X100/301

NATIONAL
QUALIFICATIONS
2004

FRIDAY, 21 MAY
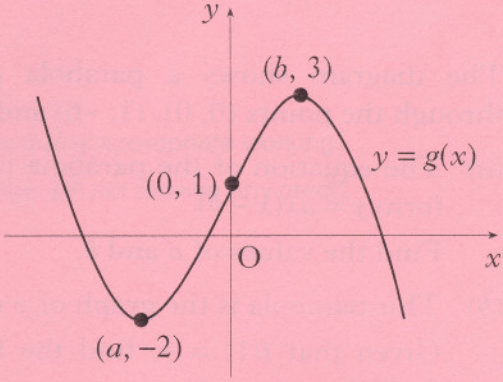9.00 AM – 10.10 AM

MATHEMATICS
HIGHER
Units 1, 2 and 3
Paper 1
(Non-calculator)

Read Carefully

1 **Calculators may NOT be used in this paper.**

2 Full credit will be given only where the solution contains appropriate working.

3 Answers obtained by readings from scale drawings will not receive any credit.

1. The point A has coordinates $(7, 4)$. The straight lines with equations $x + 3y + 1 = 0$ and $2x + 5y = 0$ intersect at B.

   (*a*) Find the gradient of AB.   3

   (*b*) Hence show that AB is perpendicular to only one of these two lines.   5

2. $f(x) = x^3 - x^2 - 5x - 3$.

   (*a*)   (i)   Show that $(x + 1)$ is a factor of $f(x)$.

        (ii)   Hence or otherwise factorise $f(x)$ fully.   5

   (*b*) One of the turning points of the graph of $y = f(x)$ lies on the x-axis.
   Write down the coordinates of this turning point.   1

3. Find all the values of x in the interval $0 \le x \le 2\pi$ for which $\tan^2(x) = 3$.   4

4. The diagram shows the graph of $y = g(x)$.

   (*a*) Sketch the graph of $y = -g(x)$.   2

   (*b*) On the same diagram, sketch the graph of $y = 3 - g(x)$.   2

5. A, B and C have coordinates $(-3, 4, 7)$, $(-1, 8, 3)$ and $(0, 10, 1)$ respectively.

   (*a*) Show that A, B and C are collinear.   3

   (*b*) Find the coordinates of D such that $\overrightarrow{AD} = 4\overrightarrow{AB}$.   2

6. Given that $y = 3\sin(x) + \cos(2x)$, find $\dfrac{dy}{dx}$.   3

[Turn over for Questions 7 to 11 on *Page four*

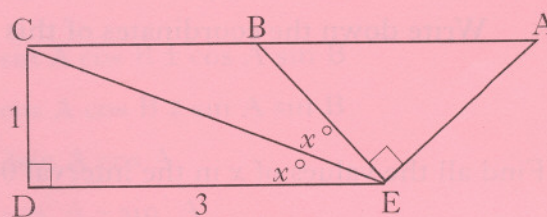7.   Find $\int_{0}^{2} \sqrt{4x+1}\ dx$.   5

8.   (*a*)   Write $x^2 - 10x + 27$ in the form $(x + b)^2 + c$.   2

     (*b*)   Hence show that the function $g(x) = \frac{1}{3}x^3 - 5x^2 + 27x - 2$ is always increasing.   4

9.   Solve the equation $\log_2(x + 1) - 2\log_2(3) = 3$.   4

10. In the diagram
     angle DEC = angle CEB = $x°$ and
     angle CDE = angle BEA = $90°$.
     CD = 1 unit; DE = 3 units.

     By writing angle DEA in terms
     of $x°$, find the exact value of
     cos(DÊA).   7
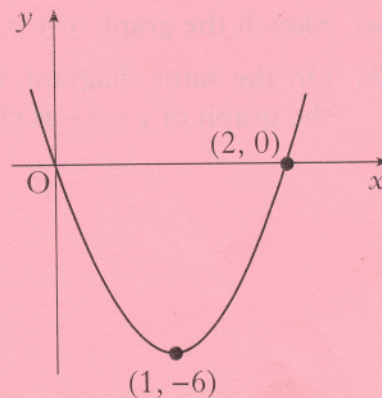
11. The diagram shows a parabola passing
     through the points $(0, 0)$, $(1, -6)$ and $(2, 0)$.

     (*a*)   The equation of the parabola is of the
             form $y = ax(x - b)$.
             Find the values of a and b.   3

     (*b*)   This parabola is the graph of $y = f'(x)$.
             Given that $f(1) = 4$, find the formula
             for $f(x)$.   5

[*END OF QUESTION PAPER*]