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Examiners' report

AS LEVEL

MATHEMATICS A

OCR Level 3 Advanced Subsidiary GCE in Mathematics A

H230

For first teaching in 2017

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Version 1

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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. A selection of candidate responses is also provided. 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 and the mark scheme can be downloaded from Teach Cambridge.

Paper 1 series overview

Candidate performance across the paper was broadly in line with 2023 and 2024. Candidates appear to have, in general, understood the significance of instructions such as 'Determine' and 'show detailed reasoning'.

Candidates who did well on this paper generally:	Candidates who did less well on this paper generally:
• paid attention to DR instructions and demonstrated full working when required • set out their work clearly so that each step was visible • showed working and used (e.g. via a calculator) all the tools available to check and verify numerical answers • used their knowledge of the Large Data Set to give appropriate comments, in context, in Question 10 • used all the tools at their disposal, including a calculator, to check numerical answers.	• gave unclear or incorrect working in proof questions that didn't lead to the answer given • gave generic facts rather than specific answers in context (perhaps, in some cases, making an assumption about what was required).

Section A overview

The Pure section of this paper was generally well answered.

Question 1 (a)

1 In this question you must show detailed reasoning.

Solve the following equations.

(a) $\sqrt{x^2-11}=5$ **[2]**

Most candidates showed sufficient working here (noting that, with the DR instruction, the requirement in the specification is that '*Their solution should contain sufficient detail to allow the line of their argument to be followed'*. Here, this meant that working equivalent to the first line in the mark scheme needed to be seen – this work could not be 'implied' by correct answers. Almost all candidates interpreted this instruction correctly and showed adequate working. Many candidates scored 2/2 but quite a few candidates omitted the second square root (-6) scoring M1A0. Some candidates made an error in rearranging the equation leading to $\sqrt{14}$ – which also scored M1A0.

Question 1 (b)

(b) $y^6+7y^3-8=0$ **[4]**

This question was generally well answered by the majority of candidates, with very few numerical or algebraic errors seen. However, a significant minority of candidates were not awarded full marks due to not meeting the detailed reasoning requirement. Typical errors in responses were:

- not showing any working to solve their quadratic (either in y^3 or another variable, e.g. $u=y^3$) – which scored B0 and tended to lead to 3/4 or

- omitting both pairs of solutions (for u or y^3) – scoring A0A1 and/or labelling solutions other than the final pair with $y=\ldots$ - scoring A1A0. A minority of candidates mistakenly stated that -8 had no cube root.

The above points are good practice that candidates should always be encouraged to include in their working, but under the detailed reasoning instruction there is a stronger requirement to show 'sufficient detail' and therefore candidates should be aware that they may not score full marks (even for correct answers) without this.

The final point on notation is important to all questions of this type (and across this paper). Candidates are of course permitted to use any variable of their choice to represent y^3 but using $y=y^3$ is not mathematically correct and leads to a misleading set of answers (suggesting that there are 3-4 solutions instead of 2).

Question 1(c)

(c) $2^{3z-10} = 16$ **[2]**

This question was very well answered by the majority of candidates. Many candidates gave quite lengthy working (often including logs) before obtaining the required linear equation in z, which scored the M1. In this case, the mark scheme allowed candidates to leave numerical (i.e. not in z) log terms in the final step before their answer so, e.g. $z = \frac{10+\log_2 16}{3}$ was acceptable for the M1. However, in general candidates should show a complete method where the DR instruction is given.

OCR support

OCR's subject advisors have written a detailed blog post setting out more detail on what is typically required when the instruction '**In this question you must show detailed reasoning'** is given. This can be found here: https://www.ocr.org.uk/blog/a-level-maths-three-things-to-consider-for-detailed-reasoning/

Question 2

2 It is given that $\int_0^5 (ax^2 - 2x + 4)\,\mathrm{d}x = 45$, where a is a constant.

Determine the value of a. **[3]**

Most candidates answered this fairly routine integration question well, with the majority achieving 3/3. A small number of candidates made an error in their integration (which, provided a cubic was obtained, could still score M1M1 if used correctly) but candidates who did not integrate (e.g. differentiated or did not change powers) scored M0M0 as the scheme required a cubic in order to gain the mark for substituting limits. The 'Determine' instruction indicated that candidates were expected to show 'working where appropriate' as detailed in the scheme and most candidates did this very well. Candidates who just gave the correct answer without any justification would have scored zero marks in this question, but this was very rarely seen. A small number of candidates substituted the given limits for *a* instead of for *x*.

Question 3 (a)

3 **(a)** Express $x^2 - 6x$ in the form $(x+p)^2 + q$, where p and q are constants. **[2]**

This question was correctly answered by the majority of candidates.

Question 3 (b)

(b) Hence or otherwise determine the centre and radius of the circle with equation $x^2+y^2-6x-16=0$. **[3]**

Most candidates correctly substituted their completed square form from (a) in place of the two terms in x. However, many candidates then went on to attempt to complete the square in y, often giving $(y-4)^2$ from not noticing that there was no linear term in y and so this wasn't correct. Most candidates with a correctly substituted form stated the centre and radius correctly, although a few gave the radius as 25 or ± 5.

Question 4 (a)

4 (a) Show that $\frac{\cos\theta}{1-\sin\theta}-\frac{1}{\cos\theta}\equiv\tan\theta$ (where $\theta\neq 90n°$ for any odd integer n). **[3]**

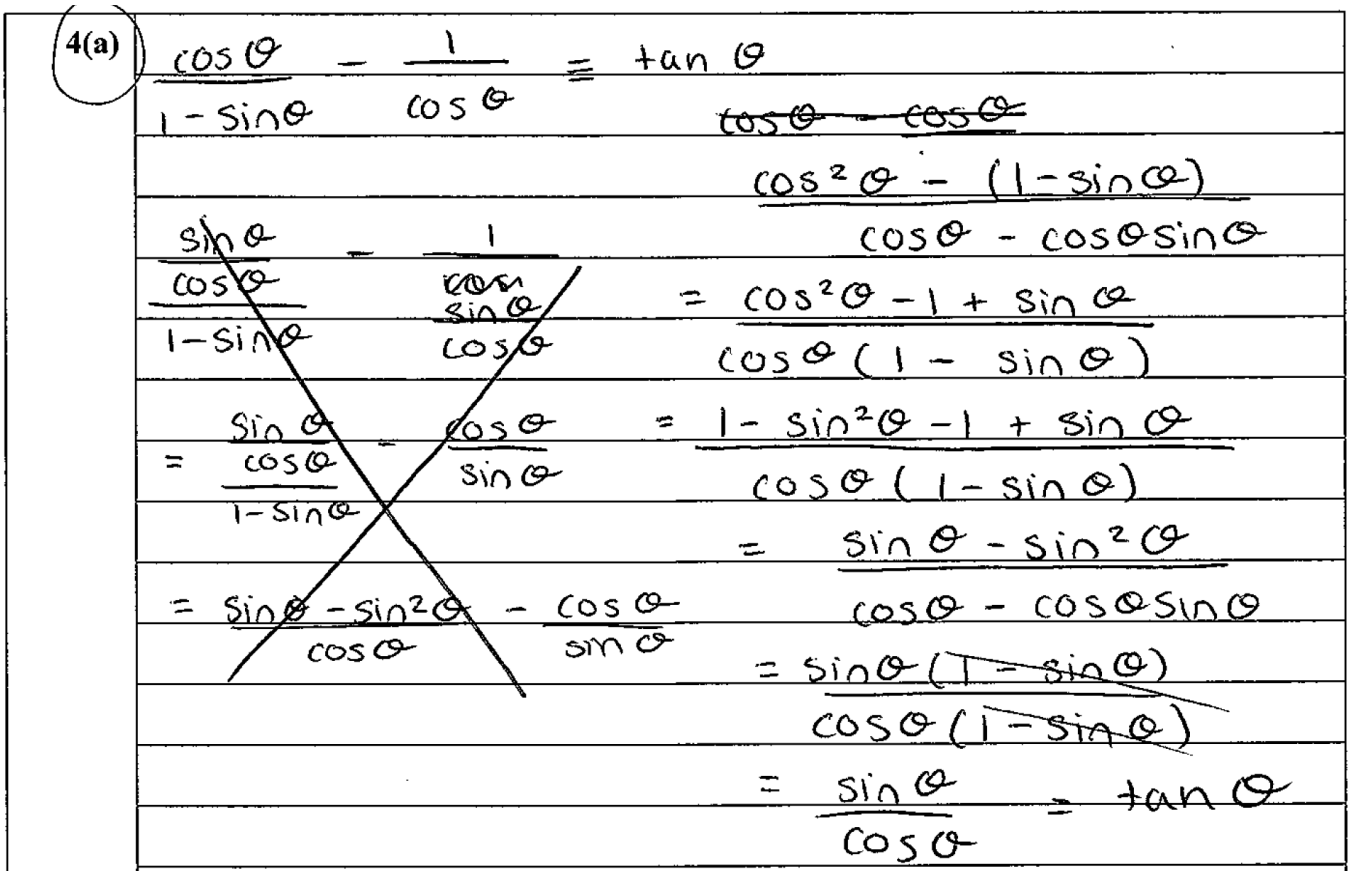
A minority of candidates made no progress with this question, offering either 'circular' working or misquoting identities (e.g. suggesting that $\sin\theta+\cos\theta=1$). Of those who did make progress, most used the main method in the scheme (combining the two terms over a common denominator) and this was generally successful. The two alternative methods were seen less often, although both provide neat routes to the answer.

As is often the case, this proof required candidates to use **both** of the trigonometric identities on this specification. It might be helpful to remind candidates that these two identities are available to them, and that a good starting point is often looking for opportunities to use them.

Some candidates attempted to combine the two fraction terms without first finding a common denominator, scoring M0M0.

Candidates who attempted to 'work backwards' from the RHS of the given identity rarely obtained a creditable proof. This is of course an acceptable method (as is working on both sides of the identity in 'parallel') but candidates should be reminded to demonstrate every step of their working so that their proof is sufficiently rigorous. As is typical on these questions, an error in the working leading to the answer resulted in A0 for the final mark.

Exemplar 1



This is a good response of a candidate who (after some crossed-out working on the left-hand side) obtains full marks for a correct and complete proof. All of the required working is seen, and each step is clear in the candidate's working. This received 3/3 marks.

Question 4 (b)

(b) Hence solve the equation $\frac{\cos 3x}{1-\sin 3x} - \frac{1}{\cos 3x} = 1$ for $0 \leqslant x \leqslant 90°$. **[4]**

Around half of candidates received 4/4 marks in this question. The majority of candidates correctly applied the identity from (a) to reduce the given equation to $\tan 3x = 1$ or equivalent, although quite a few provided unnecessary or unproductive working before reaching this step. The instruction 'Hence' means that the previous part's answer should be used to solve this equation, and there is no need for candidates to repeat all or part of the proof from part (a). Despite the given range of values, some candidates only provided a single value for $3x$ and x, scoring A0A0.

Question 5 (a)

5 **(a)** Find the coefficient of x^7 in the expansion of $(2x+3)^9$. **[2]**

Most candidates scored 2/2 marks here. Common errors included writing $2x^7$ instead of $(2x)^7$ or giving the wrong combination. Candidates should be reminded that the Binomial series is given in the formula table on page 2 of the Question Paper. This is a good example of a question where correct use of a calculator provides an efficient route to the answer.

Question 5 (b) (i)

(b) The following questions are about the binomial expansion of $(1+x)^{21}$ in ascending powers of x.

(i) Two consecutive terms have equal coefficients.

State the powers of x in these two terms. **[1]**

This question was generally well answered. Most candidates appeared to identify the link to the symmetry of the Binomial expansion, but some candidates did not note the word 'consecutive' and gave another pair. Common errors included 9 and 10, or 11 and 12. No calculation was required. Note that strictly the question said, 'state the powers of x' so the answer should have been '10 and 11'. Many candidates gave instead x^{10} and x^{11} or similar, which the scheme allowed on this occasion.

Question 5 (b) (ii)

(ii) Given that the terms in x^r and x^{r+5} have equal coefficients, find r. **[2]**

Many candidates obtained the correct answer $r = 8$, often using a calculator (and, presumably, some trial and improvement) to find two values with equal coefficients. The question command was 'Find' so no working was required for full marks, but for those candidates who didn't reach the correct answer, creditable working was rarely seen. Candidates should be encouraged to write down what they know, and interpret the question – for instance, here, translating the information in the question by substituting into two Binomial coefficients, equated, would have been sufficient for the M mark.

Question 6 (a)

6 In this question you must show detailed reasoning.

Solve the following equations.

(a) $\log_3(x+32)-\log_3(2x)+\log_3 2=2$ **[4]**

This challenging question was well answered by many candidates. As in Question 1, most candidates heeded the DR instruction and showed a good amount of working to demonstrate their work to simplify the log terms in the given equation. Some candidates combined all the log terms in a single step, which was permissible provided that it was clear and correct – specifically here this meant that candidates needed to show two in both the numerator and denominator so that it was clear that these terms had been 'handled' correctly.
Quite a few candidates misremembered the relevant log laws and confused multiplication/addition, etc. leading to errors such as $\log_3 32x$. Some candidates completed the first two simplifying steps correctly and then made an error in 'converting' the log terms, for instance giving the base as two rather than three. Some candidates incorrectly combined the last two terms to $\log 4x$.

It was quite common to see the correct answer $x=4$ from incorrect working, which was not credited.

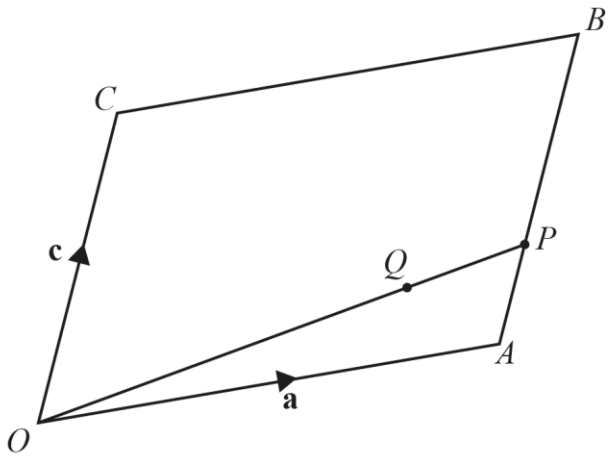
Question 6 (b)

(b) $\log_y\left(\frac{1}{8}\right)=-\frac{3}{2}$ **[3]**

Here, in contrast to Question 1 and Question 6 (a), many candidates did not show sufficient working to gain full credit under the DR instruction. For three marks, candidates needed to demonstrate appropriate understanding by removing the log (M1), simplifying to a solvable form (M1) and obtaining the correct answer (A1). Candidates should be reminded that the DR instruction is 'not a restriction on a candidate's use of a calculator' – and, here, a calculator is likely to be useful to check the final answer – but 'it is a restriction on what will be accepted as evidence of a complete method' and so candidates who 'jumped' to the final answer without an appropriate intermediate step could not score full marks. Some candidates omitted the y and so did not obtain an appropriate solvable form.

Question 7 (a)

7 In this question you must show detailed reasoning.



The diagram shows a parallelogram $OABC$. The position vectors of A and C are **a** and **c** respectively.

- The point P lies on AB such that $AP = \frac{1}{3}AB$.
- The point Q lies on OP such that $OQ = \frac{3}{4}OP$.

(a) Show that $\overrightarrow{OQ} = \frac{3}{4}\mathbf{a} + \frac{1}{4}\mathbf{c}$. **[4]**

Most candidates made a good attempt at this part, with many scoring 3 or 4 marks. As shown on the scheme, candidates needed to find a vector expression for $\overrightarrow{OP}$ in terms of the given vectors **a** and **c**, and then use the given fact $\overrightarrow{OQ} = \frac{3}{4}\overrightarrow{OP}$ to reach the answer given. Many candidates chose to combine these two steps, which was acceptable provided that sufficient working was shown. Some candidates used the path OAPQ or considered that $\overrightarrow{OQ} = \overrightarrow{OP} - \frac{1}{4}\overrightarrow{OP}$, either of which could lead to the correct result if completed in full.

As this was a 'show that' question the DR instruction serves to remind candidates that they needed to show their working in full. The scheme was quite accommodating of candidates who skipped intermediate steps, but nonetheless some candidates did not show a convincing demonstration of the given answer. Some candidates appeared to be trying to 'work backwards' based on the fractions in the given expression, but this was typically unsuccessful.

Throughout Q7, some candidates' working was not sufficiently clear as to which vector on the parallelogram they were attempting to find. Candidates should be encouraged to set out their working clearly and label vectors correctly (using the vertices of the figure) so that it is clear what they are trying to show in each step.

Question 7 (b)

(b) Hence show that Q lies on AC. **[3]**

Most candidates started well here, finding a vector expression for $\overrightarrow{AQ}$ or $\overrightarrow{QC}$, etc. and scoring M1. However, many candidates then did not score either A mark by either trying to state that this first line is sufficient to prove the required fact, or by demonstrating that $\overrightarrow{AQ} + \overrightarrow{QC} = \overrightarrow{AC}$ (which is true, but not sufficient to prove that *Q* lies on *AC*). On this occasion, the scheme condoned statements which omitted the word 'scalar' or used less precise wording, but candidates should be reminded that – especially in a DR question – they should expect to show that the given fact meets all of the requirements. Strictly, to show that *Q* lies on *AC* via this method requires that $\overrightarrow{AC}$ is a **scalar multiple** of $\overrightarrow{AQ}$ **and** that these two vectors share a common point (*A*). The latter point was not required but candidates did need to state a clear conclusion to demonstrate understanding of what they have shown.
The alternative method was rarely seen.

Question 8

8 A curve with equation $y = x^3 + 3x^2 - 9x - 12$ has stationary points A and B.

Determine the coordinates of the point where the line through A and B meets the x-axis. **[8]**

This question was generally very well answered. Almost all candidates were able to differentiate, set =0 and solve to obtain two values of *x* for M1M1A1. Some candidates made a numerical error in finding the corresponding values of *y*, but were still able to go on obtaining the subsequent method marks. Most candidates identified the need to find the gradient, equation and then set $y = 0$ although some instead solved for $x = 0$, etc. A few candidates stopped after the first four marks. Notice that (in contrast with Question 1 (b) as there is no DR instruction here, candidates were not required to show the working to solve their quadratic $\frac{dy}{dx} = 0$ but it remains best practice to do so.
The question asked for the 'coordinates of the point' so $x = -\frac{9}{8}$ was not sufficient as a final answer. This was a common omission and led to candidates receiving 7/8.

Exemplar 2

8

$y = 3x^3 + 3x^2 - 9x - 12$

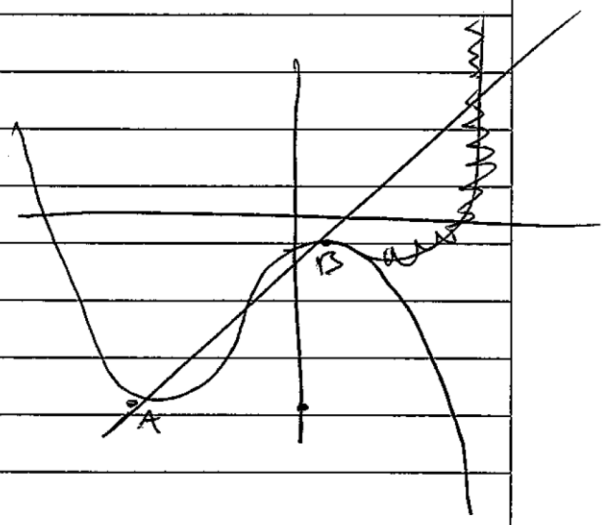
$\frac{dy}{dx} = 3x^2 + 6x - 9$

$3x^2 + 6x - 9 = 0$

$(x+3)(x-1)$

$x = -3 \quad x = 1$

$y = -39 \quad y = -15$



$\frac{\text{change in } y}{\text{change in } x} = \frac{-15 - (-39)}{1 - (-3)}$

$= \frac{24}{4} = 6$

$y = 6x + c$

$-15 = 6(1) + c$

$-15 = 6 + c$

$c = -21$

$y = 6x - 21$

When $y = 0$

$6x - 21 = 0$

$6x = 21$

$x = 3.5$

$(3.5, 0)$

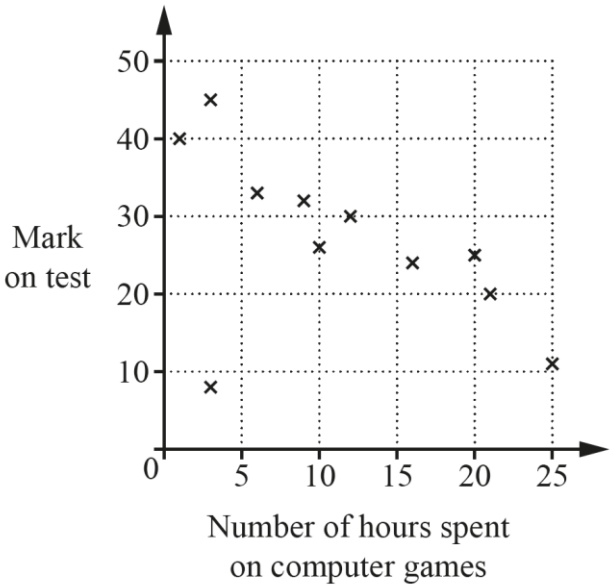
This candidate has made a good start, scoring M1M1A1 for their differentiation and correct values of x for the turning points. They then make an error in finding one of the corresponding values of y (A0) but go on to work correctly with their values, scoring M1M1M1. The final answer is incorrect (A0) so this response scored 6/8.

Section B overview

Throughout Question 9 and Question 10, as in previous years, candidates who gave answers that were in context and specific to the question gained more marks than candidates who cited generic facts or did not directly address the question. There is sometimes a tendency with statistics questions for candidates to assume what the answer will be (e.g. 'small sample size' or 'correlation does not imply causation') – these facts will rarely be enough to gain credit without being set in context.

Question 9 (a)

9 Sasha collected data from 11 students about the time they spent on computer games during the previous week and their marks in a test. The results are represented in the scatter diagram.



(a) Give **two** comments about the relationship between the mark scored on the test and the number of hours spent on computer games. **[2]**

This question required two specific observations, and most candidates addressed this well. Some candidates only gave one of the two observations required, or repeated the same information in two different ways. Although for this question the mark scheme is quite accommodating, candidates should be encouraged to use correct mathematical language – so, for instance, here there appears to be a 'negative correlation' and 'one outlier'.

Some candidates seemed to be slightly uncomfortable with using the word 'correlation' – this question specifically asked about the relationship between the two variables, so it is absolutely correct to say that there appears to be a correlation. (Making this statement does not, as candidates will be aware, give any inference about a causal link).

Some candidates went on to make suggestions about whether it was or wasn't appropriate to suggest a causal relationship – this wasn't required for this question, which asked specifically about the relationship.

Question 9 (b)

A teacher says, "The overall pattern of the points shows that, for most students, spending a long time playing computer games has a bad effect on your school work."

A student responds, "But correlation does not imply causation."

The teacher replies, "So why are the points in this overall pattern?"

(b) Suggest an answer to the teacher's question. **[1]**

Many candidates did not score a mark in this question, perhaps because they had misread or misunderstood what was being asked. Candidates needed to explain 'why are the points in this overall pattern' (i.e. answer the teacher's question) without suggesting a causal relationship. As noted above, these questions merit careful reading. Candidates who suggested a causal mechanism (for instance, explaining how spending more time on computer games might influence a student's mark on the test) did not score the B mark. Candidates needed to give an alternative explanation for the relationship – for instance, that a third factor (which need not be specified) could affect **both** variables.

Generic facts such as 'the sample size is too small' could not be credited.

Question 9 (c)

The table shows the data that are represented in the diagram.

Number of hours spent on computer games	1	3	10	20	12	25	6	21	3	16	9
Mark on test	40	45	26	25	30	11	33	20	8	24	32

(c) Find the median and inter-quartile range of the marks. **[2]**

The majority candidates received 2/2 marks here. More candidates made errors with the IQR than with the median, and a few candidates used an incorrect method to attempt to find the IQR.

Question 9 (d)

It is given that the quartiles of the number of hours spent on computer games are 3 and 20.

(d) Use the inter-quartile ranges to determine whether there are any outliers amongst the marks or the number of hours spent on computer games. **[1]**

Very few candidates completed all of the work that was required in this part. The question specifies using the IQRs to determine whether there are outliers, and in the specification there is only one method given for finding outliers using the IQR, i.e. $Q_1 - 1.5 \times IQR$ or $Q_3 + 1.5 \times IQR$. Many candidates attempted to use other methods, or an incorrect variant of this method (e.g. using the median rather than quartiles as the 'starting point').
In order to be awarded this mark, candidates needed to use these expressions at both 'ends' of both sets of data (marks and number of hours) separately, using their answers from part (c) and the given quartiles for hours, and then make an appropriate conclusion. Many candidates only attempted this for one of the two data sets, which was not sufficient to score the mark. Candidates should always be encouraged to show their calculations in full on this type of question.

Question 9 (e)

Sasha says, "The diagram shows that there is one outlier."

(e) Comment on Sasha's statement in the light of your conclusion in part **(d)**. **[1]**

This question allowed full 'follow-through' from part (d) – meaning that candidates were able to use whatever conclusion they obtained there to make an appropriate comment here. However, most candidates tried to give a binary statement such as 'Sacha is wrong, there are no outliers' which did not show appreciation of the distinction between outliers in both data set individually (as discussed in part (d)) and outliers from the correlation in the bivariate combined data set shown in the scatter diagram. Some candidates showed a correct appreciation of this and were able to score the mark.

Question 10 (a)

10 Researchers investigated the change in the numbers of people in employment using underground, metro, light rail or tram (UMLRT) between 2001 and 2011.

The data are combined for those Local Authorities (LAs) with UMLRT stations into five regions: Birmingham, Liverpool, Manchester, Sheffield and Rotherham, and Tyne and Wear.

Fig. 1 shows the total numbers of people in employment in those LAs.

Fig. 2 shows the total numbers of people in employment who use UMLRT in those LAs.

Fig. 1

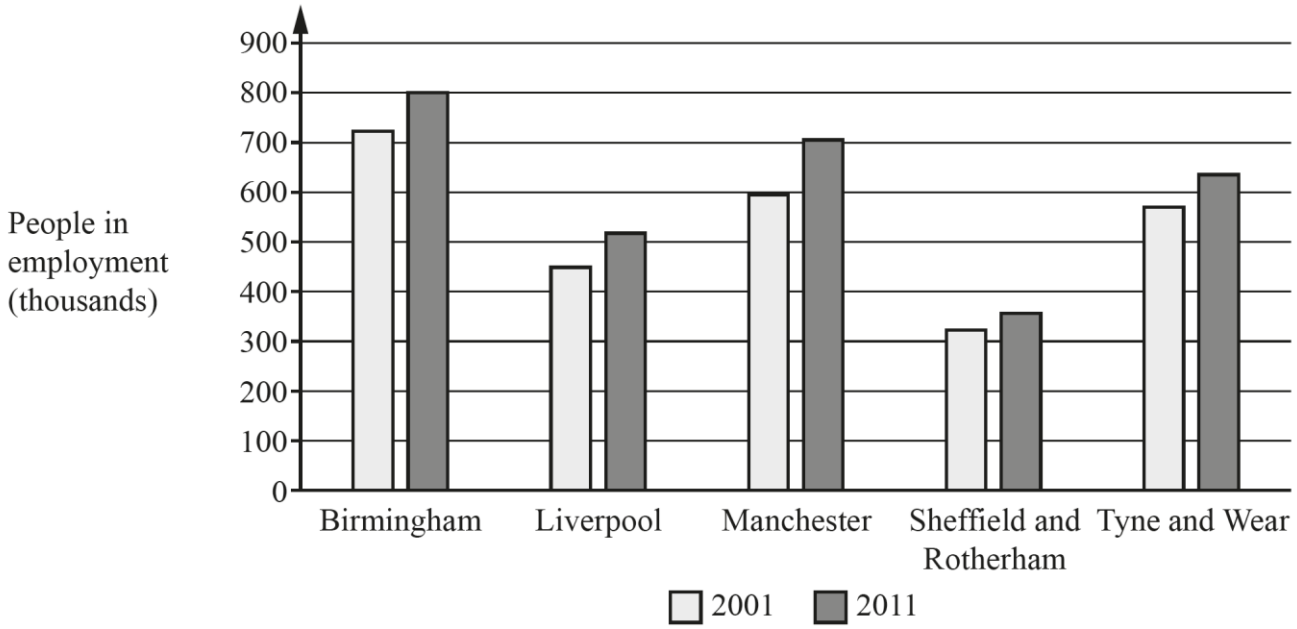
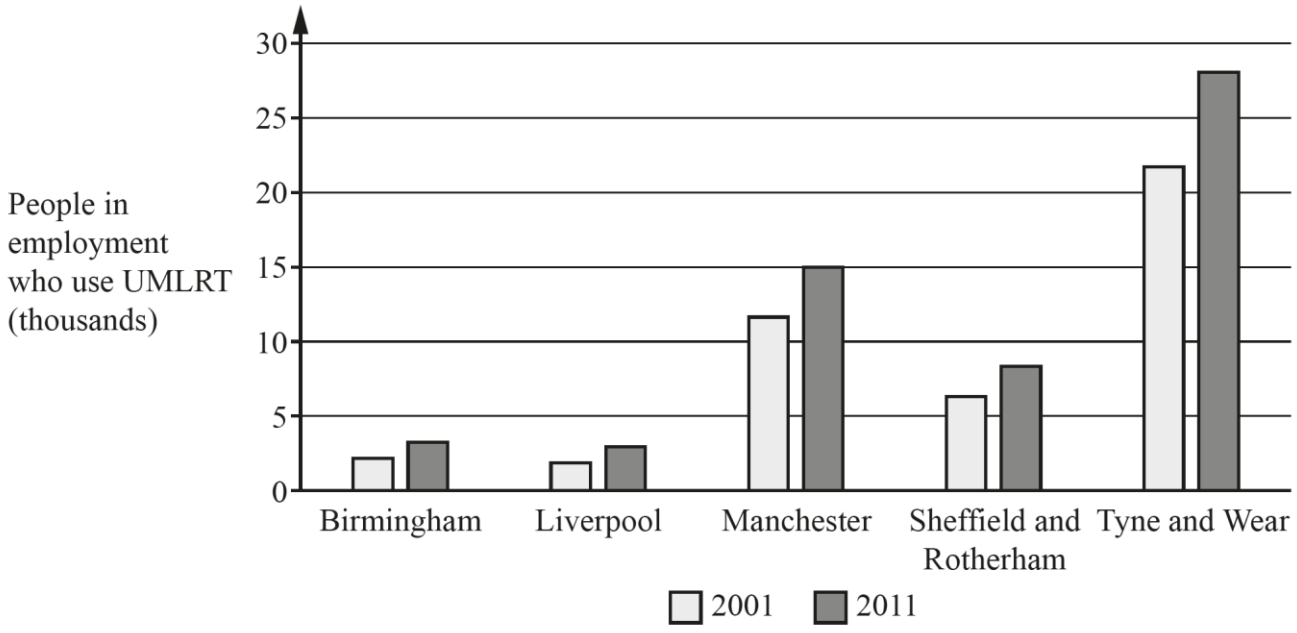


Fig. 2



(a) Use these charts to explain which of Birmingham and Liverpool has the larger proportion of people in employment who used UMLRT in 2011. **[2]**

This question (as with several other parts of Question 10) was about candidates demonstrating their appreciation of the difference between number and proportion. Many candidates here argued correctly that Liverpool has the larger proportion (of people in employment using UMLRT in 2011) because it has a similar number of UMLRT users but a smaller population (of people in employment) than Birmingham. Some candidates estimated values from the graph and used these to show that the proportion in Liverpool was greater – which was acceptable here, although values were not required. Of the minority of candidates who did not obtain either mark here, some misinterpreted the significance of the information given, or tried to make an argument based on number rather than proportion.

As is often the case in this type of question, it is important that candidates are clear and unambiguous about which city they are saying has the greater proportion.

Question 10 (b)

One of the researchers says, "Between 2001 and 2011, the increase in the number of people in employment who use UMLRT is greatest in Tyne and Wear."

Sam says, "But what matters more is which region has the greatest increase in the **proportion** of people in employment who use UMLRT."

(b) Give a reason why the planners responsible for the building of trains and the maintenance of infrastructure might **disagree** with Sam. **[1]**

This question required candidates to identify that numbers might be more useful than proportions (for planners who **disagree** with the given statement), and to explain why this might be the case. Most candidates identified this correctly and gave a plausible reason (e.g. that it is the number of people that determines 'how many trains' are needed, not the proportion of employees that those people represent). Some candidates misinterpreted the question and attempted to make more complex arguments (e.g. about profitability), or assumed that 'sample size' might be a relevant fact. The question asked specifically about Sam's statement, which is a statement about proportion, so candidates needed to give a reason in terms of this.

Question 10 (c)

(c) Explain whether those responsible for encouraging the greater use of public transport would agree with Sam. **[2]**

Most candidates did not give a full answer to this question, although many made a relevant comment and gained one of the two marks available. Candidates needed to explain whether those 'responsible for encouraging the greater use of public transport would agree with Sam'. The question part being worth 2 marks along with the slightly larger answer space indicated to candidates that a more detailed argument was needed here. Candidates could make points that supported an 'agree' or 'disagree' answer, but these needed to be detailed and in the context of the question. So, for instance, acceptable answers included 'yes, because a greater proportion using public transport means that the message is getting across' or 'but they may wish to achieve more use of public transport overall'. Creditable answers needed discuss number/proportion and be in the context of the question, so generic facts such as 'a small proportion of a large number could be larger than a large proportion of a small number' alone did not score either mark.

Question 10 (d)

(d) The charts are compiled from data in the Large Data Set by using those LAs which contain UMLRT stations in each region.

Explain a disadvantage of using these data. **[1]**

Here, candidates needed to give a specific, in context disadvantage to using the given data. For instance, many candidates correctly identified that this approach does not take account of those who live in neighbouring LAs but access the UMLRT services in these LAs (B1) or – conversely – that it will include all employees in an LA even if there is just one UMLRT station (B1). However, some candidates offered generic statements (e.g. suggesting that the data may be out of date, or that the sample size is not sufficient) which were not specific to this approach. Some candidates simply suggested that there will be 'some people in employment who are not represented' without giving a reason.

Some candidates appeared to have misunderstood that, in the context of the Large Data Set, there is one or more LA in each of the regions.

Some candidates noted that there will be some LAs that aren't included (because they don't contain an UMLRT station) – this is not a disadvantage of the approach in this context.

A small number of candidates mentioned London, which wasn't relevant because it is not included in any of the regions being considered here.

Question 11

11 A spinner has sides numbered 1, 2, 3, 4. When the spinner is spun the score is given by the number of the side on which it lands. The spinner is biased, as shown in the table.

Score	1	2	3	4
Probability	$\frac{1}{8}$	$\frac{3}{8}$	$\frac{1}{6}$	$\frac{1}{3}$

In a fairground game, each player has two spins. They win a prize if the total of the scores on the two spins is greater than 5.

Zayn says, "If I play, it's more likely that I'll win a prize than I won't win a prize."

Determine whether Zayn is correct. **[4]**

Some candidates scored full marks on this probability question. In order to determine whether Zayn's statement is correct, candidates needed to calculate the probability of a 'win' (i.e. score greater than 5) or 'lose' and then make an appropriate conclusion. Most candidates recognised the need to combine the probabilities for two spins, and some drew a tree diagram to represent these. Provided candidates had three or more correct products (for either 'win' or 'lose') then they could score M1, but they needed all 6 (or 10 for 'lose') to be correct for the first A mark, which very few candidates achieved. Candidates could score the final A mark as FT provided that they gave a conclusion (following three or more correct products) that was correct for their values. Candidates who denoted the sample space with a grid tended to have more success in identifying the correct pairs of probabilities. Candidates should be encouraged to make full use of the answer space available and to use systematic methods to make sure they have the right number of terms in their summation. Most candidates gave an appropriate conclusion, but (as in Question 10(a)) candidates needed to clearly and unambiguously state whether they were saying that Zayn is correct or incorrect.

Question 12 (a)

12 A school contains 552 students. In the past the proportion of students who bought lunch at the school canteen was $\frac{1}{3}$. Following a change in the lunches provided in the canteen, the governors want to test whether this proportion has increased. They decide to allow one term for the students to become used to the new system. They note the number of students who buy lunch at the school canteen on the last day of term. They use this number to carry out a hypothesis test.

(a) State suitable null and alternative hypotheses for the test. **[2]**

As noted in previous years, this (and previous years') mark schemes are likely to be very informative as to what is expected from candidates when setting up and completing a hypothesis test. This year, the hypotheses were requested in a separate, scaffolded part (a). Here, most candidates gave correct hypotheses for the required 1-tail test in terms of an appropriate parameter. The most common error was failing to define this parameter.

Question 12 (b)

The number of students who buy lunch at the school canteen on the last day of term is 201.

(b) Carry out the test at the 5% significance level. **[5]**

Most candidates scored most of the marks in this part, demonstrating their understanding of how to complete a hypothesis test. Candidates should be encouraged to be clear and precise when calculating the required probability (and, although on this occasion the scheme allowed this to be given to 2sf, it should always be given to 3sf in the absence of any other direction). Most candidates gave the correct conclusion in terms of the hypotheses but as is often the case, many candidates could not be awarded the final A mark because their conclusion was inappropriate –, e.g. through being definite or by making a statement that is not supported by the test. Candidates should refer to the helpful guidance from OCR's subject advisors on this (noting that 'not rejecting' the null hypothesis means that there is insufficient evidence to conclude that there has been a change – i.e. the test does not show that the proportion is, in this case, exactly $\frac{1}{3}$).

OCR support

Although on this year's paper relatively few candidates lost the final mark due to being 'definite' in their conclusion, the OCR subject advisors' blog on setting out an answer to hypothesis test questions remains highly relevant: https://www.ocr.org.uk/blog/a-level-maths-hypothesis-tests-and-the-art-of-being-non-assertive/

Question 12 (c)

(c) Suggest **one** reason why the conclusion of the test may **not** be reliable. **[1]**

Most candidates answered this part well, which required candidates to give a reason in context using the information given in the question. As previously, generic facts could not be credited. Most candidates identified that the sampling being based on a single day, and that day being the last day of term was likely to be inappropriate.

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