

# X100/12/03

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NATIONAL TUESDAY, 6 MAY  
QUALIFICATIONS 2.50 PM – 4.00 PM  
2014

MATHEMATICS  
HIGHER  
Paper 2

**Read carefully**

- 1 **Calculators may 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.



## FORMULAE LIST

### Circle:

The equation  $x^2 + y^2 + 2gx + 2fy + c = 0$  represents a circle centre  $(-g, -f)$  and radius  $\sqrt{g^2 + f^2 - c}$ .

The equation  $(x - a)^2 + (y - b)^2 = r^2$  represents a circle centre  $(a, b)$  and radius  $r$ .

**Scalar Product:**  $\mathbf{a} \cdot \mathbf{b} = |\mathbf{a}| |\mathbf{b}| \cos \theta$ , where  $\theta$  is the angle between  $\mathbf{a}$  and  $\mathbf{b}$

or  $\mathbf{a} \cdot \mathbf{b} = a_1 b_1 + a_2 b_2 + a_3 b_3$  where  $\mathbf{a} = \begin{pmatrix} a_1 \\ a_2 \\ a_3 \end{pmatrix}$  and  $\mathbf{b} = \begin{pmatrix} b_1 \\ b_2 \\ b_3 \end{pmatrix}$ .

**Trigonometric formulae:**  $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A$$

$$= 2 \cos^2 A - 1$$

$$= 1 - 2 \sin^2 A$$

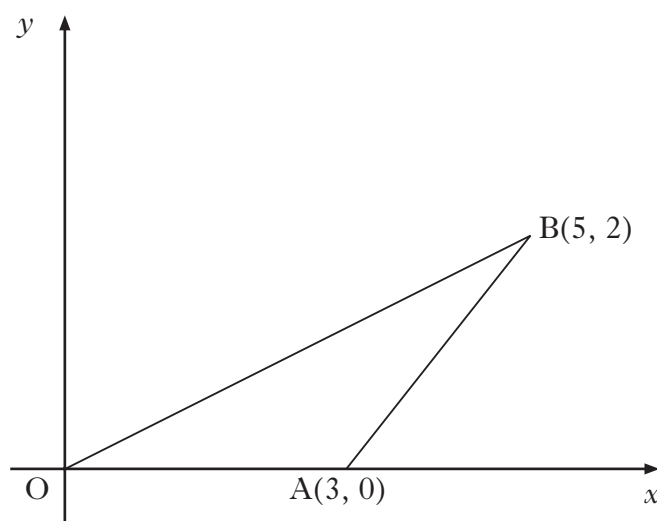
**Table of standard derivatives:**

$f(x)$	$f'(x)$
$\sin ax$	$a \cos ax$
$\cos ax$	$-a \sin ax$

**Table of standard integrals:**

$f(x)$	$\int f(x) dx$
$\sin ax$	$-\frac{1}{a} \cos ax + c$
$\cos ax$	$\frac{1}{a} \sin ax + c$

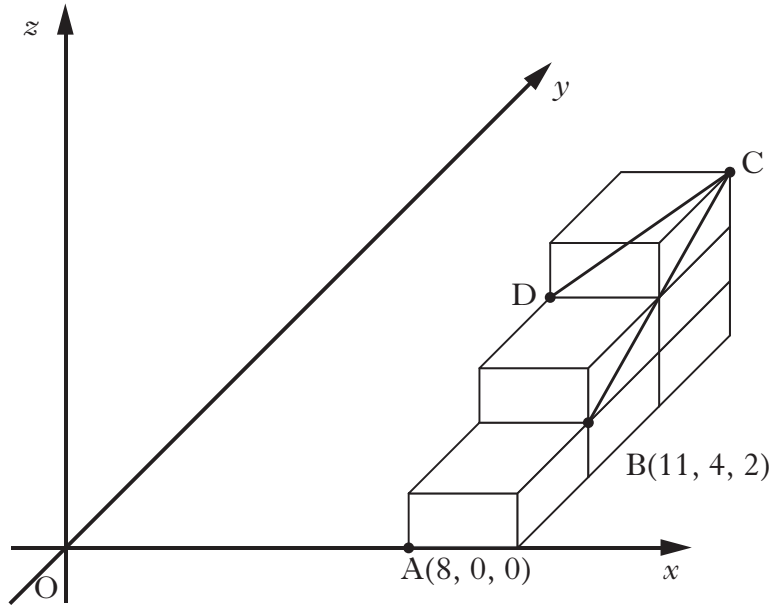
1. A(3, 0), B(5, 2) and the origin are the vertices of a triangle as shown in the diagram.



- (a) Obtain the equation of the perpendicular bisector of AB. 4
- (b) The median from A has equation  $y + 2x = 6$ .  
Find T, the point of intersection of this median and the perpendicular bisector of AB. 2
- (c) Calculate the angle that AT makes with the positive direction of the  $x$ -axis. 2
2. A curve has equation  $y = x^4 - 2x^3 + 5$ .  
Find the equation of the tangent to this curve at the point where  $x = 2$ . 4
3. Functions  $f$  and  $g$  are defined on suitable domains by
- $$f(x) = x(x - 1) + q \text{ and } g(x) = x + 3.$$
- (a) Find an expression for  $f(g(x))$ . 2
- (b) Hence, find the value of  $q$  such that the equation  $f(g(x)) = 0$  has equal roots. 4

[Turn over

4. Six identical cuboids are placed with their edges parallel to the coordinate axes as shown in the diagram.



A and B are the points  $(8, 0, 0)$  and  $(11, 4, 2)$  respectively.

- (a) State the coordinates of C and D. 2
- (b) Determine the components of  $\vec{CB}$  and  $\vec{CD}$ . 2
- (c) Find the size of the angle BCD. 5
5. Given that  $\int_4^t (3x + 4)^{-\frac{1}{2}} dx = 2$ , find the value of  $t$ . 5
6. Solve the equation
- $$\sin x - 2 \cos 2x = 1 \quad \text{for } 0 \leq x < 2\pi. \quad \text{5}$$

7. Land enclosed between a path and a railway line is being developed for housing. This land is represented by the shaded area shown in Diagram 1.

- The path is represented by a parabola with equation  $y = 6x - x^2$ .
- The railway is represented by a line with equation  $y = 2x$ .
- One square unit in the diagram represents  $300 \text{ m}^2$  of land.

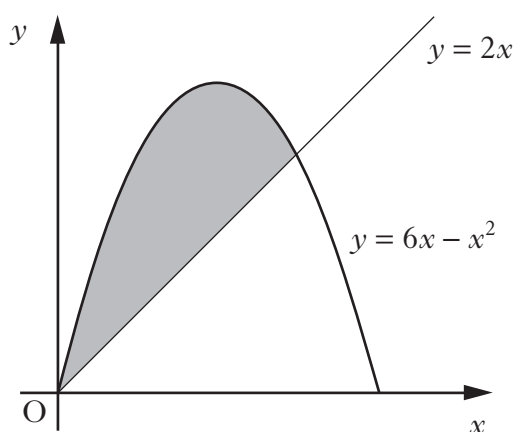


Diagram 1

- (a) Calculate the area of land being developed. 5
- (b) A road is built parallel to the railway line and is a tangent to the path as shown in Diagram 2.

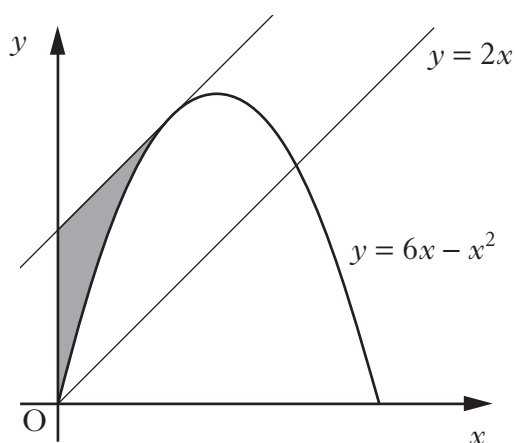


Diagram 2

It is decided that the land, represented by the shaded area in Diagram 2, will become a car park.

Calculate the area of the car park. 5

**[Turn over**

8. Given that the equation

$$x^2 + y^2 - 2px - 4py + 3p + 2 = 0$$

represents a circle, determine the range of values of  $p$ .

5

9. Acceleration is defined as the rate of change of velocity.

An object is travelling in a straight line. The velocity,  $v$  m/s, of this object,  $t$  seconds after the start of the motion, is given by  $v(t) = 8\cos(2t - \frac{\pi}{2})$ .

- (a) Find a formula for  $a(t)$ , the acceleration of this object,  $t$  seconds after the start of the motion.

3

- (b) Determine whether the velocity of the object is increasing or decreasing when  $t = 10$ .

2

- (c) Velocity is defined as the rate of change of displacement.

Determine a formula for  $s(t)$ , the displacement of the object, given that  $s(t) = 4$  when  $t = 0$ .

3

[END OF QUESTION PAPER]

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