

Further Mathematics: **9231 Mathematics - Further November 2025 Question Paper** 11

The sum $(2\alpha+1)^n + (2\beta+1)^n + (2\gamma+1)^n + (2\delta+1)^n$ is denoted by S_n .

(b) Find the value of S_2 . [2]

[illegible]

(c) Given that $S_3 = -22$, find the value of S_4 . [2]

[illegible]

7

(a)

[2]

This image shows a full page of white paper with ten horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and extend across the entire width of the page. There is no text or other markings on the paper.

(b)

[3]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There is no handwriting or other markings on the paper.

(c) Sketch C , stating the coordinates of the intersections with the axes.

[3]

.....

(d) Sketch the curve with equation $y = \left| \frac{x+2}{x^2+3x+1} \right|$.

[2]

(e)

Find in exact form the set of values of x for which $\left| \frac{x+2}{x^2+3x+1} \right| > 2$.

[4]

Additional page

If you use the following page to complete the answer to any question, the question number must be clearly shown.

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

1 Find the values of k for which the system of equations

$$x - y + z = 0,$$

$$x + ky + 3z = 0,$$

$$x + 2y + kz = 0,$$

does not have a unique solution.

[3]

7 (a) Show that $\frac{d}{dx}(\tanh^{-1} x) = \frac{1}{1-x^2}$.

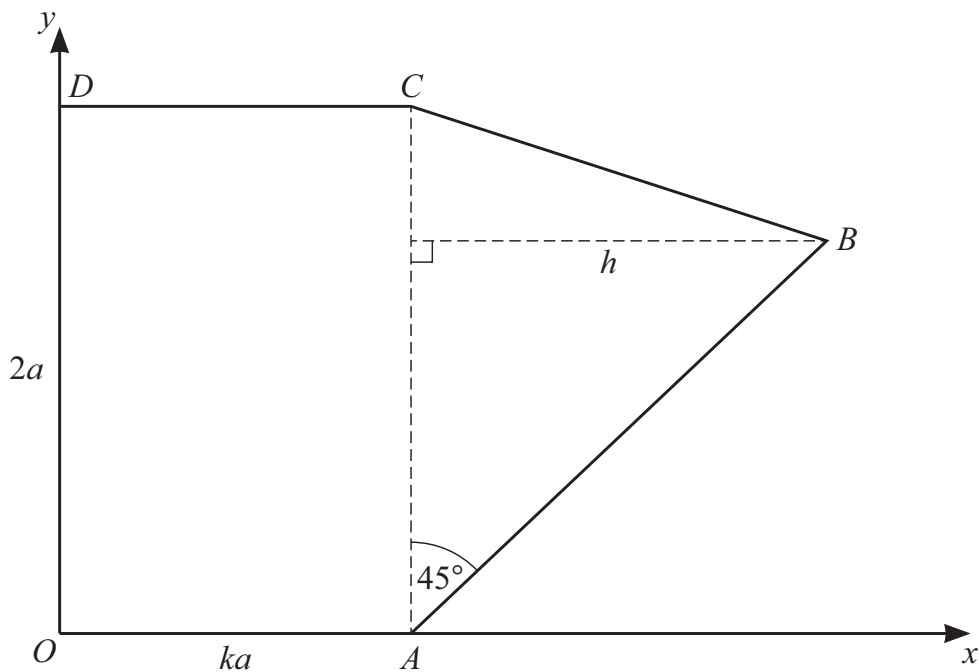
[3]

(b) Find the solution of the differential equation

$$x \frac{dy}{dx} - y = x^2 \tanh^{-1} x,$$

for $0 < x < 1$, given that $y = 0$ when $x = \frac{1}{2}$. Give your answer in an exact form. [9]

[illegible]



A uniform lamina $OABCD$ consists of a rectangle $OACD$ and a triangle ABC . The length of OA is ka , the length of OD is $2a$, the height of triangle ABC is h and angle CAB is 45° (see diagram). Relative to axes through O , parallel and perpendicular to OA as shown, the centre of mass of triangle ABC is $(\bar{x}, \bar{y})$.

- (a)** Show that $\bar{x}$ is $\frac{1}{3}(3ka+h)$, and find an expression for $\bar{y}$. [3]

The lamina $OABCD$ is placed vertically on its edge OA on a horizontal plane.

- (b) Find, in terms of a and k , the set of values of h for which the lamina is in equilibrium. [4]

[illegible]

It is now given that $k = \frac{\sqrt{3}}{3}$ and that the lamina is on the point of toppling.

- (c) Find, in terms of a , the coordinates of the centre of mass of the triangle ABC . [2]

11

7

(a)

[5]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

At point A , the particle strikes a fixed smooth barrier, rebounds, and lands on the horizontal plane. The barrier is inclined at an angle of 45° to the horizontal.

(b) Find the speed of P immediately before it collides with the barrier. [3]

(c) Given that the coefficient of restitution between the barrier and the particle is $\frac{1}{9}$, find the horizontal distance travelled by P after it strikes the barrier. [4]

Additional page

If you use the following page to complete the answer to any question, the question number must be clearly shown.

This image shows a full page of a handwriting practice worksheet. It consists of approximately 20 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The lines are evenly spaced and extend across the entire width of the page. There is no text or other markings on the page.

5 A continuous random variable X has probability density function f given by

$$f(x) = \begin{cases} \frac{1}{16}\sqrt{x} & 0 \leq x < 4, \\ \frac{1}{k\sqrt{x}} & 4 \leq x \leq 9, \\ 0 & \text{otherwise,} \end{cases}$$

where k is a constant.

(a) Show that $k = 3$. [2]

(b) Find the median value of X . [3]

Further Mathematics: **9231 Mathematics - Further November 2025 Question Paper** 41

The random variable Y is defined by $Y = \sqrt{X}$.

(c) Find the probability density function of Y .

[5]

17