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Mathematics  
Higher  
Paper 2  
Practice Paper N

Time allowed  
1 hour 10 minutes

NATIONAL  
QUALIFICATIONS

**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  $\mathbf{b}$ .

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

**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 :**

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

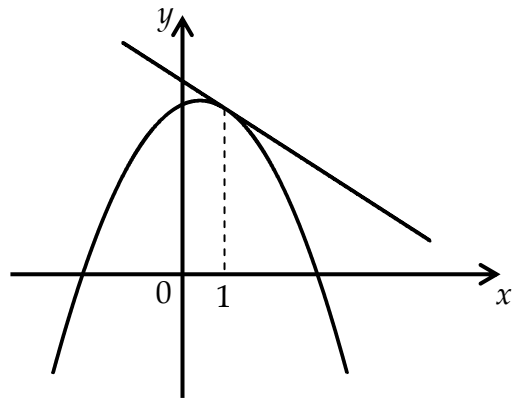
ALL questions should be attempted.

Marks

1. K is the point  $(3, -2, 3)$ , L $(5, 0, 7)$  and M $(7, -3, -1)$ .
- (a) Write down the components of  $\overline{KL}$  and  $\overline{KM}$ . 2
- (b) Calculate the size of angle LKM. 5

2. (a) (i) Show that  $(x-2)$  is a factor of  $f(x) = 2x^3 - 3x^2 - 3x + 2$ .
- (ii) Hence factorise  $f(x)$  fully. 4
- (b) Solve  $2(x^3 + 1) = 3x(x + 1)$ . 2

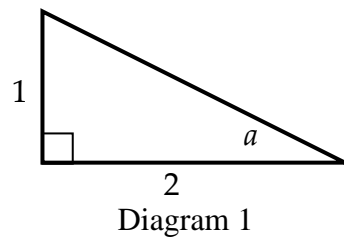
3. (a) Find the equation of the tangent to the parabola with equation
- $$y = 6 + x - x^2$$
- at the point  $(1, 6)$ .



- (b) Show that this line is also a tangent to the circle with equation
- $$x^2 + y^2 - 4x - 14y + 51 = 0$$
- 4
- 5

4. In the right-angled triangle shown in Diagram 1,  $\tan a = \frac{1}{2}$ .

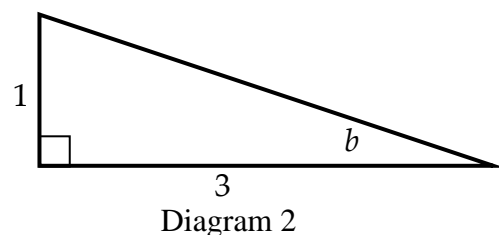
- (a) Find the exact values of
- (i)  $\cos a$ ;
- (ii)  $\cos 2a$ .



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- In the right-angled triangle shown in Diagram 2,  $\tan b = \frac{1}{3}$ .

- (b) Find the exact value of  $\sin(2a + b)$ .

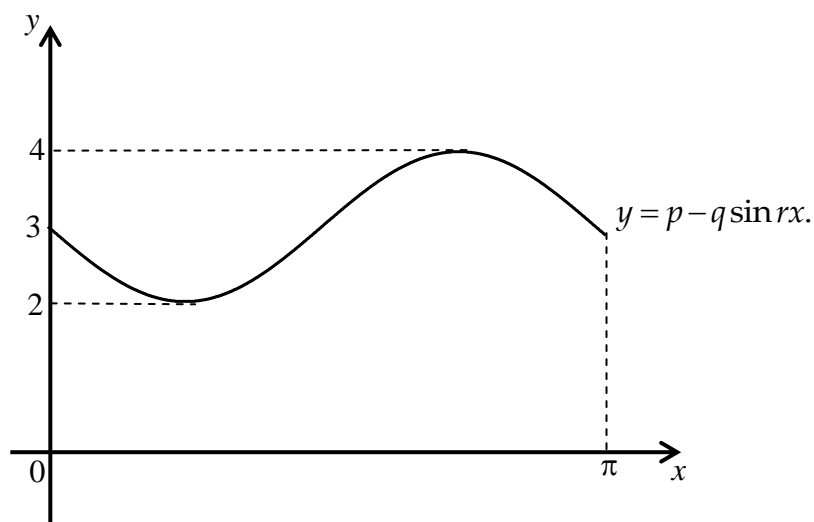


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5. Solve  $\log_9(x+2) = \frac{1}{2} + \log_9(x-5)$ ,  $x > 5$ .

5

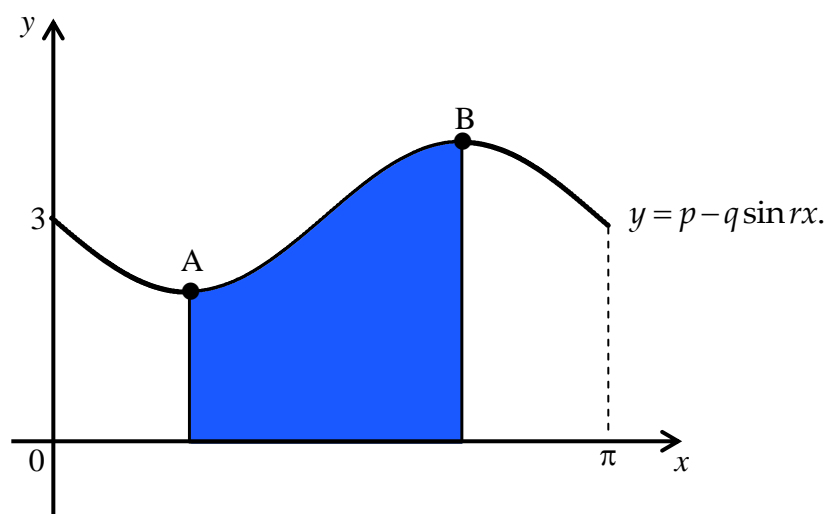
6. The diagram below shows part of the graph of  $y = p - q \sin rx$ .



(a) Write down the values of  $p$ ,  $q$  and  $r$ .

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The graph of  $y = p - q \sin rx$  has a minimum turning point at A and a maximum turning point at B.



(b) Calculate the shaded area in the diagram above.

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7. Cobalt-60 is used in food irradiation and decays to Nickel-60, which is a stable substance.

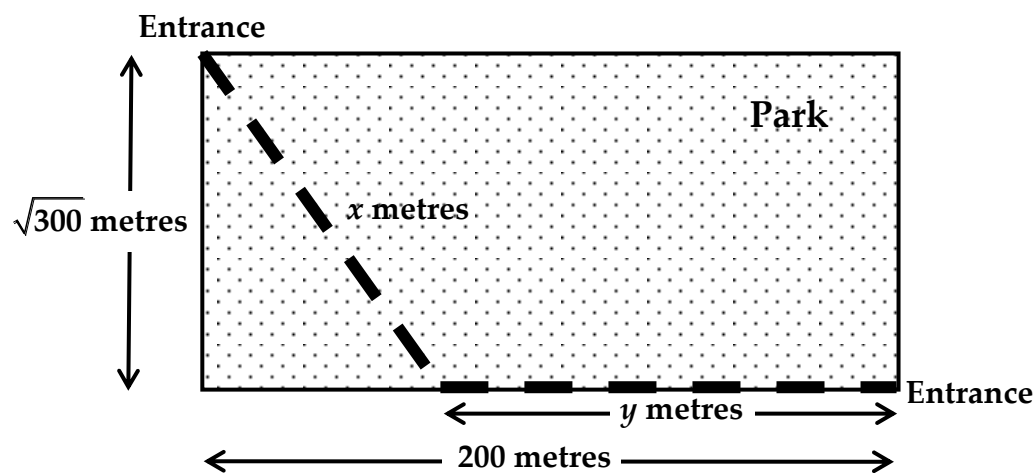
Cobalt-60 decays according to the law  $m_t = m_0 e^{kt}$ , where  $m_0$  is the initial mass of Cobalt-60 present and  $m_t$  is the mass remaining after  $t$  years.

The time taken for half the mass of Cobalt-60 to decay to Nickel-60 is 5 years.

- (a) Find the value of  $k$ , giving your answer correct to 3 significant figures. 3
- (b) In a sample of Cobalt-60 what percentage has decayed to Nickel-60 after 2 years? 3

8. A rectangular park measures 200 metres by  $\sqrt{300}$  metres.

A path connecting the two entrances, at opposite corners of the park, is to be laid through the park as shown.



The cost per metre of laying the path through the park is twice the cost, per metre, of laying the path along the perimeter.

- (a) Show that the total cost of laying this path can be modelled by

$$C(x) = 2x + 200 - \sqrt{x^2 - 300} \quad 3$$

- (b) Find the value of  $x$  which would minimise the cost of laying the path. 6

**End of Question Paper**