AS
MATHEMATICS

Paper 2
Report on the Examination

7356
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General

This first paper 2 of the new specification proved challenging to the students, especially in Section A. The students seemed more comfortable with the statistics content of Section B, and in many cases were able to pick up a significant proportion of the marks available. Students appeared confident in their use of the statistical functions and distributions on their calculators.

In many of the Section A questions, students lacked the algebraic fundamentals to be able to make significant progress, despite often formulating the basis of their solutions correctly. Method marks were available in these cases, but it was a shame that careless errors and poor algebra hindered accessing all of the marks available. Good work was seen in Q3, Q5, Q6 and Q7a in Section A and in Q15a and b, Q18 and Q19 in Section B.

In the multiple choice questions it is vital that students follow the given instructions carefully as there were cases where no choice was clearly identified and also where two choices were identified.

It was pleasing to see that in some questions, eg Q10, students persisted when their initial method proved to be unsuccessful, and they were able to improvise and find a way of getting to the correct solution. Students should always be encouraged in multi-part questions to attempt all parts, as often marks can be picked up despite not making any progress in the earlier parts.

Question 17, which was based upon the data set, was very poorly attempted. Less than 8% of students picked up any marks. It seemed that many students were unaware of the data set or had not spent much time familiarising themselves with it.

Note the following advice:

- students should know when to use their calculator and when they must show every step of their working (and assume the examiner does not know what to do), especially when questions includes the words ‘Fully justify your answer’
- students need to use a range of checking techniques to see whether their answers look sensible, not least when they obtain a probability answer greater than 1
- students should work to 4 dp for probability values in hypothesis tests.

Question 1

This integration question proved to be a good start for a large number of students with around 57% correctly choosing option 3, while around 32% chose option 2.

Question 2

Students seemed comfortable with the transformation required in this question with around 62% correctly choosing Figure 3. Around 23% mixed up the required stretch and incorrectly chose Figure 5.

Question 3

This question was well answered. Students were able to manipulate the given log expression confidently to reach the correct answer of $\log_a 12$. In a minority of cases errors such as simplifying $\log_a 36 - \log_a 3$ to $\log_a 33$ and more commonly $\log_a 36 - \log_a 3$ to $\frac{\log_a 36}{\log_a 3}$ were seen.

Question 4

Many students were able to score at least 2 marks by rearranging the given equation and finding at least three correct solutions. Fewer students considered both the negative and positive square roots of 3 to obtain the full set of 8 correct answers. The majority of students made a significant error rearranging the given equation, $\tan^2 2\theta - 3 = 0$ becoming $\tan^2\theta = \frac{3}{2}$ was the most common error. Attempts made by expressing $\tan^2 2\theta$ in terms of $\sin^2 2\theta$ and $\cos^2 2\theta$ were rarely successful.

Question 5

This question was generally well attempted with over a quarter of students achieving full marks. Students recognised the need to expand $\mathrm{f}'(x)$, integrate their expansion and evaluate the constant of integration from the given condition. Unfortunately the expansion proved to be too demanding algebraically for some, with incorrect squaring of the $2x$ and $\left(-\frac{3}{x}\right)$ terms the major issue.

The integration was generally well done, although some students had issues with the negative power and some omitted the constant of integration which prevented them from completing the solution.

Question 6

This question illustrated that many students were unclear of the geometry required to prove that the given four points formed a rectangle. Many students scored 2/4 for showing that the points formed a parallelogram, but investigating for right angles was less commonly seen. Some students incorrectly assumed that the distances between the points were vertical and horizontal. The final mark required a rigorous statement which proved beyond most students. There were many different acceptable methods of proving that the points formed a rectangle.

There were many correct attempts seen for part (b) with 60% of all students obtaining full marks.

Question 7

In part (a), the vast majority of students recognised the need to complete the square, with varying degrees of success. Most were able to remove a factor of 2, but less were able to deal with the algebraic manipulation to achieve the required $\left(x - \frac{5}{4}\right)^2$. One third of all students went on to obtain the correct final result in the given form. Some students expanded and equated coefficients, but did not always put their result back in the required form.

In part (b), students did not always use inequalities as required. A variety of approaches were employed, including using the y coordinate of the vertex, forming a quadratic and using the discriminant and calculus.

Question 8

In part (a), about two thirds of all students were able to draw the required two circles correctly. There were some poor 'hand-drawn' circles which required some liberal interpretation from examiners. It would be preferable if students use a pair of compasses when required to draw a circle.

In part (b) fewer than expected recognised or stated that the y-coordinate of the centre was $y = 5$, and fewer still were able to form an equation to find the possible x-coordinates of the centre: $\pm\sqrt{11}$. Some worked with the general equation of circles which proved a successful strategy. Any correct form of the final two circles was accepted.

Question 9

A significant number of students correctly stated that $\tan 15 = \dfrac{\sin 15}{\cos 15}$ but, disappointingly, then wrote down the given surd forms of cos15 divided by sin15. Many resorted to using their calculator, which gave the final answer immediately, but this approach received no credit as students were clearly asked to fully justify their answer. Some students did not appreciate the necessity of using the conjugate to rationalise.

Question 10

This question proved challenging for many students. Many were uncertain how to proceed and seemed unsure about the term 'coefficient' and were unable to work with the required nCr terms. A significant number of students attached the 1.5 to the wrong side of the equation. It was pleasing to see many students who were unable to complete an algebraic solution successfully resort to using a numerical approach which often generated the required n = 11. It was surprising that more students did not resort to using the equation solver on their calculator to solve their algebraic equation.

Question 11

This optimisation question proved to be the most challenging question on the paper with over 60% of students scoring 0 marks. Many made no attempt at all. Those who attempted did not help their chances by misquoting basic formulae such as the circumference of a circle and the volume of a cylinder. The lack of structure clearly had a major impact which meant that few were able to make any significant progress. Most students were unable to visualise the problem and transfer the given information into the required two equations. Fewer still then reduced these down to an equation in one variable to differentiate. Some students incorrectly thought that the weld length was the surface area. In some cases students recognised what they needed to do, but could not generate a formula that they could work with.

This type of question is one of the most challenging demands of the new specification, and schools and colleges will need to take every opportunity to consolidate the skills required to attempt these questions.

Question 12

This question required the use of the exponential function and natural logs which produced a diverse range of responses. In part (a) about a third of students were able to correctly write down the required two equations using the information given in the question, but solving them simultaneously proved beyond many students. Some used the given value of b to find the value of a, which gained 1 mark and it also enabled them to tackle later parts of the question.

There were many correct responses to part (b) which was well done as long as students had found the correct values of a and b.

In part (c) students mostly failed to use inequalities but this approach did not lose marks. Those students who isolated the exponential term before taking logs were usually more successful than those who took logs straight away, as errors occurred later when simplifying the log terms. Many lost the final mark because they did not quote a year as their final answer as required. Appropriate numerical approaches were accepted and there was some follow through of the students value of 'a', provided $b = 90$ was used.

There were some very good responses to part (d) and over half of all students were able to give a limitation of the model. It was disappointing that over 17% of students did not attempt this question despite it not being dependent upon any of the earlier work in the question.

Question 13

This question was very well done, with over 87% of students correctly choosing option 2.

Question 14

The majority of students correctly chose option 1, but a significant minority chose option 2 having mixed up the requirement to find σ rather than s.

Question 15

There were some good attempts at parts (a) and (b). In (a) students were able to use the binomial distribution function on their calculators to obtain the correct final answer. In (b) students generally recognised the need to cube their answer to (a), however it was disappointing that some multiplied their answer to (a) by 3, obtaining an answer greater than 1.

In part (c) many students did not state their assumptions in context or instead gave 'scientific/practical' rather than 'statistical' assumptions. Examples include: all extraneous variables kept constant, the same darts and dart board are used and the distance from the dart board remains the same each time. It is important that students know the correct distributional assumptions for the binomial distribution and are able to apply them to the context of a question. In this case a 'fixed number of trials' was not given credit as this was stated in the question.

Question 16

Some students were very familiar with how to take a simple random sample and gave a full and clear explanation of the method required. Some students, however, simply defined what a simple random sample is earning no credit. Some students were not familiar with this method of sampling at all and resorted to taking either systematic or cluster samples.

Drawing names from a hat was given little credit (lack of practicality for a sample of 3200). Schools and colleges need to encourage their students to use their calculators to obtain random numbers.

Students who broke the technique down into stages were most successful, although some did not state that either 4 digit random numbers were required excluding any above 3200 or numbers had to be chosen between 1 and 3200 (or 0 and 3199)

Question 17

This question was based upon the large data set and it was very poorly answered with very few students recognising the need to look at units of measurement and consequently not gaining any marks. Incorrect answers seen often related to suggestions that there were rounding errors, data entry errors, some of one type of oil/fat was included in other types, it was a specific year and the data was not representative as it was just a sample.

Clearly it is difficult to fully prepare students for any eventuality in terms of possible questions that could be set from the large data set, but students need to use their experience of the data set as well as their common sense to be flexible in terms of the demands these questions will pose.

Question 18

This question was a good source of marks for most students. In part (a), 95% of students correctly identified the outliers. Although some did not gain further marks, rather than offering an explanation as to the difference in Collins and Donovan's values compared to the others they just stated the reason they had picked them out as the outliers, effectively re-stating the co-ordinate values.

In part (b) students often lost the mark for not indicating the strength of the positive correlation.

Question 19

A hypothesis test for the population proportion was anticipated to be a tough topic for AS students. It was therefore pleasing to note that 17% of all students achieved full marks on this question. The most common error seen was comparing $P(X = 18)$ or $P(X > 18)$ with 0.05 rather than $P(X \geq 18)$. A number of students tried to work with the other tail and compare with 0.95, but those who took this approach were often confused between $P(X = 18)$, $P(X \leq 18)$ and $P(X \leq 17)$.

Other errors seen to a lesser extent included:

- failing to express H_0 and H_1 correctly
- using an incorrect model such as B(20, 0.9) or even B(18,0.9)
- over rounding probabilities in hypothesis tests causing loss of accuracy marks
- calculating 70% of 20 as 14 and using ' ≥ 14' instead of ' ≥ 18' in their test
- calculating 18/20 = 90% and comparing 70% and 90%

Mark Ranges and Award of Grades

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