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Oxford Cambridge and RSA

AS LEVEL

Examiners' report

MATHEMATICS B (MEI)

H630
For first teaching in 2017

H630/02 Summer 2019 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper 2 series overview

This is the second series of the reformed decoupled linear H630 AS Level Maths B (MEI) specification. Candidates coped well with the mixture of questions from the Pure and Statistics parts of the specification.

All part questions were answered correctly by a good number of candidates, and all part questions provided some discrimination since all were sometimes answered incorrectly. Only a few candidates gained full or almost full marks, and very few candidates were unable to make some progress on some of the questions. In particular, the first five questions appeared to be accessible for all candidates. Although the paper design was aimed to have a steady ramping of demand through the whole paper, the majority of candidates made a good attempt on the final question demonstrating good examination technique.

Question 6 was based on the large data set that has been available for some time as pre-release material. This year there were many candidates who appeared not to be very familiar with the large data set. Using the large data set during the AS course helps candidates practise statistical techniques using realistic data, and also prepares candidates to answer questions which are designed to provide material advantage to those that have a good feel for the data in the large data set.

Some candidates did not appreciate that the command word 'determine', used in question 9(c) means that they should justify their answer, giving working where appropriate.

i	**OCR support**	A poster detailing the different command words and what they mean is available here: https://teach.ocr.org.uk/italladdsup

The questions on Hypothesis testing (Q8) and using logarithms in a modelling context (Q9) proved to be the most challenging on this paper.

Question 1

1 Solve the equation $4x^{-\frac{1}{2}} = 7$, giving your answer as a fraction in its lowest terms. **[3]**

This was done correctly by many candidates, but a significant number went wrong. Some candidates did not notice that the index was negative while others thought it also applied to the '4'. Some candidates failed to square the expression to remove the square root. A small number of candidates made no progress at all on this question.

Question 2

2 Fig. 2 shows a triangle with one angle of 117° given. The lengths are given in centimetres.

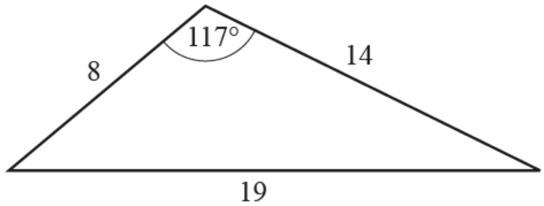


Fig. 2

Calculate the area of the triangle, giving your answer correct to 3 significant figures. **[2]**

This question was generally done correctly using the area formula, though a small minority of candidates found a value for the height of the triangle first. A small number of candidates forgot the 'half' in the area formula, while just a few candidates used cosine rather than sine. Some candidates did not give the answer correct to 3 significant figures as requested in the question.

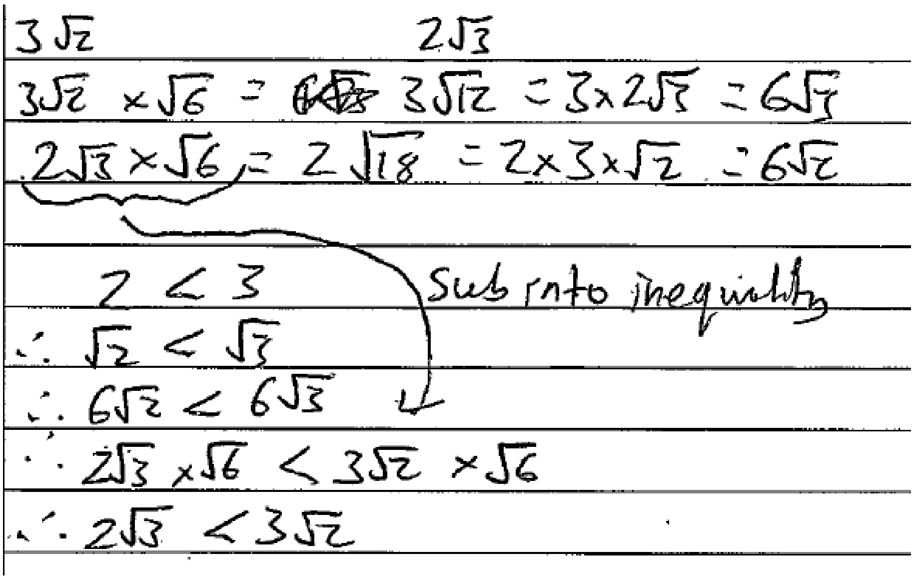
Question 3

3 **Without** using a calculator, prove that $3\sqrt{2} > 2\sqrt{3}$. **[3]**

The most common correct solutions were to write the left side as √18 and the right side as √12, or to square each side to get 18 and 12, and then to point out that 18 is bigger than 12. A considerable number of candidates did not know what to do, and some gave decimal values from calculators, which was not accepted.

There were also some different correct solutions; an elegant one is shown in Exemplar 1.

Exemplar 1


$3\sqrt{2}$ $2\sqrt{3}$

$3\sqrt{2} \times \sqrt{6} = \cancel{6\sqrt{3}}\ 3\sqrt{12} = 3\times 2\sqrt{3} = 6\sqrt{3}$

$\underbrace{2\sqrt{3} \times \sqrt{6}} = 2\sqrt{18} = 2\times 3\times\sqrt{2} = 6\sqrt{2}$

$2 < 3$ Sub into inequality

$\therefore \sqrt{2} < \sqrt{3}$

$\therefore 6\sqrt{2} < 6\sqrt{3}$

$\therefore 2\sqrt{3} \times \sqrt{6} < 3\sqrt{2} \times \sqrt{6}$

$\therefore 2\sqrt{3} < 3\sqrt{2}$

Question 4 (a)

4 The equation of a circle is $x^2 + y^2 + 8x - 6y - 39 = 0$.

(a) Find the coordinates of the centre of the circle. **[2]**

Most candidates were able to complete the square correctly and give the coordinates of the centre, though a few made sign slips. A significant number of candidates did not recognise the need to complete the square, writing things like $x(x + 8) + y(y - 6)$ and often giving the answer as (−8, 6).

Question 4 (b)

(b) Find the radius of the circle. **[1]**

Candidates with the centre wrong in part (a) usually got this part wrong, as did those whose rearrangement of the circle equation in part (a) went astray when finding the constant term.

Question 5 (a)

5 Each day John either cycles to work or goes on the bus.

- If it is raining when John is ready to set off for work, the probability that he cycles to work is 0.4.
- If it is not raining when John is ready to set off for work, the probability that he cycles to work is 0.9.
- The probability that it is raining when he is ready to set off for work is 0.2.

You should assume that days on which it rains occur randomly and independently.

(a) Draw a tree diagram to show the possible outcomes and their associated probabilities. **[3]**

The vast majority of candidates were able to draw a correct tree diagram with correct probabilities and outcomes, but a small number of candidates started with cycling or bus and then went on to raining and not raining . A small number of tree diagrams had three branches and a few others had incorrect probabilities.

Question 5 (b)

(b) Calculate the probability that, on a randomly chosen day, John cycles to work. **[3]**

This part was well done. A small number of candidates with an incorrect tree diagram in part (a) did this part correctly from the information in the question.

Question 5 (c)

John works 5 days each week.

(c) Calculate the probability that he cycles to work every day in a randomly chosen working week. **[2]**

Almost all candidates correctly evaluated $(0.8)^5$, while a few used a Binomial distribution, usually correctly. Common wrong answers came from 5 x 0.8, $(0.8)^7$ or 7 x 0.8.

Question 6 (a)

6 The large data set gives information about life expectancy at birth for males and females in different London boroughs. Fig. 6.1 shows summary statistics for female life expectancy at birth for the years 2012–2014. Fig. 6.2 shows summary statistics for male life expectancy at birth for the years 2012–2014.

Female Life Expectancy at Birth

n	32
Mean	84.2313
s	1.1563
Σx	2695.4
Σx^2	227078.36
Min	82.1
Q1	83.45
Median	84
Q3	84.9
Max	86.7

Fig. 6.1

Male Life Expectancy at Birth

n	32
Mean	80.2844
s	1.4294
Σx	2569.1
Σx^2	206321.93
Min	77.6
Q1	79
Median	80.25
Q3	81.15
Max	83.3

Fig. 6.2

(a) Use the information in Fig. 6.1 and Fig. 6.2 to draw two box plots. Draw one box plot for female life expectancy at birth in London boroughs and one box plot for male life expectancy at birth in London boroughs. **[5]**

Almost all candidates were able to draw two boxplots. However, only a minority were completely correct, with many errors in plotting values.

Question 6 (b)

(b) Compare and contrast the distribution of male life expectancy at birth with the distribution of female life expectancy at birth in London boroughs in 2012–2014. **[2]**

Candidates were expected to make comments in context and provide support from the information given in the question for their comment. While many did this well, quite a lot of candidates either only quoted values from the information given in the question or only made an unsupported comment – like females live longer than males.

A good answer in shown in Exemplar 2.

Exemplar 2

On average women have a higher life expectancy as the median for women of 84 > 80.25 for men.

Women have a more consistent set of results for life expectancy as their interquartile change of 1.45 < 2.15 for men, therefore there is less of a range ~~of variation~~ in life expectancy.

Question 6 (c)

Lorraine, who lives in Lancashire, says she wishes her daughter (who was born in 2013) had been born in the London borough of Barnet, because her daughter would have had a higher life expectancy.

(c) Give **two** reasons why there is no evidence in the large data set to support Lorraine's comment. **[2]**

Many candidates appeared to have little knowledge of the large data set, judging by common answers like 'there is no data for Barnet alone in the large data set'. The most common correct answer was that there was no information available in the large data set for Lancashire alone, although some candidates did not appear to know that Lancashire is not a London borough. A common incorrect answer was that the summary statistics were for the range 2012-2014, and so would not apply to 2013.

Question 6 (d)

(d) Use the mean and standard deviation for the summary statistics given in Fig. 6.1 and Fig. 6.2 to show that there is at least one outlier in each set. **[2]**

There were many good answers to this question, with some candidates explaining carefully that there could be more than two outliers, but there were certainly at least two. Some candidates did not use the definition for outliers based on the mean as standard deviation, which the question required; others did not know the definition involved 2 standard deviations. A small number of candidates found the correct boundaries for outliers, but then failed to compare the boundaries correctly with both maximum values.

Question 6 (e)

The scatter diagram in Fig. 6.3 shows male life expectancy at birth plotted against female life expectancy at birth for London boroughs in 2012–14. The outliers have been removed.

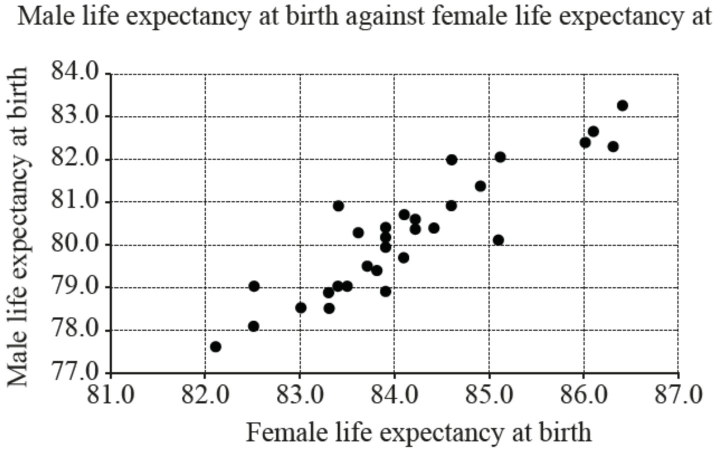


Fig. 6.3

(e) Describe the association between male life expectancy at birth and female life expectancy at birth in London boroughs in 2012–14. **[2]**

Most candidates provided the expected correct answer of positive correlation.

Question 7 (a)

7 (a) Find $\int x^3\left(15x+\frac{11}{\sqrt[3]{x}}\right)\mathrm{d}x$. **[5]**

Some candidates attempted to integrate each term before expanding the bracket while others were unable to expand the bracket to obtain two correct terms to integrate. The problem was in multiplying x^3 by $\frac{11}{\sqrt[3]{x}}$ and the result was that a considerable number of candidates gained a mark for showing $15x^4$ and another mark for integrating this to $\frac{15}{5}x^5$ but no other marks. Those candidates who gained the first 2 marks for expanding the bracket generally ended up with full marks for this part, except for a few who omitted the arbitrary constant.

Question 7 (b)

(b) Show that $\int_0^8 x^3\left(15x+\frac{11}{\sqrt[3]{x}}\right)\mathrm{d}x = a\times 2^{11}$, where a is a positive integer to be determined. **[3]**

Most candidates gained a mark for attempting to evaluate their answer to part (a) at the limits, and many gained a second mark for a correct attempt to then find the value of *a*. A few candidates wrongly applied the limits to the original expression, before it had been integrated.

Question 8 (a)

8 According to the latest research there are 19.8 million male drivers and 16.2 million female drivers on the roads in the UK.

(a) A driver in the UK is selected at random. Find the probability that the driver is male. **[1]**

Most candidates did this correctly, with some candidates using the values 19 800 000 and 16 200 000 rather than the easier values of 19.8 and 16.2.

Question 8 (b)

(b) Calculate the probability that there are 7 female drivers in a random sample of 25 UK drivers. **[1]**

Most candidates used their calculators correctly to find the answer. A common wrong answer was 0.28 (from 7 ÷ 25).

Question 8 (c)

When driving in a built-up area, Rebecca exceeded the speed limit and was obliged to attend a speed awareness course. Her husband said "It's nearly always male drivers who are speeding." When Rebecca attends the course, she finds that there are 25 drivers, 7 of whom are female. You should assume that the drivers on the speed awareness course constitute a random sample of drivers caught speeding.

(c) **In this question you must show detailed reasoning.**

Conduct a hypothesis test to determine whether there is any evidence at the 5% level to suggest that male drivers are more likely to exceed the speed limit than female drivers. **[7]**

Good answers were either based on females, using B(25, 0.45) and the hypotheses H_0: $p = 0.45$ and H_1: $p < 0.45$, or males, using B(25, 0.55) and the hypotheses H_0: $p = 0.55$ and H_1: $p > 0.55$. Most candidates using a correct value of p then went on to compare 0.0639 ($P(X \leq 7)$ or $P(X \geq 18)$) with 0.05. Most then correctly stated that the result is not significant, or that H_0 should not be rejected, and then went on to give an appropriate conclusion in context. However, even good candidates often defined p incorrectly as the probability that a female (or male) driver was speeding, rather than the correct definition as the probability that a driver speeding (or caught speeding) was female (or male).

Partial credit was allowed for candidates who used the value of 0.5 for p.

There were a considerable number of candidates who made little, or no, progress on this question.

Exemplar 3

let p = proportion of drivers at speed awareness causes that are female.

H_0: $p = 0.45$

H_1: $p < 0.45$

$X \sim B(25, 0.45)$

$P(X \leq 7) = 0.06385$

AS $0.06385 > 0.05$, we accept the H_0.

There is not evidence to suggest male drivers are more likely to exceed the speed limit than female drivers.

This candidate is set up and concluded the hypothesis test nicely. The conclusion is non-assertive and in context.

Question 8 (d)

(d) State a modelling assumption that is necessary in order to conduct the hypothesis test in part **(c)**. **[1]**

This part was often omitted or generic. The context of the question needed to be considered in the answer.

Exemplar 4

Events occurred randomly and independantly.

The candidate has offered up the idea of independence, but has not used this in the context of the question looking at the probability of any one driver caught speeding being selected is independent of any other driver caught speeding being selected.

Question 9 (a)

9 In 2012 Adam bought a second hand car for £8500. Each year Adam has his car valued. He believes that there is a non-linear relationship between t, the time in years since he bought the car, and V, the value of the car in pounds. Fig. 9.1 shows successive values of V and $\log_{10}V$.

t	0	1	2	3	4
V	8500	6970	5720	4690	3840
$\log_{10}V$	3.93	3.84	3.76	3.67	3.58

Fig. 9.1

Adam uses a spreadsheet to plot the points (t, $\log_{10}V$) shown in Fig. 9.1, and then generates a line of best fit for these points. The line passes through the points (0, 3.93) and (4, 3.58). A copy of his graph is shown in Fig. 9.2.

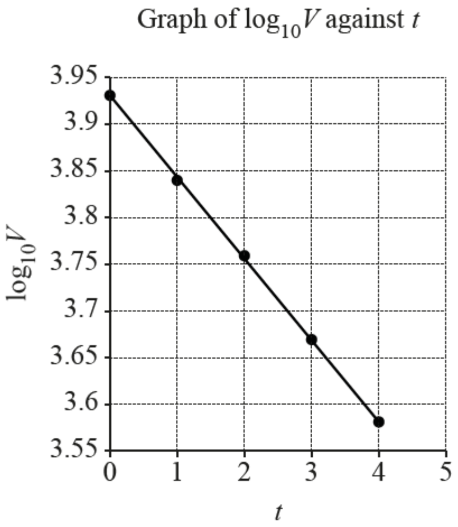


Fig. 9.2

(a) Find an expression for $\log_{10}V$ in terms of t. **[3]**

Only about half the candidates realised that they needed to find the gradient and intercept of the line in Fig. 9.2 and then form an equation for $\log_{10} V$ in terms of t. Some of these candidates made errors in finding the gradient of the line.

Question 9 (b)

(b) Find a model for V in the form $V = A \times b^t$, where A and b are constants to be determined. Give the values of A and b correct to 2 significant figures. **[3]**

Most candidates were able to find the value of *A,* but many had difficulty finding the value of *b*. Some candidates failed to give the answers correct to 2 significant figures.

Question 9 (c)

In 2017 Adam's car was valued at £3150.

(c) Determine whether the model is a good fit for this data. **[1]**

This part was omitted by a considerable number of candidates.

The command word 'determine' is intended to convey to candidates that a calculation may well be needed to justify their answer. Answers without both an approximately correct value and a correct conclusion were given no credit.

Candidates were expected to show that the model in part (b) gives a value for the car of approximately £3151 after 5 years, and to conclude that the model was a (very) good fit. Answers were also accepted where candidates used more accurate values of *A* and *b* in the model, where candidates used the expression in part (a) to work out the value of the car after 5 years, and where candidates showed that the model would give the value of £3150 after about 4.98 years, which is very close to 5.

Question 9 (d)

A company called Webuyoldcars pays £500 for any second hand car. Adam decides that he will sell his car to this company when the annual valuation of his car is less than £500.

(d) According to the model, after how many years will Adam sell his car to Webuyoldcars? **[3]**

This part was often omitted.

Most candidates tackled this using the model from part (b), though answers from the equation in part (a) were also accepted. Many of these arrived at a correct answer of (usually) 14.27 years, but then lost a mark by failing to round up to 15 years. A considerable number of candidates made errors in the manipulation of logarithmic expression.

Question 10

10 In this question you must show detailed reasoning.

The equation of a curve is $y = \frac{x^2}{4} + \frac{2}{x} + 1$. A tangent and a normal to the curve are drawn at the point where $x = 2$.

Calculate the area bounded by the tangent, the normal and the x-axis. **[10]**

This question was found accessible by almost all candidates, with a considerable number giving completely correct answers. However a small minority of candidates who integrated the equation of the curve – presumably triggered by the word 'area'.

Candidates started by differentiating the equation of the curve. Candidates making errors in this step were still able to gain marks for attempting to find the slope of the tangent when x =2, attempting to find the equations of the tangent and normal, and for attempting to find the area between the tangent, normal and the x-axis. They were also able to gain a mark for finding the value of y when x = 2.

It was noted that candidates drawing a sketch of the tangent, normal and x-axis were more successful in identifying the area required and to calculate it efficiently and correctly.

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