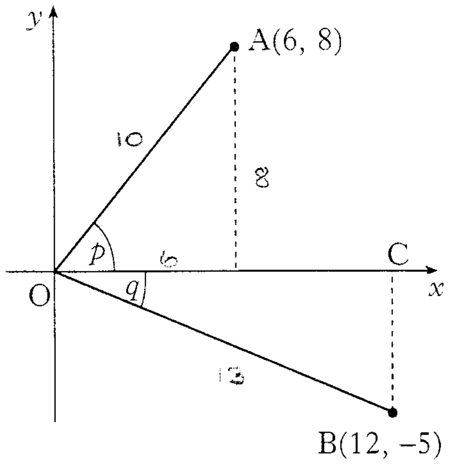
## SECTION A (Mathematics 1 and 2)

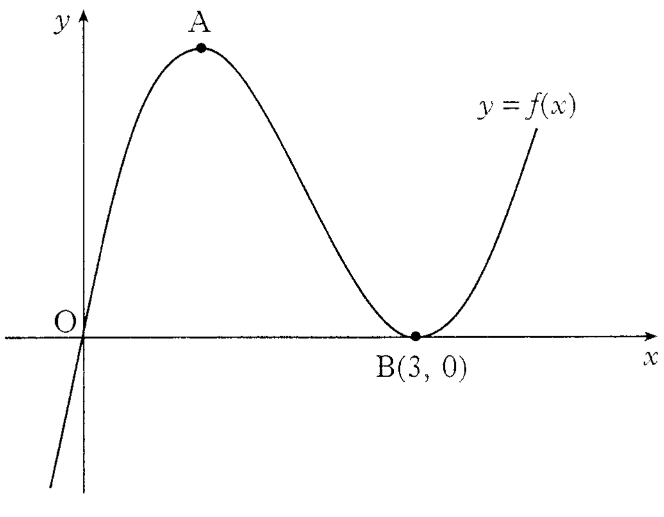
**ALL candidates should attempt this Section.**

**A1.** On the coordinate diagram shown, A is the point (6, 8) and B is the point (12, −5). Angle AOC = $p$ and angle COB = $q$.

Find the exact value of $\sin(p + q)$. **4**




**A2.** A sketch of the graph of $y = f(x)$ where $f(x) = x^3 - 6x^2 + 9x$ is shown below. The graph has a maximum at A and a minimum at B(3, 0).




(*a*) Find the coordinates of the turning point at A. **4**

(*b*) Hence sketch the graph of $y = g(x)$ where $g(x) = f(x + 2) + 4$.

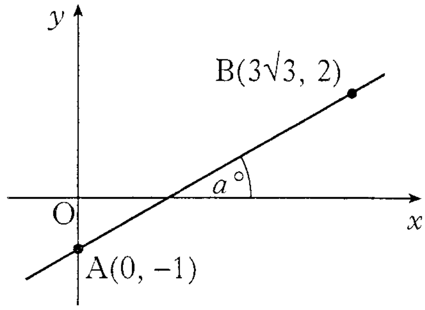
Indicate the coordinates of the turning points. There is no need to calculate the coordinates of the points of intersection with the axes. **2**

(*c*) Write down the range of values of $k$ for which $g(x) = k$ has 3 real roots. **1**

**[Turn over**

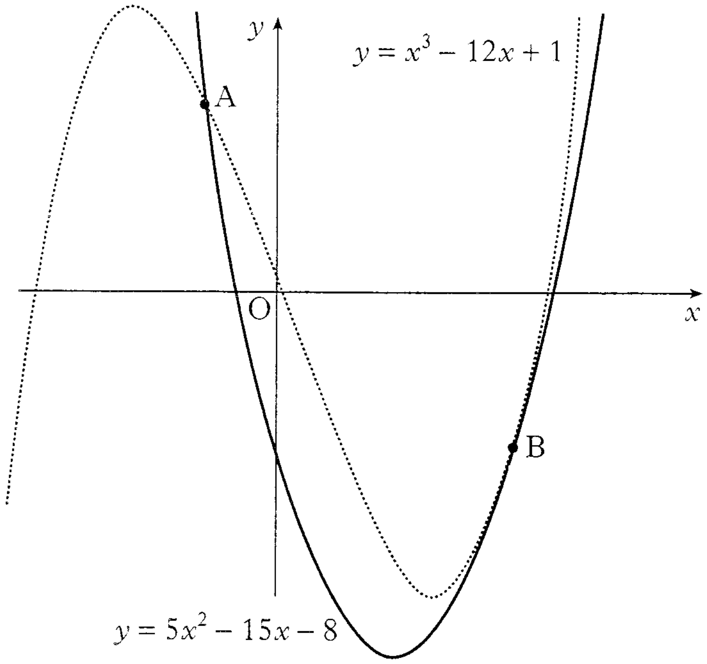
*Marks*

**A3.** Find the size of the angle $a°$ that the line joining the points A(0, −1) and B($3\sqrt{3}$, 2) makes with the positive direction of the $x$-axis. **3**




**A4.** The diagram shows a sketch of the graphs of $y = 5x^2 - 15x - 8$ and $y = x^3 - 12x + 1$.

The two curves intersect at A and touch at B, ie at B the curves have a common tangent.




(*a*) (i) Find the $x$-coordinates of the points on the curves where the gradients are equal. **4**

(ii) By considering the corresponding $y$-coordinates, or otherwise, distinguish geometrically between the two cases found in part (i). **1**

(*b*) The point A is (−1, 12) and B is (3, −8).

Find the area enclosed between the two curves. **5**

*Marks*

**A5.** Two sequences are generated by the recurrence relations $u_{n+1} = au_n + 10$ and $v_{n+1} = a^2v_n + 16$.

The two sequences approach the same limit as $n \to \infty$.

Determine the value of $a$ and evaluate the limit. **5**

**A6.** For what range of values of $k$ does the equation $x^2 + y^2 + 4kx - 2ky - k - 2 = 0$ represent a circle? **5**

[*END OF SECTION A*]

**Candidates should now attempt**

**EITHER Section B (Mathematics 3) on *Page six***

**OR Section C (Statistics) on *Pages seven and eight***

**[Turn over**

## SECTION B (Mathematics 3)

*Marks*

**ONLY candidates doing the course Mathematics 1, 2 and 3 should attempt this Section.**

**B7.** VABCD is a pyramid with a rectangular base ABCD.

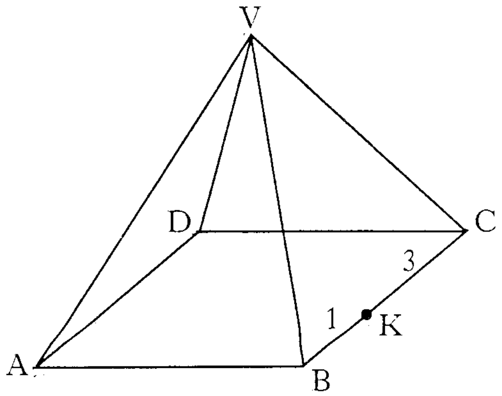
Relative to some appropriate axes,

$\overrightarrow{VA}$ represents $-7\boldsymbol{i} - 13\boldsymbol{j} - 11\boldsymbol{k}$

$\overrightarrow{AB}$ represents $6\boldsymbol{i} + 6\boldsymbol{j} - 6\boldsymbol{k}$

$\overrightarrow{AD}$ represents $8\boldsymbol{i} - 4\boldsymbol{j} + 4\boldsymbol{k}$.

K divides BC in the ratio 1:3.




Find $\overrightarrow{VK}$ in component form. 3

**B8.** The graph of $y = f(x)$ passes through the point $\left(\frac{\pi}{9}, 1\right)$.

If $f'(x) = \sin(3x)$, express $y$ in terms of $x$. 4

**B9.** Evaluate $\log_5 2 + \log_5 50 - \log_5 4$. 3

**B10.** Find the maximum value of $\cos x - \sin x$ and the value of $x$ for which it occurs in the interval $0 \leq x \leq 2\pi$. 6

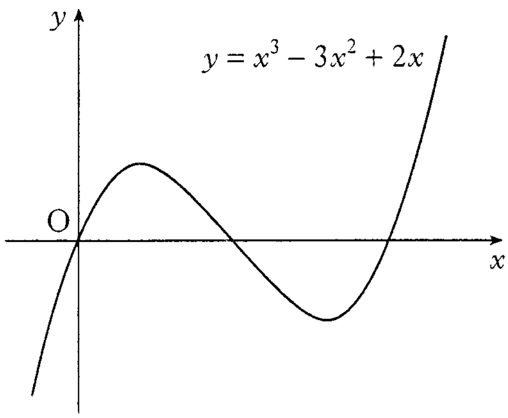
*[END OF SECTION B]*

## SECTION A (Mathematics 1 and 2)

*Marks*

**ALL candidates should attempt this Section.**

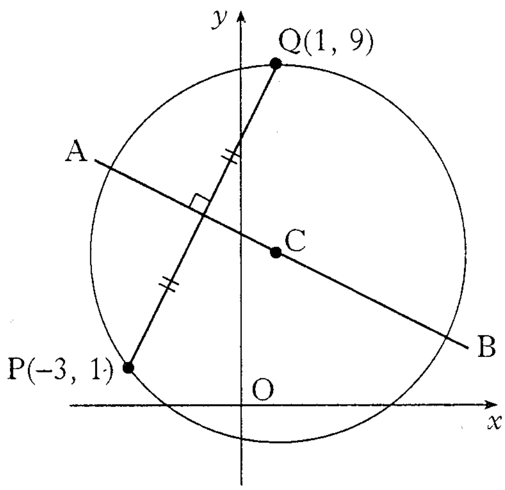
**A1.** The diagram shows a sketch of the graph of $y = x^3 - 3x^2 + 2x$.




(*a*) Find the equation of the tangent to this curve at the point where $x = 1$. **5**

(*b*) The tangent at the point (2, 0) has equation $y = 2x - 4$. Find the coordinates of the point where this tangent meets the curve again. **5**

**A2.** (*a*) Find the equation of AB, the perpendicular bisector of the line joining the points P(–3, 1) and Q(1, 9). **4**




(*b*) C is the centre of a circle passing through P and Q. Given that QC is parallel to the $y$-axis, determine the equation of the circle. **3**

(*c*) The tangents at P and Q intersect at T.

Write down

(i) the equation of the tangent at Q

(ii) the coordinates of T. **2**

**A3.** $f(x) = 3 - x$ and $g(x) = \frac{3}{x}$, $x \neq 0$.

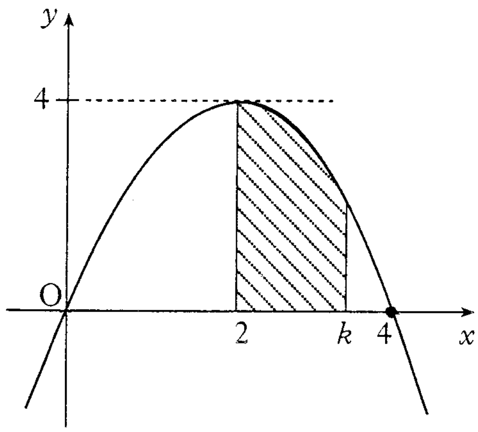
(*a*) Find $p(x)$ where $p(x) = f(g(x))$. **2**

(*b*) If $q(x) = \frac{3}{3 - x}$, $x \neq 3$, find $p(q(x))$ in its simplest form. **3**

Marks

**A4.** The parabola shown crosses the $x$-axis at (0, 0) and (4, 0), and has a maximum at (2, 4).

The shaded area is bounded by the parabola, the $x$-axis and the lines $x = 2$ and $x = k$.




(a) Find the equation of the parabola. **2**

(b) Hence show that the shaded area, A, is given by

$$A = -\tfrac{1}{3}k^3 + 2k^2 - \frac{16}{3}.$$ **3**

**A5.** Solve the equation $3\cos 2x° + \cos x° = -1$ in the interval $0 \leq x \leq 360$. **5**

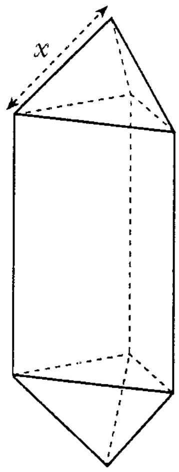
**A6.** A goldsmith has built up a solid which consists of a triangular prism of fixed volume with a regular tetrahedron at each end.

The surface area, $A$, of the solid is given by

$$A(x) = \frac{3\sqrt{3}}{2}\left(x^2 + \frac{16}{x}\right)$$

where $x$ is the length of each edge of the tetrahedron.

Find the value of $x$ which the goldsmith should use to minimise the amount of gold plating required to cover the solid. **6**




[*END OF SECTION A*]

**Candidates should now attempt**

**EITHER Section B (Mathematics 3) on *Pages five and six***

**OR Section C (Statistics) on *Pages seven and eight***

## SECTION B (Mathematics 3)

*Marks*

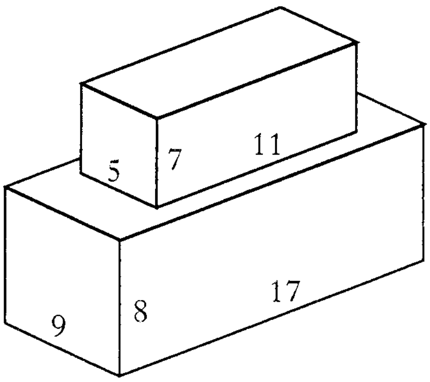
**ONLY candidates doing the course Mathematics 1, 2 and 3 should attempt this Section.**

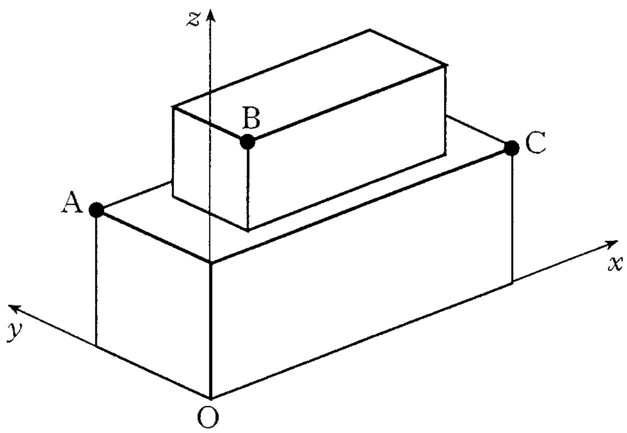
**B7.** For what value of $t$ are the vectors $u = \begin{pmatrix} t \\ -2 \\ 3 \end{pmatrix}$ and $v = \begin{pmatrix} 2 \\ 10 \\ t \end{pmatrix}$ perpendicular? **2**

**B8.** Given that $f(x) = (5x - 4)^{\frac{1}{2}}$, evaluate $f'(4)$. **3**

**B9.** A cuboid measuring 11 cm by 5 cm by 7 cm is placed centrally on top of another cuboid measuring 17 cm by 9 cm by 8 cm.

Coordinate axes are taken as shown.




(*a*) The point A has coordinates (0, 9, 8) and C has coordinates (17, 0, 8).

Write down the coordinates of B. **1**

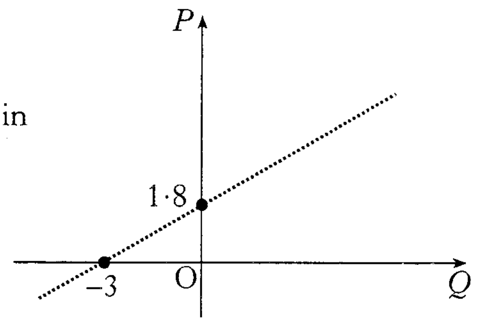
(*b*) Calculate the size of angle ABC. **6**

**[Turn over**

*Marks*

**B10.** Find $\int \frac{1}{(7-3x)^2}\,dx$. 2

**B11.** The results of an experiment give rise to the graph shown.




(*a*) Write down the equation of the line in terms of $P$ and $Q$. 2

It is given that $P = \log_e p$ and $Q = \log_e q$.

(*b*) Show that $p$ and $q$ satisfy a relationship of the form $p = aq^b$, stating the values of $a$ and $b$. 4

[*END OF SECTION B*]