0606 Additional Mathematics Paper 1 - Calculus

Topical questions | 36 questions

1. Question part 1/2 | 0606 Feb-March 2025 P1 V2 Q7

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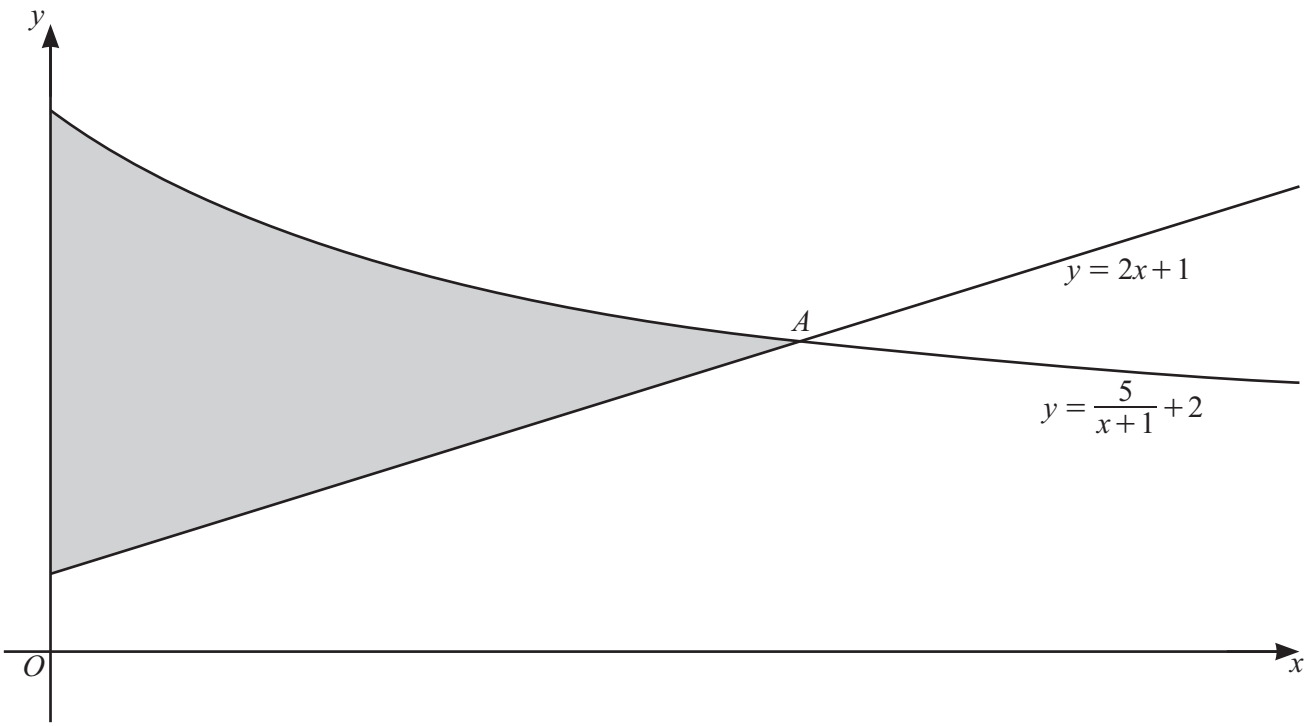

The diagram shows part of the curve $y = \frac{5}{x+1} + 2$ and part of the line $y = 2x + 1$ intersecting at the point A.

(a) Find the coordinates of A. [4]

1. Question part 2/2 | 0606 Feb-March 2025 P1 V2 Q7

(b) Find the exact area of the shaded region. [6]

2. Question part 1/2 | 0606 Feb-March 2025 P1 V2 Q10

10 The point P lies on the curve $y = (5x+2)^{\frac{1}{3}}$.
The x-coordinate of P is 5.
The normal to the curve at P intersects the line $x+y=11$ at the point Q.
The point R is the reflection of Q in the tangent to the curve at P.

Find the coordinates of R. [9]

2. Question part 2/2 | 0606 Feb-March 2025 P1 V2 Q10

Continuation of working space for Question 10.

3. Question | 0606 Feb-March 2025 P1 V2 Q12

12 It is given that $y = x\mathrm{e}^{3x+2}$.

(a) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$. [3]

(b) Hence find $\int x\mathrm{e}^{3x+2}\mathrm{d}x$. [4]

4. Question part 1/2 | 0606 May-June 2025 P1 V1 Q6

6 A curve has equation $y = \left(\frac{x^2 - 1}{x^2 + 1}\right)^4$.

(a) Show that $\frac{\mathrm{d}y}{\mathrm{d}x}$ can be written as $\frac{Ax\left(x^2 - 1\right)^3}{\left(x^2 + 1\right)^5}$, where A is a positive integer to be found. [5]

4. Question part 2/2 | 0606 May-June 2025 P1 V1 Q6

(b) (i) Show that the curve has stationary points where $x = -1$, $x = 0$ and $x = 1$. [1]

(ii) Use the first derivative test to determine which two stationary points have the same nature and state whether they are maximum or minimum points. [2]

5. Question part 1/2 | 0606 May-June 2025 P1 V1 Q9

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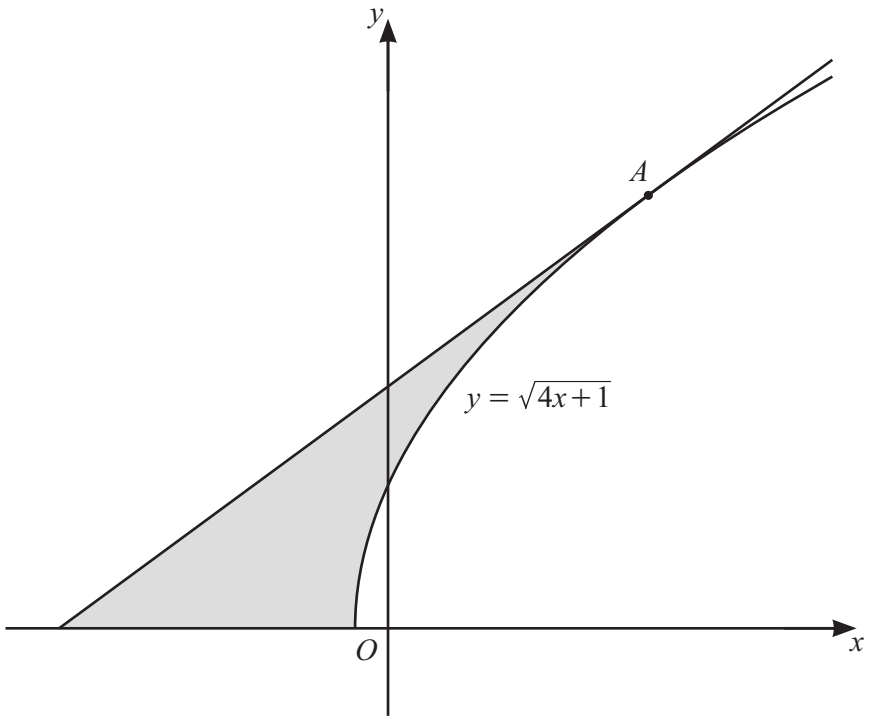

The point A with x-coordinate 2 lies on the curve $y = \sqrt{4x+1}$.
The diagram shows part of this curve and the tangent to the curve at A.

Find the area of the shaded region enclosed by the curve, the tangent and the x-axis. [10]

5. Question part 2/2 | 0606 May-June 2025 P1 V1 Q9

Continuation of working space for Question 9.

6. Question | 0606 May-June 2025 P1 V2 Q8

8 It is given that $y = \dfrac{\ln(3x^2+16)}{x+2}$.

(a) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$ when $x = 0$.

Give your answer in the form $\ln p$, where p is a constant. [5]

(b) Given that x increases from 0 to h, where h is small, write down the approximate change in y. [1]

7. Question | 0606 May-June 2025 P1 V2 Q12

12 A curve is such that its gradient at the point (x, y) is given by $(5x-2)^{\frac{1}{3}}$.

The curve passes through the point $\left(2, \frac{32}{5}\right)$.

Find the coordinates of the stationary point on the curve. [6]

8. Question | 0606 May-June 2025 P1 V3 Q8

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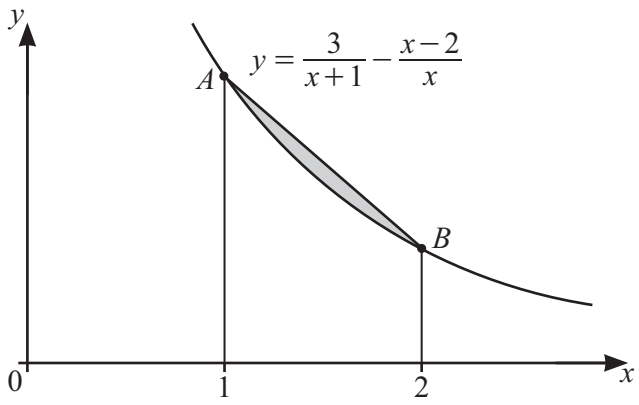


The diagram shows part of the curve $y = \frac{3}{x+1} - \frac{x-2}{x}$.

The points A and B lie on the curve such that the x-coordinate of A is 1 and the x-coordinate of B is 2.

(a) Find the y-coordinates of A and B. [1]

(b) Show that the area of the shaded region enclosed by the line AB and the curve is $\frac{a}{4} - \ln\frac{b}{2}$, where a and b are integers to be found. [7]

9. Question part 1/2 | 0606 May-June 2025 P1 V3 Q11

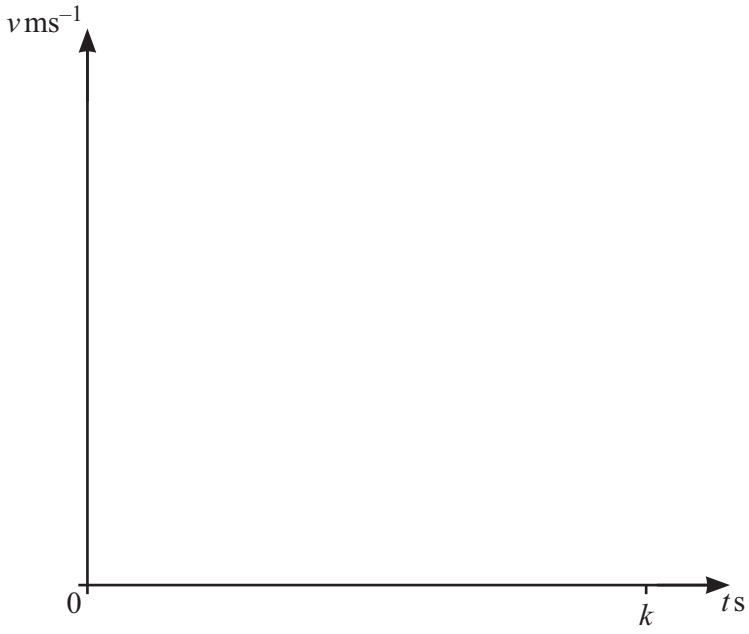
11 A particle P moves in a straight line and passes through a fixed point O.
At time t seconds, its displacement from O, s metres, is given by

$$s = t + 6t^2 - t^3 \qquad \text{for } 0 \leqslant t \leqslant 3$$

$$s = 12t - \frac{1}{3}t^2 - 3 \qquad \text{for } 3 \leqslant t \leqslant k \qquad \text{where } k \text{ is a constant.}$$

It is given that, for $3 \leqslant t \leqslant k$, the velocity of P is positive and its acceleration is negative.

(a) The maximum velocity of P occurs when $t = 2$.
On the axes below, sketch a velocity–time graph for the first k seconds of the motion of P. [4]



9. Question part 2/2 | 0606 May-June 2025 P1 V3 Q11

(b) The total distance travelled by P for $0 \leqslant t \leqslant k$ is 57 metres.

Given that when $t = 3$ the distance and displacement of P from O are equal, find the value of k.
[6]

Question 12 is printed on the next page.

10. Question | 0606 May-June 2025 P1 V3 Q12

12 The normal to the curve $y = \frac{4}{x^2} + ax + 7$ at the point where $x = 2$ has equation $x + 4y = b$.

Find the values of a and b. [6]

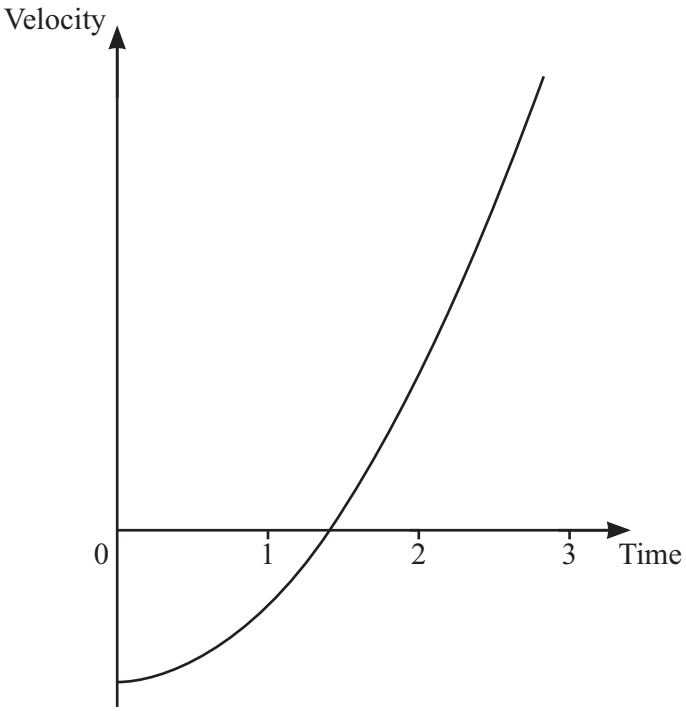
11. Question | 0606 Oct-Nov 2025 P1 V1 Q7

7 **(a)** Differentiate $\frac{\sin x + \cos x}{e^{1-3x}}$ with respect to x. [4]

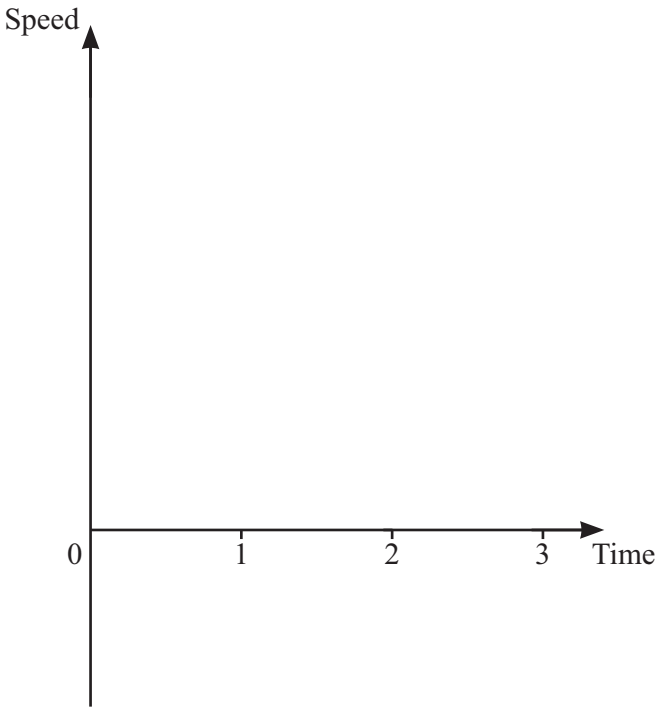
(b) Find $\int \left(1 + \tan^2 3x\right) dx$. [3]

12. Question part 1/2 | 0606 Oct-Nov 2025 P1 V1 Q9

9 The diagram shows the velocity–time graph for a particle moving in a straight line.



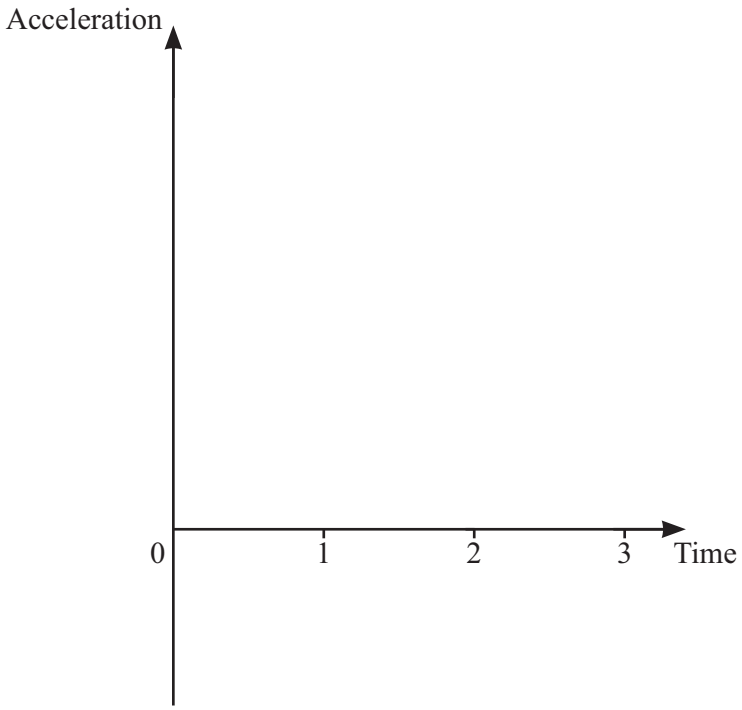
(a) On the diagram below, sketch the speed–time graph for the motion of this particle. [1]



12. Question part 2/2 | 0606 Oct-Nov 2025 P1 V1 Q9

It is given that the velocity–time graph is part of a quadratic curve.
The curve has gradient 0 when time is 0.

(b) On the diagram below sketch a possible acceleration–time graph for the motion of the particle. [2]



13. Question part 1/2 | 0606 Oct-Nov 2025 P1 V1 Q10

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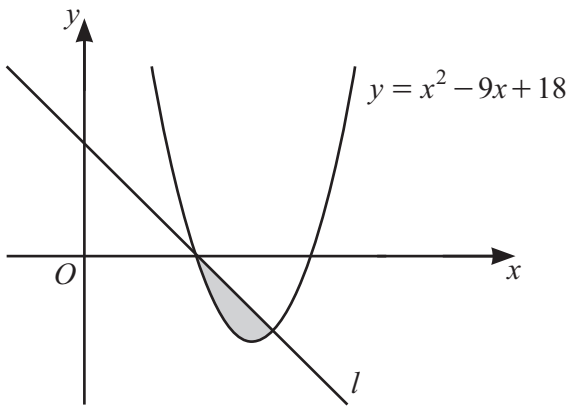

The diagram shows the curve $y = x^2 - 9x + 18$ and the line l, which is the normal to this curve at the point where $x = 5$.

Find the area of the shaded region. [11]

13. Question part 2/2 | 0606 Oct-Nov 2025 P1 V1 Q10

Continuation of working space for Question 10.

14. Question part 1/2 | 0606 Oct-Nov 2025 P1 V2 Q9

9 A curve $y = \mathrm{f}(x)$ is such that $\mathrm{f}''(x) = (2x+5)^{-\frac{3}{2}}$.

The curve has gradient $\frac{2}{3}$ at the point (2, 2).

(a) Find the coordinates of the stationary point on the curve. [11]

14. Question part 2/2 | 0606 Oct-Nov 2025 P1 V2 Q9

Continuation of working space for Question 9(a).

(b) Determine the nature of this stationary point. [1]

15. Question | 0606 Oct-Nov 2025 P1 V2 Q12

12 A curve has equation $y = \dfrac{e^{(x^2)}}{x-2}$ for $x < 2$.

(a) Find the value of $\dfrac{dy}{dx}$ when $x = 0$. [4]

When $x = 0$, y is increasing at the rate of 0.5 units per second.

(b) Find the corresponding rate of change of x. [2]

Question 13 is printed on the next page.

16. Question | 0606 Oct-Nov 2025 P1 V3 Q2

2 Differentiate $x^2 e^{3x}$ with respect to x. [3]

17. Question | 0606 Oct-Nov 2025 P1 V3 Q3

3 In this question you may use the values in the table below.

θ radians	$\sin\theta$	$\cos\theta$	$\tan\theta$
$\frac{\pi}{6}$	$\frac{1}{2}$	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{3}}{3}$
$\frac{\pi}{3}$	$\frac{\sqrt{3}}{2}$	$\frac{1}{2}$	$\sqrt{3}$

Variables x and y are related by the equation $y = \sin 5x$ where $0 \leqslant x \leqslant \frac{\pi}{10}$.

Use calculus to find the approximate change in x when y increases from $\frac{\sqrt{3}}{2}$ by the small amount 0.01. [4]

18. Question | 0606 Oct-Nov 2025 P1 V3 Q4

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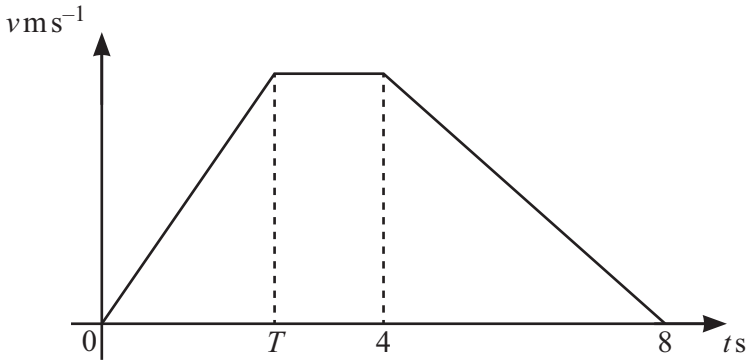

The velocity–time graph represents the motion of a particle moving in a straight line.
The acceleration during the first T seconds of the motion is $2\,\text{m s}^{-2}$.
The total distance travelled is 27 m.

(a) Calculate T. [4]

(b) Calculate the acceleration during the last 4 seconds of the motion. [2]

19. Question | 0606 Oct-Nov 2025 P1 V3 Q5

5 The normal to the curve $y = x^3 + \frac{3}{2}x^2 - 2x + 1$ at the point where $x = 0$ cuts the curve again at two other points.

Find the x-coordinates of these two points. [8]

20. Question | 0606 Oct-Nov 2025 P1 V3 Q8

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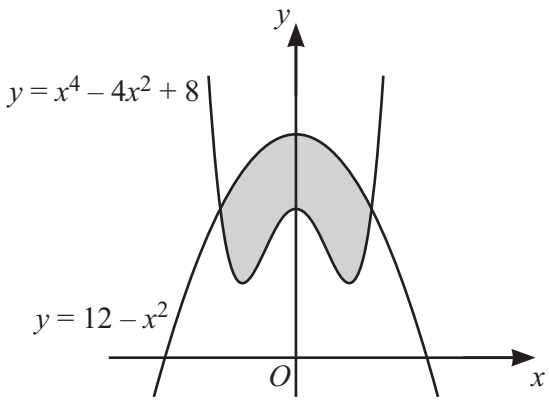


The diagram shows part of each of the curves $y = 12 - x^2$ and $y = x^4 - 4x^2 + 8$.

Find the area of the shaded region enclosed by the two curves. [7]

21. Question part 1/2 | 0606 Specimen 2025 P1 Q8

8 **(a)** Given that $\int_1^a \left(\frac{2}{2x+3} + \frac{3}{3x-1} - \frac{1}{x}\right) \mathrm{d}x = \ln 2.4$, where $a > 1$, find the value of a. [7]

21. Question part 2/2 | 0606 Specimen 2025 P1 Q8

(b) **(i)** Find $\frac{\mathrm{d}}{\mathrm{d}x}(6\sin^3 kx)$, where k is a constant. [2]

(ii) Hence find $\int(\sin^2 2x\cos 2x)\,\mathrm{d}x$. [2]

22. Question part 1/2 | 0606 Specimen 2025 P1 Q9

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

A particle P is travelling in a straight line. Its acceleration, a, away from a fixed point O, at time t, is given by $a = (3t + 2)^{-\frac{1}{3}}$, where $t \geqslant 0$.

When $t = 2$, P is travelling with a velocity of 8 and has a displacement of -4.8 from O.

(a) Find an expression for the velocity of P at time t. [3]

(b) Explain why P is never at rest. [1]

(c) Find the displacement of P from O when $t = \frac{25}{3}$. [4]

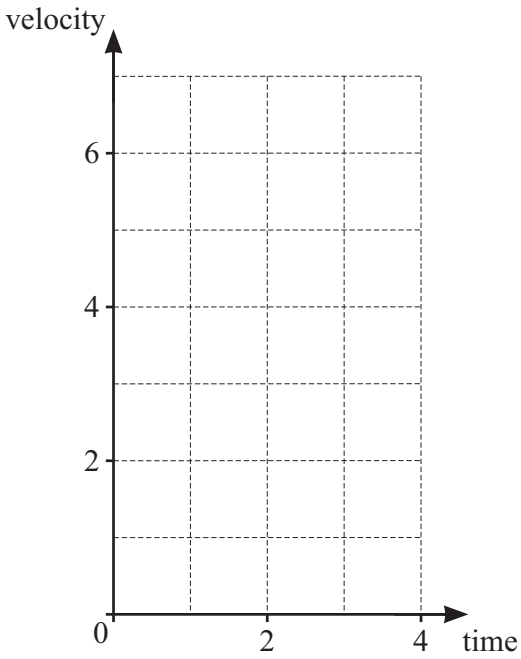
Question 10 is printed on the next page.

23. Question | 0606 Feb-March 2026 P1 V2 Q3

3 In this question, time t is in seconds and displacement s is in metres.

A particle starts from rest at the origin O and moves in a straight line with constant positive acceleration.
When $t = 4$, $s = 6$.

(a) Draw the velocity−time graph for $0 \leqslant t \leqslant 4$. [2]



(b) Hence find the acceleration. [1]

24. Question | 0606 Feb-March 2026 P1 V2 Q5

5 A curve has equation $y = \frac{x^2 - 8}{3 - x}$.

P and Q are the stationary points on the curve.

Find $\frac{\mathrm{d}y}{\mathrm{d}x}$ and the exact length of the line PQ. [7]

25. Question | 0606 Feb-March 2026 P1 V2 Q7

7 The variables x and y are related by $y = 3\sqrt{x} + \frac{1}{\sqrt{x}}$.

Use calculus to find the approximate change in y when x increases from 4 to $4 + h$, where h is small. [4]

26. Question part 1/2 | 0606 Feb-March 2026 P1 V2 Q8

8 A curve has equation $y = xe^{2x+1}$.

(a) Find $\frac{dy}{dx}$. [3]

(b) The line L is the tangent to the curve at the point where $x = \frac{1}{2}$.

Find the exact coordinates of the two points where L meets the axes. [5]

26. Question part 2/2 | 0606 Feb-March 2026 P1 V2 Q8

(c) Use your answer to **8(a)** to find $\int x\mathrm{e}^{2x+1}\mathrm{d}x$. [4]

27. Question | 0606 Feb-March 2026 P1 V2 Q11

11 A curve has equation $y = -x^2 + 3ax - 2a^2$ where a is a positive constant.
The area of the region enclosed by the curve and the x-axis is $\frac{9}{16}$.

Find the value of a. [6]

Question 12 is on the back page.

28. Question | 0606 May-June 2026 P1 V1 Q4

4 Given that $\int_0^a \frac{1}{3x+2}\mathrm{d}x = \ln 4$, find the value of the constant a. [5]

29. Question part 1/2 | 0606 May-June 2026 P1 V1 Q7

7 A curve has equation $y = \dfrac{4+\mathrm{e}^{2x}}{2+\mathrm{e}^{x}}$.

(a) Show that, when $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 0$, $\mathrm{e}^{2x} + 4\mathrm{e}^{x} - 4 = 0$. [5]

29. Question part 2/2 | 0606 May-June 2026 P1 V1 Q7

(b) Hence find the x-coordinate of the stationary point on the curve.
Give your answer in the form $\ln\left(a\sqrt{b}+c\right)$, where a, b and c are integers. [4]

30. Question | 0606 May-June 2026 P1 V1 Q10

10 A curve has equation $y = f(x)$, where $f''(x) = (2x+10)^{-\frac{1}{2}} - 2x$.

The curve has a stationary point at $\left(3, \frac{64}{3}\right)$.

Find the equation of the curve. [8]

31. Question | 0606 May-June 2026 P1 V2 Q5

5 Find, in exact form, the equation of the tangent to the curve $y = \ln\left((2x-4)^5\right)$ at the point where $x = 3$. [4]

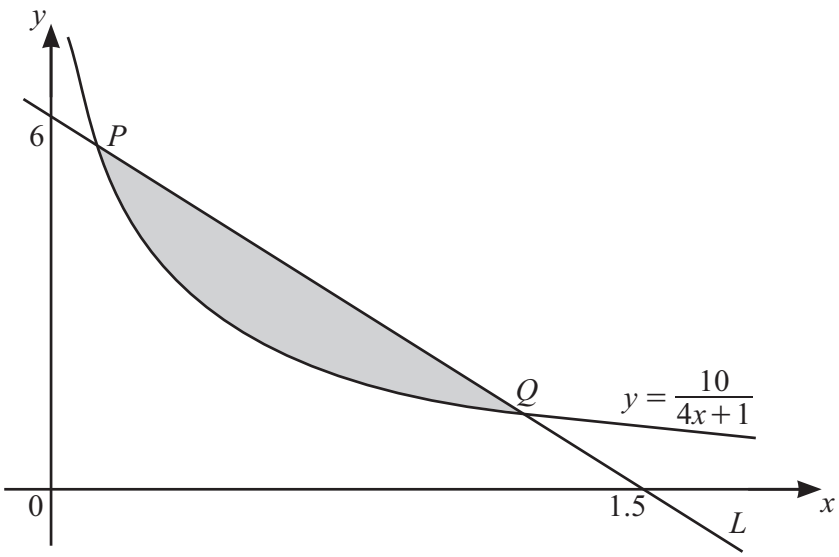
32. Question | 0606 May-June 2026 P1 V2 Q8

8 Variables x and y are related by the equation $y = \frac{5x+1}{x-2}$.

Using calculus, find the approximate change in x when y increases from 4 by the small amount h. [5]

33. Question part 1/2 | 0606 May-June 2026 P1 V2 Q12

12



The diagram shows part of the curve $y = \frac{10}{4x+1}$ and the line L.

L passes through the points (0, 6) and (1.5, 0).
The curve and L intersect at the points P and Q.

Find the exact area of the shaded region. [11]

33. Question part 2/2 | 0606 May-June 2026 P1 V2 Q12

Continuation of working space for Question 12.

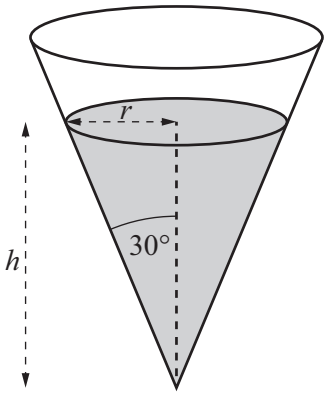
Question 13 is on the back page.

34. Question | 0606 May-June 2026 P1 V3 Q6

6 In this question time is in seconds and lengths are in centimetres.

You are given that $\cos 30° = \frac{\sqrt{3}}{2}$, $\sin 30° = \frac{1}{2}$ and $\tan 30° = \frac{1}{\sqrt{3}}$.

A water tank is shaped as a cone with its axis vertical.
The angle between the vertical axis and the sloping edge of the cone is 30°.



At time t the depth of the water is h, the volume of water in the tank is V, and the radius of the circle formed by the surface of the water is r.

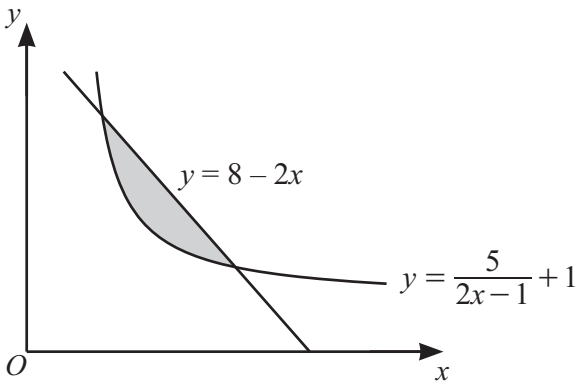
(a) Show that $V = \frac{1}{9}\pi h^3$. [2]

Water is flowing into the tank at a constant rate of $50\,\text{cm}^3\,\text{s}^{-1}$.

(b) Find the rate at which h is increasing at the instant when $h = 60$.
Give your answer in terms of π. [4]

35. Question | 0606 May-June 2026 P1 V3 Q11

11



The diagram shows part of the curve $y = \frac{5}{2x-1} + 1$ and part of the line $y = 8 - 2x$.

Find the exact area of the shaded region enclosed by the curve and the line. [10]

36. Question | 0606 May-June 2026 P1 V3 Q12

12 A curve has equation $y = e^{\frac{2a}{x}}$ where a is a positive constant.

(a) Find $\frac{dy}{dx}$ in terms of a. [2]

The normal to the curve at the point where $x = a$ passes through the origin.

(b) Find the value of a. [5]