IMPERIAL Maths School

MEI Mathematics Education Innovation

Admissions Test

2025 Sample paper 2

1½ hours

This admissions test is designed to assess your mathematical thinking.

All questions require no more than the content of GCSE mathematics, but they may not be of the style you are accustomed to.

You may find some of the questions challenging. As schools teach the GCSE mathematics content in different orders, there may be a small number of questions that you have not yet covered in your maths lessons. You may be able to work out how to do these questions anyway.

Remember that if you find something challenging, it is likely that others are finding it similarly challenging.

Consider carefully how to distribute your time across the three sections.

Instructions to candidates

Please read these instructions carefully, but do not open the paper until you are told to do so.

Answer **all** questions.

You may **not** use a calculator.

Enter your answers in the appropriate spaces in the answer booklet.

If you run out of space, you may ask for additional paper.

The test is in three parts. There are 60 marks in total.

Section A is worth 20 marks. It consists of 10 multiple choice questions which test your understanding of GCSE Mathematics content.

Section B is worth 20 marks. It consists of 10 multiple choice questions which test your reasoning and thinking skills.

Section C is worth 20 marks. It consists of 3 multi-part questions which test your understanding of mathematical arguments and your ability to analyse a mathematical situation.

There are no marks for showing working out but you can do working on the paper to help you find the correct answer.

If you change your mind about the answer to a multiple choice question, make it clear which answer you are choosing.

If you require more space for working, you may ask for additional paper.

You should not discuss the content of this paper with anyone, either online or in person. Any candidates found to have shared details about this paper may have their applications terminated, or offer or place at the school withdrawn.

Section A

20 marks

Answer all questions

Each question is worth 2 marks.

Put a circle around the one correct answer in the answer booklet. If you change your mind about an answer, make it clear which answer you are choosing.

1 Which of the following is $(2 \times 10^5)^4$ expressed in standard form?

A 1.6×10^{21}

B 16×10^{20}

C 8×10^{20}

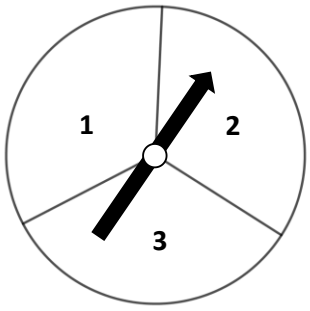
D 16×10^{625}

E 1.6×10^{626}

2 Work out $1\frac{1}{2} \times 1\frac{1}{3} \times 1\frac{1}{4} \times 1\frac{1}{5} \times 1\frac{1}{6}$.

A $1\frac{1}{720}$ **B** $2\frac{9}{20}$ **C** 3 **D** 7 **E** 3.5

3 The fair spinner below can land on 1 or 2 or 3.



The spinner is spun three times.

The spins are independent.

What is the probability that the sum of the numbers it lands on is even?

A $\frac{1}{27}$ **B** $\frac{5}{27}$ **C** $\frac{4}{9}$ **D** $\frac{13}{27}$ **E** $\frac{1}{2}$

4 The n^{th} term of a sequence is given by the formula $n^2 + n$.

n takes values from 1 onwards.

Which of the following statements is true?

A All the numbers in the sequence are odd.

B All the numbers in the sequence are even.

C The first 5 numbers in the sequence are odd but it's not possible to be sure what happens as the sequence continues.

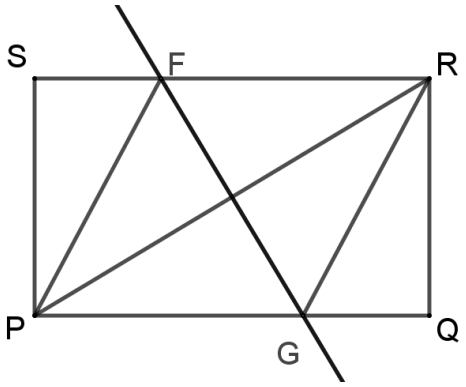
D The first 5 numbers in the sequence are even but it's not possible to be sure what happens as the sequence continues.

E The numbers in the sequence are alternately odd and even.

5 The diagram shows rectangle PQRS.

FG passes through the midpoint of diagonal PR.

FG is perpendicular to PR.



Which of these statements is true about the sides of quadrilateral PGRF?

A All 4 sides have the same length.

B 3 of the sides have the same length; the other side has a different length.

C 2 of the sides have the same length; the other 2 sides have different lengths.

D 2 of the sides have the same length; the other 2 sides have the same length as each other but different from the first pair of sides.

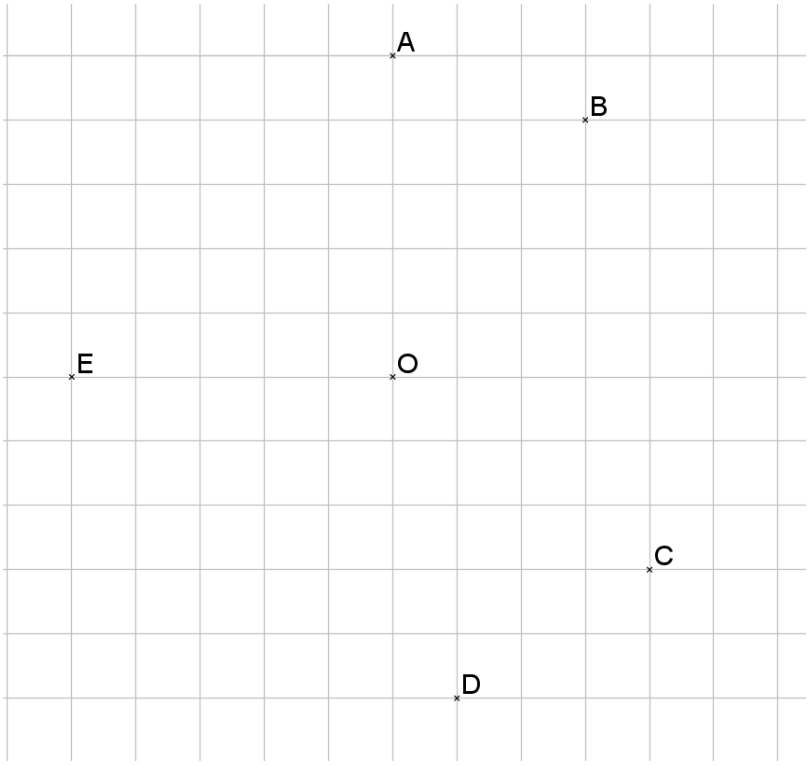
E The number of sides with the same length depends on the size of the rectangle.

6 The diagram shows six points on a square grid.

Each of the points is at the intersection of two grid lines.

Four of the points lie on the same circle with centre O.

Which one of A to E does not lie on the circle?



7 $x = -1$ is a root of the quadratic equation $x^2 + ax + 3 = 0$, where a is a constant.

Find the other root.

A 3 **B** -3 **C** 1 **D** 4 **E** -4

8 How many of the following expressions have the same value as

$$\frac{1}{2022}+\frac{1}{2023}\ ?$$

- $\frac{2023}{2022}-\frac{2022}{2023}$
- $\frac{2023^2-2022^2}{2022\times 2023}$
- $\frac{2022+2023}{2022\times 2023}$
- $\frac{(2023-2022)^2}{2022\times 2023}$

A 0

B 1

C 2

D 3

E 4

9 You are given that $\frac{10x-9y}{2x}=3.$

What is the value of $\frac{x}{y}$?

A $\frac{4}{9}$

B $\frac{9}{4}$

C $\frac{9}{16}$

D $\frac{16}{9}$

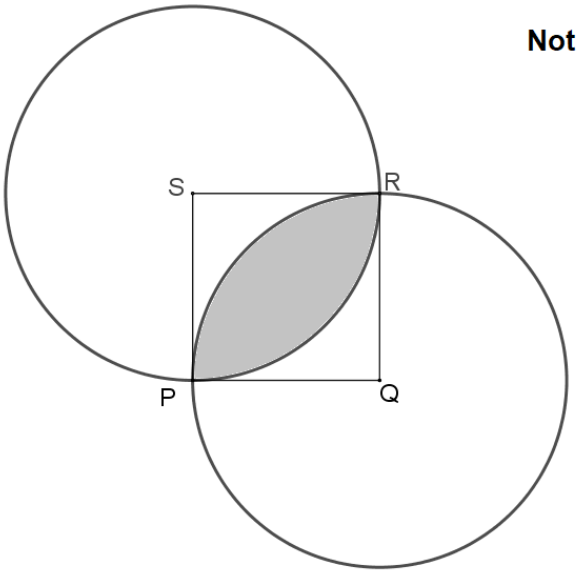
E There isn't enough information to find the value of $\frac{x}{y}$.

10 The diagram shows a square, PQRS, with sides $1\ \text{cm}$ long.

Circles with radius $1\ \text{cm}$ are drawn with centres at Q and S.

Find the area of overlap of these circles, in cm^2.

The area is shaded in the diagram below.



Not actual size

A $1-\frac{\pi}{4}$ **B** $1-\frac{\pi}{2}$ **C** $\frac{\pi}{2}-1$ **D** $\frac{\pi}{4}-1$ **E** $\frac{\pi}{4}$

Section B starts on the next page.

Section B

20 marks

Answer all questions

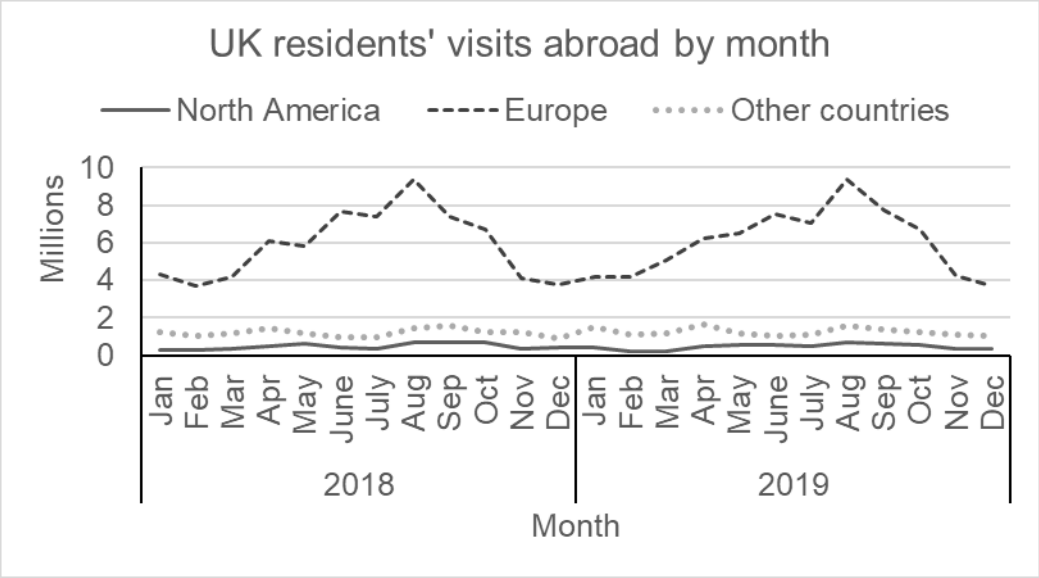
Each question is worth 2 marks.

Put a circle around the one correct answer in the answer booklet. If you change your mind about an answer, make it clear which answer you are choosing.

11 The chart below shows how many people from the UK travelled abroad each month in 2018 and 2019 and where they went to.

Countries have been grouped into three groups.

- North America,
- Europe,
- Other countries which are not included in either North America or Europe.



Which of the following is a reasonable conclusion to draw from the chart?

A Most of the visits abroad are to countries outside Europe.

B There were definitely no visitors to North America in March 2019.

C The lowest number of people visiting Europe in a month was about 4000.

D In the busiest months, over 10 million people travelled abroad from the UK.

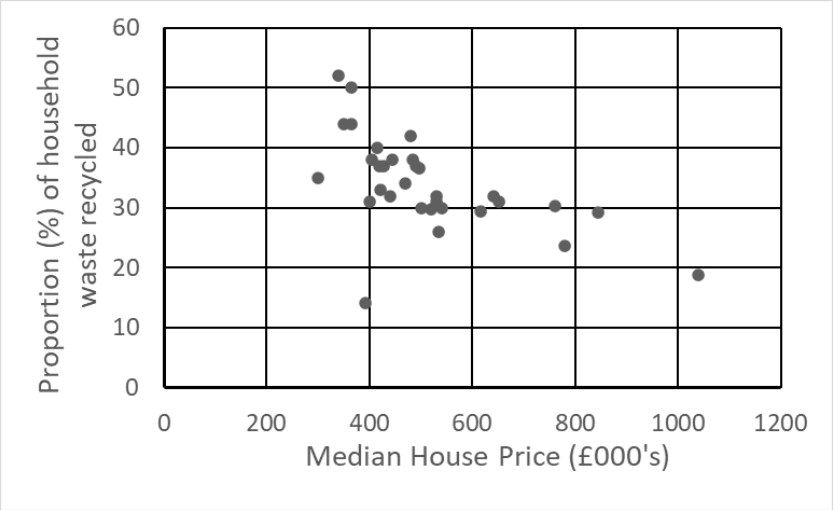
E No month had more than 2 million people visiting countries outside Europe.

12 London is divided into 32 areas called 'boroughs.'

Each point in the scatter graph below represents a London borough.

For each borough the graph shows

- The median price for a house in the borough
- The proportion of household waste that is recycled



Which of the following is a reasonable conclusion to draw from the graph?

A In general, London boroughs with higher house prices recycle more of their household waste than those with lower house prices.

B No boroughs recycle more than half of their household waste.

C Someone living in a house valued at £400 000 will recycle more than one in house valued at £1 040 000.

D The mean amount of household waste recycled by London boroughs is 30%.

E In general, London boroughs with lower median house prices recycle a higher proportion of their household waste.

13 The price of an item goes up by 25%.

What percentage reduction in the new price will bring the price of the item back to its original value?

A It can never get back to where it started.

B It depends on the original price.

C 33%

D 25%

E 20%

14 An opinion poll finds that 47% of a large random sample of voters think that the prime minister is doing a good job.

Mo asks her friends on social media about this and finds that 85% of them agree that the prime minister is doing a good job.

Which one of the following is a reasonable conclusion?

A 47% is a reasonable estimate for the proportion of all voters who think that the prime minister is doing a good job.

B The proportion of all voters who think that the prime minister is doing a good job is exactly 47%.

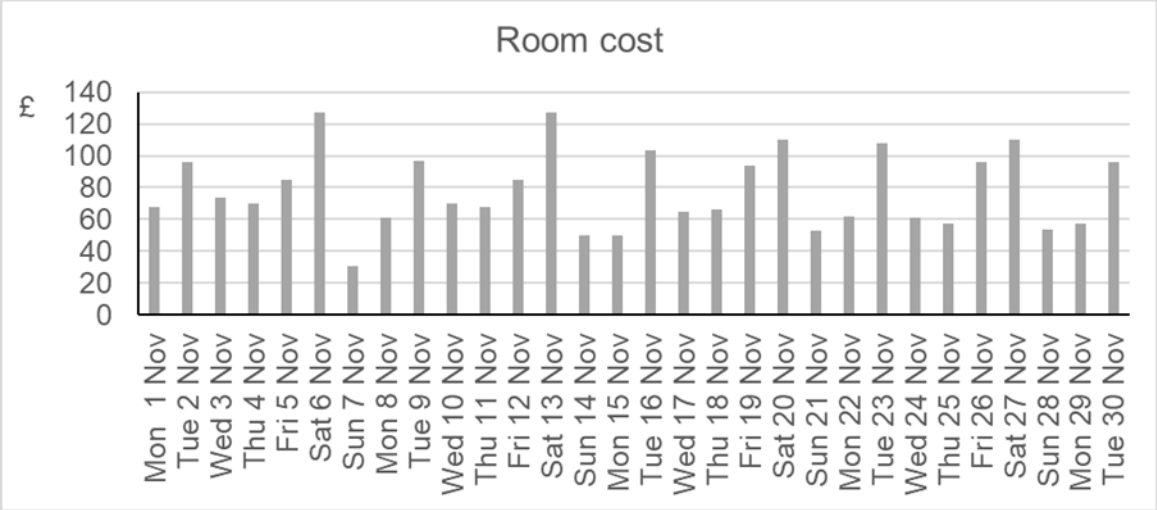
C 85% is a reasonable estimate for the proportion of all voters who think that the prime minister is doing a good job.

D The proportion of all voters who think that the prime minister is doing a good job must be between 47% and 85%.

E You can't draw any conclusions from opinion polls.

15 A customer wants to book two consecutive nights in a hotel room in November.

The bar chart shows the cost of the room on each night.



One of the following is the cheapest cost of the two-night stay. Which is it?

A £31 **B** £100 **C** £62 **D** £105 **E** £92

16 A group of seven people is going on a train journey.

Two of the group are children. Their tickets cost half the price of an adult ticket.

Two of the group are adults who have railcards. They get a one third reduction on the price of an adult ticket.

The rest of the group are adults who pay the full adult price for tickets.

The total train ticket price for the group is £140.

How much is a full price adult ticket for the same journey?

A £84

B £26.25

C £23.33

D £20

E There isn't enough information to work out the price.

17 The following distances are travelled in the times shown.

Each distance is travelled at constant speed.

Assume that times and distances are exact.

Which is the fastest speed?

Distance	Time
$696\,\text{m}$	2 minutes
$297\,\text{m}$	1 minute
$570\,\text{m}$	1 minute and 50 seconds
$903\,\text{m}$	3 minutes

A $696\,\text{m}$ in 2 minutes.

B $297\,\text{m}$ in 1 minute.

C $570\,\text{m}$ in 1 minute and 50 seconds.

D $903\,\text{m}$ in 3 minutes.

E Two of them have the same fastest speed.

18 An online quiz has 20 questions.

Each question is multiple choice with 5 possible answers.

People doing the quiz start with 20 marks.

4 marks are added on for a correct answer.

1 mark is subtracted for a wrong answer.

Missing out a question gets 0 marks.

Tariq does the quiz and gets 27 marks.

Tariq got X questions correct. How many different possible values of X are there?

A 2 **B** 3 **C** 4 **D** 5 **E** 6

19 Stefan throws two fair six-sided dice.

He is interested in these three events.

- The difference between the two numbers is 0
- The sum of the two numbers is 6
- The two numbers multiplied gives 6

Which one of the following statements is true?

A The most likely event is that the difference between the two numbers is 0.

B The most likely event is that the sum of the two numbers is 6.

C The most likely event is that the two numbers multiplied gives 6.

D The three events are all equally likely.

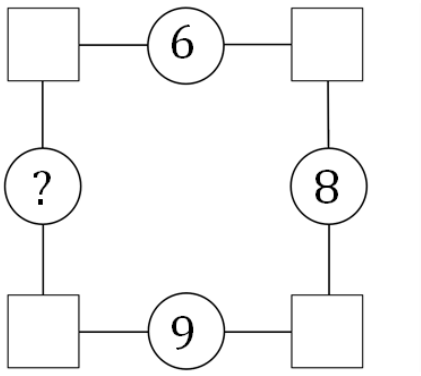
E Two of the three events are equally likely.

20 Kim is making a number puzzle, as shown in the diagram below.

She writes numbers in the circles.

The person solving the puzzle has to find numbers for the squares.

Each adjacent pair of numbers in the squares must sum to the number in the circle between them.



How many possible numbers can Kim put in place of the question mark to ensure that the puzzle has at least one solution?

A None **B** More than 3 **C** 1 **D** 2 **E** 3

Section C starts on the next page.

Section C

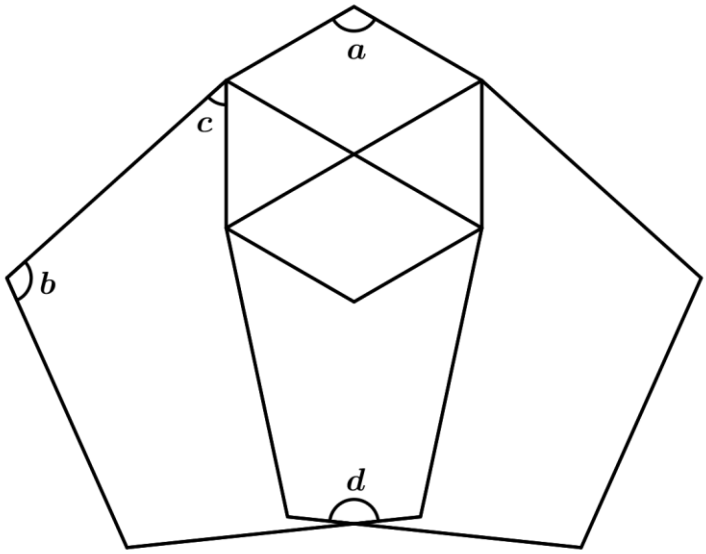
20 marks

Answer all questions

It is important to show full working in this section. Write your full answers to each question in the answer booklet.

Mark allocations are shown in square brackets [ ].

21 The diagram shows a regular hexagon and two regular pentagons arranged in such a way that each pentagon shares two vertices with the hexagon:



21a The size of angle $\boldsymbol{a}$ is

A $240°$ **B** $150°$ **C** $135°$ **D** $120°$ **E** $60°$

[1]

21b The size of angle $\boldsymbol{b}$ is

A $120°$ **B** $115°$ **C** $108°$ **D** $100°$ **E** $95°$

[1]

21c The size of angle $\boldsymbol{c}$ is

A $60°$ **B** $58°$ **C** $50°$ **D** $48°$ **E** $35°$

[2]

21d The size of angle $\boldsymbol{d}$ is

A $176°$ **B** $168°$ **C** $154°$ **D** $148°$ **E** $135°$

[2]

22 These questions are about the curve with equation $5y = (x + 2)(x - 10)$

22a Which of the following gives the y intercept of the curve?

A $(0, 4)$ **B** $(0, 2)$ **C** $(0, -1)$ **D** $(0, -2)$ **E** $(0, -4)$

[1]

22b For which of the following values of x does the y coordinate on the curve have an integer value?

A $x = -1$ **B** $x = 1$ **C** $x = 2$ **D** $x = 4$ **E** $x = 5$

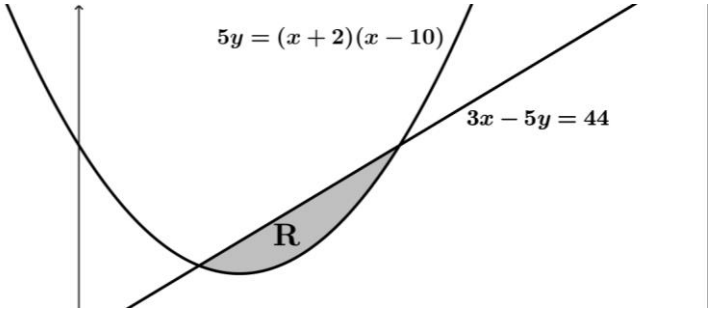
[2]

22c For how many values of x where $-2 \leq x \leq 10$ (x is between -2 and 10 inclusive of -2 and 10) are **both** coordinates of points on the curve whole numbers?

A 6 **B** 5 **C** 4 **D** 3 **E** 2

[2]

22d The line $3x - 5y = 44$ and the curve $5y = (x + 2)(x - 10)$ are drawn on the same axes. They enclose a region R that is shown in the diagram below. Only the y-axis is shown.



Some students find how many points (a, b), where both a and b are whole numbers, lie in the region R. Lines that are on the boundary of the region are considered to be in R.

Each student writes an explanation for their answer.

Marie's reason The line and curve meet at $x = 3$ and $x = 8$ and these are two whole number points. For $x = 4$ there is only one value of y where $3x - 5y \geq 44$ and $5y \geq (x + 2)(x - 10)$. For $x = 5$ there are two y values. For $x = 6$ and $x = 7$ there is one y value for each.
Neal's reason The line and curve meet at $x = 3$ and $x = 8$ which give two whole number points. There are four more points on the line, one each for $x = 4$, $x = 5$, $x = 6$ and $x = 7$ and one more on the curve for $x = 5$.
Oliver's reason Between $x = 3$ and $x = 8$ there is only one value of y where $3x - 5y > 44$ and $5y > (x + 2)(x - 10)$ for each of $x = 4$, $x = 5$, $x = 6$ and $x = 7$.
Parul's reason The lowest point on the curve is when $y = -7.2$. When $y = -7$ there are three x values where $3x - 5y \geq 44$ and $5y \geq (x + 2)(x - 10)$. For $y = -6$ there are two, for $y = -5$ there is one and for $y = -4$ there is one. After that y values are above the highest intersection of the line and the curve.

Two of the students explanations contain errors.

Which two students have made a mistake?

A Marie and Neil.

B Marie and Oliver.

C Neal and Oliver.

D Neil and Parul.

E Oliver and Parul.

[2]

23 Three six-sided dice are coloured red, yellow and blue.

None of the dice are fair.

The red dice is weighted so that the probability of rolling a multiple of rolling a 1 is equal to $\frac{1}{4}$. All of the other outcomes have equal probabilities to each other.

The yellow dice is weighted so that the probability of rolling a 2 is equal to $\frac{5}{8}$. All of the other outcomes have equal probabilities to each other.

The blue dice is weighted so that the probability of rolling each odd number is p and the probability of rolling each even number is $2p$, where p is a fraction to be found.

23a What is the probability of rolling a 6 with one roll of the red dice?

A $\frac{3}{8}$ **B** $\frac{3}{20}$ **C** $\frac{3}{40}$ **D** $\frac{1}{20}$ **E** $\frac{1}{8}$

[1]

23b What is the probability of rolling an **even number** with one roll of the yellow dice?

A $\frac{3}{8}$ **B** $\frac{17}{20}$ **C** $\frac{31}{40}$ **D** $\frac{37}{40}$ **E** $\frac{5}{8}$

[2]

23c What is the probability of rolling a 6 with one roll of the blue dice?

A $\frac{1}{6}$ **B** $\frac{1}{3}$ **C** $\frac{3}{8}$ **D** $\frac{2}{9}$ **E** $\frac{5}{12}$

[2]

23d Amita thinks that the probability of rolling an even number on the blue dice is over one and a half times the probability of rolling an even number on the yellow dice.

Bernard thinks that there is a higher probability of rolling a prime number on the red dice than there is on the blue dice.

Carol thinks that the probability of rolling a total of 3 on the yellow and blue dice is less than that of rolling a total 3 on the red and blue dice.

David thinks that the probability of rolling a total of over 10 on the red and blue dice is twice the probability of rolling a total of over 10 on the yellow and blue dice.

Two of the students are correct.

Which two students are correct?

A Amita and Bernard only.

B Amita and Carol only.

C Bernard and Carol only.

D Bernard and David only.

E Carol and David only.

[2]

End of test.