Answer **all** the questions.

1 The quadratic equation $3x^2 - 5x - 1 = 0$ has roots α and β.

Find

(i) the value of $\alpha^2 + \beta^2$ [3]

(ii) a quadratic equation whose roots are $\frac{4}{\alpha^2}$ and $\frac{4}{\beta^2}$. [3]

2 (i) Express $\frac{6+5x-8x^2}{(2x-1)(x^2+3)}$ as partial fractions. [4]

(ii) Differentiate $\ln(x^2+3)$ with respect to x. [1]

(iii) Using the results of parts **(i)** and **(ii)**, find $\int \frac{6+5x-8x^2}{(2x-1)(x^2+3)}\,dx$. [4]

3 **(a)** Given that $\log_2 p = x$ and $\log_2 q = y$, express the following in terms of x and y.

(i) $\log_2 1 - p + q$ [1]

(ii) $\log_2 \sqrt{\frac{p^5}{q^3}}$ [3]

(iii) $\log_{\sqrt{2}} 4p$ [4]

(b) Solve $4\log_4 x + 1 = 3\log_8(5-3x)$. [5]

4 (i) A curve has the equation $y = 2x^2 + 4x - 6$. Express $y = 2x^2 + 4x - 6$ in the form $y = a(x+h)^2 + k$, where a, h and k are constants. [2]

(ii) State the coordinates of the minimum point of the curve. [1]

(iii) Explain how you find the minimum point of the curve. [1]

(iv) Hence, sketch the graph of $y = |2x^2 + 4x - 6|$, indicating the minimum point and the intercept(s) [3]

5 A circle, C_1, has the equation $x^2 + y^2 - 4x + 6y - 12 = 0$.

(i) Find the coordinates of the centre and radius of the circle. [3]

(ii) Find the coordinates of the points where the circle cuts the x axis. [2]

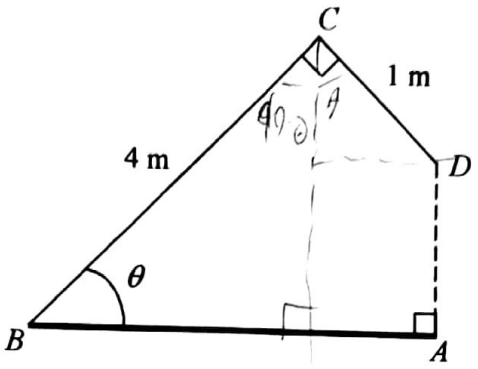
(iii) Find the equation of another circle such that the new circle is a reflection of $x^2 + y^2 - 4x + 6y - 12 = 0$ along the y-axis. [1]

(iv) State whether the point (4, 1) is found inside, on the circumference or outside of circle C_1. Give reasons for your answer. [2]

6 (i) Show that $\frac{1}{\sin x+1} - \frac{1}{\sin x-1} = 2\sec^2 x$. [4]

(ii) Hence solve $\frac{1}{\sin x+1} - \frac{1}{\sin x-1} = 3 - \tan x$ where $0 \le x \le 2\pi$. [5]

7



The diagram above shows the side view of a bus stop shelter BCD such that $BC = 4$ m, $CD = 1$ m, angle $BCD = 90°$ and angle $CBA = \theta$. AB is a concrete pavement under the shelter such that DA is perpendicular to AB.

(i) Show why $AB = 4\cos\theta + \sin\theta$. [2]

(ii) Express AB in the form of $R\cos(\theta - \alpha)$, where $R > 0$ and $0^0 < \alpha < 90^0$. [3]

(iii) State the maximum value of AB and the value of θ at which this occurs. [3]

(iv) Find the value of θ when $AB = 3$ m. [2]

8 A particle P moves in a straight line so that, t seconds after passing through a fixed point O, its velocity v m/s, is given by $v = 3t^2 + kt + 18$, where k is a constant. When $t = 1$, the acceleration of the particle is -9 m/s^2.

(i) Show that $k = -15$. [2]

(ii) Find the values of t for which P is instantaneously at rest. [2]

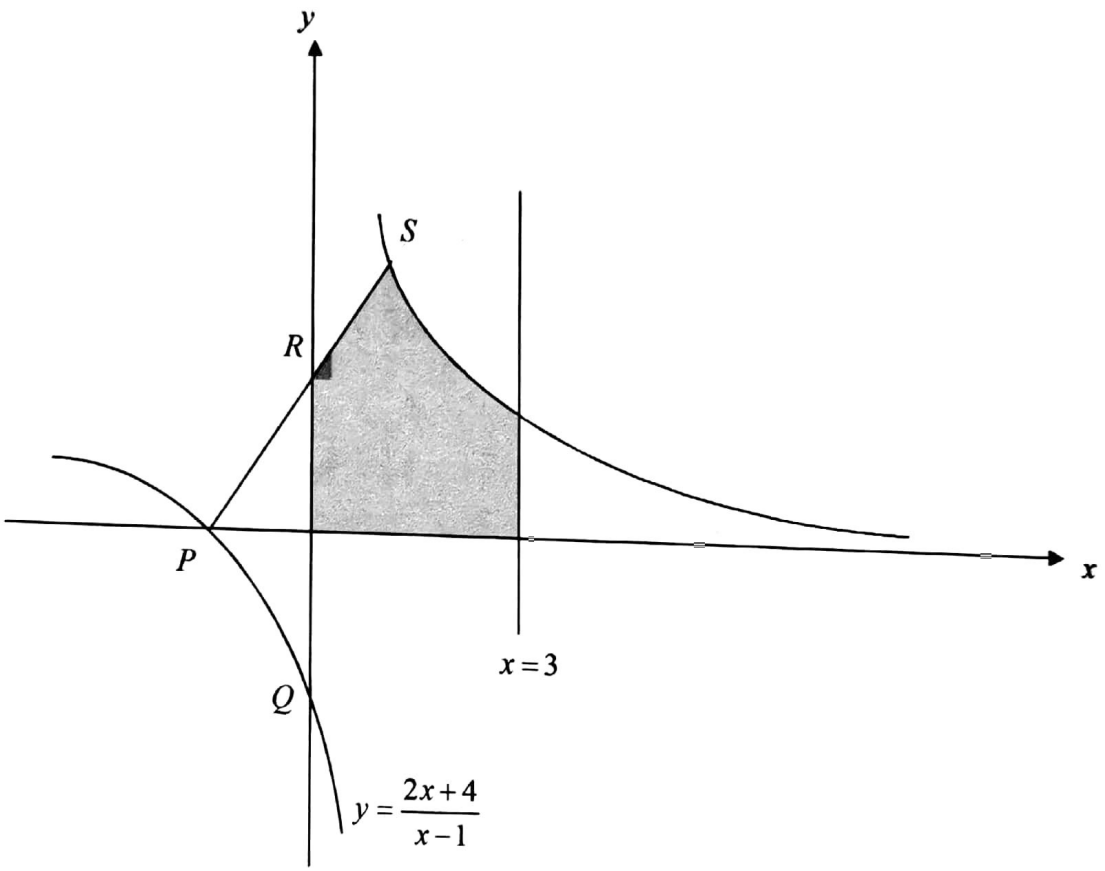
(iii) Find the total distance travelled by P in the first 3 seconds after passing through point O. [4]

9 Two variables x and y are connected by the equation $y = \dfrac{3x+1}{1-2x}$.

(i) Find $\frac{dy}{dx}$. State the value of x for which $\frac{dy}{dx}$ is not defined and explain why $\frac{dy}{dx}$ is not defined for this value of x. [4]

(ii) Is y an increasing or a decreasing function? Explain your answer. [2]

10 The diagram below shows the curve $y = \frac{2x+4}{x-1}$ which cuts the x-axis at P and the y-axis at Q. The normal to the curve at P meets the y-axis at R. S is the point where the normal meets the curve again.



(i) Find the coordinates of P and of Q. [2]

$f(x) = \frac{2x+4}{3x+1}$

(ii) Find the coordinates of R and of S. [7]

(iii) Express $y = \frac{2x+4}{x-1}$ in the form of $y = A + \frac{B}{x-1}$ and hence find the area of the shaded region. [5]

11 **Answer the whole of this question on the next page.**

The table below shows experimental values of two variables x and y, which are connected by the equation $y = ax + \frac{b}{x}$ where a and b are constants. It is suspected that an error occured in one of the values of y.

x	0.5	1.0	1.5	2.0	2.5	3.0
y	11.2	8.0	8.1	11.0	10.2	11.7

(i) Plot xy against x^2 for the given data and draw a straight line graph. [3]

(ii) Use your graph to estimate the value of a and of b. [4]

(iii) Find the inaccurate reading of y and estimate its correct value using your graph. [3]