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ADDITIONAL MATHEMATICS

0606/21

Paper 2

October/November 2025

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a scientific calculator where appropriate.
- You must show all necessary working clearly.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- For π , use either your calculator value or 3.142.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages.

List of formulas

Equation of a circle with centre (a, b) and radius r .

$$(x - a)^2 + (y - b)^2 = r^2$$

Curved surface area, A , of cone of radius r , sloping edge l .

$$A = \pi r l$$

Surface area, A , of sphere of radius r .

$$A = 4\pi r^2$$

Volume, V , of pyramid or cone, base area A , height h .

$$V = \frac{1}{3}Ah$$

Volume, V , of sphere of radius r .

$$V = \frac{4}{3}\pi r^3$$

Quadratic equation

For the equation $ax^2 + bx + c = 0$,

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

Binomial theorem

$$(a + b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \dots + \binom{n}{r}a^{n-r}b^r + \dots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

Arithmetic series

$$u_n = a + (n-1)d$$

$$S_n = \frac{1}{2}n(a + l) = \frac{1}{2}n\{2a + (n-1)d\}$$

Geometric series

$$u_n = ar^{n-1}$$

$$S_n = \frac{a(1 - r^n)}{1 - r} \quad (r \neq 1)$$

$$S_\infty = \frac{a}{1 - r} \quad (|r| < 1)$$

Identities

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$

Formulas for $\triangle ABC$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

$$\Delta = \frac{1}{2} ab \sin C$$



- 1 The polynomial p is such that $p(x) = x^3 + ax^2 + bx - 2$, where a and b are constants.

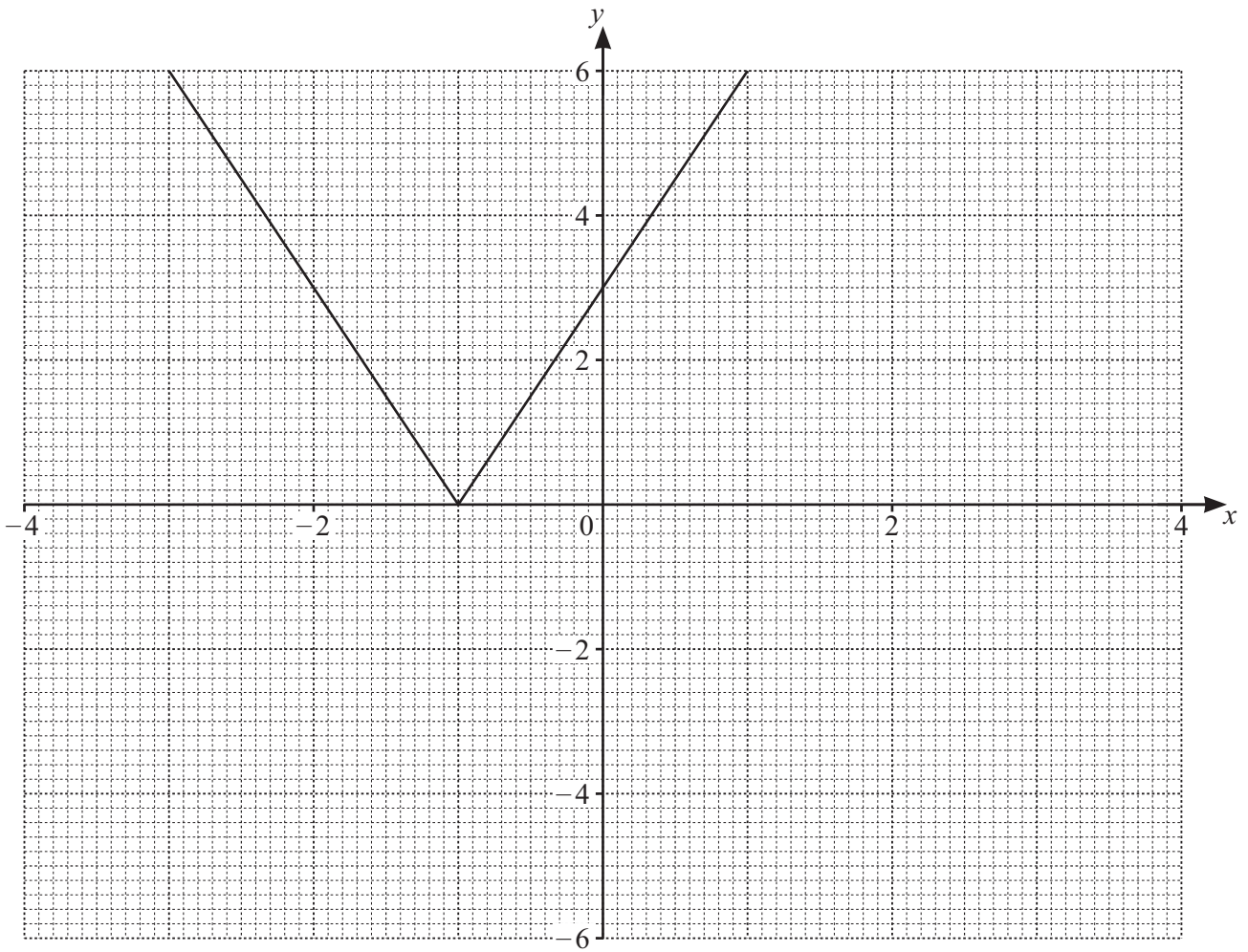
It is given that:

- $x + 2$ is a factor of $p(x)$
- when $p(x)$ is divided by $x - 3$ the remainder is 40.

Find the values of a and b .

[5]





The diagram shows the graph of $y = |3x + 3|$.

Use a graphical method to solve the inequality $|3x + 3| \geq |x - 2|$.

[3]



- 3 (a) 3 men and 3 women are standing in a line.
The 3 men are standing next to each other.

Find how many different arrangements are possible.

[2]

- (b) In the 13-letter word MULTIBRANCHED, there are 4 vowels, U, I, A and E.

7 different letters are selected from these 13 letters.

Find how many different selections are possible if the selection includes at least 2 vowels.

[3]



- 4 (a) Show that $\frac{1-\sin x}{\cos x} + \frac{\cos x}{1-\sin x} = 2 \sec x$.

[3]

- (b) Hence solve the equation $\frac{1-\sin \frac{\theta}{2}}{\cos \frac{\theta}{2}} + \frac{\cos \frac{\theta}{2}}{1-\sin \frac{\theta}{2}} = 3$ for $0^\circ \leq \theta \leq 720^\circ$.

[3]



5 Solutions to this question by accurate drawing will not be accepted.

A circle has centre $(4, 2)$ and meets the x -axis at $(-2, 0)$.

(a) Find the equation of the circle.

[2]

(b) Find, in exact form, the coordinates of the points where the circle meets the y -axis.

[3]



- 6 Variables x and y are such that when $\ln y$ is plotted against x a straight-line graph is obtained. The line passes through the points $(1, \ln 15)$ and $(2, \ln 75)$.

Show that $y = Ab^x$ where A and b are integers to be found.

[4]



- 7 Show that the curve $y = x - \ln(x^2 + 2x)$ has exactly one stationary point.

Find the x -coordinate of this point.

[6]





8 In this question, the units are metres and seconds.

A particle P is travelling in a straight line through a fixed point O .

At time t its acceleration, a , is given by $a = (2t - 3)^2$, where $t \geq 0$.

When $t = 3$, P has a velocity of 6.

(a) (i) Find an expression for the velocity, v , of P at time t .

[3]

(ii) Find the time when P is at rest.

[3]



When $t = \frac{5}{2}$, the displacement of P from O is 4.

(iii) Find the displacement of P from O when $t = 3$.

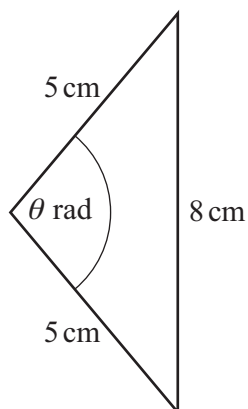
[4]

(b) Use calculus to find the approximate change in v when t increases from $\frac{5}{2}$ by the small amount 0.02.

[3]



9 (a)

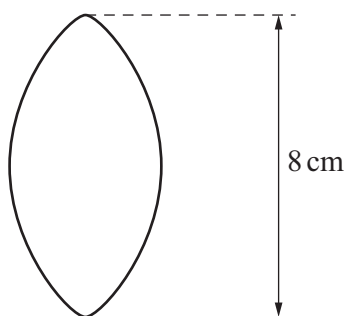


The diagram shows an isosceles triangle.

Find the value of θ in radians.

[2]

(b)



This diagram shows a shape made of two arcs.

Each arc is part of a circle with radius 5 cm.

The height of the shape is 8 cm.

Use your answer to **part (a)** to find

(i) the perimeter of the shape

[2]





(ii) the area of the shape.

[3]

10 In this question a , b and n are constants.

When $5(2 + ax)^n$ is written in ascending powers of x , the first three terms are $640 + b^2x + 30240x^2$.

Find the value of a and the possible values of b . [5]





- 11 A cylinder has radius r cm and height h cm.
The total surface area, including the two ends, is A cm².
The volume of the cylinder is 330 cm³.

(a) Show that $A = 2\pi r^2 + \frac{660}{r}$.

[3]

- (b) Given that r can vary, find the value of r that gives a stationary value for A and show that this value is a minimum.

[5]



- 12 In this question, the x - and y -directions are east and north respectively. The units are metres and seconds. Boat A starts from the origin O and moves with constant speed $5\sqrt{3} \text{ ms}^{-1}$ on a bearing of 030° .

After 100 seconds boat B starts from point P , which has position vector $\begin{pmatrix} 0 \\ 1000 \end{pmatrix}$.

Boat B moves with constant speed 10 ms^{-1} on a bearing of 060° .

- (a) Find the velocity of each boat in vector form. [2]

- (b) Show that the two boats will collide. [5]

Question 13 is printed on the next page.





13 Solve the equation $2\sin^3\theta = 3\sin\theta\cos\theta$ for $-\frac{\pi}{2} \leq \theta \leq \frac{\pi}{2}$.

[6]

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