inconsistent number of decimal places. 'Mins' and 'secs' are not acceptable as units for time.

Pack A Activity 1 Task C

Most candidates were able to calculate the mean times, but some candidates were confused about times recorded in minutes and seconds, and then found keeping consistent decimal places difficult. Most candidates could then calculate the mean rate of decomposition, although there were a number of error carried forward versions.

Most of the Higher Tier candidates could successfully plot the bar chart, although some lost marks for not adding a correctly written origin on their mean time scale, and some plotted 'mean time' rather than 'mean rate of decomposition'.

The majority of candidates identified manganese(IV) dioxide as their best choice to propel the drone and then justified their choice in terms of the shortest time to produce a fixed volume of gas, or the greatest rate of decomposition.

Many candidates could then calculate the volume of gas produced in 60 minutes, but once again 'error carried forward' was used frequently.

Pack A Activity 1 Task D

Candidates have still found the evaluation tasks quite hard, and it is clear that they need even more support from centres prior to the exams.
Candidates were first asked to evaluate their method. This requires an answer (whether it is suitable or unsuitable) plus a plausible reason why. Many candidates generally discussed how they did the experiment, rather than evaluating it.

Some candidates were able to discuss the quality of their data in terms of the repeatability of their results. Candidates needed to state if their results were or were not repeatable, and then needed to qualify their statement. Some candidates were able to suggest a source of inaccuracy, mostly in terms of it being difficult to determine when the volume of the froth reached 100 cm^3.

A few candidates successfully discussed the validity of their conclusion.

The suggested improvements did not need to link to the suggested source of inaccuracy. Most candidates suggested more repeats as a possibility. Any sensible suggestions were given credit.

Pack A Activity 2 Task A

(a) **(i)** The majority of candidates were able to correctly determine the missing test levels.

(ii) Most candidates could use the values from **(a)(i)** to state why the water is unsuitable for fish.

(iii) Most candidates also stated that water conditioner could be added to the water to make it suitable for fish.

(b) Many higher tier candidates could calculate the rate of change of total nitrogen.

(c) Most candidates could state the relationship between the three different nitrogen compounds but found explaining the interplay between the compounds using the diagram of the aquatic nitrogen cycle more difficult.

Pack A Activity 2 Task B

Many candidates were able to suggest if the method detailed in the Resource folder was suitable or unsuitable, with most opting for suitable and then qualifying this by stating how easy it was to do the tests. A minority of candidates simply described what the test was.

A good number of candidates were able to suggest an improvement, with many stating 'repeat the test' and some suggesting to 'use a digital meter'. Both of these were acceptable answers.

Some candidates were able to suggest and explain why the test alone is unsuitable for testing water from a water butt, although those that did, managed to talk about potential micro-organisms or other pollutants in the water.

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 in the 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.

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.
Most candidates at higher level can identify the specific nature of a hazard but then struggle to identify the risks with the actions causing the risk. For example, whilst many candidates could identify that the rubber bands could snap and flick back into someone's eye, not many identified that this could cause an eye injury whilst adding the weights. 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 Activity 1 Task B

The vast majority of candidates managed to take a good set of repeatable results on 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 not spotting that the required mean extensions needed to be in metres.

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. Most candidates on the higher tier were able to use the graph to identify a suitable combination of rubber bands needed to produce an extension between 5 and 10 cm, although some candidates who used a non-uniform assortment of bands found this more difficult.

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.

Most candidates at higher tier were able to evaluate the quality of their data, and generally discussed repeatability and sources of inaccuracy.

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 higher tier 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 ^{o}C rather than 10 ^{o}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 tier candidates were able to answer this question well, unlike on the foundation tier paper. They were not confused by the unusual shape of the sodium sulfate solubility graph.

(c) Most candidates got this question correct but a few simply left it out.

(d) This question proved harder for the higher tier candidates. There are several possible valid answers, but quite a few candidates simply talked about the variation in the solubility of sodium sulfate.

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 ^{o}C and 60 ^{o}C and justify their answer.

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 (SINGLE AWARD)

GCSE (NEW)

Summer 2019

UNIT 4 – 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 Single 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), **(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 compounds using chemical analysis
This experiment was only available to Single Award Applied Science candidates and was not a popular choice.

Section A

(a) Candidates had difficulty in the risk assessment in linking the risk to an action.

(b) Candidates could choose to present their data in 1 table or in 4 separate tables. With so much data to record it was common to see a lack of clarity in column headings.

Section B

(a) It was pleasing to see that some candidates were able to identify all 4 compounds correctly.

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

Although it was evident that many knew the meaning of the term reproducibility, candidates could not clearly express whether the results given showed reproducibility. Some were able to identify colour perception as an issue, but answers lacked clarity.

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

Candidates were presented with information about an unfamiliar experiment. Some of the better candidates handled this well and were able to identify the independent and dependent variables but they could not suggest a controlled variable.

(iii) Many could state the range which was pleasing.

(iv) Candidates were given relatively simple data to plot but candidates in single award applied science often struggle to determine a suitable scale. It was common to see incorrect plotting and the quality of the line was often poor.

(v) Most could state the relationship between the variables.

(vi) It was pleasing to see some good attempts here with candidates using the graph to determine a value and reach a conclusion.

(vi) Most candidates did not know the difference between qualitative and quantitative data.

(d) **(i)** and **(ii)**

The final section of this paper suggested another method for determining nitrate concentration. Candidates found it difficult to compare this to the colorimetry experiment previously outlined.

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.

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