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Mathematics: analysis and approaches
Standard level
Paper 1

1 May 2024

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

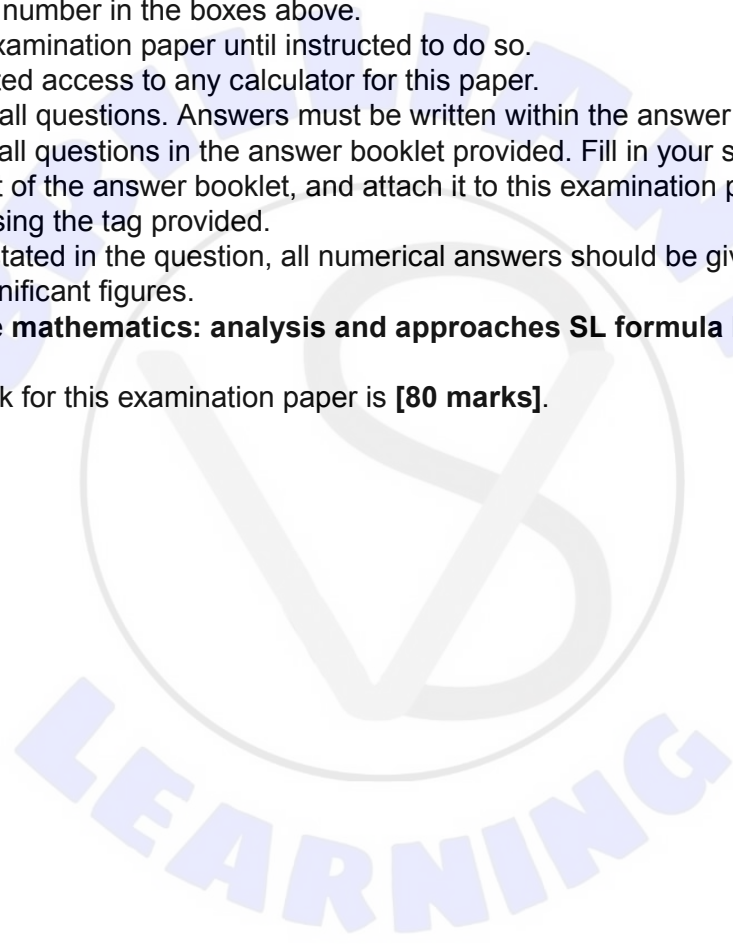
Candidate session number

1 hour 30 minutes

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Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- You are not permitted access to any calculator for this paper.
- Section A: answer all questions. Answers must be written within the answer boxes provided.
- Section B: answer all questions in the answer booklet provided. Fill in your session number on the front of the answer booklet, and attach it to this examination paper and your cover sheet using the tag provided.
- Unless otherwise stated in the question, all numerical answers should be given exactly or correct to three significant figures.
- A clean copy of the **mathematics: analysis and approaches SL formula booklet** is required for this paper.
- The maximum mark for this examination paper is **[80 marks]**.



2. [Maximum mark: 6]

Claire rolls a six-sided die 16 times.

The scores obtained are shown in the following frequency table.

Score	Frequency
1	p
2	q
3	4
4	2
5	0
6	3

It is given that the mean score is 3.

(a) Find the value of p and the value of q . [5]

Each of Claire's scores is multiplied by 10 in order to determine the final score for a game she is playing.

(b) Write down the mean final score. [1]

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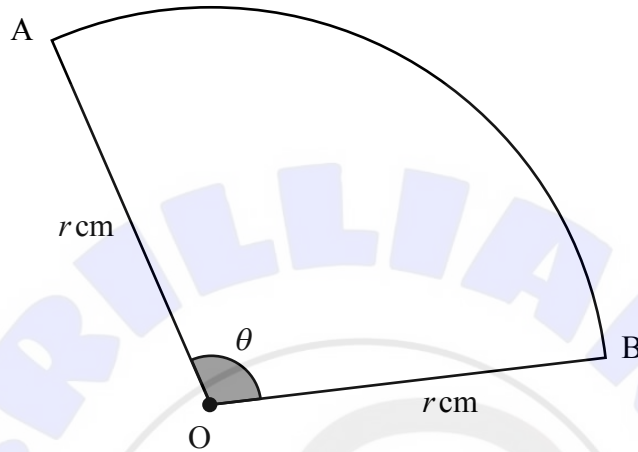


4. [Maximum mark: 8]

Points A and B lie on the circumference of a circle of radius r cm with centre at O.

The sector OAB is shown on the following diagram. The angle \widehat{AOB} is denoted as θ and is measured in radians.

diagram not to scale



The perimeter of the sector is 10 cm and the area of the sector is 6.25 cm^2 .

(a) Show that $4r^2 - 20r + 25 = 0$. [4]

(b) Hence, or otherwise, find the value of r and the value of θ . [4]

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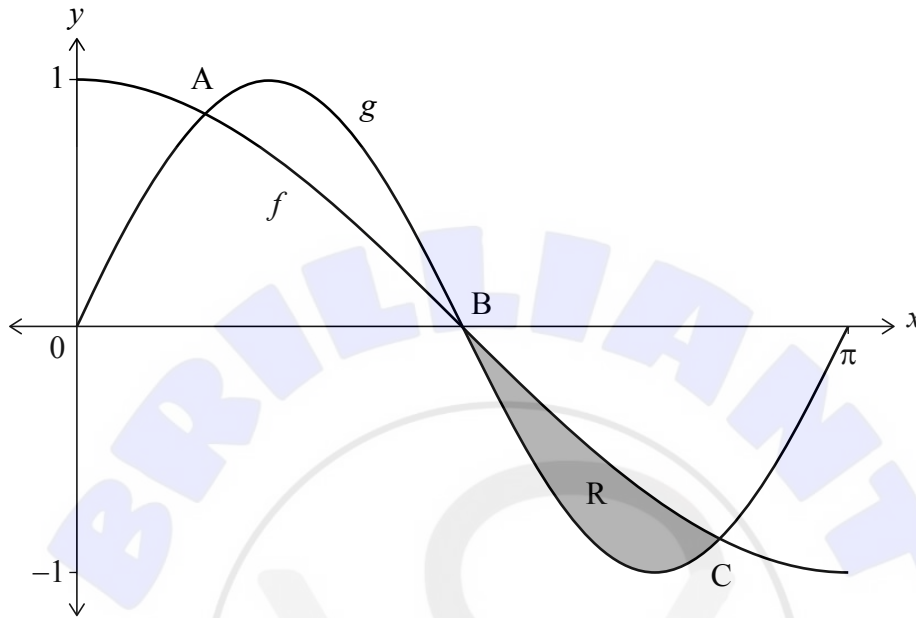
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5. [Maximum mark: 7]

Consider the functions $f(x) = \cos x$ and $g(x) = \sin 2x$, where $0 \leq x \leq \pi$.

The graph of f intersects the graph of g at the point A, the point B $\left(\frac{\pi}{2}, 0\right)$ and the point C as shown on the following diagram.



(a) Find the x -coordinate of point A and the x -coordinate of point C. [3]

The shaded region R is enclosed by the graph of f and the graph of g between the points B and C.

(b) Find the area of R. [4]

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Section B

Answer **all** questions in the answer booklet provided. Please start each question on a new page.

7. [Maximum mark: 14]

Consider the curve with equation $y = x^3 - x^2 - x + 1$.

(a) Find

(i) $\frac{dy}{dx}$;

(ii) $\frac{d^2y}{dx^2}$.

[3]

The curve has a local maximum at A.

(b) Find the coordinates of A, using your answer to part (a)(ii) to justify your answer.

[6]

The curve has a point of inflexion at B.

(c) Find the x -coordinate of B.

[2]

The line L is the normal to the curve at the point $(0, 1)$.

(d) Find the equation of L .

[3]



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8. [Maximum mark: 14]

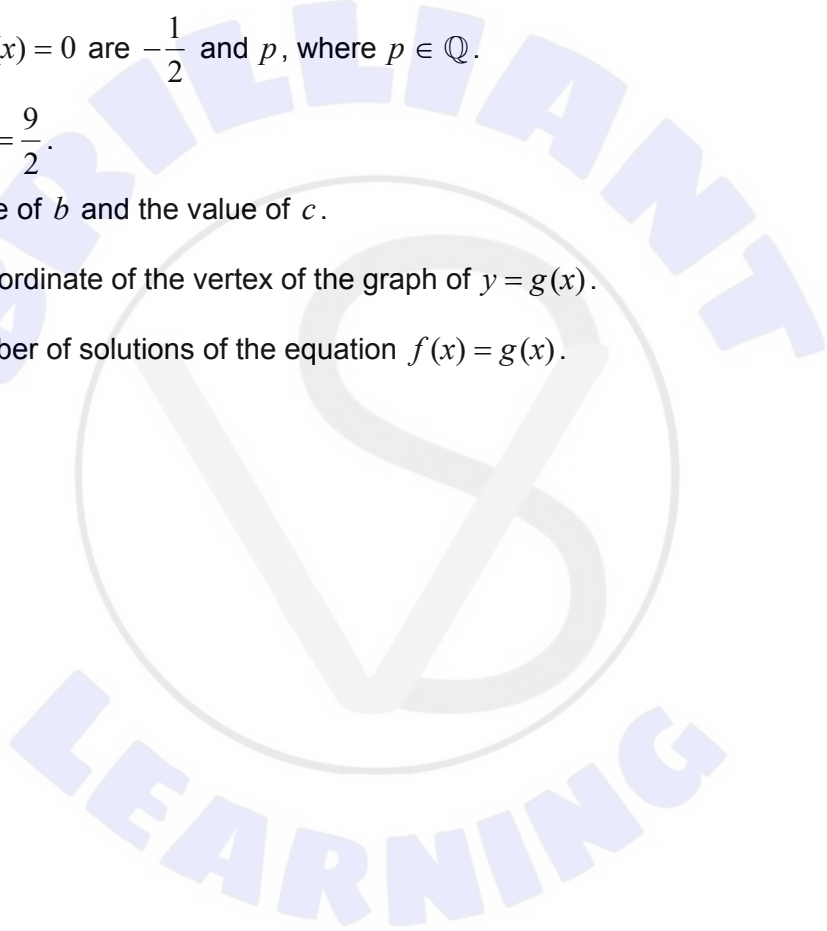
Consider the function $f(x) = \frac{4x+2}{x-2}$, $x \neq 2$.

- (a) Sketch the graph of $y = f(x)$. On your sketch, indicate the values of any axis intercepts and label any asymptotes with their equations. [5]
- (b) Write down the range of f . [1]

Consider the function $g(x) = x^2 + bx + c$. The graph of g has an axis of symmetry at $x = 2$.

The two roots of $g(x) = 0$ are $-\frac{1}{2}$ and p , where $p \in \mathbb{Q}$.

- (c) Show that $p = \frac{9}{2}$. [1]
- (d) Find the value of b and the value of c . [3]
- (e) Find the y -coordinate of the vertex of the graph of $y = g(x)$. [2]
- (f) Find the number of solutions of the equation $f(x) = g(x)$. [2]



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9. [Maximum mark: 17]

A bag contains buttons which are either red or blue.

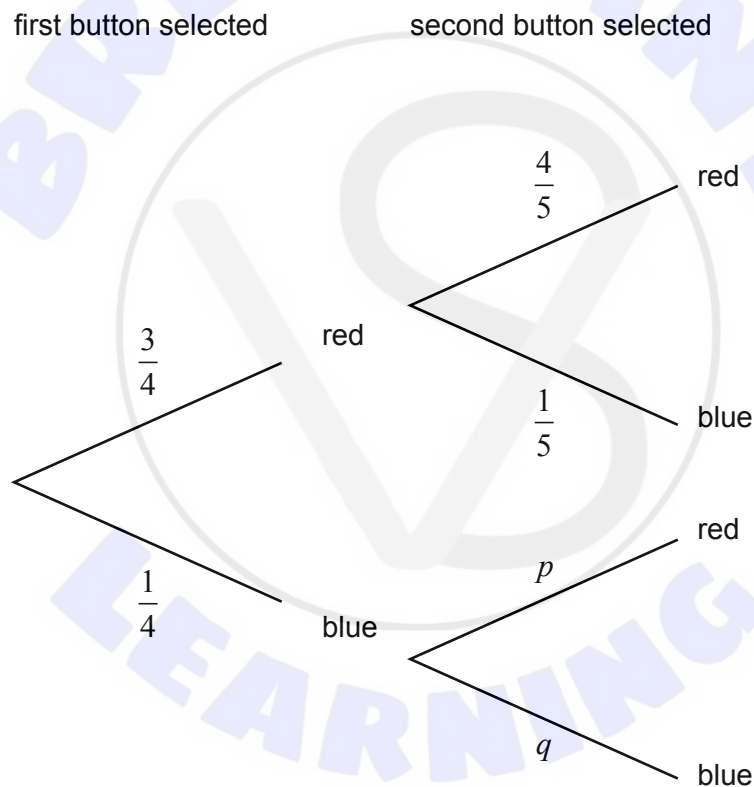
Initially, the bag contains three red buttons and one blue button.

Francine randomly selects one button from the bag. She then replaces the button and adds one extra button of the same colour.

For example, if she selects a red button, she then replaces it and adds one extra red button so that the bag then contains four red buttons and one blue button.

Francine then randomly selects a second button from the bag.

The following tree diagram represents the probabilities of the first two selections.



- (a) Find the value of p and the value of q . [2]
- (b) Show that the probability that Francine selects two buttons of the same colour is $\frac{7}{10}$. [2]
- (c) Given that Francine selects two buttons of the same colour, find the probability that she selects two red buttons. [3]

(This question continues on the following page)



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(Question 9 continued)

The random variable X is defined as the number of red buttons selected by Francine.

The following table shows the probability distribution of X .

x	0	1	2
$P(X = x)$	$\frac{1}{10}$	a	b

(d) Find the value of a and the value of b . [2]

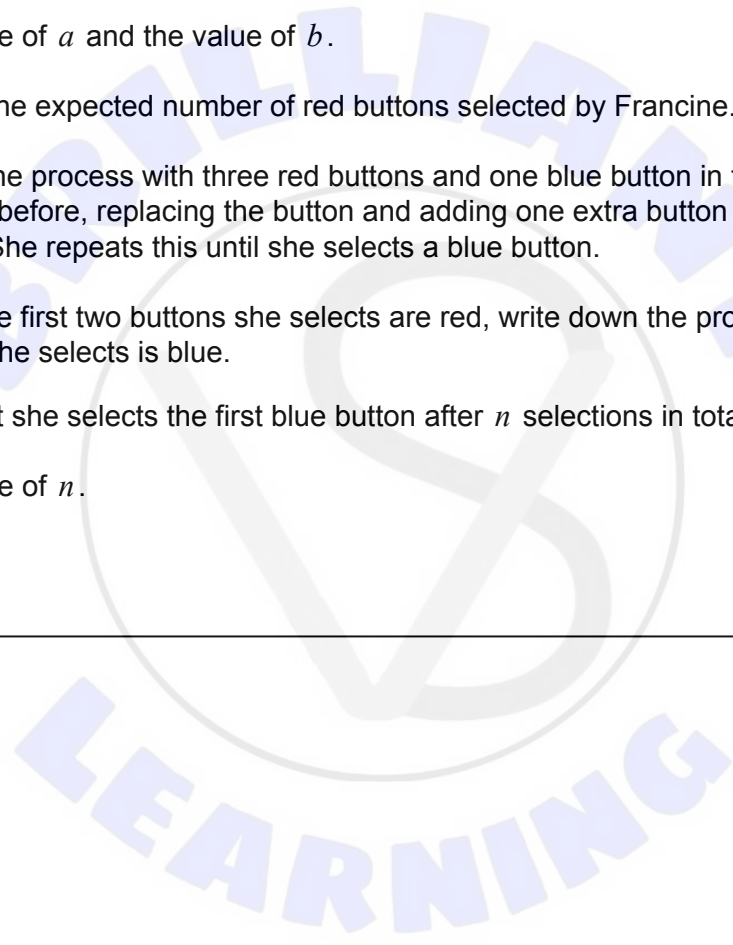
(e) Hence, find the expected number of red buttons selected by Francine. [2]

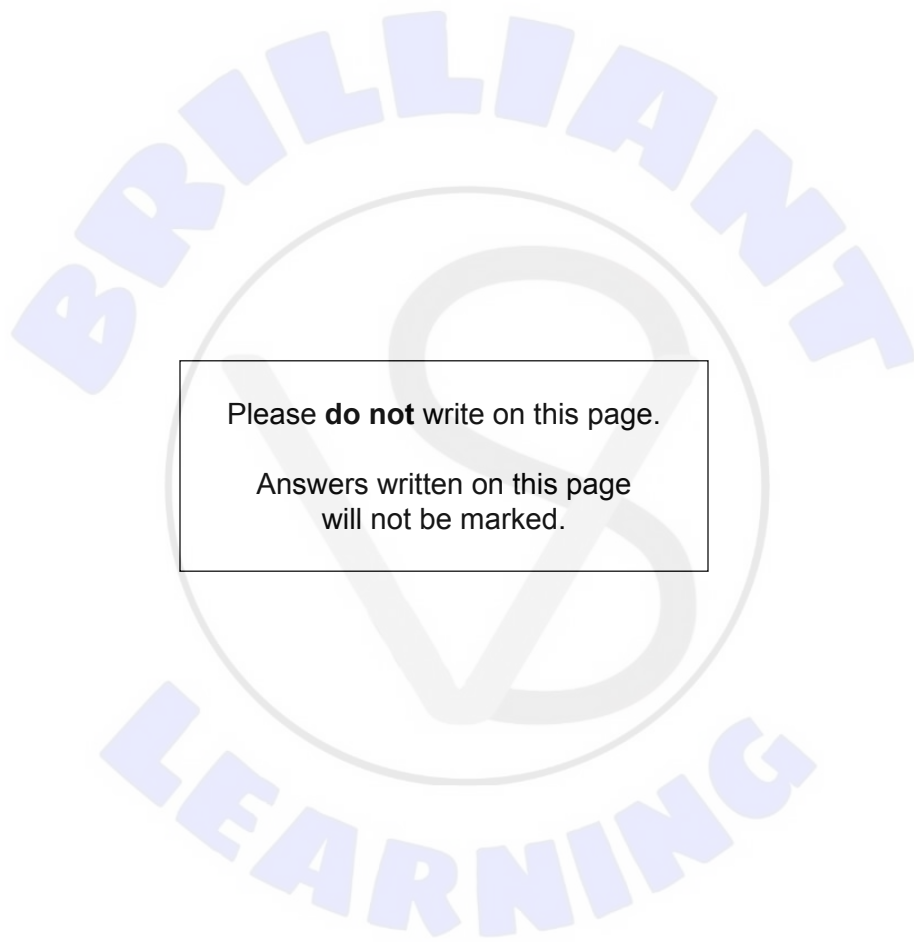
Francine restarts the process with three red buttons and one blue button in the bag. She selects buttons as before, replacing the button and adding one extra button of the same colour each time. She repeats this until she selects a blue button.

(f) Given that the first two buttons she selects are red, write down the probability that the next button she selects is blue. [1]

The probability that she selects the first blue button after n selections in total is $\frac{3}{56}$.

(g) Find the value of n . [5]





Please **do not** write on this page.

Answers written on this page
will not be marked.

