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Principal Examiner Feedback

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Students who were well prepared for this paper were able to make a good attempt at all questions.

Arithmetic errors were a cause of lost marks for a significant number of students, particularly when working with negative numbers or with standard form on a calculator. There were also a significant number of misreads especially on question 5(c) with 13 being 'read' as 3, or 18 as 8 and on question 6 (a) with 10.6 being 'read' as 10 or 5.9 as 5.6.

1 It was clear from the responses seen to both parts of this question that some students were unable to recall or calculate the metric conversions necessary to move from kilometres to centimetres. There was also confusion over whether to multiply or divide. Both parts of this question called for division which then brought the further complication of knowing which number to divide by. Ideally, students should be able to look at their answer and question its reasonableness. Getting, for example, a distance on a map of 1 750 000 cm should have raised concern.

2 Many correct answers were seen for part (a). However, some students did give an incorrect answer; if no correct interim values were shown then no marks could be awarded. The main error in part (b) was to round to 2 decimal places rather than the required 2 significant figures.

3 It is disappointing to see so many students unable to square a negative number correctly; this is something that students should be able to do without a calculator. For this reason, −14 was a very common incorrect answer in part (a). On the whole, students had greater success in part (b) than in part (a). The correct answer was very prevalent; when the answer was incorrect the majority of responses gained the first method mark for correct substitution and then followed by errors in rearrangement leading to $11^2 - 100 = 7q$ or found $21 = -7q$ or $21 = 7q$, but then gave an answer of $q = 3$.

4 Whilst many correct answers were seen in part (a), so were a number of incorrect methods. The most popular of these was ordering the frequencies and then selecting the middle number of the ordered list (15) – the spinner number of 5 associated with this frequency was sometimes also given.

In part (b) the usual error of division by 5 rather than 80 was sometimes seen but the majority of students were able to recall the correct method and give the correct answer to this part. A surprising number of students gave an answer of 16 obtained by dividing 80 by 5.

The common incorrect answer in part (c) was $^2/_5$ from those students who spotted that there were 2 even numbers out of the 5 numbers on the spinner but failed to use the relative frequencies. A few students did find the correct probabilities of $^{32}/_{80}$ and $^{12}/_{80}$ but then multiplied rather than added these. Some students used 81 rather than 80 as the denominator of their fraction, wrongly believing that they had to include the forthcoming spin.

5 In part (a) the majority of responses seen were correct. However, it was not uncommon to see an incorrect final answer of 0.8 from the division 8 ÷ 10 rather than the correct 10 ÷ 8. Students who expanded the bracket correctly sometimes then failed to cope with the rearrangement of the equation; occasionally when the 3 was subtracted from both sides, $6y$ rather than the correct $-6y$ was left on the left hand side of the equation. When $2y$ was subtracted from both sides the left hand side of the equation often became $-4y$ rather than $-8y$.

The correct inequality was the most common answer in part (b) but there were a significant number of students who either had the inclusive inequality at the wrong end or completely reversed the inequality signs. Some students attempted to write down an inequality without a variable such as $-3 < 4$. When asked to solve an inequality it is essential that the final answer is an inequality. Hence, in part (c) a final answer of just -2.5 or $m = -2.5$ gained just the method mark. The fact that the answer was negative seemed to confuse some students who decided that this meant they had to reverse the inequality and so gave the answer as $m \leq -2.5$ which also gained just the method mark.

6 When there was an error in part (a) it was due to the sides being squared and added rather than subtracted. Students would be well advised to write down uncorrected values from their calculator before attempting to round to the given accuracy. It was not uncommon in part (a) to see a final answer of 8.8 rather than the 3 significant figures demanded by the question.

There was evidence in part (b) that some students were calculating the size of angle *QPR* rather than of angle *PRQ*. Provided angle *QPR* was clearly indicated on their diagram then the first method mark could be awarded. Students are advised to mark the angle they are calculating on their diagram. Some students lost accuracy in their final answer due to premature rounding; the value of the fraction used in their trigonometric ratio was sometimes rounded before using the inverse trigonometric function.

Common incorrect answers in part (c) were 12.4, 12.44 and 13 but, on the whole, it was well answered.

7 The vast majority of responses were fully correct. Few part marks were awarded in the marking of this question; graphs drawn tended to be either fully correct or completely wrong or blank. A handful of students plotted points and then omitted to join them. A number of students dealt wrongly with the negative x-values, and so plotted only four points correctly out of the six

8 A good number of correct bisectors with correct supporting construction arcs were seen. Some students clearly had no idea what was required of them while some simply drew in a bisector rather than producing a construction. Several students drew intersecting arcs centred at A and C which resulted in them drawing an inaccurate bisector.

9 Those who started by using the fact that the sum of the interior angle and the exterior angle is 180° generally went on to gain at least two marks for finding the correct value for x. Some students recognised the need to work with the $(4x + 28)$ and $(x - 13)$ but produced a quadratic equation to solve, possibly because of the two expressions being in brackets. Having got this far, a significant number of students were able to substitute their value of x to find the size of either the interior or exterior angle of the polygon but were then unable to make any further progress. Others gave the value of n as 33 or divided 180 by 20.

10 Many students gained either full marks or no marks for their solution to this question. Many realised that the question was ‘to do with $y = mx + c$’ but were unable to make sufficient progress to gain any marks. Errors from those who made a start included rearranging the given equation incorrectly to find the gradient and, having found what they thought was the gradient, being unable to use this to find the value of c. Several students were able to use $y = mx + c$ with the given coordinates to find c but many used a value for m that they had not indicated was their gradient.

11 Many correct answers were seen to this question. Some students found the depreciation in the first year and then worked with three times this amount. A few students worked with 4

years rather than 3 years, possibly from an error in counting years. Some gave an answer for just one year rather than three.

12 Whilst many fully correct solutions were seen it was disappointing to see so many students failing at the first hurdle in this question. It was not unusual to see just the left hand side of the equation multiplied by 12, thus giving the incorrect equation of $4(x + 4) + 3(2x + 3) = 7$, or for the numerators to be multiplied by their denominator rather than the denominator of the other fraction. Very few correct answers were seen without accompanying algebraic working but, when this did occur, no marks could be awarded. Students should be reminded of the need to show working when this is demanded by the question. It is, of course, good practice to show working with every question.

13 Part (a) was well done. In part (b) the question required that the answer be given in standard form. Unfortunately, a significant number of students failed to read the question properly and gave an answer of 2600 or 2644 so losing the mark available for the correct answer in standard form.

14 Students should be reminded that, when there is a limited amount of data then using $(n + 1)/4$ to locate the lower quartile and $3(n + 1)/4$ to locate the upper quartile is the more appropriate method. Those who worked with $n/4$ and $3n/4$ frequently got in rather a muddle. Occasionally, the range rather than the interquartile range was given.

15 A common error was to start by marking angle *AOC* as 76°; this resulted in no marks. Students should be reminded that any angles calculated should be attributed. For example, just writing 104° in the work space by itself will not gain a mark – it must be attributed to angle *AOC*, either in the working or by writing it in the correct position on the diagram. Some students clearly thought that *DABC* was a cyclic quadrilateral.

16 Those students who realised the need to work with, for example, x and $100x$ or $10x$ and $1000x$ generally gained full marks. Some students recognised the need to multiply by 10, 100 or 1000, but chose to work with two decimals which, when subtracted, would not leave a non-recurring value, for example x and $1000x$.

17 Students who failed to gain full marks often gained either one mark for squaring both sides of the equation or two marks for carrying on to clear the fraction. Having got this far, the algebraic manipulation to isolate terms in a and then take out a common factor proved a step too far for many. Some students failed at the first hurdle because they did not square the x on the left hand side of the initial formula when squaring both sides.

18 Very common incorrect answers to this question were 15.75 cm in part (a) and then 252 cm in part (b) from those students who used the area scale factor in both parts. The students who realised the need to find the linear scale factor in (a) and then work with the volume scale factor in (b) generally gained full marks.

19 The common error in part (a) was to use the frequency as the height of each bar rather than as the area. Some otherwise correct histograms lacked a scale on the frequency density axis (or a key) and so failed to gain the accuracy mark. Some students attempted to use a key of 1 small square to represent one person. this resulted in a graph that was virtually impossible to read from accurately – such small scales should be avoided. In part (b) some students failed to read the question carefully enough as an answer of 39 rather than a probability was seen on a number of occasions. A common incorrect answer in this part was $^{2}/_{5}$ from those students who found the probability that the person travelled more than 25 km rather than more than 30 km.

20 In part (a), giving the value of n as $3\sqrt{2}$ rather than 3 gained one mark only. In part (b) a significant number of those who multiplied both numerator and denominator by a multiple of $\sqrt{a}$ then failed to simplify the resulting fraction correctly. A common error was to cancel the 5 and the 10 or the $\sqrt{a}$ with the $\sqrt{a}$ at the very start.

21 The most efficient method to factorise the given expression was to use the difference of two squares; this was not spotted by many students. The most common method of solution employed was to multiply out the brackets. Those that did this accurately often got as far as $96a^2 - 24b^2$ but were then unable to factorise this expression. Common errors when expanding brackets included getting b rather than b^2, $-b^2$ rather than $+b^2$ and making sign errors.

22 Those who made a correct start to this question by finding the fifth root of the given probability generally went on to gain at least two marks. Many students who made a successful start to the question gave an answer of $\frac{48}{3125}$, omitting to consider the 5 different permutations for throwing 4 heads and one tail.

23 At this stage in the paper it was disappointing to see otherwise correct solutions spoiled by careless arithmetic errors, for example writing $-12 \div -6$ as -2 or $-12 \div (-4 - 2)$ as -1.5. In part (a) g(−4) × f(−4) was frequently found rather than gf(−4). Whilst the correct unsimplified expression was seen relatively frequently in part (b) it was far rarer for the correct simplified form to be seen. The algebraic manipulation involving fractions caused all sorts of problems. Occasionally in part (c) students would find the correct inverse function but then give this in terms of y rather than x. Some students appeared to think that they were required to give the reciprocal of the function rather than the inverse.

24 A good number of correct vectors were seen for vector *OY*. However, it was notable that a number of students gave the vector *CY* for their answer rather than vector *OY*. Students would be well advised to write down a vector equation for the vector they are attempting to find to make their method of solution clear. Problems were encountered with interpreting the given ratio in order to find vector *BX* (or vector *CX*).

25 Those who failed to work with the angle properties of a pentagon to find an angle in the base of the pyramid were unable to gain any marks in this question. The main error from those who did make some progress through the question was to assume that angle *APO* was equal angle *MPO* or equivalently that the point *O* was the midpoint of *AM*; this was an incorrect assumption. Students who made this assumption were able to gain a maximum of 3 marks. When working through a complex problem like this one, students would be well advised to produce clearly labelled triangles to make clear exactly which angle or side was being calculated. Whilst some solutions were very well presented and made good use of diagrams, others were very hard to follow. Many students made inappropriate use of Pythagoras sometimes in non right-angled triangles or by assuming incorrect right angles.

Summary

Based on their performance in this paper, students should:

- learn metric conversions e.g. 1 km = 1000 m, 1m = 100 cm
- read the question carefully to ensure that the answer given is that required by the question
- practise working with negative numbers and standard form on calculators
- practise algebraic manipulation, involving fractions in particular
- maintain accuracy throughout a solution, only rounding the final answer.

- make sure all sides and angles are clearly identified when working with geometry and trigonometry.