Mathematics Practice Paper H Paper 2 Assessing Units 1, 2 & 3

NATIONAL QUALIFICATIONS

Read carefully

1. Calculators may be used in this paper.

Time allowed - 1 hour 10 minutes

- 2. Full credit will be given only where the solution contains appropriate working.
- 3. Answers obtained from readings from scale drawings will not receive any credit.

FORMULAE LIST

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: $a \cdot b = |a| |b| \cos\theta$, where θ is the angle between a and b.

or

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

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

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$
$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$
$$\cos 2A = \cos^2 A - \sin^2 A$$
$$= 2\cos^2 A - 1$$
$$= 1 - 2\sin^2 A$$
$$\sin 2A = 2\sin A \cos A$$

Table of standard derivatives:

f(x)	f'(x)
sin <i>ax</i>	$a \cos ax$
$\cos ax$	$-a \sin ax$

Table of standard integrals:

$$f(x) \qquad \qquad f(x) \, dx$$

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$$\sin ax \qquad -\frac{1}{a}\cos ax + C$$
$$\cos ax \qquad \frac{1}{a}\sin ax + C$$

All questions should be attempted

1. Triangle ABC has vertices A(-5,5), B(11,-3) and C(7,9). Q(4,8) lies on AC and AM is a median of the triangle.



(a)	Given that A, P and B are collinear, find the value of k.	4
(b)	Hence find the equation of PQ.	2
(c)	Find the coordinates of R, the point of intersection between the line PQ and the median AM.	5

- 2. A scientist studying a large colony of bats in a cave has noticed that the fall in the population over a number of years has followed the recurrence relation $U_{n+1} = 0.75U_n + 200$, where *n* is the time in years and 200 is the average number of bats born each year during a concentrated breeding week.
 - (a) He estimates the colony size at present to be 2100 bats with the breeding week just over. Calculate the estimated bat population in 4 years time immediately before that years breeding week.
 3
 - (b) The scientist knows that if in the long term the colony drops, at any time, below 700 individuals it is in serious trouble and will probably be unable to sustain itself. Is this colony in danger of extinction?
 Explain your answer with words and appropriate working.

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3. The diagram below shows a rectangle and an isosceles triangle. The letter p is a constant. All lengths are in centimetres.



(a) Taking A_1 as the area of the rectangle, and A_2 as the area of the triangle, show clearly that the difference between the two areas can be written in the form

$$A_1 - A_2 = x^2 - (8p+4)x - 8p$$
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- (b) Given that $A_1 A_2 = 1 \text{ cm}^2$, establish the value of p, where p is >-1, for this equation to have **only one solution** for x.
- (c) Hence find x when p takes this value.

4. The diagram shows part of the graph of the curve with equation $y = \frac{x^2}{2} + \frac{8}{x}$, $x \neq 0$.

- (a) Find the coordinates of the stationary point A.
- (b) Also shown is the line with equation 2y = 7x - 8 which is a tangent to the curve at B.

Establish the coordinates of B.



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5. The diagram, which is not drawn to scale, shows part of a graph of $\log_3 p$ against $\log_3 V$. The straight line passes through the points (0,-2) and (4,0) as shown.



Find an equation connecting p and V.

6. The diagram, which is not drawn to scale, shows the cross-section of an iron bar. The units are in centimetres.

When placed in the coordinate diagram the curved section of the rod has as its equation $y = x^2 - 6x + 12$.



Calculate the shaded area in square centimetres.

7. The vector diagram below shows triangle POQ where T is the mid-point of PQ. Displacements \overrightarrow{OP} , \overrightarrow{OQ} and \overrightarrow{OT} are represented by vectors p, q and t respectively. Vectors p and q have magnitudes of 3 units and 6 units and $\angle POQ = 120^{\circ}$.



(a) Show clearly that vector *t* can be expressed in terms of vectors *p* and *q* as

$$t = \frac{1}{2}(p+q)$$
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(b) Hence, by considering the scalar product *p.t*, show that angle TOP is a right-angle.

[END OF QUESTION PAPER]