AQA

LEVEL 3
CERTIFICATE IN MATHEMATICAL STUDIES

1350/2C Graphical Techniques
Report on the Examination

1350/2C
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Question 1

Students scored well on this question. In **part a**, the vast majority of students were able to work out the correct ratio. The most common incorrect response was the first option, as they had chosen the reverse order for the ratio.

In part b, most students chose the first alternative method to check if the data given supported the claim. On some occasions, mistakes were made as a result of choosing the wrong values from the table. While most students were able to work out the total number of medals for the two countries identified, some made arithmetic errors in the division or rounded the final values incorrectly. Students who used the second alternative method often made incorrect conclusions at the end. Those who followed this method usually scored two marks but lost the final mark. A few students continued with further incorrect methods after getting the right answer, and as a result they did not gain the final accuracy mark. There were instances of missing brackets which were not recovered, leading to incorrect answers.

Question 2

Just over one third of students scored full marks in **part a**. The most common responses typically related to adding the *y*-axis, adding gridlines, or avoiding the symbols from overlapping each other. Some students made criticisms about the graphs, but did not make any recommendation to improve them. These students were able to gain one mark for writing at least two errors on the graphs. Common incorrect responses on the improvement included labelling the axes or using colours.

On **part b**, about 90% of students correctly identified from the preliminary material that 35 (children aged 7) equated to 42% of the data. Only 60% of students went on to apply a valid reverse percentage method to establish the correct answer, with many students attempting to combine their findings with other percentages from the graph. There was no tolerance of subsequent working on the mark scheme.

Only 25% of students got full marks on **part c**. Students found identifying or describing the mistake difficult, in many cases offering an alternative method instead. The most common incorrect response was suggesting that there needed to have been a conversion to minutes. Building on this conversion would still typically lead to a correct re-calculation for two marks, with 28% of students being awarded as such. There are many examples in the additional guidance on the mark scheme that highlight the tolerance to the range of responses, but simply stating that 4hr 45m does not equate to 4.54hr would have been adequate.

Less than a third of students obtained the single mark available on **part d**. The ideal response was to reference unknown population sizes, but there was a common misconception that different sample sizes impacted the claim. A typical incorrect response would state that a small percentage from a large sample was greater than a large percentage of a small sample. The mark scheme was tolerant of some other responses, such as those that indicated the survey may not be representative. Simply stating a sample was taken was insufficient. Some students did make the argument that children (or parents) may disclose incorrect information due to the age restrictions for social media. This was accepted.

Despite being told not to comment on the graphs in **part e**, many students proceeded to do so and so could not gain any credit for their remarks. However, more than two thirds of students were able to make at least one valid comment, with the most common being to point out the mixture of fractions and percentages, as well as noting various issues with the age groups used. Some students stated that the report would have been better if actual numbers of people were used rather than percentages. This was not accepted as a valid reason because it would have made it more difficult to make comparisons between ages or groups of ages.

Part f required students to use the values given in the question along with one sourced from the preliminary material to make an estimate. The required value from the preliminary material was stated as two thirds in the text but 66% on graph 2. Both values led to the same rounded answer and we accepted working that used either. Around a quarter of students were able to reach the rounded answer of £28 million. Many students made place value errors when working with millions and billions. The mark scheme allowed for such errors without penalty up to a maximum of four marks. Around 88% of students were able to gain at least one mark. Those who scored 1-3 marks generally missed one or two parts of the chain of calculations required. It was also common to see the currency conversion applied incorrectly.

Question 3

This question was the first of the component specific section of the paper. Sections G4 and G5 of the specification were primarily assessed, but other elements and skill sets were embedded within the items. The context centred around the design parameters of a playground slide.

Part a was well attempted by the majority of students. It comprised a single-mark calculation of time, given speed and distance. There was a 2-decimal place degree of accuracy expected in final answers, but the mark scheme tolerated two significant figures if working was shown. Incorrect responses usually came from multiplying rather than dividing.

The mark scheme for **part b (i)** allowed many students to access partial credit on this item, and a follow-through from **part a** was permitted. The procedural element that proved hardest for students was the correct calibration of their time-axis based on their last answer, with many students placing their time at the end of the graph rather than under the apex. An incorrect calibration could still unlock two marks for using the appropriate intersections at a speed of $2ms^{-1}$. 70% of students were awarded 1 mark, 40% 2 marks, and 20% the full 5-marks, making this item a strong differentiator.

Only 17% of students achieved full marks on **part b (ii).** This item required an interpretation of acceleration on the graph. One mark was awarded for either stating it was constant in both instances or specifying the direction of both, with deceleration allowed to imply direction. A quarter of students failed to score, with the misinterpretation that the graph showed acceleration was increasing and decreasing. Phrases such as ‘increasing constantly’ had to be awarded zero and were in line with other responses that described speed rather than acceleration.

A multiple-choice response was used in **part c** to confirm which values lied within the design parameters by validating coordinates lied within a graphical region. This was well attempted by the majority of students.

Question 4

Question 4 assessed linear equations from worded descriptions. The context compared a linear flight path of a tennis ball to a parabolic one.

70% of student correctly identified the curve as a quadratic parabola in **part a**. The most common incorrect response was exponential.

In **part b,** two marks were accredited to drawing the correct linear path of the ball and an additional mark was for taking a reading from the intersection. The mark scheme did allow a follow-through from an incorrect line providing it was from a valid attempt. Invalid attempts include arbitrary curves (contrived parabolas). Some students potentially did not realise the question demanded a plot of a line, instead interpolating between some points they felt represented the flight enough to extract a reading. About a third of students were awarded full marks, with two thirds awarded one mark, usually from a follow-through intersection.

Question 5

This question was contextualised around the dimensions of a sculpture with unusual geometry. It linked four variables together: length; width, height and cross-sectional perimeter. An annotated image was used to help students visualise what was to be analysed in each item.

Part a required students to recognise that a constant dimensional rate of change would result in mid-values of width and height, half way along the sculpture. Unexpectedly, only half of students scored on this item and many students could find the mid value of 1 and 0.4 much better than they could between 1 and 4, with only 36% scoring for both.

The calculation of values from the equation in **part b (i)** was well attempted, with nearly all students scoring at least partial credit. Once the points were plotted a smooth curve was to be drawn connecting the points, but many students missed out on the final mark as they did not recognise the domain of w and extended their curve out of valid range.

The requirement in **part b (ii)** was to recognise the correct relationship between perimeter, width and position along the length of the sculpture. Only 17% of students successfully did this. The majority of incorrect responses stated that the perimeter decreased. These incorrect responses possibly stemmed from their previous graph showing a decreasing function of P with respect to w.

Question 6

Question 6 was the first analysis of exponential models on this paper. The context was the growth of water hyacinths, an invasive plant. Students were primarily assessed on taking graphical data and processing it into an exponential equation, before being asked to describe the limitations of such a model.

Just less than a quarter of students scored the single mark on **part a**. The knowledge of gradient representing instantaneous change has not been assessed in this manner previously, but the mark scheme gave a generous window of tolerance to allow students to find where the gradient was 1.

There was high variance in the marks awarded on **part b**, with just over a quarter of students achieving full marks. From the low-scoring attempts, there was evidently a lack of knowledge that the value at the initial time is equivalent to the coefficient of the exponential term. Most single mark attempts came instead from attempting to substitute in a valid coordinate from the graph. For students progressing to apply logarithms, there were often errors in how to apply it to each term, with the coefficient A often being ignored or incorrectly eliminated. Very few students attempted alternative method 2, which was applying simultaneous equations. The majority of these attempts failed to correctly eliminate one variable.

Part c required a reasoning statement about limitations of the model, allowing for contextualised responses. 28% of students scored 2 marks and 35% scored 1. Many attempts at the second reason were effectively repeats of the first. Typical incorrect responses suggested that the data could not be graphed or that an extrapolation was impossible.

Question 7

Students had to analyse more exponential models in question 7, contextualised around temperature changes. The time variable was calibrated in minutes so that students would have to undertake conversions where appropriate. The final item proved accessible to most students, relying on taking a tangent to measure instantaneous rate of change.

Part a only required a time substitution, while recognising 30 seconds should be input as 0.5 minutes. Two thirds of students were able to calculate the correct temperature.

Part b (i) was well attempted, with 40% scoring 4 marks and 24% scoring 3 marks. The majority of those not awarded full marks did not convert the answer into the appropriate format. A small proportion of students attempted trial and improvement techniques, with about half of these obtaining the required level of accuracy. Trial and improvement techniques that did not result in a correct solution were awarded zero.

Very few students were awarded full marks on **part b(ii)**. There was no evidence that students could recall the knowledge that e^x is the instantaneous rate of change for $y = e^x$, or were able to interpret the wording ‘just as the fans start’ as an instant. The majority of responses were average rates taken by calculating two temperatures from two arbitrary times. The mark scheme did allow 28% of students to access a single mark by stating a correct unit for their value of rate, with the proviso it corresponded to the units they had used in a temperature over time calculation.

Part c returned an even distribution of marks from students across the 4 marks that were available. 67% accessed at least partial marks, and 16% were awarded full marks. The majority of students did draw a valid tangent that was within the mark scheme threshold. Mistakes were often made when reading the scale from their tangent. Equating the gradient to the correct time unit was often not seen. For those citing a negative gradient, there was an expectation to take the absolute value given the question demanded a rate of cooling. It is unknown whether those correctly stating positive values did so for this reason.

Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.