

- 1 (a) Without using a calculator, find the value of 6^x , given that $2^{x+2} = 3^{2-x}$. $9/4$ [2]
 (b) Hence, solve for x . $x = \lg(9/4)/\lg(6) = 0.453$ [1]
- 2 A rectangle of length $(8 + \sqrt{18})$ cm has an area of $(26 + \sqrt{32})$ cm².
 (a) Without using a calculator, find the breadth of the rectangle, in cm, in the form $a + b\sqrt{2}$, where a and b are integers. $4 - \sqrt{2}$ [3]
 (b) The rectangle is the base of a cuboid with a height of $(7\sqrt{2} + 6)$ cm. Find the volume of the cuboid, in cm³, in the form $(c + d\sqrt{2})$, where c and d are integers [3]
 $212 + 206\sqrt{2}$
- 3 Find the coordinates of the points of intersection of the line $3y - 2x - 8 = 0$ and the curve $xy = 8$. $x = 2, y = 4$ or $x = -6, y = -4/3$ [4]
- 4 Solve the equation $\sqrt{2x+7} + 1 = x - 3$. $x = 9$ [4]
- 5 By using an appropriate substitution, or otherwise, solve the equation $3^x + 9^{x-1} = 108$. $x = 3$ [4]

[Turn over]

- 6 The height above the ground, y metres, of the ball released by a machine can be modelled by the equation $y = -\frac{1}{2}x^2 + 4x + 3$, where x is the horizontal distance from the machine in metres.
- (a) State the height above the ground from which the ball is just released by the machine. 3m [1]
- (b) Express y in the form $a(x+b)^2 + c$ where a , b and c are constants to be determined.
 $y = -\frac{1}{2}(x-4)^2 + 11$ [3]
- (c) Sketch the graph of $y = -\frac{1}{2}x^2 + 4x + 3$, indicate clearly the turning point, x -intercept and y -intercept. [4]
- (d) There is an object which is 6 metres horizontally from the machine and 9 metres above the ground. Determine whether the object will be hit by the ball. [1]
the object will be hit by the ball
- 7 (a) Find the value of the constant p such that the line $y = 2x + p$ is tangent to the curve $y = \frac{1}{2}x^2 + 3x + 1$. $p = 1/2$ [3]
- (b) Find the range of values of the constant k for which the curve $y = kx^2 + 8x + k - 6$ lies completely above the x -axis. $k < -2$ or $k > 8$ [4]
- 8 (a) Solve the equation $\log_5(4x-3) = \log_{\frac{1}{5}}(x-1) + 1$. $x = 2$ [4]
- (b) Without using a calculator, evaluate $\log_a 5a^2 + \log_a 2a^2 - \log_a 10$. 4 [2]

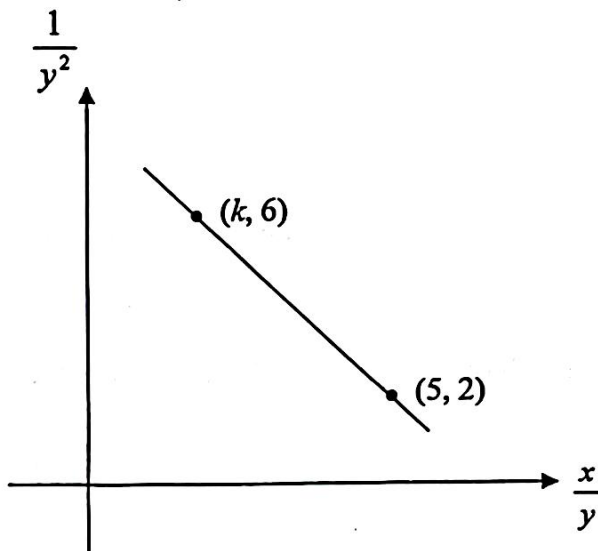
- 9 (a) The equation of a polynomial is given by $P(x) = 2x^3 - 7x^2 + 4x + 3$.
- (i) Find the remainder when $P(x)$ is divided by $(x+1)$. -10 [2]
- (ii) Show that $(2x-3)$ is a factor of $P(x)$. [2]
- (iii) Solve the equation $2x^3 = 7x^2 - 4x - 3$, expressing non-rational roots in surd form. $x=3/2, 1+\sqrt{2}, 1-\sqrt{2}$ [4]
- (b) Using long division, find the quotient and remainder when $3x^4 - 2x^3 - 4x + 5$ is divided by $x^2 + 3$. $2x+32$ [3]
- 10 The graph of $y = \log_a x$ passes through the points with coordinates $(16, 4)$, $(1, b)$ and $(c, -3)$.
- (a) Find the value of a , of b and of c . $a=2, b=0, c=1/8$ [4]
- (b) Sketch the graph of $y = \log_a x$, indicating clearly the x -intercept. [2]
- 11 In order to obtain a graphical solution of the equation $x = \ln \sqrt{\frac{3x+5}{2}}$, a suitable straight line l , can be drawn on the same set of axes as the graph of $y = 2e^{2x} + 1$.
- (a) Using $x = \ln \sqrt{\frac{3x+5}{2}}$, express e^{2x} in the form of $mx + c$ where m and c are constants to be determined. $3/2x+5/2$ [2]
- (b) Hence, find the equation of the line l . [1]

- 12 The variables x and y are connected by the equation $y^2 = axy + b$, where a and b are constants

The diagram shows part of a straight line graph obtained by plotting $\frac{1}{y^2}$ against $\frac{x}{y}$.

Given that the line passes through the points $(5, 2)$ and $(k, 6)$ and has gradient -1.5 , find

- (a) the value of k , $k=7/3$ [2]
 (b) the value of a and of b . $a=3/19, b=2/19$ [5]



Answer the whole of Question 13 on a sheet of graph paper.

- 13 When a substance is dissolved in acid, a reaction occurs. Recorded values of the mass, m grams, of the substance, t minutes after the start of the reaction, are shown in the table below.

m (grams)	25.8	20.1	14.9	11.6	9.0
t (minutes)	1	2	3	4	5

It is known that m and t are related by the equation $m = Ae^{-kt}$, where A and k are constants.

On the graph paper,

- (a) plot $\ln m$ against t and draw a straight line graph. [3]

Use your graph to estimate

- (b) the mass of the substance at the start of the reaction, $m=33.1$ [2]
 (c) the value of k , $k=21/80$ [3]
 (d) the time taken when half of the substance has been dissolved. 156 [2]

End of paper