AS

MATHEMATICS

7356/2: Paper 2

Report on the Examination

7356

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General

The second sitting of Paper 2 of the new AS specification proved to be more accessible to students, with the overall mean mark up over 2%. This increase masked varying performances in Sections A and B however, with an improvement in Section A (up over 7%) but a fall in Section B (down over 7%).

It was pleasing to note that students had responded positively to the advice given on tackling 'fully justify your answer' type questions. In many cases much more detail was provided in solutions to justify the required proof, giving the necessary rigour the questions required.

Overall, good work was seen in Q5, Q6, Q8(a) and Q9(a) in section A and in Q16(a) in Section B.

In Section A, students displayed improved algebraic skills in general, although many failed to gain marks through errors in manipulation, for example when simplifying the multiplied out expression in Q9(a) or when completing the solution to Q6.

The use of the calculator by many students continues to impress, although students need to remember that it should not be used to solve a 'fully justify' question with no other working. This was particularly important in Q6 where quoting the correct answer $a = 16$, with no supporting working, scored zero.

Centres are reminded that some knowledge of the Large Data Set is a part of the specification. It is disappointing to report that comments made by students on scripts indicate that a number of centres are not using the Large Data Set. Centres need to make students aware of the new Large Data Set containing data on car emissions.

It is unclear why students found Section B more challenging this year with questions14, 15 and 16(b) proving less successful than expected.

Question 1

This question on finding the gradient of an exponential curve at a point proved to be a good start to the paper for the majority of students, with the majority correctly choosing option 1.

Question 2

There was an excellent response to this question. Students completed the square confidently to obtain the correct centre, with the large majority correctly choosing option 2.

Question 3

This question proved to be more challenging than expected. The vast majority of students went straight to finding θ using $\sin^{-1}(-0.1)$ and from that $\cos\theta$. This approach scored 0 marks as the question required the exact value of $\cos\theta$.

It was necessary to use the identity $\sin^2\theta + \cos^2\theta = 1$ to obtain $\cos\theta$ and then to recognise that because $180^\circ < \theta < 270^\circ$, $\cos\theta$ would be negative. Errors noted included using incorrect versions of the identity such as $\sin\theta + \cos\theta = 1$, not identifying that $\cos\theta$ would be negative and squaring -0.1 to get -0.01.

Question 4

The vast majority of students made a positive start to this question and were able to use at least one rule of logarithms correctly, and in many cases two. However, only a few students then went on to complete a rigorous argument to show the required result.

There were two main approaches used. Those students who started by fully simplifying each term were much more successful in reaching the required result. Those who combined all of the terms to reach $log_{10}\left(\frac{9x^2}{100}\right)$ or an unsimplified equivalent for 2 marks, struggled to go on and obtain the required result. A minority of students tried to work with both sides and invariably ended up confusing themselves.

In some cases, students made too many 'jumps' in their proofs which got them to the given result. This led to the loss of 1 mark for not showing enough working to make it clear that the required result had been shown.

Errors seen included mistaken application of the laws of logarithms, such as, for example:

- $log_{10}\frac{x^4}{100} = 4log_{10}\frac{x}{100}$
- 'cancelling' the logs on both sides, creating an equation which was solved to find a solution for x.

Question 5

This question on the sine rule and area of a triangle proved to be a good source of marks for many students.

The approach expected was to use the sine rule to find one of the missing sides and then to use the area of a triangle formula $\frac{1}{2}absinC$ to find the area of the cross section, and finally multiply by 300 to obtain the required volume correct to 3 significant figures

An alternative approach of trying to find the perpendicular height of the triangle was taken by a few students with limited success.

A significant minority of students quoted the formulae for the sine and cosine rules, but did not know how to apply them in this case.

Common errors made in this question included:

- just finding the area of the triangle, not the volume of the triangular prism
- finding the surface area of the prism rather than its volume
- rounding the area too early, giving a volume of 61800 rather than the required 61900.

Question 6

A significant number of students were unable to convert the $\frac{2}{x\sqrt{x}}$ term into the required $2x^{-\frac{3}{2}}$ in order to integrate. Even if the correct power was used, there were still students who subtracted rather than added one to the power when integrating. Some thought that converting to the negative power also completed the integration process and did no integration at all.

There were two accessible method marks for equating any recognisable attempt at an area to 3 and for substituting the upper limit of ‘a’ and the lower limit of ‘1’ into an area expression and subtracting.

A number of students failed to gain the final mark because they incorrectly went from $\sqrt{a} = 4$ to an answer of $a = 2$.

A minority of students solved an integral equation on their calculators and simply quoted ‘$a = 16$’ without any justification. This approach scored zero as the question clearly asked students to fully justify their answer.

Despite all of this, some excellent work was seen.

Common errors made in this question included:

- writing the limits of ‘a’ and ‘1’ the wrong way around
- incorrect integration.

Question 7

There was a wide range of responses to this question, some valid and some invalid. Often students were unable to picture the relative positions of the given points on the circle and the given point on the diameter thus leading to incorrect assumptions about the points (for example that the coordinate (2, 4) was on the circle.) Those students who drew a quick sketch of the situation seemed to make better attempts at the question.

To find the value of a the gradient from (2, 4) to the point B could be equated to the gradient AB to obtain $a = -2$. Unfortunately many students did not consider the gradient of AB or from A to the point (2, 4) and so did not get to a value for a

Most students picked up a method mark for finding at least one midpoint.

Many students failed to gain marks by not fully appreciating that e was the radius squared, so once the diameter had been found, (which was what most students attempted), it had to be halved and then squared in order to get the correct value for e. Some students, who had actually calculated e by using the midpoint, didn’t realise what had been calculated and went on to do further work with this value, which failed to gain the final mark.

Common errors in this question included:

- not quoting the values of, in particular, c, d and e
- incorrectly quoting the values of b and c having not referred to the equation of the given circle
- quoting incorrect formulae for the midpoints and distance between two points.

Question 8

There was some very pleasing work seen in (a) although there were some errors when both simplifying and solving the two equations.

In terms of forming the required two equations, more students seemed comfortable forming an equation using the gradient of the curve, correctly differentiating the given cubic equation and substituting in the given condition. Few students were put off by seeing coefficients given in terms of ‘p’ and ‘q’.

Perhaps more surprising was that many students did not use the fact that the curve passed through the point R to generate the second equation, and so did not substitute R’s coordinates into the original equation

Common errors in (a) included:

- substituting 3 and 2 the wrong way around into the original equation
- calculating the differential and equating it to 3 rather than to 8.

Part (b) proved to be more challenging and was a good discriminator between students.

Many students started correctly by stating the gradient of the normal to the curve and going on to find the equation of this normal at R. Only a minority used the incorrect gradient of 8, but even using this value could still pick up a number of method marks.

It was clear from the work that followed, that the vast majority of students did not understand what the question was asking them to do. Seeing the words ‘area enclosed’ led to many trying to find the area enclosed between the normal and the curve. This incorrect strategy generated some very complex algebra, with students making no further progress.

What was required was the area between the normal to the curve at R and the coordinate axes, i.e. a triangle. Those students who recognised this went on to find the x and y intercepts and hence the required area of 42.25.

Question 9

Part (a) of this question proved to be a good source of marks with the majority of all students scoring at least 5 out of the 8 marks available. In (a), there was a requirement for students to fully justify their answer, so it was important for each necessary step to be seen, and explained, in the solution given.

Students recognised the need to initially multiply out the brackets to obtain a cubic expression, but there were often errors when doing this. Method marks were still available to those who obtained an incorrect multiplied out version of $\mathrm{f}(x)$.

Students differentiated their cubic functions well, set their resulting quadratic expression equal to zero and solved to find the two values of x. There was a specific mark, as part of the full justification, for stating that at a turning point/stationary value $\mathrm{f}'(x)=0$. This was not often seen in otherwise complete solutions, so students could not gain the final mark. A number of students did not find the y coordinates of the turning points as required.

Many students recognised the need to find the second differential to check the nature of their turning points and carried out this process correctly.

It is important that at the end of the solution the turning points, with their nature, are clearly stated. This was not done in some cases.

Common errors in (a) included:

- expanding $(x - 3)^2$ as $x^2 - 6x - 9$
- assuming that the stationary points were at $x = 2$ and $x = 3$ due to the bracketed terms in f(x).

In (b), many students did not answer the question and made the common error of thinking that the required translation was in fact the final answer, i.e. (-1, -4), thereby gaining zero marks. However, many students gained at least 1 mark for getting the coordinate (2, -4) or applying the correct translation to at least one of their coordinate answers in (a).

Question 10

In (a), many students just stated that A was the initial temperature of the water with no explanation. It was necessary to substitute $t = 0$ to show that $\theta = A$, and then conclude. Some students simply stated that A was a constant, which was given in the question.

In (b), it was necessary to show the given result clearly as the answer was given. Any students who wrote $log_{10}\theta = log_{10}A \times log_{10}10^{-kt}$ scored 0 marks whatever followed. If the addition sign was seen at this stage, then students usually went on to achieve the given result.

In (c), many students achieved 2 marks for forming two correct equations in A and k. It was surprising that the result shown in (b) was not used more, as equations in the original exponential form were commonly seen. Some students found one equation only and tried to find the two missing values from this equation without recognising the need for a second equation. There were also a number of careless errors in setting up the equations, for example 20 being substituted into the 12 position as well as its own position.

Going on to find A and k from the two equations proved to be challenging for many students, especially those who used the exponential form.

In (d) students who did not find a value for A or k in (c) were unable to gain any marks here. There was a method mark for carrying forward incorrect values found in (c) even if the resulting answer was clearly incorrect. Some students did not make a clear comparison with 1°C and consequently failed to gain the final mark.

In (e) many students incorrectly assumed the model would go into negative temperature values after 45 minutes and made incorrect comments relating to this. A significant number of students referred to water freezing at zero or to the rate of change changing (which was covered by this model). Some students lacked the clarity needed to gain this mark – some referred to 'temperature', but did not state whether they were referring to the initial temperature of the water, the temperature of the water after 45 minutes or the outside temperature.

Question 11

This question was very well answered.

Question 12

This question was not well answered. Many students were unaware that the value of the product moment correlation coefficient must lie between -1 and +1.

Question 13

In (a) it was clear that many students had little practical experience of the Large Data Set. In fact, as was noted by a number of students in their responses, many did not even know of its existence. A very small number of students quoted the required electric/petrol (hybrid was accepted on this occasion), but only a handful knew the reason why this was the correct category of propulsion type.

Parts (b) and (c) were very well answered. In (b) some students failed to gain the mark for just quoting a mean of 72. Whilst we expect the population standard deviation to be used, the sample standard deviation was accepted.

Part (d) was generally well answered, provided the answers to (b) and (c) were correct. Some students were unclear what the phrase ‘more than 2 standard deviations from the mean’ meant in terms of the calculation required.

For part (e) students only had to state that the value would decrease (in any acceptable form), and the majority successfully did this.

Question 14

In (a) many students were unable to find the probabilities for each individual value of X. Whether this was due to the notation used in the question or something else was unclear. Students do need to be able to handle various ways that the probability distribution for X could be given. In some cases the students did not sum the individual probabilities and equate to 1. Those who assumed that $c = 0.1$ and then added the probabilities to achieve a total of 1, scored 1 of the 2 marks available.

In (b) the expectation was that students would use the given value of c from (a), even if they could not complete the required “show that.” Some students tried to use a B(4, 0.1) distribution to find $P(X \geq 1)$

Question 15

In many cases, students recognised the need in (a)(i) to use the formula, from the formula booklet, $P(A \cup B) = P(A) + P(B) - P(A \cap B)$. However little progress was often made after that, especially when incorrectly assuming that $P(A \cap B) = 0$, which led to the common incorrect answer of $P(B) = 0.6$

A significant number of students obtained a value of $P(B)$ greater than 1 (most commonly 4) and did not seem concerned by this. Those who correctly used the independence result for $P(A \cap B)$, generated an equation in $P(B)$, although some were unsure how to combine the two terms in $P(B)$, and so did not solve the final equation.

Those students who answered (a)(i) correctly, usually answered (a)(ii) correctly as well. There was a mark available here for any answer from (a)(i) multiplied by 0.2, provided the value of P(B) used was less than 0.8

Few students obtained the mark in part (b) for correctly identifying with a reason that A and B were mutually exclusive. The most common response accepted being that if A and B were independent events then A and B could not be mutually exclusive.

Question 16

There was an improved response to the hypothesis testing question this year, with the average mark up around 4%.

Many students were able to correctly define the null and alternative hypotheses, although some errors were still noted, including using μ as the parameter, mixing up the inequality/equals signs and defining a 2-tailed instead of a 1-tailed test.

Most students recognised the need to use a B(60, 0.12) distribution and credit was given if any clear use of this distribution was made, even incorrect use. As usual, the major issue was whether P(X = 4) or P(X ≥ 4) was calculated as the test statistic. Students using P(X = 4) were only able to achieve 2 of the available marks. A few used P(X ≤ 3) and obtained some further credit for this. A few students were very confused and either expressed $\frac{4}{60}$ as a percentage and compared this to 0.1 or found E(X) as 7.2 and then tried to work with P(X ≥ or ≤ 7.2)

It was clear that students recognised the need to compare the value of their test statistic with the significance level of the test, however this comparison must be clear, and students are advised to express this comparison as a direct inequality rather than some unclear comparison in words.

In a number of cases getting to 0.139 > 0.1 still led to a rejection of Ho. Many students also failed to gain the final mark by not making a sufficiently clear concluding statement. It is useful to use 'insufficient evidence to suggest that the proportion of faulty chargers has reduced' rather than saying 'it has not reduced'. It is important that in this statement students use 'proportion of' rather than 'number of'.

In part (b) many students knew that independence and a constant probability of success were relevant assumptions, but did not discuss these in the context of 'faulty chargers' as required. An alternative correct assumption was that the sample of chargers was random.

Mark Ranges and Award of Grades

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