Analysis by
Craig Barton

Exemplar student responses – from a teacher's perspective

Any questions?
Call us on 0161 957 3852 and get straight through to the Maths team, or email us at maths@aqa.org.uk

AQA
Realising potential

In April 2015, we asked a number of schools to participate in a student trial of our first set of practice papers. We wanted to understand more about how individual questions perform and provide some exemplar student responses. We gave teacher Craig Barton data for two papers so he could provide a teacher's perspective.

"In analysing the performance of the students who sat these trial Foundation and Higher Papers (3) for the new AQA GCSE specification, I learnt a few things that I will certainly be incorporating into the teaching and preparation of my Year 10 class from September 2015. I hope you find the following reports and the subsequent comments alongside each question useful."
Craig Barton, September 2015

The scripts

In this booklet, Craig Barton has taken an in-depth look at two papers – 3F and 3H – to see how students responded. The exemplar answers in this document are transcribed from student scripts. Sometimes they are fully correct answers and sometimes they highlight common errors or misconceptions. Alongside each question is a summary of how students performed and many of the questions are accompanied by brief comments on:

- how more successful students approached the question
- common errors, misconceptions and misunderstandings.

These exemplars show how students are reacting to these questions. We see them as an important tool in helping us all understand how real students perform on these new style questions. In doing so, we hope they are of value when thinking about how to deliver the new specification in a way that prepares students for the new Assessment Objectives.

Key

Each question contains a performance box showing the breakdown of marks by percentage of students, from 0 to the maximum number of marks for a question.
X = question not attempted.

The research

There were limitations with the research – schools were focusing on preparing their Year 11 students for the real examination, there wasn't the same motivation from students and it would be impossible for all schools to reproduce the conditions of a live exam. We also accepted that it would also be unreasonable to expect all students to sit a full set of papers, and that teachers would want to select the students who took part. Additionally, the new GCSE contains some content not covered in the current specification, and it was recognised that students might not be familiar with these topics. Despite all of this, we collected over 1,000 scripts from 10 schools and they have told us a great deal about how students approach this new GCSE.

The papers

The students in this trial sat our first set of practice papers for the new GCSE Mathematics qualification (8300), which we released in December 2014. These were written before Ofqual's research and review, published in June 2015. As a result, they haven't been reviewed and approved by Ofqual and may not reflect in full the standard of AQA GCSE Mathematics for 2017 and beyond. However, the purpose of this work was to focus on how individual questions might perform and we remain confident that these questions give a good indication of what you and your students can expect in 2017.

Craig Barton
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Unless otherwise stated, the commentary in this introduction and the annotated questions has been provided by Craig Barton and represents his independent view, not the view of AQA.

Start of the paper: Multiple choice questions

It will come as no surprise that I am a huge fan of the multiple choice questions that appear on AQA's papers. One of the main reasons I created my Diagnostic Questions website was because I believe that carefully written multiple choice questions, together with well-chosen alternate answers (or "distractors") can expose students' misconceptions more effectively than other types of questions. They are also efficient in getting right to the heart of the topic, allowing only one mark to be taken up where previously two or three may have been required.

More so than in the Higher Paper (3H), I believe the set of four multiple choice questions at the start of this paper had a calming effect on the students, which is important at the start of a high pressure exam. The topics covered were the kind students are used to seeing at the start of a Foundation paper, and the questions themselves contained no nasty twists to throw them. They were a straightforward test of students' knowledge, and the candidates on the whole performed well.

Indeed, these were four of the most successfully answered questions of the whole paper, with a total of 70% of students gaining 3 or 4 of the available 4 marks. This should have had the effect of settling the students' nerves and getting their minds prepared for the challenges that lie ahead.

Multiple choice questions

We share your view of multiple choice questions and for the same reasons. They may not always be easy marks, as we want to test a range of topics and assessment objectives this way, but should be appropriate for the first half of a Foundation paper. The questions that follow the first four marks are likely to be the most accessible on the paper.

Andrew Taylor, AQA

Topics new to Foundation GCSE

This paper contained a significant number of questions that are brand-new to the Foundation specification, and student performance is interesting to look at.

12a – Fibonacci-type sequences
Finding the next two terms in the sequences (part a) was very well answered, but then in part b, when implicitly asked to continue the sequence, generalise and explain their thinking, students really struggled, with over 90% failing to score a mark.

17a – Factorising quadratics
This question was specifically about the difference of two squares and was very poorly answered, with just 8% of students gaining a mark. Unlike Fibonacci sequences, this was not something students could figure out without being taught it, and their responses particularly highlighted their lack of algebraic understanding. My prediction is that factorising standard $ax^2 + bx + c$ quadratics may be accessible to the majority of Foundation students once the method is taught, but any twists which rely on a deeper algebraic understanding are likely to cause problems.

19 – Rounding with inequalities
This question, involving "using inequality notation to specify simple error intervals due to truncation or rounding", was successfully answered by exactly zero students! This question also appeared in the Higher paper, and the level of success was not much better. Clearly, students during this trial had not been taught this new content. On the face of it, it is just upper and lower bounds in disguise, but then students find bounds hard enough without an inequality being thrown into the mix! It remains to be seen how Foundation students take to this particular addition.

20a – Trigonometry
This one mark question on trigonometric ratios was correctly answered by only one student! Interestingly, many students who attempted this question displayed an awareness of SOHCAHTOA, were able to label sides correctly, and stated that tan(x) = opp/adj. Perhaps this is because, unlike say, inequality notation to specify error intervals, this is a topic the teachers are familiar with teaching and that students may well have met in Year 9. It is just a pity that the appearance of this new topic on a Foundation paper comes with a twist, and hence even the students who appeared to have sound knowledge of the concepts involved were not rewarded with a mark. A similar trend was seen on the Higher paper. Hopefully we will see more straight-forward, accessible appearances of trigonometry in the future.

25 – Simultaneous equations
Solving simultaneous equations is new to Foundation. However, it was interesting to see many students opted to attempt the question using trial and error. Because the numbers involved were quite nice and there was no explicit algebraic requirement in the question, successful attempts using this method were awarded full marks. I suspect in the future that the questions will change to make sure that this option is not as viable!

Level of challenge
When flicking through current GCSE Foundation papers, I am often surprised by just how challenging they can be. Indeed, I regularly challenge my (at times, cocky!) top-set Year 11 students to try to get full marks on a Foundation Paper, and they very rarely achieve it.

But this paper is on a whole new level. Naturally, towards the end of the paper, there are cross-over questions which also appear in the earlier stages of the Higher paper. It was no surprise that Foundation students struggled to access many of these. But before students even get to those, there are quite a few challenges awaiting them.

20a – Trigonometry
Your comment on 20(a) is interesting. I guess the presence of two triangles may be confusing to students but, using the first diagram, the question should be very straightforward for a student who knows the trig ratios. Putting the diagrams side by side was intended to give students two approaches to part (b). They could use the Tan value from part (a) or ignore that and use similarity. Of course, they are the same thing but many students would not see it that way. Within the Foundation tier, we will tend to ask straightforward trigonometry questions and you will see examples of that in later practice papers I am sure.

25 – Simultaneous equations
On simultaneous equations, we will set problems like this where different methods could work well, and we will set more formal, straightforward questions where a non-algebraic approach would be less viable. As with every topic, we will always set questions that we hope will differentiate effectively across the grade range for the paper.

Andrew Taylor, AQA

Question 4 requires them to know the meaning of “debit” and “credit”, which very few did. To successfully answer **Question 6**, students must know about factors, primes, averages, range and probability, and if any of those areas are lacking, they will struggle to access any of the marks available. **Question 12b** requires students to know to continue a Fibonacci sequence, generalise and then come up with a convincing argument for the number of negative terms. **Question 13** requires three sets of conversions between imperial and metric units, some multiplying and some dividing, to arrive at the right answer. And then **Question 17** involves factorising a quadratic expression.

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Of course, all of this is to be expected, as we know these new Foundation papers are going to present more of a challenge, with a wider range of higher grades/levels being the reward. Furthermore, there are certainly difficult questions like this in current Foundation papers. But what surprised me is the relatively small number of easily accessible questions, and I worry for the Grade F, E and D students taking on a paper like this.
It is also worth pointing out that many of the cross-over questions that appeared on both papers caused Higher students almost as much difficulty as their Foundation counterparts. New topics like the rounding using inequality notation (**Question 19**) were a whitewash across both papers. However, familiar topics, such as **Question 22** involving non-routine averages, caused both sets of students problems.

The lesson here is simple to state, but tricky to put in practice: students need to be prepared for the new topics, and also prepared to answer non-routine questions on topics they are familiar with. It’s as simple as that.

Level of challenge
Knowledge of financial terms is part of the specification and will certainly be tested. If these are familiar as they should be to students in two years’ time, then Question 4 becomes straightforward. Question 6 is a good example of testing AO2 and AO3 early in the paper. There is a lot to deal with so we have tried to present the question clearly and keep the language as simple as possible. We ask questions similar to this in current papers and they tend to perform pretty well. Your point about the proportion of questions accessible to the weakest students is well made and is a concern. Ofqual require all boards to target no more than half the Foundation paper at grades 1 to 3, and grade 3 is around a current grade D. In 2015 papers, more than half of the marks are targeted at grades E to G so the difference is clear.

Andrew Taylor, AQA

Appropriate tier of entry
All of this leads us to the wider issue about the level of difficulty of the Foundation paper, and the subsequent implications for the tier of entry of students. Of course, anything I say here is based on very limited information, having analysed this paper and the Higher equivalent in detail, seen all the Sample Assessment Materials, and read of all the specifications. So, please digest the following with a big pinch of salt!

I have already touched upon my view that the use of accessible multiple choice questions at the start of the Foundation paper can have a positive, calming effect on students, whereas that is not what we have seen on the equivalent Higher paper. However, this benefit may well be offset by the level of difficulty that exists throughout the rest of the paper. If students are having to answer tricky questions – indeed, some of the trickiest of which appear across both papers – then isn’t it better that they encounter these on a Higher paper where any success will be rewarded by higher grades/levels?

Unfortunately, as with everything, the decision will likely be made on the grade/level boundaries. Teachers will, quite rightly, enter their students for the paper that will give them the best chance of achieving the highest possible level. I only hope – perhaps naively – that the boundaries are set in such a way to make the Foundation paper more appealing to more students. It breaks my heart when we enter students for the current Higher paper as it is clearly their best chance of achieving a D or C, despite the fact that they cannot access the vast majority of the paper.

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Appropriate tier of entry

I share your hope that students will be entered for the tier that gives them the best opportunity to show positive achievement but decisions about tiering are for schools to make. We will try to help by offering evidence drawn from trials like this one and making plenty of practice material available. Our concern in 2017 will be to ensure that all grades, particularly those that overlap tiers, are fairly and robustly set.

Andrew Taylor, AQA

Reluctance to use a calculator

A final point! A great frustration of my teaching career has been students' apparent reluctance to use their calculator on a calculator paper! Time and time again I am faced with lines and lines of working out, often littered with mistakes, when pressing a few buttons would have yielded an accurate result in a fraction of the time. I know this is a broad generalisation, but it tends to be the less able students who fall into this trap, which is obviously unfortunate as they are the ones who perhaps need their calculators more.

I have often thought this is just me, but I (thankfully!) observed something similar throughout this paper. On **Questions 5a** and **5b**, students tried to deal with the relatively challenging job of adding and subtracting negative decimals by using pen and paper, often making mistakes. Was this because they were unwilling to use their calculator, or maybe because they were unable to enter negative numbers into it?

There were many other instances of this reluctance to use a calculator seen throughout the paper:

- **Question 9**: multiplying 3.625 by 4
- **Question 12a**: which involved a tricky Fibonacci-type sequence
- **Question 15**: even though they often got the question correct, many students opted to work out 1.5% of 2000, and then multiply this by 3, using pen and paper.

The bottom line is we, as teachers, need to ensure our students give themselves the best chance of success by checking they are comfortable, able and willing to use their calculators when needed.

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AQA

PRACTICE PAPER SET 1

GCSE
Mathematics
Specification (8300/3F)

Paper 3 Foundation tier

F

Date Morning 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments.

Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the bottom of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book.
- In all calculations, show clearly how you work out your answer.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number Candidate number

Surname

Forename(s)

Candidate signature

Version 1.0

8300/3F

Answer **all** questions in the spaces provided.

1 (a) Circle the percentage that is greater than $\frac{3}{4}$ and less than $\frac{4}{5}$

[1 mark]

1a Performance
X 4%
0 18%
1 78%

75% 78% 80% 82%

1a A lovely multiple choice question to begin the paper, and the vast majority of students (78%) got off to a flyer. The most popular distractor was 80%, which lured in 12% of students.

1 (b) Circle the fraction that is greater than 0.3 and less than 0.4

[1 mark]

1b Performance
X 7%
0 42%
1 51%

$\frac{1}{4}$ $\frac{1}{3}$ $\frac{3}{10}$ $\frac{2}{5}$

0·25 0·33 0·3 0·4

1b Interestingly, students found this question a little more difficult, with just over half managing to find the correct answer. Almost a quarter of students opted for an answer of 2/5, with 3/10 also proving a popular distractor. This is perhaps explained by the more challenging nature of the fractions, relative to part a.

2 Which statement is true?

Circle your answer.

[1 mark]

–6 is greater than –2

–6 is greater than 2

–2 is greater than –6

–2 is greater than 6

2 A very well answered question, with only 14% of students falling for the tempting distractor that -6 is greater than -2.

Performance
X 4%
0 18%
1 78%

3 y is a whole number.

Circle the words that describe $5y$

[1 mark]

always odd always even could be odd or even

3 Performance
X 6%
0 13%
1 81%

3 The most successfully answered question on the paper, which is quite impressive given the algebraic nature. It is worth noting at this point that 37% of students have answered the first four multiple choice questions correctly, with a further 33% scoring 3 out of 4 marks. This was certainly not the case in the Higher paper (only 7% had scored 3 marks, and not a single student got all 4 questions correct), and may well have a positive influence on students' confidence and nerves as they approach the remainder of the paper.

4 Here is a bank statement.

Date	Description	Credit £	Debit £	Balance £
14 Oct	Starting balance			176.05
15 Oct	Refund	65.20		241.25
16 Oct	Go Shop		83.19	324.44
17 Oct	Water bill		164.76	489.20
18 Oct	Wage	46.00		535.20

Complete the balance column.

[3 marks]

4 Students performed poorly on this question for one reason and one reason only – they did not understand the terms "debit" and "credit". I'm not entirely sure my top set Year 11 class would either. Students opted to either leave the question out, muddle up the two operations or, in the case of the exemplar, simply add both debits and credits onto the final balance. Many students were able to pick up method and follow-through marks for making attempts at the final column. It is clear that students will need to be made aware of the meaning of these terms in order to access questions such as this.

Performance
X 48%
0 7%
1 10%
2 17%
3 9%

Interesting answers – Question 4

Full marks:

4 Here is a bank statement.

Date	Description	Credit £	Debit £	Balance £
14 Oct	Starting balance			176.05
15 Oct	Refund	65.20		241.35
16 Oct	Go Shop		83.19	158.06
17 Oct	Water bill		164.76	- 6.70
18 Oct	Wage	46.00		39.30

Complete the balance column.

[3 marks]

1 mark: muddling up debit and credit

4 Here is a bank statement.

Date	Description	Credit £	Debit £	Balance £
14 Oct	Starting balance			176.05
15 Oct	Refund	65.20		110.85 x
16 Oct	Go Shop		83.19	27.66 ✓
17 Oct	Water bill		164.76	- 137.1 ✓
18 Oct	Wage	46.00		- 91.1 ✓

Complete the balance column.

[3 marks]

5 Here are some cards.

+8.3	+8.9	–8.9	–8.3

5a Performance
X 6%
0 10%
1 28%
2 57%

5 (a) Choose a card so that the answer is as small as possible.

Work out the answer.

[2 marks]

–3.5 + -8.9 = -12.8

5a This question reminded me of an old Key Stage 3 SATs question. It was the fourth most successfully answered question on the paper, with 85% of students able to score at least one mark. This demonstrates an impressive knowledge of both operations and ordering negative numbers. Students who dropped a mark tended to choose the correct card, but then make a mistake with the final answer. Such mistakes are all too common (certainly amongst my students), despite the fact that students have a calculator to hand!

5 (b) Choose a card so that the answer is as small as possible.

Work out the answer.

[2 marks]

–3.5 – +8.3 = -11.8

5b A very wide spread of success, with answers falling pretty evenly in the 0, 1 and 2 mark categories. It is perhaps no surprise that students found subtraction harder than the addition required for part a. Again, many students appeared to be reluctant (or unable?) to use their calculators for operations involving negative numbers. There were also a significant number of students, as in the exemplar, who selected the wrong card, but were able to gain a valuable follow-through mark by working out the correct answer for their choice.

Performance
X 13%
0 24%
1 29%
2 33%

Interesting answers – Question 5(a)

Full marks:

5 Here are some cards.

+8.3	+8.9	–8.9	–8.3
4.8 · 11.8	5.4 12.4	–12.4 5.4	–11.8 4.8

5 (a) Choose a card so that the answer is as small as possible.

Work out the answer.

[2 marks]

–3.5 + –8.9 = –12.4

Interesting answers – Question 5(b)

0 marks:

5 (b) Choose a card so that the answer is as small as possible.

Work out the answer.

[2 marks]

–3.5 – –8.3 = –11.8

1 mark: right card, wrong answer

5 (b) Choose a card so that the answer is as small as possible.

Work out the answer.

[2 marks]

–3.5 – +8.9 = 12.4

Full marks:

–11.8 –12.4

5 (b) Choose a card so that the answer is as small as possible.

Work out the answer.

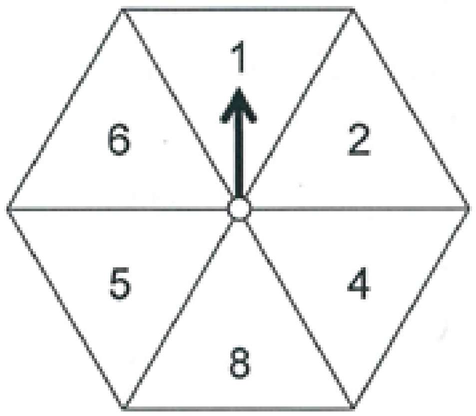
[2 marks]

–3.5 – +8.9 = ~~3.4~~ –12.4

6 (a) A fair spinner has 6 equal sections.

6a Performance

X	11%
0	48%
1	30%
2	11%



6a Over half of candidates failed to secure a mark on this question, and looking at their responses this was not due to a lack of understanding of probability (nearly all denominators were given as 6), but poor knowledge of factors and prime numbers. Many candidates, as in the exemplar, claimed that there was only one factor of 8 (did they forget the 1 or the 8?), and there was a whole range of answers for prime numbers. It just goes to show how the definitions of types of numbers find their way into many topics.

The arrow on the spinner is spun.

Complete each of the following sentences with the correct probability.

[2 marks]

The probability that the arrow will land on a factor of 8 is 1/6

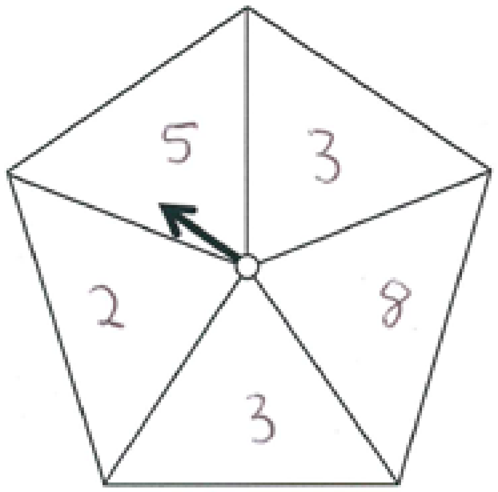
The probability that the arrow will land on a prime number is 4/6 = 2/3

0

6 (b) This fair spinner has five equal sections.

6b Performance

X	18%
0	26%
1	27%
2	30%



6b Another question that produced a wide spread of results. Again, it was not the probability aspect of the question that troubled most students (the majority had two 3s on their spinners), but the difficulty of producing a range of 3 and a total sum of 21. As in the exemplar, many students made valiant efforts and obtained one of these goals. Also, is there anywhere else in the world, apart from Probability questions on GCSE Maths Exams, where spinners are used?

1

Write a number on each section so that

the probability that the arrow lands on 3 is $\frac{2}{5}$

the range of the numbers is 3

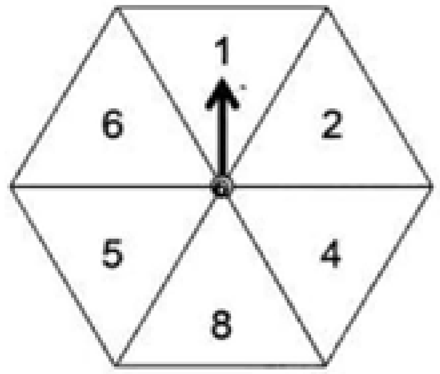
the sum of the numbers is 21

[2 marks]

Interesting answers – Question 6(a)

Full marks:

6 (a) A fair spinner has 6 equal sections.



The arrow on the spinner is spun.

Complete each of the following sentences with the correct probability.

[2 marks]

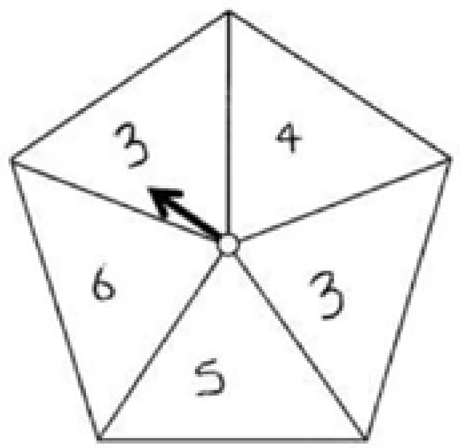
The probability that the arrow will land on a factor of 8 is 4/6 $\frac{2}{3}$

The probability that the arrow will land on a prime number is 2/6 $\frac{1}{3}$

Interesting answers – Question 6(b)

Full marks:

6 (b) This fair spinner has five equal sections.



Write a number on each section so that

the probability that the arrow lands on 3 is $\frac{2}{5}$

the range of the numbers is 3 → 6 - 3 = 3

the sum of the numbers is 21

↘ 3+3+2+5+8=21

[2 marks]

7 In a class, the number of girls as a fraction of the number of boys is $\frac{5}{4}$

7 (a) Write down the number of boys as a fraction of the number of girls.

[1 mark]

Answer 4/5

1

7a I was pleasantly surprised at how well students did on this question. Was this a subtle use of reciprocals by AQA, which is new content, or just a slightly strange fractions question? Either way over half the students had no trouble with it.

Performance

X	26%
0	19%
1	56%

1

7 (b) There are 20 girls in the class.

Work out the number of boys.

[2 marks]

20 ÷ 4 = 5

5 × 5 = 25

Answer 25

7b A third of students were able to answer this relatively tricky fractions question, which had more than a hint of ratio about it. Students who went wrong, as in the exemplar, tended to divide by 4 and then multiply by 5, for which they were awarded 1 mark.

Performance

X	39%
0	11%
1	17%
2	33%

Interesting answers – Question 7(b)

Full marks:

7 (b) There are 20 girls in the class.

Work out the number of boys.

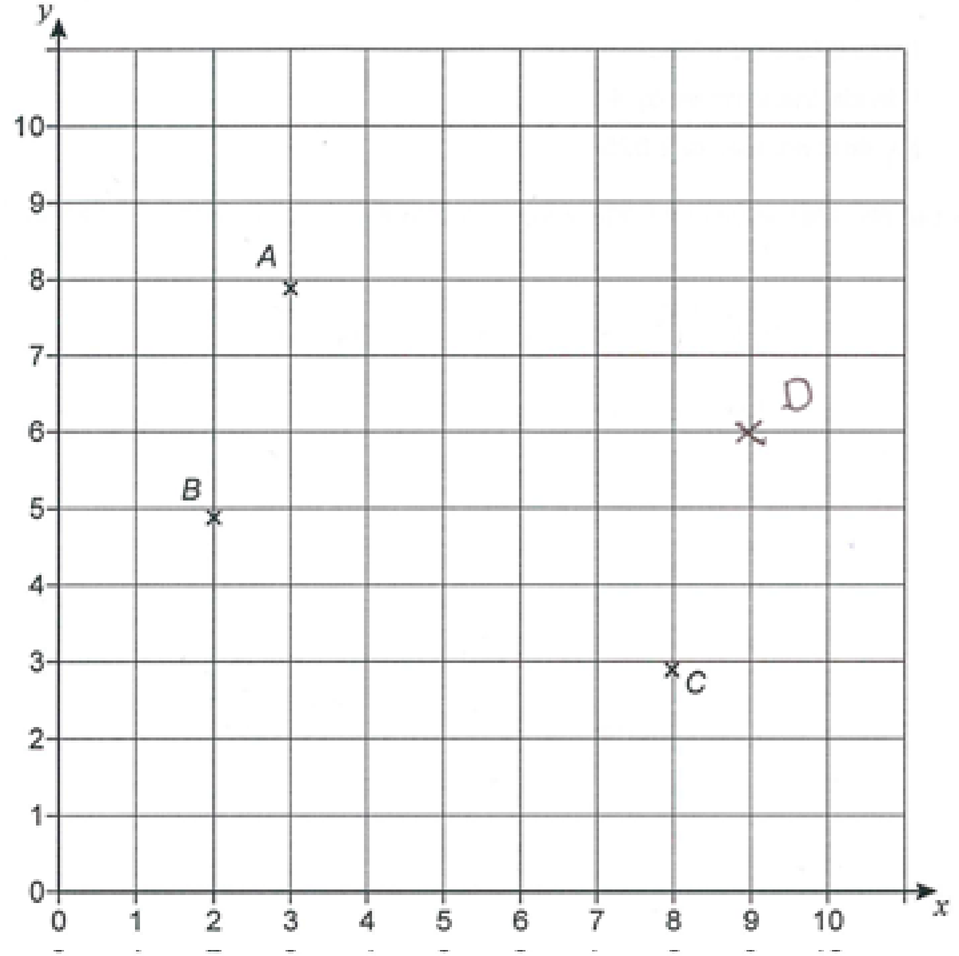
$\frac{5}{4}$ of 20 not need.

[2 marks]

$\frac{4}{5}$ of 20 = 16 $\frac{5}{4}$ of 16

Answer 16

8 *A*, *B* and *C* are three vertices of a quadrilateral plotted on a centimetre grid.



8a Performance	
X	14%
0	20%
1	66%

8 (a) Plot *D* on the grid so that *ABCD* is a rectangle.

[1 mark]

8a The fifth most successfully answered question on the paper, with two-thirds of students scoring full marks. I tend to find that students who struggle with number and algebra topics can often capitalise when it comes to spatial awareness questions.

8 (b) *E* is the midpoint of *BC*.

Circle the **two** answers that describe triangle *ABE*.

[2 marks]

8b Performance	
X	13%
0	17%
1	60%
2	10%

scalene isosceles equilateral right-angled

8b Students had to select two answers in this multiple choice question, which required them to combine knowledge of midpoints with properties of triangles. Only 10% succeeded getting both correct, with 60% choosing one correct answer. The most popular combination was to recognise that the triangle was right-angled, but to claim it was also scalene. This is perhaps understandable, given the "tilted" nature of the triangle.

8 (c) Circle the ratio area of triangle *ABE* : area of rectangle *ABCD*

[1 mark]

8c Performance	
X	24%
0	43%
1	32%

1 : 2 1 : 3 ~~1 : 4~~ 1 : 8

8c A challenging multiple choice question that only a third of students got right. The most popular distractor was 1:3, possibly because students saw that the area of the triangle was one-part, and the remaining area was three-parts. Indeed, you can almost witness that thought-process going on in the exemplar answer as the selection is changed at the last minute!

Interesting answers – Question 8(b)

Full marks:

8 **(b)** *E* is the midpoint of *BC*.

Circle the **two** answers that describe triangle *ABE*.

[2 marks]

scalene isosceles equilateral right-angled

9 I am thinking of a number.

I add 5 to my number.

I divide the answer by 4

My final answer is 3.625

Work out my final answer if I add 4 to my original number and then divide by 5

[4 marks]

3.625 × 4 = 14.5

14.5 − 5 = 9.5

Answer 9.5

2

9 A significant number of students either achieved full marks on this question (26%) or two marks (22%). Perhaps not surprisingly, both sets of students overwhelmingly opted for an inverse operations / function machine approach, as opposed to any form of algebra. The students who dropped two marks, as in the exemplar, tended to ignore the second part of the question – hence the eternal teachers' plea to READ THE QUESTION CAREFULLY!!!

Performance

X	26%
0	18%
1	7%
2	22%
3	2%
4	26%

Interesting answers – Question 9

Full marks:

9 I am thinking of a number. AU 1

I add 5 to my number.
I divide the answer by 4
My final answer is 3.625

Work out my final answer if I add 4 to my original number and then divide by 5

[4 marks]

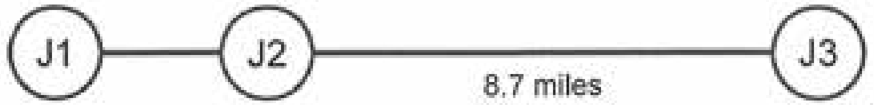
$3.625 \times 4 - 5 = 9.5$

$9.5 + 4 \div 5 = 2.7$

Answer 2.7

10 J1, J2 and J3 are three junctions on a motorway.

Not drawn accurately



10	Performance
X	31%
0	56%
1	2%
2	2%
3	9%

The distance from J1 to J2 is one-quarter of the distance from J1 to J3

The distance between J2 and J3 is 8.7 miles.

Work out the distance from J1 to J3

[3 marks]

$\frac{1}{4}$ of 8.7 = 2.175

J_1 to J_2 = 2.175

J_1 to J_3 = 8.7 + 2.175

= 10.875

Answer 10.9 miles 0

10 87% of students did not score a mark on this pretty challenging question. Those students that attempted it tended to make the same mistake as shown in the exemplar – dividing 8.7 by 4 instead of 3. Unfortunately, even if they then went on to add this number to 8.7, they were awarded 0 marks. I often feel that questions like this lend themselves particularly well to a more visual, barmodel approach, so students would see the distance between J2 and J3 as three parts and not four.

11 The scale on a map is 1 : 200 000

Work out the number of kilometres represented by 2.5 cm on the map.

[2 marks]

$2.5 \times 200000 =$ 1

11	Performance
X	50%
0	26%
1	23%
2	1%

Answer 500 000 km

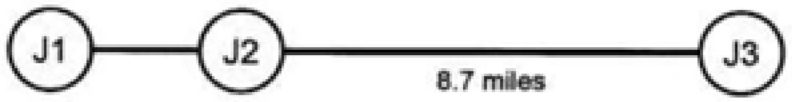
11 Students found this scale / ratio question very challenging, with three-quarters of students gaining 0 marks, and hardly anyone getting it completely correct. By far the most common way of obtaining one mark was the multiply 2.5 by 200,000, as in the exemplar, which secured a method mark. The difficulty then came in converting this answer to kilometres. It is also interesting to note that an answer of half a million kilometres did not appear to strike the students who wrote this as strange, once again suggesting that all the research and emphasis in the US about the importance of "Number Sense" certainly has a key role to play over here.

Interesting answers – Question 10 and 11

Full marks:

10 J1, J2 and J3 are three junctions on a motorway.

Not drawn accurately



The distance from J1 to J2 is one-quarter of the distance from J1 to J3 $\frac{1}{4}$

The distance between J2 and J3 is 8.7 miles.

Work out the distance from J1 to J3

[3 marks]

8.7 ÷ 3 = 2.9

J1 to J2 = 2.9

2.9 x 4 = 11.6

Answer 11.6 miles

Full marks:

11 The scale on a map is 1 : 200 000

Work out the number of kilometres represented by 2.5 cm on the map.

[2 marks]

200 000 x 2 = 400,000 400,000

200,000 ÷ 2 = 100 000 + 100,000

500,000

Answer 5 km

12 Here are the first three terms of a sequence.

21.2 −12.9 8.3

Each term is obtained by adding the previous two terms together.

12a Performance

X	29%
0	17%
1	54%

12 (a) Work out the next **two** terms in the sequence.

[1 mark]

−12.9 + 8.3 = −4.6 8.3 + −4.6 = 3.7

Answer −4.6 and 3.7

1

12a Fibonacci-type sequences are new to Foundation GCSE, and yet students performed relatively well on this question, with over half getting it correct. Perhaps this is because, unlike something completely new like standard form, intuition and a careful reading of the question makes this perfectly accessible.

12 (b) How many negative terms are in the sequence?

Circle your answer.

1 2 3 4 more than 4

Give reasons for your answer.

[2 marks]

0

12b Over 90% of students failed to score a mark on this question, which combined multiple choice with the dreaded "explain your answer". The most common combination was an incorrect selection ("2" being favoured the most), followed by no explanation. Those who did manage to get the multiple choice part correct really struggled to articulate their thinking. It was no surprise that answers such as "I just worked it out", and "I am great" did not appear on the mark scheme as worthy of credit. Students of all abilities struggle to articulate their mathematical thinking, and this is something that we, as teachers, need to keep working on.

Performance

X	28%
0	63%
1	8%
2	1%

Interesting answers – Question 12(b)

Full marks:

12 (b) How many negative terms are in the sequence?

Circle your answer.

1	2	3	4	more than 4

Give reasons for your answer.

[2 marks]

after the 3rd it will be −0.9 + 2.8 which = 1.9 so then its 2.8 + 1.9 = 6.7 and it will keep getting higher

13 1 inch = 2.54 cm

1 foot = 12 inches

1 mile = 5280 feet

Use the given conversions to show that 1 mile is approximately 1.6 kilometres.

[3 marks]

1 mile = 1.6 km

5280 × 12 = 63360 1km = 100 000

÷ 10 = 528 ×100 = 100 000 000

× 6 = 3168 1600 160000000

+ 5280 5280 × 12 × 2.54

8448 = 155232

÷12 = 440

÷ 2.54 = 173.228

Turn over for the next question

13

Imperial measurements are still alive and kicking in the new GCSE, and after this question most students (and teachers) might wish they were not! This was the 5th most poorly answered question on the paper, with well over 90% failing to secure a mark, and three-quarters of students opting to leave it out altogether. Valiant attempts were made, but it was clear that students struggled to structure their answers and, crucially, to write down the units of each answer they worked out. Often what remained was a page full of numbers that the examiner found hard to give any credit for, as in the exemplar. It would be interesting to see how Higher Tier candidates would cope with this challenging question, which required several conversions involving both multiplying and dividing.

Performance

X	75%
0	19%
1	2%
2	2%
3	2%

Interesting answers – Question 13

Full marks:

13 1 inch = 2.54 cm

1 foot = 12 inches

1 mile = 5280 feet

Use the given conversions to show that 1 mile is approximately 1.6 kilometres.

[3 marks]

Alt 1

2.54×12 = 30.48cm (1 foot)

30.48cm × 5280 = 160,934.4 cm

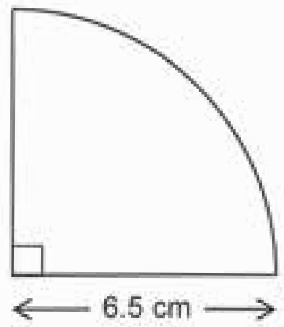
place value ~~100~~ ~~10cm = 100mm~~

Th	H	T	U	.	$\frac{1}{10}$	$\frac{1}{100}$
160	9	3	4	.	4	
16	0	9	3	4		

160,934.4cm = ~~16.09~~ 1.60934 km

14 The diagram shows a quarter-circle with radius 6.5 cm

14 Performance	
X	42%
0	20%
1	12%
2	9%
3	17%



Not drawn accurately

14 This standard, twist-free, question about finding the area of a quarter-circle managed to split candidates. 17% managed to score 3 out of 3, but many dropped marks. Those that did either were not aware of the formula for the area of a circle (often doing the classic thing and confusing it with circumference), or messed up the squaring in their calculator. Other common errors, as in the exemplar, included forgetting to divide their answers by 4. However, it was nice to see some students writing down the full calculator value and then rounding, giving them the best possible chance of gaining the follow-through mark.

Work out the area of the quarter-circle.

Give your answer to 1 decimal place.

[3 marks]

$\pi r^2 = 3.142 \times 6.5 \times 6.5$

$= 132.73228\ 96$

1dp ↓

Answer 132.7 cm²

2

15 There were several potential traps for students lingering within this question, and many fell into it. Firstly, there was the all-too-common problem of muddling up compound with simple interest (interesting to note that few of the attempts to apply the compound interest formula were correct). Secondly, there was the issue of increasing something by 1.5%, with increases by 15% being seen consistently. Finally, there was the fact that the question required total interest and not total amount. Unfortunately, the exemplar answer fell into all of these camps.

15 £2000 is invested for 3 years at 1.5% **simple** interest per year.

Work out the total interest paid.

[3 marks]

1 year: 1.5 × 2000

= 0.5 × 2000 = 300 + 2000

= 2300

0.15 × 2300 = 345 + 2300

= 2645

0.15 × 2645 = 396.75

2645 + 396.75

Answer £ = 3041.75

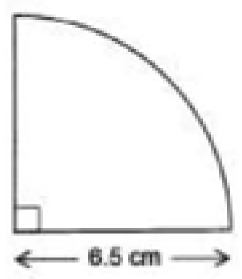
0

15 Performance	
X	49%
0	23%
1	4%
2	3%
3	20%

Interesting answers – Question 14

Full marks:

14 The diagram shows a quarter-circle with radius 6.5 cm



Not drawn accurately

Work out the area of the quarter-circle.

Give your answer to 1 decimal place.

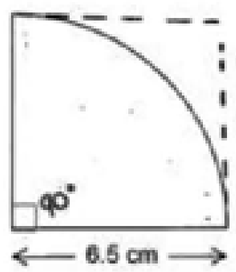
[3 marks]

$$\frac{\pi \times 6.5^2}{4} = 33.2$$

Answer 33.2 cm²

Using the square: 0 marks

14 The diagram shows a quarter-circle with radius 6.5 cm



Not drawn accurately

Work out the area of the quarter-circle.

Give your answer to 1 decimal place.

[3 marks]

$6{\cdot}5 + 6{\cdot}5 = 13$

$13 + 6{\cdot}5^{7}$

$6{\cdot}5 \times 7 = 45{\cdot}5$

Answer 58·5 cm²

Interesting answers – Question 15

Full marks:

15 £2000 is invested for 3 years at 1.5% **simple** interest per year.

Work out the total interest paid.

[3 marks]

10% of £2000 = 200

1% of £200 = 20

0.5% (½) of £200 = 10

1.5% interest per year = £30 interest

£30 × 3 = £90 interest

~~£2000 + £90 = 2~~

Answer £ 90

Misapplies compound interest formula:

15 £2000 is invested for 3 years at 1.5% **simple** interest per year.

Work out the total interest paid.

[3 marks]

$2000 \times 0.985^3 = 1911.34325$

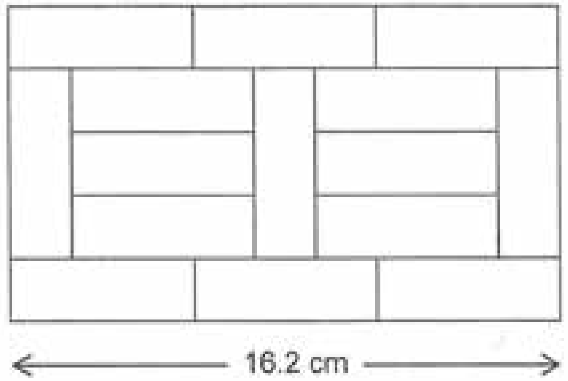
~~+2000 = 3911.34325~~

Answer £ ~~3911~~ 1911

16 A shape is made using 15 identical rectangles.

Not drawn accurately

16 Performance	
X	36%
0	23%
1	23%
2	1%
3	1%
4	16%



Work out the area of the shape.

[4 marks]

A = b × h

16.2 ÷ 3 = 5.4 = 16.2 × 10.8

5.4 ÷ 2 = 2.7 = 174.96

5.4 × 2 = 10.8

Answer 175 cm^2

16 Students of all abilities tend to find these non-routine area questions tricky, and so it proved here with only 18% of students scoring more than 1 mark. A common response, as seen in the exemplar, was to correctly work out the length of one of the rectangles (16.2 ÷ 3), but then make an erroneous assumption when working out the other dimension. "Not drawn accurately" are three words that never fail to catch students out.

Turn over for the next question

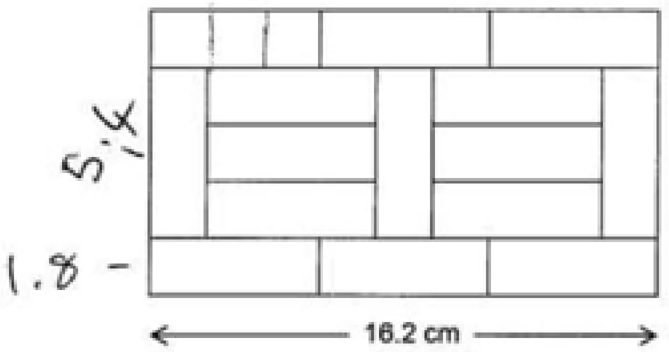
Interesting answers – Question 16

Full marks:

A4 2

16 A shape is made using 15 identical rectangles.

Not drawn accurately



Work out the area of the shape.

[4 marks]

16.2 ÷ 3 = 5.4

5.4 ÷ 3 = 1.8

5.4 + 1.8 + 1.8 = 9

16.2 × 9 = 145.8

Answer 145.8 cm^2

17 (a) Factorise $x^2 - y^2$

$x(x - y) - y(y - x)$

$x^2 - xy - y^2 + xy$

[1 mark]

0

Answer $x(x - y) - y(y - x)$

17 (b) Solve $\frac{2x}{5} + 1 = 13$

[3 marks]

3

$\frac{2x}{5} + 1 = 13$ (−1) (−1)

$2x = 60$

$2x/5 = 12$

$2x = 12 \times 5$

$x =$ 30

17a Factorising quadratics, including the difference of two squares, is new content to the Foundation GCSE, and students clearly struggled. There were a wide variety of interesting, quite imaginative approaches, one of which is shown in the exemplar. However, this isn't really the type of topic you can figure out on the spot if you have never seen it before, so very few students scored a mark. I get the feeling that factorising standard $ax^2 + bx + c$ quadratics may be accessible to the majority of Foundation students once the method is taught, but any twists which rely on a deeper algebraic understanding are likely to cause problems.

Performance

X	43%
0	49%
1	8%

17b A relatively well answered question, given the potential pitfalls lurking in this linear equation. Predictably there were students who muddled up the order of operations, confused their inverses, or attempted a failed trial and improvement approach. However, as seen in the exemplar, many students were not only able to solve the equation, but also lay out their work in a structured, algebraically sound manner.

Performance

X	44%
0	19%
1	13%
2	0%
3	23%

Interesting answers – Question 17(a)

[1 mark]

Answer $x + y$

0 marks:

17 (a) Factorise $x^2 - y^2$

[1 mark]

$(x + y)(y - x)$

Answer $(x + y)(y - x)$

0 marks:

17 (a) Factorise $x^2 - y^2$

[1 mark]

$x \times x - y \times y$

Answer $x \times x - y \times y$

Interesting answers – Question 17(b)

Mixing up inverses – 0 marks:

17 (b) Solve $\frac{2x}{5} + 1 = 13$

[3 marks]

$\frac{2x}{5} + 1 = 13$
$-1 \quad -1$

$\frac{2x}{5} = \frac{13}{\div 5}$ $\quad 2x = 2.6 \quad 2.6 \div 2$

$x =$ 1.3

Using numbers – 0 marks:

17 (b) Solve $\frac{2x}{5} + 1 = 13$

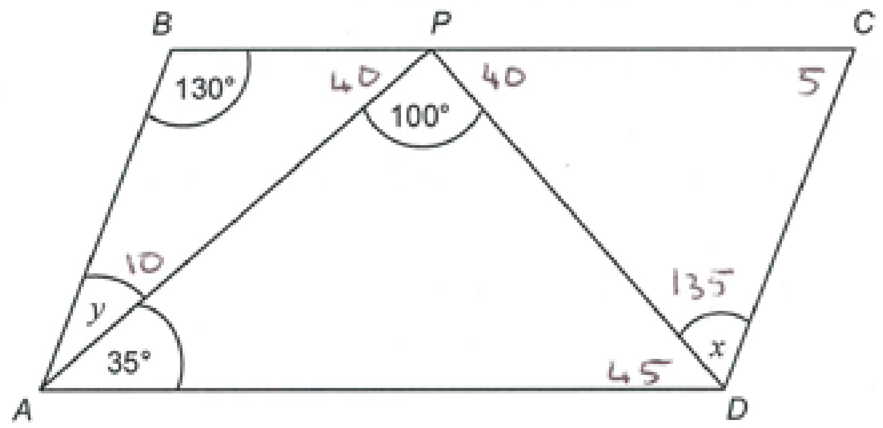
[3 marks]

~~$13 + 1 \div 7 = 2$~~ $\quad 14 - 5 = 9$
$13 + 1 = 14 \quad$ ~~$14 \div 5 = 2$~~
$9 \div 2 = 4.5$

$x =$ 4.5

18 The diagram shows a parallelogram *ABCD*.

Not drawn accurately



P is a point on *BC*.

18a Performance

X	42%
0	14%
1	30%
2	1%
3	12%

18 (a) Work out the size of angle x.

You **must** show your working, which may be on the diagram.

[3 marks]

$100 + 35 = 135$

1

18a I liked this question for two reasons. Firstly, students were explicitly told that they could show their working out on the diagram. Secondly, they did not have to remember the names of reasons such as as “corresponding angles are equal”, so their understanding of these rules could simply be implicit in their working out. 12% of students managed to gain all 3 marks on this question. The most common outcome, however, was to gain 1 mark for correctly working out and labelling the third angle in the triangle. Many students then struggled knowing where to go from here. I suspect this is because many students, like some of my top set Year 11s, are not entirely familiar with the properties of parallelograms. Properties of quadrilaterals is something that is often covered in Year 7 and not really revisited, and yet it sneaks its way into a surprising number of Foundation and Higher GCSE questions.

Answer 135 degrees

18 (b) Work out the size of angle y.

[1 mark]

0

18b Performance

X	48%
0	47%
1	6%

Answer 10 degrees

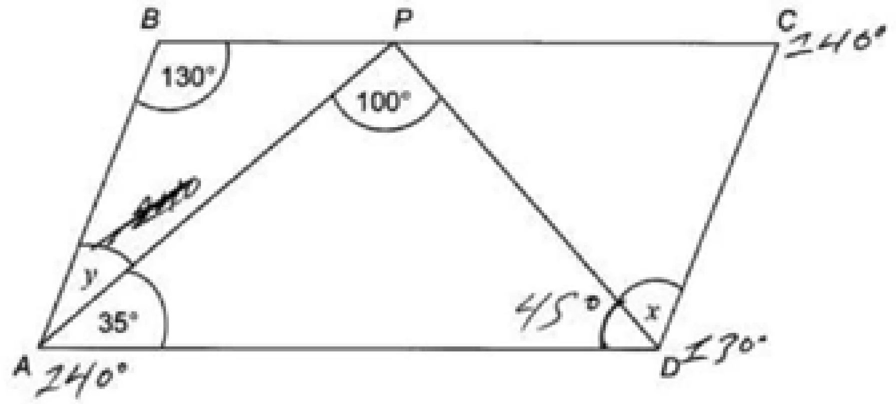
18b All but one of the students who got 18b correct also scored full marks on 18a, which is not surprising as success on this part of the question was certainly made more likely if students had got their heads around part a. It is interesting to note that successful attempts tended not to use the properties of adjacent angles in parallelograms and instead, like in the exemplar, made implicit use of corresponding angles, angles on a straight line and angles in a triangle.

Interesting answers – Question 18(a)

Full marks:

18 The diagram shows a parallelogram *ABCD*.

Not drawn accurately



P is a point on *BC*.

18 (a) Work out the size of angle x.

You **must** show your working, which may be on the diagram.

[3 marks]

~~Rex~~ D is corisponding with angle B
which is 130°
130° − 45° = 85°
So x = 85°

Answer 85° degrees

19	Performance
X	66%
0	14%
1	0%
2	0%

19 Paul won a race with a time of 71.579 seconds.

This time is to the nearest one thousandth of a second.

Use inequalities to write down the error interval due to rounding.

[2 marks]

71.579 ÷ 60 = 1.192983333

Answer 1.2 ≤ 71.579

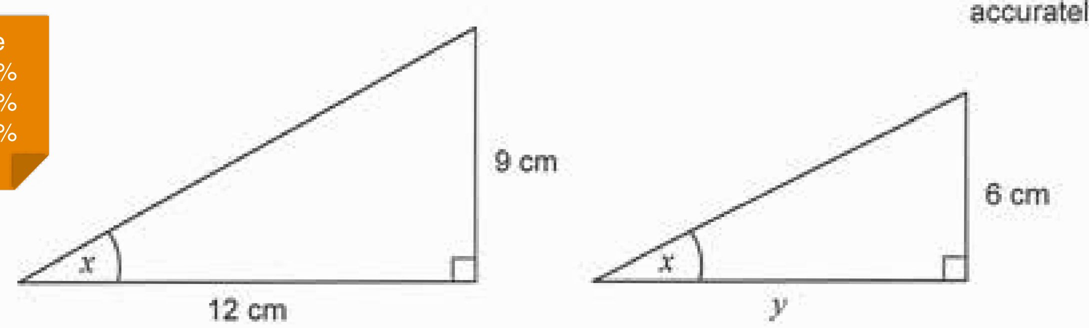
0

19 The statistics speak for themselves – not a single student scored a mark on this question. This question also appeared on the Higher paper, where performance was not much better. "Using inequality notation to specify simple error intervals due to truncation or rounding" is brand new content, and is essentially upper and lower bounds in disguise. The problem is that students of all abilities tend to find bounds a tricky concept, and when you combine that with inequality I'm not convinced it will ever be truly accessible to the majority.

20 These two right-angled triangles are similar.

Not drawn accurately

20a	Performance
X	58%
0	41%
1	1%



20 (a) Write down the value of tan x.

tan x = 9/12

tan x = (9 ÷ 12)

[1 mark]

Answer 36.9

0

20a Using the trigonometric ratios is new content to Foundation. Interestingly, many students who answered this question displayed an awareness of SOHCAHTOA, were able to label sides correctly, and stated that tan(x) = opp/adj. Some students, as seen in the exemplar, were even able to solve to find the value of x.

20a It is just a pity that the appearance of this new topic on a Foundation paper comes with a twist, and hence even the students who appeared to have sound knowledge of the concepts involved were not rewarded with a mark. A similar trend was seen on the Higher paper. Hopefully we will see more straightforward, accessible appearances of trigonometry in the future.

20 (b) Work out the value of y.

[2 marks]

2

9 ÷ 6 = 1.5

12 ÷ 1.5 = 8

20b This was the third most left-out question on the paper, with 60% of students opting to give it a miss. Perhaps this is unsurprising, as students may have assumed they needed to get the tricky part a correct in order to access it. Indeed, this is an example of new Foundation content: "make links to similarity (including trigonometric ratios). However, those students who did attempt the question and were successful, tended to ignore part a and focus purely on similar shapes and scale factors, as can be seen in the exemplar. A similar pattern also emerged amongst students sitting the Higher paper, where this question also appeared.

20b	Performance
X	60%
0	28%
1	7%
2	6%

Answer 8 cm

Interesting answers – Question 19

0 marks:

19 Paul won a race with a time of 71.579 seconds.
This time is to the nearest one thousandth of a second.

Use inequalities to write down the error interval due to rounding.

[2 marks]

71.579 ≥ 72.

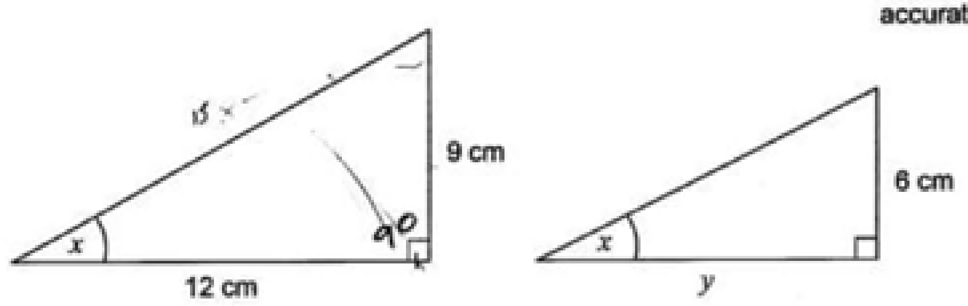
Answer 71.579 > 72.

Interesting answers – Question 20(a)

Correct ratio:

20 These two right-angled triangles are similar.

Not drawn accurately



20 (a) Write down the value of tan x.

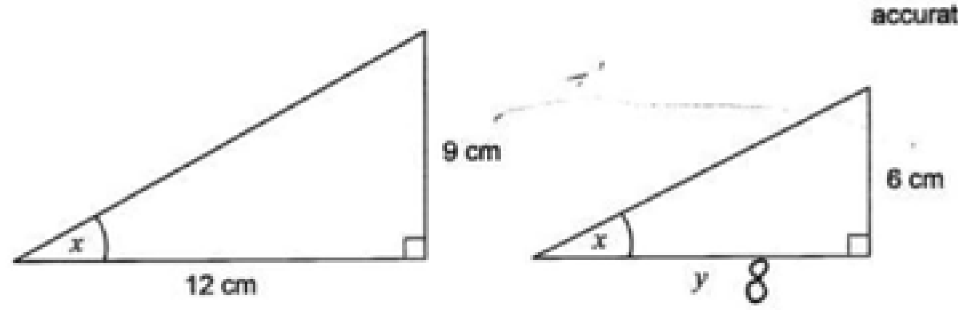
[1 mark]

Answer

Full marks:

20 These two right-angled triangles are similar.

Not drawn accurately



$\tan x = \frac{9}{12}$.

20 (a) Write down the value of tan x.

[1 mark]

Answer 0.75

21 A line has the equation $y - 4x = 5$

21 (a) What is the gradient of the line?

Circle your answer.

[1 mark]

–5 –4 4 5

0

21 (b) What is the y-intercept of the line?

Circle your answer.

[1 mark]

–5 –4 4 5

1

21b Perhaps not surprisingly, this part of the question was answered slightly more successfully than part a, presumably because no rearrangement of the linear function was required to obtain the y-intercept.

Performance

X	41%
0	37%
1	22%

Turn over for the next question

21a A challenging multiple choice question, requiring students to first rearrange the equation and then correctly choose the part that represents the gradient. I was pleasantly surprised that the most popular distractor was "-4", which suggests that students have an understanding that gradient is to do with the number in front of the x, but of course the deeper understanding of the form the equation needs to be in is lacking. Interestingly, whist "use the form y = mx + c to identify parallel lines" is new content, interpreting a linear function in this particular way is not.

Performance

X	38%
0	44%
1	18%

22 At a nursery, the mean age of 16 children is 31 months.

Twins, each of age 26 months, join the nursery.

Katy also joins the nursery.

The mean age of **all** 19 children is now 30 months.

Work out the age of Katy.

[4 marks]

1

$30 + 26 + 26 = \frac{82}{3} = 27$

Answer 27 months

22 Students tend to find non-routine questions about averages particularly difficult, and this has certainly proved the case here with only 3% of students scoring full marks, and nearly 90% failing to score a single mark. This "backwards mean" question also appeared on the Higher paper, and caused almost as much trouble. Students tended to add up any number in sight and divide by however many numbers there were, assuming/hoping this worked just like a standard question. It is interesting to note that the mark scheme gives credit for realising (and stating somewhere!) that twins involve two children, and hence two lots of 26 months. The exemplar answer did this, and scored a valuable mark.

Performance

X	57%
0	32%
1	8%
2	0%
3	0%
4	3%

Interesting answers – Question 22

Full marks:

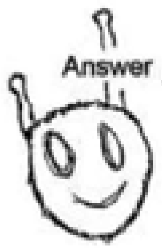
22 At a nursery, the mean age of 16 children is 31 months.
Twins, each of age 26 months, join the nursery.
Katy also joins the nursery.
The mean age of **all** 19 children is now 30 months.

Work out the age of Katy.

[4 marks]

31 x 16 = 496 m
496 + 52 = 548 m
548 ÷ 18 = 30.4
30 x 19 = 570
570 − 548 = 22 m

Answer 22 months



23 John chooses a number at random from the digits 1 to 9
Matt also chooses a number at random from the digits 1 to 9

Work out the probability that the product of the two numbers chosen is a single-digit number.

[3 marks]

1 + 2 2 + 2
1 + 3 2 + 3
1 + 4 2 + 4
1 + 5 2 + 5
1 + 6 2 + 6
1 + 7 2 + 7
1 + 8 2 + 8
1 + 9 2 + 9

Answer 7/18

23 Students found this probability question very challenging. Indeed, 98% of students failed to score a mark. Those who attempted it made some efforts to list a few possibilities, but there was often no structure to the combinations they found or, as in the exemplar, there were combinations missing. This question also appeared on the Higher paper where, perhaps unsurprisingly, students were more successful at listing out correct combinations.

Performance	
X	60%
0	38%
1	1%
2	1%
3	0%

Turn over for the next question

Interesting answers – Question 23

Highest scoring answer - 2 marks:

23 John chooses a number at random from the digits 1 to 9

Matt also chooses a number at random from the digits 1 to 9

Work out the probability that the product of the two numbers chosen is a single-digit number.

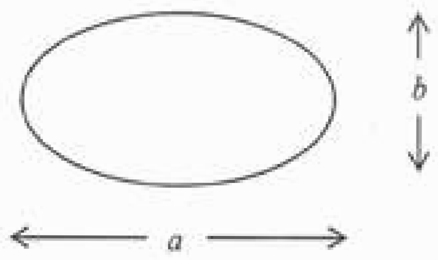
[3 marks]

$8+7+6+5+4+3+2+1$

$\frac{36}{81}$

24 The area of an ellipse, width a and height b, is given by

$$\text{Area} = \frac{\pi ab}{4}$$



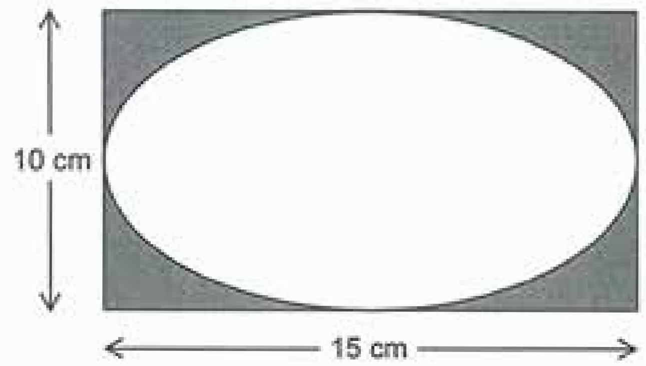
24 Performance	
X	57%
0	17%
1	22%
2	2%
3	2%

24 Students were more successful with this area/percentage question than the previous questions that have appeared on both the Higher and Foundation paper. It was pleasing – if not a little frustrating – to see that the majority of the students who attempted this question were able to work out the area of the quarter circle correctly. The frustration then came, as in the exemplar, when many students were then unable to combine this answer, together with the area of the rectangle, to work out the percentage area. This only gained them one mark out of the three available. Again, this may be an indication that more topics will be combined – in this case, area or a circle and percentage of an amount – than has been seen in the GCSE before.

A rectangular photograph measures 15 cm by 10 cm

It is put into a frame as shown.

Not drawn accurately



The part of the photograph that can be seen is an ellipse.

Work out the percentage of the photograph that can be seen.

[3 marks]

$\pi \times 15 \times 10 = \frac{471.23}{4} = 117.80$

$10 \times 15 = 150$

$150 - 117.80 = 32.2$

$100 - 32.2 = 67.8$

Answer 67.8 %

Interesting answers – Question 24

Full marks:

The part of the photograph that can be seen is an ellipse.

Work out the percentage of the photograph that can be seen.

[3 marks]

10 x 15 = 150 all together

$\frac{\pi \times 10 \times 15}{4}$ = ~~118~~ $\frac{118}{150} \times 100 = 79\%$

Answer 79 %

25 A flower shop sells

4 roses and 3 carnations for £6.10

5 roses and 1 carnation for £5.70

Work out the cost of a rose and the cost of a carnation.

[4 marks] 4

7 = 6.10

6 = 5.70

4R = £4 5R = £5

3C = £2.10 1C = £0.70

1C = £0.70 £5.70

£6.10

Cost of a rose £ 1

Cost of a carnation £ 0.70

25	Performance
X	50%
0	36%
1	1%
2	2%
3	0%
4	11%

Turn over for the next question

25 Of all the Higher/Foundation cross-over questions, this is the one Foundation students performed the best on. Deriving an equation (or in this case simultaneous equations), solving the equation and then interpreting the solution, is new to Foundation, together with simultaneous equations as a standalone topic. Interestingly, few students took an algebraic approach, and a significant number of the students who attempted this question were successful using trial and error, possibly because the numbers involved were quite nice. This was something that was also seen, to a lesser extent, in the Higher paper, and was awarded full marks. When the numbers are more difficult, such an approach will be less viable.

Interesting answers – Question 25

Full marks with algebra:

25 A flower shop sells

4 roses and 3 carnations for £6.10

5 roses and 1 carnation for £5.70

Work out the cost of a rose and the cost of a carnation.

Alt 1

[4 marks]

4R + 3c = 6.10   4R + 3c = 610

5R + 1c = 5.70 ×3 → 15R + 3c = 17.10

15R + 3c = 17.10
4R + 3c = 6.10
sub 11R + 0c = 11.00   4R + 3c = 6.10

11R/11 = 11/11   R = 1

4×1 + 3c = 6.10
−4 4 + 3c = 6.10 −4

Check: 5R + 1c = 5.70   3c/3 = 2.10/3
5 × 1 + 1.0.7 = 5.70   c = 0.70.
5 + 0.7 = 5.70 ✓

Cost of a rose £ 1

Cost of a carnation £ 0.70

26 A doctor claims that people who have poor sleep have twice the risk of having regular headaches than those who have good sleep.

She collects data from 2000 patients.

26 Performance	
X	57%
0	34%
1	9%
2	0%
3	0%
4	0%

	Quality of sleep	
	Good sleep	Poor sleep
Regular headaches	128	64
Not regular headaches	1472	336

Good sleep:
128 is twice risk
of regular headaches

Poor sleep:
64 is not twice
the risk of
regular headaches

Comment on the doctor's claim.

Show how you worked out your answer.

[4 marks]

0

She collected from 2000 people, a reasonable number. The ones who got poor sleep had 5 times more unregular headaches than ones with regular.
However, the ones who got good sleep had 11 times more unregular headaches than ones with regular.
The doctors claim of people who have 'poor sleep' have twice the risk of regular headaches than those who have good sleep is wrong.

END OF QUESTIONS

26 Over 90% of students failed to score a mark on this challenging final question of the paper. Interestingly, of the candidates who attempted this question, many gave comprehensive, well-structured, clear answers. The problem was, as is the case in the exemplar, these almost always failed to take an account of the relative proportions of the numbers involved, and instead make comparisons based on absolute number size. Students find questions that require them to comment and compare very tricky, but with this particular question also requiring students to know to make some percentage/fraction calculations, it was no surprise that it proved inaccessible to so many.

Interesting answers – Question 26

More general comments:

26 A doctor claims that people who have poor sleep have twice the risk of having regular headaches than those who have good sleep. ✗

She collects data from 2000 patients.

	Quality of sleep		
	Good sleep	Poor sleep	
Regular headaches	128	64	=192
Not regular headaches	1472	336	=1808

Comment on the doctor's claim.

Show how you worked out your answer.

[4 marks]

128 - 64 = 64. This shows that the doctor is correct.
Twice the number of people who get regular headaches are from
poor sleep. However, the doctor does not mention that
not regular headaches. 1472 ÷ 336 = 4.38, meaning
that over 4x the number of the ~~irregular~~ not regular headaches happen to
people who get good ~~no~~ sleep, meaning there is no link between
irregular headaches and amount of sleep.

Higher Paper

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Start of the paper: Multiple choice questions

As with the Foundation paper, I'm a huge fan of the multiple choice questions that appear on AQA's papers.

The use of multiple choice diagnostic questions to start this paper appears to cause some students difficulty. Their performance on the relatively low-demand, skill-based, AO1 questions (**Question 1** and **Question 2**) seems to me worse than I would expect if these questions appeared, in non-multiple choice form, in the current GCSE specification. One-third of students failed to score a mark on the Indices question (**Question 1**), and almost half on the Angles question (**Question 2**). Is this because students are not used to answering multiple choice questions, or because at this early stage of the exam they are not warmed up enough yet, and hence fall victim to the well-chosen, tempting distractors?

It is also worth noting that challenging topics (such as bearings in this paper, which is **Question 3**) can appear far earlier in the paper, via these multiple choice questions, than students might expect. Likewise, questions where the topic being tested is not immediately obvious (such as Pythagoras in **Question 4**) can also appear in the first four questions. Students need to be ready for this, and I am not sure mine would be yet!

An important point to note is that this is very much in contrast to the Foundation paper, where the four multiple choice questions to start the paper were relatively straightforward and very well answered by candidates. Indeed, 70% of candidates scored 3 or 4 marks, compared to just 7% for the Higher paper. This may well have had a calming, settling effect on the students sitting the Foundation paper, and helped prepare them for the challenges that lay ahead. Whereas there is every possibility that at least a couple of the multiple choice questions at the start of the Higher paper could well have knocked some students' confidence, which may have been hard to recover. If this becomes a consistent difference between the two papers, it will be yet another factor to take into consideration when deciding which students to put in for which tier.

The bottom-line is that these multiple choice questions are a fantastic discriminator, are efficient at getting right to the heart of the topic, and we as teachers may need to give our students regular experience with these types of questions as early as possible to prevent them being caught out.

Multiple choice questions

Your points here highlight what we are trying to achieve with multiple choice questions. They are not intended to be the easiest questions on the paper as we want to use this question style across a range of topics and at different demand. At the same time, we wanted to establish a familiar layout in all papers with four multiple choice questions at the start. They should, however, be of a demand that is broadly appropriate and I would be concerned if any of the early multiple choice questions were among the worst performing on the paper. Of the twelve items at the beginning of the three Higher papers, about half were close to the highest performing questions in the exam. Ten of the twelve were comfortably in the 'top half' by performance. That leaves two multiple choice questions that performed much less well than we would hope. As we always do, we will look at those items and think about what they tell us for future questions. I want to be very clear that there is no intention to take a different approach to multiple choice in the different tiers. Looking at the twelve early multiple choice items in the Foundation tier papers, all but one were in the 'top half' by performance but, as with Higher, they were by no means the twelve easiest questions across the papers. So, there is no intention that there will be a consistent difference in the demand of multiple choice items between the tiers.

Andrew Taylor, AQA

Familiar, but non-routine topics

Questions and topics that may, on the surface, have seemed familiar to students, but were in fact non-routine variants, certainly caught out many of the candidates sitting this paper. Notable examples include Ratio (**Question 13**) and Percentages (**Question 16**). Here, many candidates appeared to fall into well-rehearsed routines, which may have been successful in the straightforward types of questions they had encountered in the past, but which it would appear simply will not cut it in this new GCSE.

Perhaps this has implications for how topics such as percentages and ratio are delivered. Do we need to adopt the much-discussed “bar model” approach, which has certainly been shown to improve students’ flexibility and problem solving capabilities with these topics. Or will exposure to a whole host of non-routine questions and examples be enough?

Not to answer, but to explain…

Students (and teachers!) may well be surprised by the amount of times questions require students to explain something as opposed to answering it. In the Standard Form question (**Question 12**), candidates are not asked to convert to and from standard form in the familiar sense, but instead to criticise two other attempts. Then in **Question 22**, students are faced with what looks like a straight-forward SOHCAHTOA question, but with a twist which requires them to explain the effect of changing the size of the “right-angle”.

It is clear from the performance statistics on these questions that students are not entirely comfortable with so many explanations. Indeed over 40% of students chose not to answer the trigonometry question. Of course, there are similar questions to this in the current GCSE specification, but they are often sandwiched around more straightforward tests of their skills.

This is again more evidence that a deeper knowledge of topics, together with a flexibility, resilience and robustness, will be required to succeed at the new GCSE.

Not to answer, but to explain…

Your last sentence is spot on and captures a key aim for these revised GCSEs. Assessment objectives 2 and 3 place emphasis on explanation and critical evaluation as well as setting a higher bar for problem solving and reasoning. This is reflected in the questions you highlight. Challenging questions on what may, in the past, have been considered ‘easy’ content will be a feature of all new GCSEs. A challenge for us is to understand the demand however it arises, and position questions accordingly to set balanced papers.

Andrew Taylor, AQA

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New GCSE content

The performance on questions relating to content brand new to GCSE was mixed. On the one hand, students made a valiant effort at set notation (**Question 15**). Conversely, students struggled with early appearance of inequality notation related to rounding errors (**Question 5**), and the second most poorly answered question on the paper (**Question 27**) involved the brand-new inverse functions.

I suspect that many of the students taking this trial paper would not have been taught these concepts. I am certainly taking heart from the fact that once students have had experience of these concepts, there is no reason at all why they should not be accessible. For example, inequality notation related to rounding errors is just upper and lower bounds in disguise, and the algebraic manipulation required to answer the inverse functions question is relatively straightforward. Once we, as teachers, have a clear understanding of the exact nature of the new content and how it will be tested, we can begin to prepare our students appropriately.

New GCSE content

I agree. Across the scripts I looked at, there were instances of students answering tough questions on new topics really well. I suspect these students had experience of either the linked pair or our further maths certificate, both of which feature content and question styles that are beginning to appear in the main GCSE.

Andrew Taylor, AQA

Order of difficulty

This is undoubtedly a tough paper for students who have been used to the current GCSE. Especially around the middle of the paper, students are faced with a mixture of new topics, and familiar ones presented in a challenging way. This, combined with the fact that this trial was (understandably) not taken as seriously as an official GCSE exam would be, makes it unsurprising that a significant number of students appear to have given up from the middle of the paper onwards. This is clearly seen by the increasing number of non-attempts for each question, with students possibly being of the opinion that if they could not do, say, **Question 18 and 19**, then there is no chance that they will be able to do **Questions 20 to 25**.

However, the students who had not given up then come across something like **Question 24** – a relatively straightforward direct proportion question, with no twists whatsoever, and worth an invaluable 5 marks. Even the last question was a fairly standard linear inequality regions question.

The lesson to be learnt here is clear – students more than ever must not give up. This is certainly true in the current GCSE, but the evidence available suggests this may be even more important in the new incarnation. Relatively easy, accessible questions could appear anywhere in the paper, and students need to be prepared for them and in the correct, positive mind-set to capitalise.

Robustness and resilience are very much the order of the day.

Order of difficulty

I think that straightforward questions on the Higher only content will appear later in papers and many students will find these more accessible than some earlier problem solving questions even though the content has been defined as appropriate only for the second half of the Higher tier. Of course, that may change over the next couple of years as teaching approaches for this new GCSE evolve.

Andrew Taylor, AQA

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Links to AQA Further Maths Level 2 Qualification

There is little doubt that this is a challenging paper – significantly more challenging than one would expect of a Higher GCSE Calculator paper. It is not just the new content and the familiar but non-routine questions described above. There is also the appearance of questions that remind me (in a good way!) of the lovely Level 2 Further Maths Qualification. The unfamiliar nature of the proof question (**Question 20**) is one example of this, but even more so is **Question 21**, which combines co-ordinate geometry and ratio in a way that was previously reserved for our Further Mathematicians.

As part of a more challenging GCSE, I believe this a good thing. I love the Further Maths qualification, and believe there is no better way to stretch and challenge our most able Year 11s, and prepare them as well as possible for the demands of Maths A-level, particularly in the areas of algebra and co-ordinate geometry. Exposing more of our most able students to these concepts has to be a good thing.

Links to AQA Further Maths Level 2 Qualification

We were required to produce a more challenging GCSE and the rules we work to around number of marks targeted at a particular demand, plus the assessment objectives, plus the size of the specification, plus the length of the papers all make a contribution to a more challenging exam. What we have tried to do throughout is ensure that the demand comes from valid mathematical challenge. At the end of the Higher tier papers, we have also tried to think about the demands of A-level and further study and set questions which will put students on that journey. We did this very successfully with the Further Maths Certificate and have learned a lot from that experience.

Andrew Taylor, AQA

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AQA

PRACTICE PAPER SET 1

GCSE
Mathematics
Specification (8300/3H)

Paper 3 Higher tier

H

Date | Morning | 1 hour 30 minutes

Materials

For this paper you must have:
- a calculator
- mathematical instruments.

Instructions
- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the bottom of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book.
- In all calculations, show clearly how you work out your answer.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname

Forename(s)

Candidate signature

Version 1.0

8300/3H

Answer **all** questions in the spaces provided.

1 Simplify $(x^5)^2$

Circle your answer.

[1 mark] 1

$x^{2.5}$ x^7 x^{10} x^{25}

1 Performance	
1	67%
0	32%
X	1%

1 Students will need to get used to these multiple choice questions to kick-start their exam. Whilst this was the most successfully answered question on the paper, one-third of candidates still dropped a mark. The most popular distractor, luring in 20% of students, was calculating 5 squared to arrive at an answer of x^{25}.

2 What is the sum of the **exterior** angles of a polygon?

Circle your answer.

[1 mark] 0

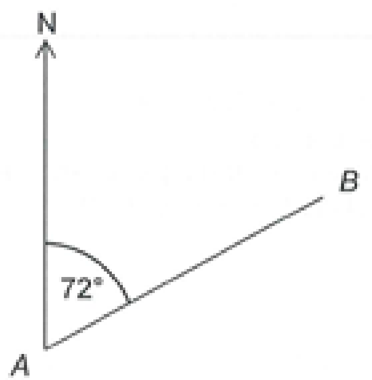
180° 360° 380° 540°

2 Performance	
1	58%
0	38%
X	4%

2 This question caused a few more problems, with just over half of the candidates scoring full marks. The distractor that caught out a significant minority (31% of candidates) is a classic! I would hazard a guess that students answering 540° are mistaking "polygon" for "pentagon" (and also "exterior" for "interior"!)

3 The bearing of *B* from *A* is 072°

Not drawn accurately



Circle the bearing of *A* from *B*.

[1 mark] 0

108° 612° 252° 288°

3 Performance	
1	13%
0	84%
X	4%

3 My Year 11s hate bearings and so to, it would appear, do the 88% of students who failed to answer this challenging question correctly. The most popular choice of distractor (enticing almost half of all candidates) was 288°, with students presumably subtracting 72° from 360° to arrive at this answer. It is interesting to note that challenging topics such as bearings are unlikely to be seen as early on in the paper in the current GCSE specification, so students need to be ready!

4 Which of these points is **not** 5 units from the point (0, 0)?

Circle your answer.

[1 mark] 0

(–5, 0) (1, 4) (3, 4) (0, 5)

4 Performance	
1	6%
0	92%
X	2%

4 According to the data, this was the 7th most poorly answered question on the paper (just 6% scored one mark), and yet it is the fourth mark available! It seems students need to be on their toes as early as possible during these new GCSE papers! 87% of candidates, including students who had scored full marks up to this point, fell victim to choosing (3, 4). Was this a trick question? Not really. Was it too much for this stage of the paper? Possibly.

5 Paul won a race with a time of 71.579 seconds.

This time is to the nearest one thousandth of a second.

Use inequalities to write down the error interval due to rounding.

[2 marks] 0

The thousanths number has to be a zero

Answer 71.580

5 Inequality notation to specify simple error intervals is new content. This question proved a bit of a nightmare for many students. Only 4% achieved the maximum 2 marks, and 43% opted to leave the question out altogether. Many of those that did attempt the question made the shrewd decision to ignore the word "inequalities" and instead focus on something they were more comfortable with – "rounding". We saw answers rounded to the nearest whole, tenths or, in the case of the exemplar, hundredths. Whilst this topic is essentially upper and lower bounds in disguise, bounds alone are a difficult concept for many students, and the addition of inequality notation may only make an already difficult topic even less accessible.

Performance	
2	4%
1	12%
0	41%
X	43%

Turn over for the next question

Interesting answers – Question 5

Dodgy inequalities:

5 Paul won a race with a time of 71.579 seconds.
This time is to the nearest one thousandth of a second.

Use inequalities to write down the error interval due to rounding.

[2 marks]

The thousandth number has to have a zero

Answer 71.580

Just rounds:

5 Paul won a race with a time of 71.579 seconds.
This time is to the nearest one thousandth of a second.
Use inequalities to write down the error interval due to rounding.

[2 marks]

Answer 71.6000.

One mark:

5 Paul won a race with a time of 71.579 seconds.
This time is to the nearest one thousandth of a second.
Use inequalities to write down the error interval due to rounding.

[2 marks]

$71.5785 \leq x < 71.5795$

Answer $71.5785 \leq x < 71.5795$

Correct answer:

5 Paul won a race with a time of 71.579 seconds.
This time is to the nearest one thousandth of a second.

Use inequalities to write down the error interval due to rounding.

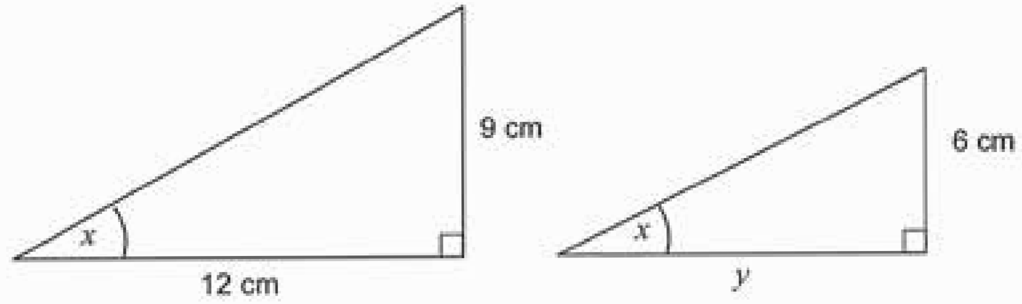
[2 marks]

$71.5785 \leq x < 71.5795$

Answer $71.5785 \leq x < 71.5795$

6 These two right-angled triangles are similar.

Not drawn accurately



6 (a) Write down the value of tan x.

[1 mark]

$\tan x = 9/12$
$\tan x = 0.75$

Answer 36.9

0

6 (b) Work out the value of y.

[2 marks]

2

$9.6 \div 6 = 1.5$
$12 \div 1.5 = 8$

Answer 8 cm

6a Only 13% of students got this question correct, but many of those who did not were a bit unlucky! The question asks for the value of tan(x), and many students appear to have fallen into their usual routine of working out the value of x, often completely correctly. Despite having the correct answer embedded in their working, and performing a higher level skill to go ahead and find x, candidates did not answer the question asked, and therefore scored no marks. Harsh!

Performance

1	13%
0	69%
X	18%

6b Almost half of candidates answered this relatively straightforward question successfully. Interestingly, the vast majority made no use of part a, and instead solved it using similar triangles and scale factor. I think I would have done the same!

Performance

2	47%
1	11%
0	24%
X	19%

7 At a nursery, the mean age of 16 children is 31 months.

Twins, each of age 26 months, join the nursery.

Katy also joins the nursery.

The mean age of **all** 19 children is now 30 months.

Work out the age of Katy.

[4 marks] 4

$\frac{(16 \times 31) + (26 \times 2) + \text{katy}}{19} = 30$

$496 + 52 + \text{katy} = 570$

$548 + \text{katy} = 570$

$\text{Katy} = 570 - 548 = 22$

Answer 22 months

Turn over for the next question

7 Questions involving what I call "backwards means" often prove troublesome, with many students falling back upon a well-rehearsed algorithm for finding the mean that they apply to all questions, regardless of the context. Here, 26% of students gained all four marks available on this question, and many of the solutions (as is the case with the exemplar) were beautifully structured and presented. Less successful candidates made no account of the fact that 16 children contributed to the mean age of 31 months, and instead added this to the 26 months. Interestingly, candidates who were able to demonstrate an awareness that twins involved two children, could gain a pretty easy mark!

Performance

4	26%
3	1%
2	9%
1	13%
0	25%
X	26%

Interesting answers - Question 7

One mark:

7 At a nursery, the mean age of 16 children is 31 months.

Twins, each of age 26 months, join the nursery.

Katy also joins the nursery.

The mean age of **all** 19 children is now 30 months.

Work out the age of Katy.

[4 marks]

$31 + 26(2) = 83$

$83 \div$

8 John chooses a number at random from the digits 1 to 9

Matt also chooses a number at random from the digits 1 to 9

Work out the probability that the product of the two numbers chosen is a single-digit number.

[3 marks]

1:1, 1:2, 1:3, 1:4, 1:5, 1:6, 1:7, 1:8, 1:9

2:1, 2:2, 2:3, 2:4

3:1, 3:2, 3:3

4:1, 4:2

5:1

6:1, 7:1, 8:1, 9:1

Answer 23/54

8 This is what I like to see in a question – a wide spread of marks! Many students tackled this question by attempting to list out all the possible combinations, but often not in a systematic way – how many times do we tell them?!? A significant number deduced that there were either 81 possible outcomes or (as in the case of the exemplar answer) 23 outcomes that they were interested in, and hence scored 1 mark. Those that got the answer correct tended to set their work out in a lovely, neat sample space diagram.

Performance

3	7%
2	13%
1	21%
0	43%
X	16%

Interesting answers - Question 8

Adding:

8 John chooses a number at random from the digits 1 to 9

Matt also chooses a number at random from the digits 1 to 9

Work out the probability that the product of the two numbers chosen is a single-digit number.

[3 marks]

	1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9	10
2	3	4	5	6	7	8	9	10	11
3	4	5	6	7	8	9	10	11	12
4	5	6	7	8	9	10	11	12	13
5	6	7	8	9	10	11	12	13	14
6	7	8	9	10	11	12	13	14	15
7	8	9	10	11	12	13	14	15	16
8	9	10	11	12	13	14	15	16	17
9	10	11	12	13	14	15	16	17	18

Interesting answers - Question 8

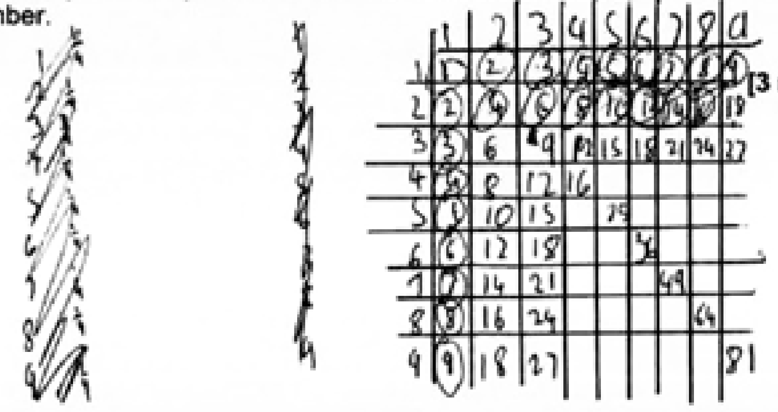
Full marks:

8 John chooses a number at random from the digits 1 to 9

Matt also chooses a number at random from the digits 1 to 9

Work out the probability that the product of the two numbers chosen is a single-digit number.

[3 marks]



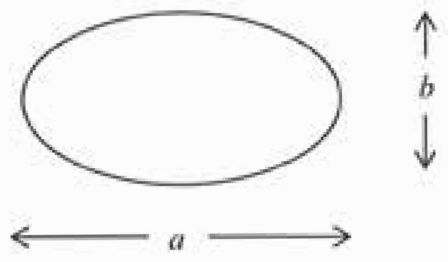
$\frac{23}{81}$ → Numbe of single digit products

$23/81 = 0.284$

Answer 0.284

9 The area of an ellipse, width a and height b, is given by

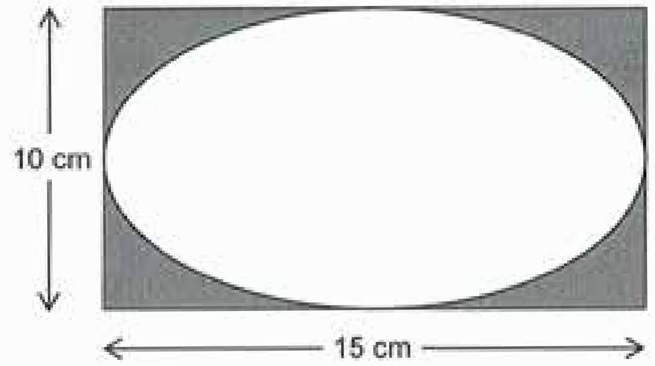
$$\text{Area} = \frac{\pi ab}{4}$$



A rectangular photograph measures 15 cm by 10 cm

It is put into a frame as shown.

Not drawn accurately



The part of the photograph that can be seen is an ellipse.

Work out the percentage of the photograph that can be seen.

[3 marks] 3

$10 \times 15 = 150$ $\quad \frac{\pi \times 15 \times 10}{4} = 117.8$

$\frac{117.8}{150} = 0.7853 \times 100 = 78.53$

Answer 78.53 %

9 An example of a question where a potentially new formula is given at the start. According to the data, this was the 2nd most successfully answered question on the paper, with almost half of all students scoring the full 3 marks. Almost all candidates were successful in their attempts to substitute numbers into the ellipse formula for 1 mark, and then it came down to whether they knew the steps required to find the required area percentage.

Performance

3	48%
2	8%
1	27%
0	7%
X	9%

Interesting answers – Question 9

Other interesting Answers:

One mark for ellipse:

Work out the percentage of the photograph that can be seen.

[3 marks]

$\frac{\pi \times 15 \times 10}{4} = 117.80$

$10 \times 15 = 150$

Answer ______ %

10 A flower shop sells

4 roses and 3 carnations for £6.10

5 roses and 1 carnation for £5.70

Roses = x

carnations = y

Work out the cost of a rose and the cost of a carnation.

[4 marks] 4

$4x + 3y = 6.10$ (1)

$5x + y = 5.70$ (2) $\times 3$

$15x + 3y = 17.10$ (3)

$15x + 3y = 17.1$ (3) (3) − (1)

$-\ 4x + 3y = 16.1$ (1)

Into (2)

$11x = 11$

$5 + y = 5.10$

$x = £1$

$5.7 - 5 = 0.70$

$y = 0.70$

Cost of a rose £ 1.00

Cost of a carnation £ 0.70

10 Success on this question basically came down to whether students could spot it was simultaneous equations in disguise. This has been a common feature of recent GCSE papers, so is nothing out of the ordinary. Half of the students sitting this paper spotted it, and went ahead and solved it. How many of those 27% who scored zero marks would have been successful if the question had been laid out as straightforward simultaneous equations is a question that could give their teachers nightmares for years to come! Interestingly, full marks were awarded to a significant minority of students for a successful answer using trial and improvement, as there was no explicit algebraic requirement in the question. If the solutions did not involve such nice numbers, I doubt many of these students would have been as successful.

Performance

4	50%
3	8%
2	6%
1	2%
0	27%
X	6%

Interesting answers - Question 10

Doesn't spot it is simultaneous equations:

10 A flower shop sells

4 roses and 3 carnations for £6.10

5 roses and 1 carnation for £5.70

Work out the cost of a rose and the cost of a carnation.

✗

[4 marks]

1R − 2C = 40p

Cost of a rose £ ____________

Cost of a carnation £ ____________

Interesting answers - Question 10

Uses trial and improvement for 4 marks:

10 A flower shop sells

4 roses and 3 carnations for £6.10

5 roses and 1 carnation for £5.70

Work out the cost of a rose and the cost of a carnation.

[4 marks]

4 × 100 = 400 T + I

= £4 £2.10.

2.10 ÷ 3 = 0.7

= 70p

0.70 × 3 = 2.10

5 × 100 = 500 0.70 × 1 = 0.70

= £5 70p

a rose = £1

carnation = 70p

Cost of a rose £ 1

Cost of a carnation £ 0.70

11 A doctor claims that people who have poor sleep have twice the risk of having regular headaches than those who have good sleep.

She collects data from 2000 patients.

	Quality of sleep	
	Good sleep	Poor sleep
Regular headaches	128	64
Not regular headaches	1472	336

Comment on the doctor's claim.

Show how you worked out your answer.

[4 marks]

The people that had bad sleep got more regular headaches than those who got good sleep as out of 2000 people, 336 that got bad sleep didn't get regular headaches and out of 2000 that got good sleep 1472 didn't get regular headaches

11 Questions requiring students to compare data sets and make a comment often lead to trouble. Indeed this was the case here. Whilst there were some comprehensive, well-structured solutions, over 70% of students either did not attempt this question or failed to secure a mark. The exemplar was an approach seen by many students, with the candidate simply quoting numbers and failing to make any account for proportions. Encouraging students to structure their answers and back-up statements with clear, meaningful calculations is the key to success here, but we all know that is easier said than done!

Performance

4	10%
3	5%
2	1%
1	10%
0	51%
X	22%

Interesting answers – Question 11

Comment for 4 marks:

Comment on the doctor's claim.

Show how you worked out your answer.

X

[4 marks]

The doctors ~~claimb~~ claim from the evidence seems corect

As the numbers of people who have good or bad sleep isn't equel I found the easyiest way to compare was to add up the people who had good sleep and add ~~upp~~ up all who had bad then find corolction

good = 1600 as 1600 ÷ 400 = 4
bad = 400
is headaces is same
128 ÷ 64 should = 4 but = 2 so more likely to get headace

Interesting answers – Question 11

Numbers, no proportion for 0 marks:

11 A doctor claims that people who have poor sleep have twice the risk of having regular headaches than those who have good sleep.

She collects data from 2000 patients.

	Quality of sleep	
	Good sleep	Poor sleep
Regular headaches	128	64
Not regular headaches	1472	336

Comment on the doctor's claim.

Show how you worked out your answer.

X

[4 marks]

The doctor's claim is false because 64 people who had poor sleep had reguler headings but 128 people who had good sleep had regular heading. You have twice the risk of having a reguler headahe when you have good sleep compared to poor sleep.

12 A teacher asks Amy and Jack to convert 101 376 into standard form.

12 (a) Amy writes 10.1376×10^4

Criticise Amy's answer.

[1 mark] 0

There should only be one number before the decimal point

> 12a Performance
> 1 45%
> 0 44%
> X 10%

> 12a Being asked to "criticise" an answer may be language that is unfamiliar in maths exams for some students. Whilst nearly half of students got this question correct, a lot of the near-misses were simply not specific enough. Answers such as "not in standard form" or like the one in the exemplar did not do enough to gain a mark. Students need to be more precise in their responses.

12 (b) Jack writes 1.01376×10^{-5}

Criticise Jack's answer.

[1 mark] 1

He has written -5, it should be positive

> 12b Performance
> 1 55%
> 0 30%
> X 15%

> 12b 12b was, in general, answered better than 12a. Perhaps this was because students found it easier to explain, or simply state, that the power should be positive, as opposed to the more specific explanation required in part a.

13 At a concert the ratio of men to women is 5 : 3

The ratio of women to children is 7 : 4

Show that more than half of the people at the concert are men.

[3 marks] 0

5 + 3 = 8

7 + 4 = 11

11 ÷ 8 = 1.375

5 × 1.375 = 6.875

3 × 1.375 = 4.125

6.875 : 4.125

> 13 Whilst there were a number of beautiful answers to this question, often involving lowest common multiples, 80% of candidates failed to secure a single mark. Many students (as in the exemplar) appeared to fall back into a well-rehearsed routine for dealing with ratio questions that involves adding together the two parts and finding something to divide it by. These more difficult ratio questions have been seen before in the excellent Level 2 Further Maths qualification, and if they are now seeping into GCSE, students will need to be on their toes and develop a more flexible approach. Does this suggest that the much-discussed Bar Model approach to ratio is the way to go?
>
> Performance
> 3 16%
> 2 2%
> 1 3%
> 0 50%
> X 30%

Interesting answers - Question 12(a)

0 marks:

12 (a) Amy writes 10.1376×10^4

Criticise Amy's answer.

[1 mark]

She hasn't written it in standard form.

Interesting answers - Question 13

Full marks:

13 At a concert the ratio of men to women is 5 : 3

The ratio of women to children is 7 : 4

Show that more than half of the people at the concert are men.

[3 marks]

×7 ×3

5 : 3 7 : 4 $\frac{35}{68} \times 100 = 51.47\%$

35 : 21 21 : 12

35 + 21 + 12 = 68

14 Use the quadratic formula to solve $5x^2 + 11x - 2 = 0$

Give your solutions to 2 decimal places.

[3 marks] 2

$a = 5 \quad b = 11 \quad c = -2$

$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \dfrac{-11 \pm \sqrt{11^2 - 4 \times 5 \times -2}}{2 \times 5}$

$x = \dfrac{-11 \pm \sqrt{161}}{10}$

$x = \dfrac{-11 \pm \sqrt{121 + 40}}{10}$

$x = \dfrac{-11 + \sqrt{161}}{10} = -13.96$

$x = \dfrac{-11 - \sqrt{161}}{10} = -2.37$

Answer $-13.96, \quad -2.37$

Turn over for the next question

14 A straightforward question requiring the use of the quadratic formula – which it kindly told you in the question! Students who wrote out the formula and substituted their numbers in tended to be successful. Interestingly, as can be seen in the exemplar, there were a significant minority of students (12%) who gained 2 out of 3 marks due to a last minute calculator slip.

Performance

3	13%
2	12%
1	7%
0	43%
X	26%

Interesting answers - Question 14

Full marks

14 Use the quadratic formula to solve $5x^2 + 11x - 2 = 0$

Give your solutions to 2 decimal places.

[3 marks]

$\dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a} \qquad \dfrac{-11 \pm \sqrt{11^2 - 4 \times 5 \times -2}}{10}$

$\dfrac{-11 \pm \sqrt{121 + 40}}{10}$

$\dfrac{-11 \pm \sqrt{161}}{10}$

$x = \dfrac{-11 + \sqrt{161}}{10} \quad x = 0.17 \quad$ or $\quad x = \dfrac{-11 - \sqrt{161}}{10} \quad x = -2.37$

Answer $x = 0.17$ or $x = -2.37$

15 The universal set contains the whole numbers 1 to n.

n is an even number greater than 100

O is the set of odd numbers.

P is the set of prime numbers.

S is the set of square numbers.

15 (a) Explain why there are no numbers in $P \cap S$

[1 mark]

Any square number has more multiples than just itself and 1, so can't be a prime number

15a Performance

1	16%
0	30%
X	54%

15a Some brand new GCSE content! There was little surprise that the set notation caught out many students, but those that had seen it before (as in the exemplar) had a really good stab at explaining their answers. Exposing students to the beauty of Venn diagrams may well be the way to master this new area of content.

15 (b) How many numbers are there in $O \cup P$?

Circle your answer.

[1 mark]

$\frac{n}{2} - 1$ $\qquad$ $\frac{n}{2}$ $\qquad$ $\frac{n}{2} + 1$ $\qquad$ n

15 Due to the nature of a multiple choice question, more students were willing to have a go at this one than 15a. However, once again the unfamiliar set notation caught them out. Almost a third of students got this question correct, but without their explanations we cannot know how much of this was due to inspired guesswork.

Performance

1	31%
0	34%
X	36%

Interesting answers - Question 15

0 marks:

15 The universal set contains the whole numbers 1 to n.

n is an even number greater than 100

O is the set of odd numbers.

P is the set of prime numbers.

S is the set of square numbers.

15 (a) Explain why there are no numbers in $P \cap S$ what?

[1 mark]

~~All prime numbers are all (except~~

15 (a) Explain why there are no numbers in $P \cap S$

[1 mark]

Because prime numbers are only divisible by 1 and themselves. Square numbers are numbers that are the product of ~~a~~ ~~an~~ number being timesed ~~by~~ by itself.

16 A calculator gives a value of π as 3.14159

An approximation for π is $\sqrt{\frac{40}{3} - \sqrt{12}}$

Show that the value of the approximation is within 0.01% of the calculator value.

[4 marks]

$\sqrt{\frac{40}{3} - \sqrt{12}} = 3.14153$

Calculator = 3.14159

thus within 0.01%

of the calculator value

16 Whilst estimation is a familiar sight on current GCSE papers, this question falls under the new umbrella of "estimate answers; check calculations using approximation and estimation, including answers obtained using technology". 35% of students managed to score 1 mark on this question by typing the given formula into their calculator and writing down the result. Only a few students (5%) could then carry this forward to show that it was within 0.01% of the calculator value. A challenging question, and certainly not the routine kind of percentages questions that some students will be used to.

Performance

4	5%
3	7%
2	5%
1	35%
0	13%
X	34%

Turn over for the next question

Interesting answers - Question 16

Full marks:

16 A calculator gives a value of π as 3.14159

An approximation for π is $\sqrt{\frac{40}{3} - \sqrt{12}}$

Au3

Show that the value of the approximation is within 0.01% of the calculator value.

[4 marks]

$\sqrt{\frac{40}{3} - \sqrt{12}} = 3.141533339$

0.01% = 10 thousandth

Calc = 3.14159 ÷ 10,000

= 0.000314159

3.14159 − 0.000314159 = 3.141275841

3.141275841 − 3.14159

3.141533339

17 The length of a plank of wood is 3 metres to the nearest centimetre.
A piece of length 50 centimetres, to the nearest millimetre, is cut off.

Work out the **maximum** possible length of wood remaining.
Give your answer in millimetres.

[3 marks]

50 LB = 49.5 300 UB = 300.5

300.5 - 49.5 = 251

251 × 1000 = 251,000

Answer 251,000 mm

17 Part of the skill of solving a bounds question is first of all spotting it is a bounds question! And almost three-quarters of students do not appear to have done so. Those that did were able to secure an easy mark by successfully finding a bound of one of the measurements given. It is little surprise that few students (5%) were able to successfully subtract a lower bound from an upper bound to arrive at the correct answer. Interestingly, this is the second appearance of Bounds in this paper – and for many students, that will be two times too many!

Performance

3	5%
2	1%
1	20%
0	49%
X	25%

Interesting answers – Question 17

Full marks:

17 The length of a plank of wood is 3 metres to the nearest centimetre.
A piece of length 50 centimetres, to the nearest millimetre, is cut off.

Work out the **maximum** possible length of wood remaining.
Give your answer in millimetres.

[3 marks]

300cm = UB : 300.5cm 3005mm
~~50cm~~ 500mm LB = ~~495mm~~ 499.5mm

3005 - 499.5 = 2505.5

Answer 2505.5 mm

18 $y = \frac{5\sqrt{x}}{2}$

Circle the expression in x for y^2

[1 mark] 1

$\frac{25x}{4}$ $\frac{5x}{2}$ $\frac{5x^2}{2}$ $\frac{25x^2}{4}$

18 Only a third of students got this question correct, and the wrong answers were spread pretty evenly across all the distractors. A sign of a very good question!

Performance	
1	33%
0	48%
X	19%

19 The square of x is 7

Circle the value of x^3

[1 mark] 0

343 $\sqrt[3]{49}$ 117 649 $7\sqrt{7}$

19 Another multiple choice question that did a good job in splitting students' answers. The most popular distractor was a), suggesting students have simply cubed 7.

Performance	
1	44%
0	42%
X	14%

Turn over for the next question

20 w, x and y are three integers.

w is 2 less than x

y is 2 more than x

Prove that $wy + 4 = x^2$

[3 marks] 0

$4 \times 8 + 4 = 6^2$

$4 \times 8 + 4 = 36$

20 Whilst proof certainly appears regularly on the current GCSE, it is rarely in this form. Usually, it involves something like proving an expression is even, or a multiple of a given number. Unless students are exposed to this type of proof, it is clear they will struggle to know where to start on questions like this. A few students (6%) produced lovely, complete solutions. But it was also clear that many students did not know where to begin, with many attempting to solve an equation that wasn't really there to be solved or, in the case of the exemplar, adopting the common approach of using numbers.

Performance	
3	6%
2	0%
1	24%
0	31%
X	39%

Interesting answers – Question 20

Full marks:

20 w, x and y are three integers.

w is 2 less than x

y is 2 more than x

Prove that $wy + 4 = x^2$

All 3

[3 marks]

$x - 2 = w$ $\quad$ $y + 2 = x$

$+2 \quad = \quad +2$

$x = w + 2$

$wy + 4 = x^2$

$(x-2)(x+2) + 4 = x^2$

$x^2 \cancel{+2x} \cancel{-2x} - 4$

They cancel each other out

$x^2 - 4 + 4 = x^2$

$x^2 = x^2$

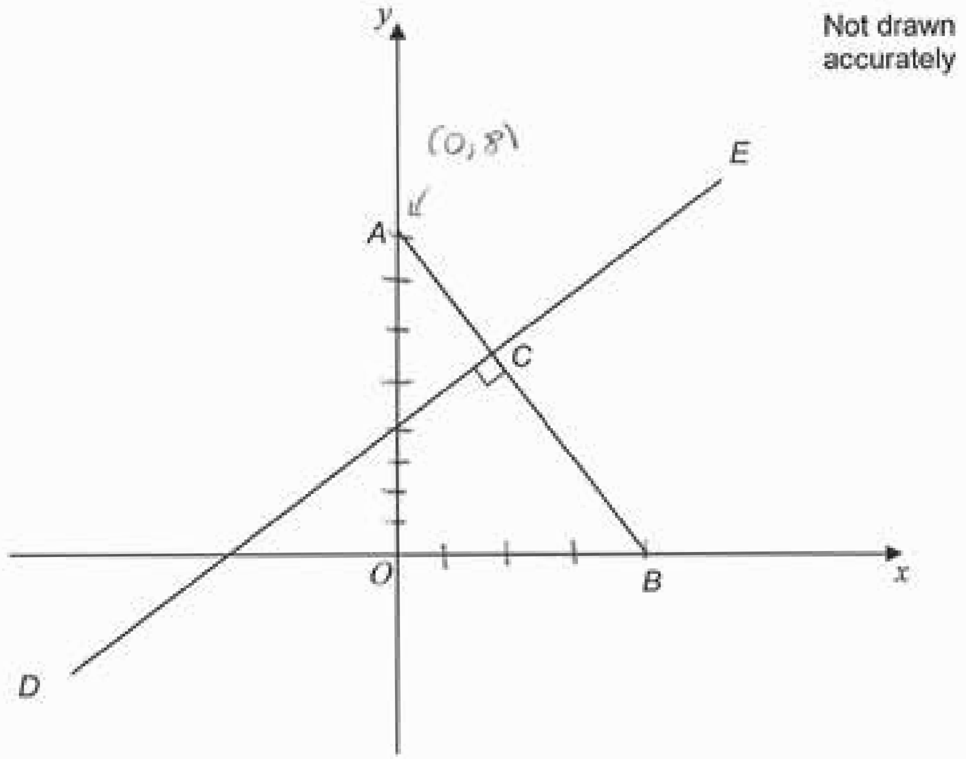
21 ACB is a straight line.

A is the point (0, 8), and B is the point (4, 0)

$AC : CB = 1 : 3$

Line DCE is perpendicular to line ACB.

Not drawn accurately



Work out the equation of line DCE.

[5 marks]

DC : CE

(2, 5)

Answer ______________________

21 A question right out of the AQA Level 2 in Further Mathematics locker! Co-ordinate geometry, ratio and some good old-fashioned problem solving all bundled up into a lovely 5 mark question in which 90% of candidates failed to score one mark. Once again, we are seeing that routine knowledge of topics like ratio and straight lines will not be enough – the students who will be successful in this new GCSE will be those who are flexible and can apply their skills and knowledge across several topics and concepts.

Performance	
5	1%
4	0%
3	0%
2	4%
1	5%
0	45%
X	45%

Interesting answers - Question 21

Full Marks:

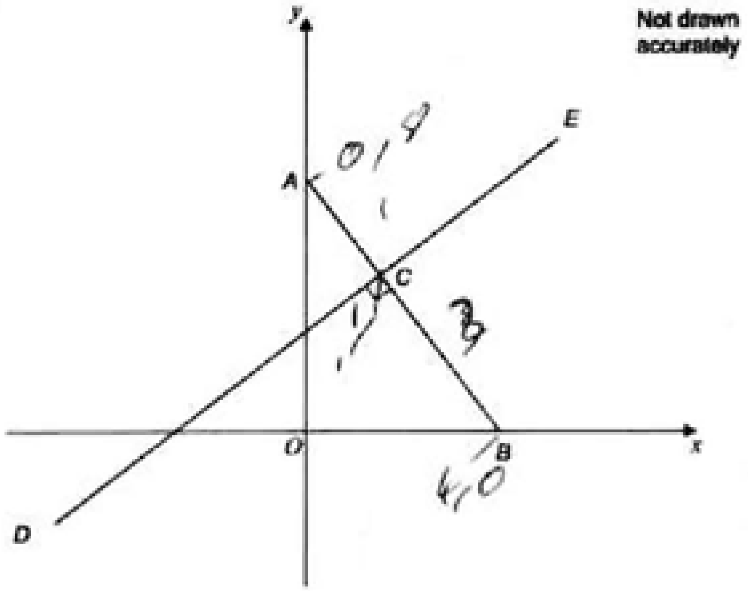
21 *ACB* is a straight line.

A is the point (0, 8), and *B* is the point (4, 0)

$AC : CB = 1 : 3$

Line *DCE* is perpendicular to line *ACB*.

Not drawn accurately



Work out the equation of line *DCE*.

[5 marks]

0, 8   4, 0 $\frac{8}{4} = 2$

$9 : 2$

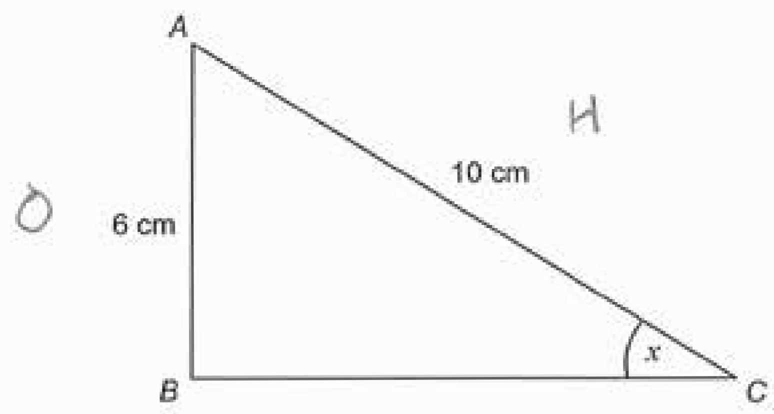
$y = \frac{1}{2}x + 5.5$ 1, 6

0, 5.5x

Answer $y = \frac{1}{2}x + 5.5$

22 Kemal is working out the size of angle x in the triangle below.

Not drawn accurately



s o h c a h

Kemal assumes that angle *ABC* is a right angle.

In fact, the size of angle *ABC* is 89°

Explain the effect of Kemal's assumption on the accuracy of his calculation.

You **must** show working to support your explanation.

[3 marks]   1

$6 \div 10 = 0.6$

$\sin (0.6)$

$x = 36.86989765$

$\sin 6 = 0.002835$

36.86

This accuracy will be out by about 1%

22 Students found this question very tricky – in fact, perhaps "inaccessible" is a better word, with over 40% opting to leave it out entirely. At first glance it appears to be a straight forward SOHCAHTOA question, but the appearance of the changing angle and the requirement to explain as opposed to work out the value of x seems to have put many students off even attempting the question. Those with the resilience to have a go were able to pick up a mark, as in the exemplar, for a successful use of either the sine rule or SOHCAHTOA.

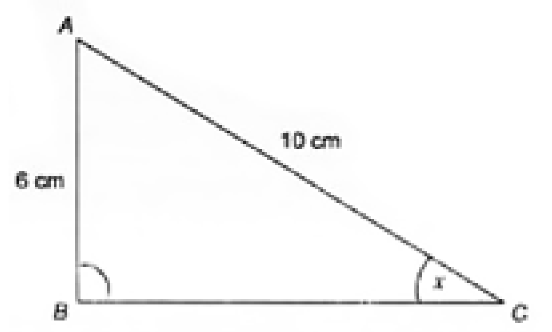
Performance	
3	3%
2	3%
1	13%
0	40%
X	42%

Interesting answers – Question 22

Full marks:

22 Kemal is working out the size of angle x in the triangle below.

Not drawn accurately



Kemal assumes that angle ABC is a right angle.

In fact, the size of angle ABC is 89°

Explain the effect of Kemal's assumption on the accuracy of his calculation.

You **must** show working to support your explanation.

[3 marks]

$$\frac{\sin 89}{10} = \frac{\sin x}{6}$$

$$\frac{6 \sin 89}{10} = \sin x = \text{ans} \sin^{-1} = 36.8637$$

~~6 sin 90~~

$$\frac{6}{10} = 0.6 \quad \sin^{-1} 0.6 = 36.86489$$

sin 90 = 1

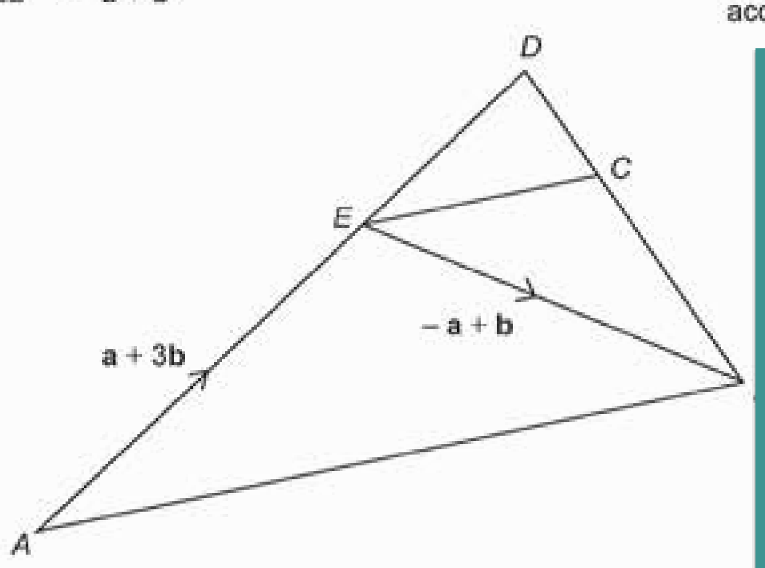
They are different and so lowered be a accuracy to 1 dp.

23 *AED* is a straight line.

$\overrightarrow{AE} = \mathbf{a} + 3\mathbf{b}$

$\overrightarrow{EB} = -\mathbf{a} + \mathbf{b}$

Not drawn accurately



23a My students often say to me that if you don't know the answer to part a) if it's a vectors question, just stick down "a – b" as more often than not it is correct. Unfortunately, that fool-proof strategy would not have gained you a mark on this particular question. However, a third of students taking this paper seemed content that they were back on familiar ground, and succeeded in tracing a route from one point to the next, simplifying expressions along the way.

Performance

1	33%
0	19%
X	47%

23 (a) Work out the vector $\overrightarrow{AB}$

[1 mark] 1

a + 3b + - a + b

4b

Answer 4b

23b Part b of vectors questions are always challenging, and indeed so this one proved. But the style and complexity was not significantly different to what students would expect in the current GCSE specification. The reason so few (2%) got this question correct was probably due to a combination of the complexity of the content, and also that many students appear to have given up at this point! The lesson here – keep going until the very end!

23 (b) Also $\overrightarrow{ED} = \frac{1}{4}\overrightarrow{AD}$ and $\overrightarrow{DC} = -\frac{1}{3}\mathbf{a}$

Prove that *EC* is parallel to *AB*.

[3 marks] 3

23b Performance

3	2%
2	1%
1	2%
0	16%
X	78%

$\overrightarrow{EC}$ needs to be a factor of $\overrightarrow{AB}$

$\overrightarrow{AB} = k\overrightarrow{EC}$

$\overrightarrow{EC} = \frac{1}{3}(a + 3b) + -\frac{1}{3}a = \frac{1}{3}a + b - \frac{1}{3}a = b$

$\overrightarrow{AB} = 4b$ ∴ they are parallel as $\overrightarrow{AB} = 4\overrightarrow{EC}$

24 The time of each swing of a pendulum, length l cm, is T seconds.
T is directly proportional to the square root of l.

When $l = 90.25$ $T = 1.9$

Work out the value of T when $l = 132.25$

[5 marks] 5

$T \propto \sqrt{L}$

$1.9 = k\sqrt{90.25}$

$1.9 = 9.5k$

$k = 1.9/9.5 = 0.2$

$T = 0.2\sqrt{L}$

$T = 0.2 \times \sqrt{132.25} = 2.3$

24 Performance	
5	15%
4	2%
3	0%
2	0%
1	0%
0	39%
X	43%

Answer 2.3 seconds

24 A relatively straightforward question on direct proportion, with no twists. Unfortunately, 43% of students made no attempt at it whatsoever. Was this because they were not familiar with the topic or – and this would be my best bet – because they had already given up at this stage of the exam, perhaps put-off by the deluge of tricky, unfamiliar questions they had faced up to this point. Students who attempted this question, like the exemplar, were able to access all 5 marks. Once again the lesson is the same – stay positive and focused, and do not give up!

25 The graph with equation $y = x^2$ is translated by vector $\begin{pmatrix} 2 \\ 0 \end{pmatrix}$

Circle the equation of the translated graph.

[1 mark] 0

$y = (x-2)^2$ $\quad$ $y = (x+2)^2$ $\quad$ $y = x^2 + 4$ $\quad$ $y = x^2 + 2$

25 Performance	
1	5%
0	58%
X	37%

25 The final multiple choice question of the paper again caught out many students, with only 5% getting the correct answer. f(x) transformation are one of my Year 11s' Achilles' heels, and it was little surprise to see many students lured into the two appealing distractors of $(x + 2)^2$, and $x^2 + 2$.

Interesting answers - Question 24

0 marks:

24 The time of each swing of a pendulum, length l cm, is T seconds.
T is directly proportional to the square root of l.

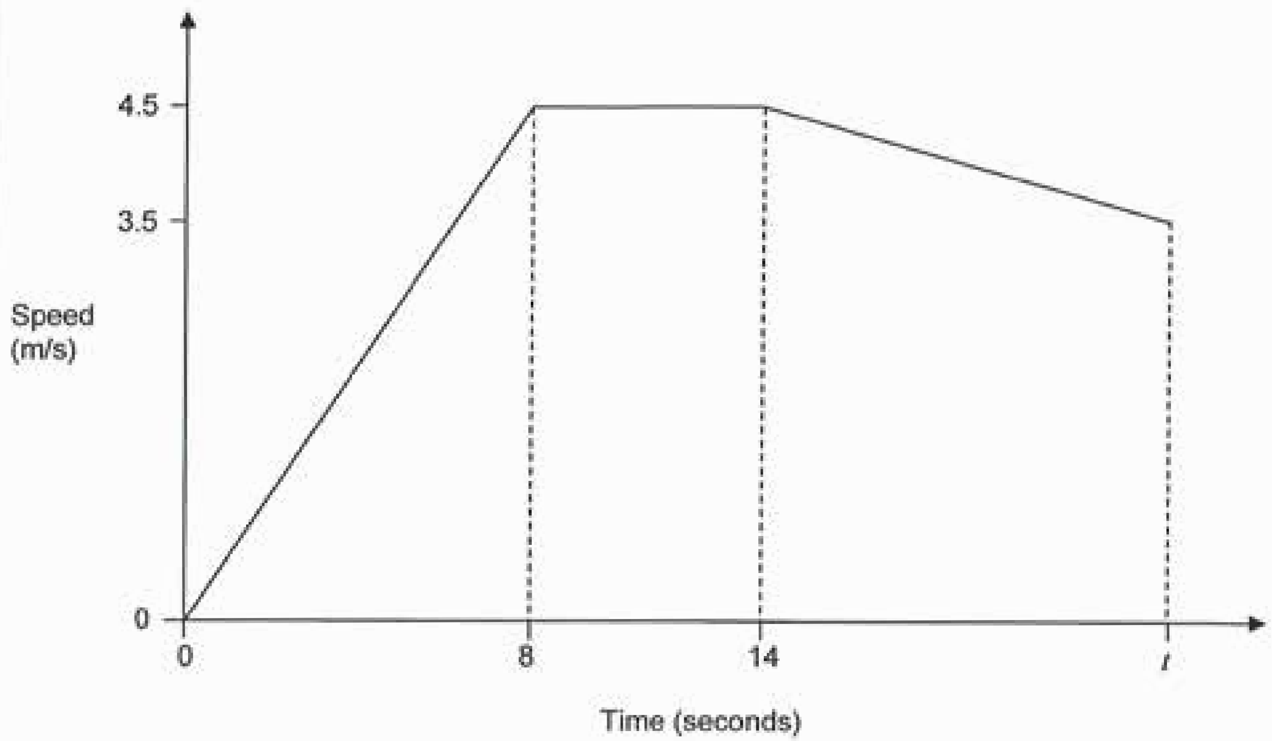
When $l = 90.25$ $T = 1.9$

Work out the value of T when $l = 132.25$

[5 marks]

$\sqrt{132.25} = 11.5$

26 Here is a sketch of a speed-time graph for part of a journey.



The average speed from 0 to t seconds was 3.6 m/s

Work out the value of t.

[5 marks] 0

S
D | T

Speed = distance × time

8 seconds travelled 4.5m = 1.78

26 Performance

5	0%
4	0%
3	0%
2	0%
1	3%
0	40%
X	57%

26 Here we have officially the trickiest question on the paper! Just 3% of students managed to score one mark out of the five available, and nobody scored more than that! Whilst students will have obviously met speed and time before, this was a challenging context. Those students that did attempt the question, as in the exemplar, tended to pretend that the more familiar "distance" was in fact on the y-axis and proceeded (incorrectly) from there.

Answer ______________ seconds

27 For all values of x, $f(x) = \dfrac{4x-3}{5}$

Work out $f^{-1}(x)$

[3 marks] 0

$f(x) = \dfrac{4x-3}{5}$

$\dfrac{4-3}{5} = 0.2$

Answer ______________

27 The second most poorly answered question on the paper, with 73% of candidates making no attempt at all! The concept of inverse functions is completely new GCSE content, and I can only surmise from many of the attempts, that students had not been taught it. When they have, I would suspect that questions such as this will pose relatively little challenge as the algebraic manipulation involved is fairly straightforward – it is no more than changing the subject of an equation.

Performance

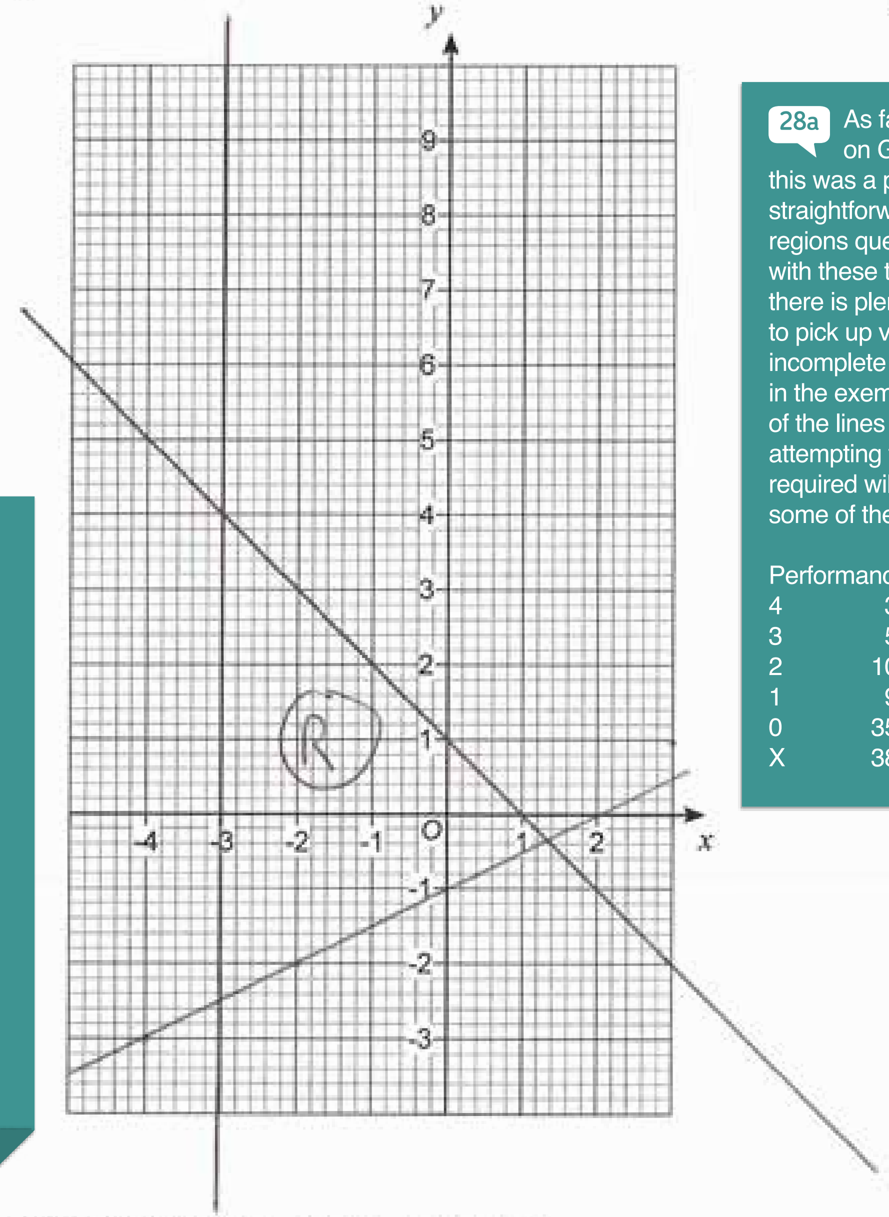
3	0%
2	0%
1	4%
0	24%
X	73%

28 The region R satisfies the three inequalities

$x > -3$ $\qquad$ $x + y \leqslant 2$ $\qquad$ $y > \dfrac{x}{2} - 1$

28 (a) Show the region R in the grid.

[4 marks] 2



28a As far as last questions on GCSE papers go, this was a pretty nice one. A straightforward linear inequality regions question. As ever with these types of questions, there is plenty of opportunity to pick up valuable marks for incomplete solutions. As we see in the exemplar, plotting some of the lines correctly and then attempting to identify the region required will be rewarded with some of the marks available.

Performance

4	3%
3	5%
2	10%
1	9%
0	35%
X	38%

28b An interesting question to end the paper, reminiscent of a linear programming question from the Decision 1 A-level module. I suspect the 72% of students who did not attempt this question had endured more than enough by this point, because if a student were to try out a few logical values within their region (as the exemplar answer did), they could arrive at the answer of 4 without too much difficulty.

Performance

1	2%
0	26%
X	72%

28 (b) Work out the maximum value of $2x + y$ in region R.

[1 mark] 1

$2x + y \qquad 2 \times 2 = 4 + y \qquad y = 0 \qquad 4 + 0 = 4$

Answer 4

END OF QUESTIONS

Interesting answers - Question 28a

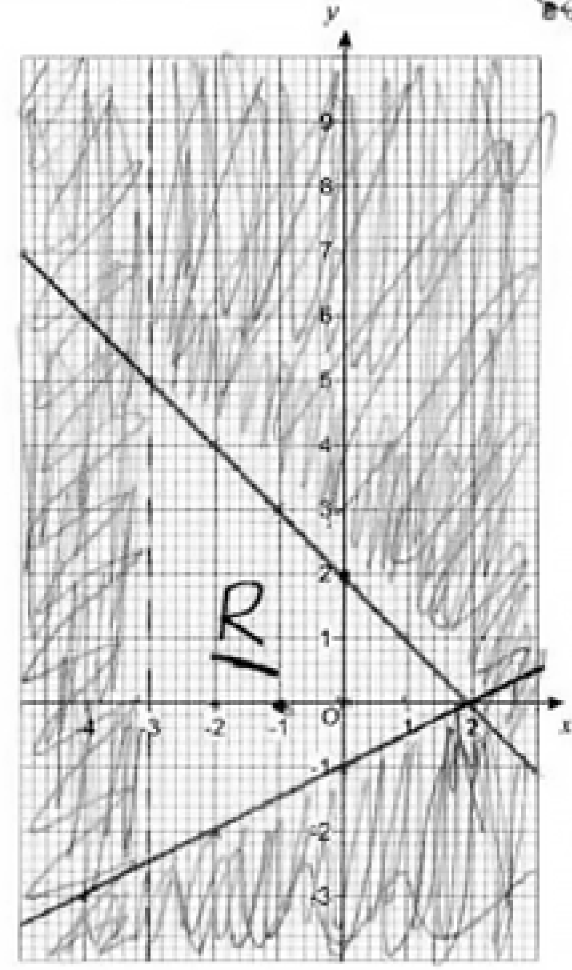
Full marks:

28 The region R satisfies the three inequalities

$x > -3$ $\qquad$ $x + y \leqslant 2$ $\qquad$ $y > \dfrac{x}{2} - 1$

28 (a) Show the region R in the grid.

[4 marks]



$0 = \frac{x}{2} - 1$

$1 = \frac{x}{2}$

$2 = x$

$-1 = \frac{x}{2} - 1$

$0 = \frac{x}{2}$

$0 = x$

$-2 = \frac{x}{2} - 1$

$-1 = \frac{x}{2}$

$-2 = x$

$-3 = \frac{x}{2} - 1$

$-2 = \frac{x}{2}$

$-4 = x$

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

NOTES:

NOTES:

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@MrBartonMaths

Craig Barton is a Secondary Maths Advanced Skills Teacher from Thornleigh Salesian College, Bolton, in the UK. He is the creator of the highly successful mrbartonmaths.com website, which offers free resources to teachers and students with the aim of making maths more fun and exciting for everyone. He is the co-founder of diagnosticquestions.com, which aims to help students and teachers all over the world identify, understand and resolve misconceptions.

He is also the Secondary Mathematics advisor for the TES, the largest professional network of teachers in the world. Through this role, Craig is responsible for selecting, promoting and organising the many thousands of maths resources that have been created and uploaded by teachers from all over the world, as well as co-ordinating exciting projects as leader of the TES Maths Panel. His fortnightly newsletter for TES goes out to over 30,000 maths teachers around the globe, his blog covers all areas of mathematics teaching and learning.

Andrew Taylor
@AQAMaths

Before joining AQA, Andrew taught mathematics for 17 years and was Head of Faculty in large comprehensive schools in Cambridgeshire and Manchester. His first role with AQA was in 2001 when he was appointed as Senior Subject Officer for GCSE Mathematics. He moved into the newly created Head of Mathematics role in 2011. Andrew is responsible for the development and delivery of all of our mathematics qualifications from Entry level through to our GCSEs and A-levels. Currently, he is heavily involved in the reform of GCSEs and A-levels as well as the development of the new Core Maths qualifications.

AQA
Realising potential

We've teamed up with Craig Barton's Diagnostic Questions website to share free diagnostic question assessment for our new 2017 GCSE Maths specification. We will aim to produce quizzes for each of the topics covered by our Route Maps, providing a truly comprehensive package to support your teaching and assessing of the new GCSE specification.

Use the ready-made quizzes or individual questions as part of your own assessments to measure progress, highlight misconceptions and get your students ready for this important style of questioning.

Find out more by visiting **diagnosticquestions.com/AQAMaths**

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Any questions?
Call us on 0161 957 3852 and get straight through to the Maths team, or email us at maths@aqa.org.uk