NATIONAL QUALIFICATIONS

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

Time allowed - 1 hour 10 minutes

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 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 $\sqrt{\left(g^2 + f^2 - c\right)}$.

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

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

Trigonometric formulae:

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

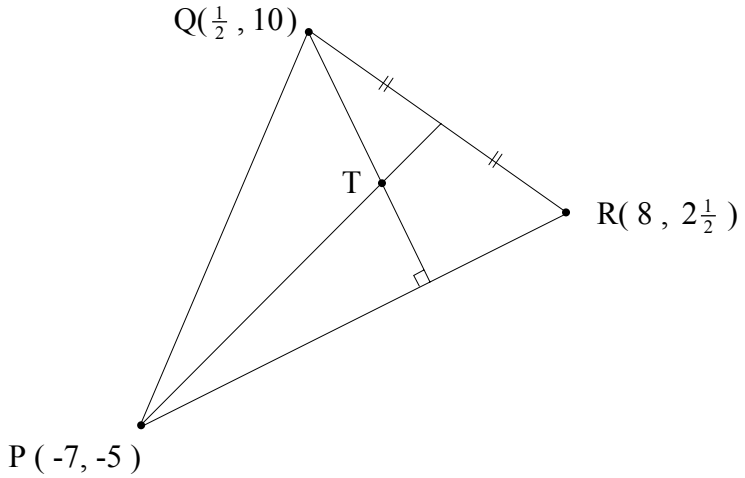
Table of standard derivatives:

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

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. In the diagram below triangle PQR has vertices as shown.



(a) Find the equation of the median from P to QR. **(3)**

(b) Find the equation of the altitude from Q to PR. **(4)**

(c) Hence find the coordinates of the point T where these two lines cross. **(3)**

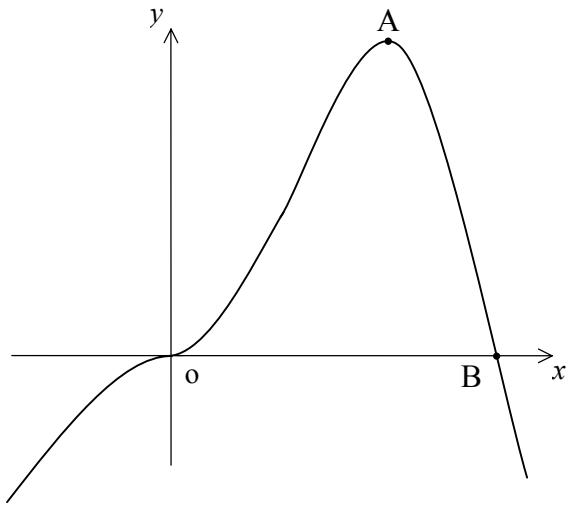
2. A circle, centre C, has as its equation $x^2 + y^2 - 4x - 2y - 15 = 0$.

(a) Show that the line with equation $y + 2x = 15$ is a tangent to this circle and state the coordinates of T, the point of tangency. **(5)**

(b) The point P(k, -5) lies on this line of tangency. Find k. **(1)**

(c) Establish the equation of the circle which passes through the points C, T and P. **(4)**

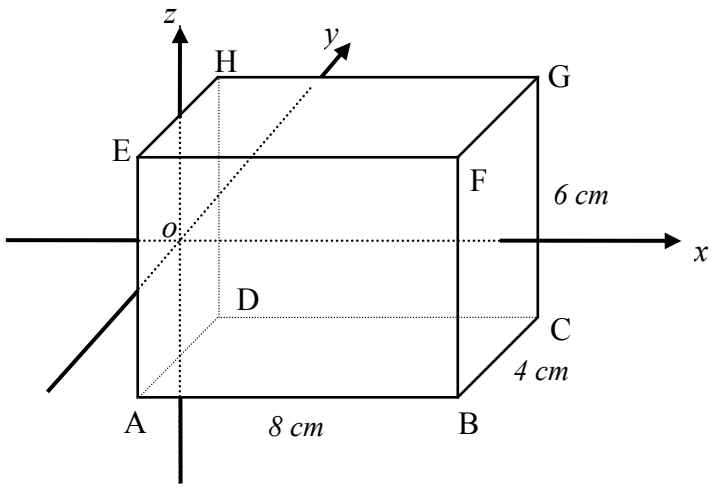
3. The curve shown below has as its equation $y = 8x^3 - 2x^4$.



(a) Find the coordinates of the points A and B . **(7)**

(b) Find the equation of the tangent to the curve at the point where $x = \frac{1}{2}$. **(5)**

4. A cuboid is placed relative to a set of coordinate axes as shown in the diagram.
The cuboid has dimensions *8 cm* by *4 cm* by *6 cm*.



The origin of the axes is at the intersection point of the diagonals ED and HA and *1 unit* represents *1 cm* .

(a) Find the coordinates of B , D and G. **(3)**

(b) Hence calculate the size of angle BDG. **(6)**

5. The main power source used to run the looms at the New Lanark cotton mills was water. Each mill had its own large water wheel which consisted of a central hub and an array of trough like blades. The wheels were driven by water being poured over the wheel thus filling the troughs and allowing the weight of the water to turn the wheel in a continuous process.
The diagram below shows the structure of one of these trough-blades.

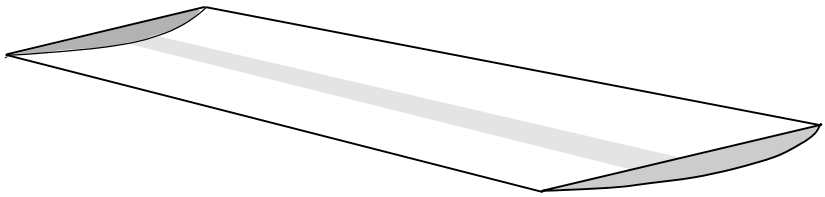
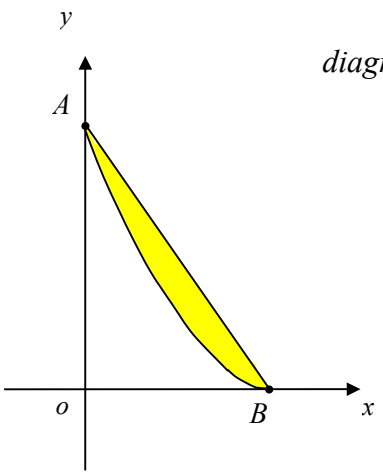


diagram 1

The shaded end-section consists of part of a curve and a straight line.
This end-section can be rotated and placed on a set of rectangular axes as shown in *diagram 2*.

The axes are not drawn to scale.

diagram 2



The curved section from A to B is part of the curve $y = x^3 - 2x^2 - 4x + 8$.

(a) State the coordinates of point A. **(1)**

(b) The line AB is a tangent to the curve at A.
Hence, or otherwise, show that this line has as its equation $y = 8 - 4x$. **(3)**

(c) Calculate, in **square units**, the shaded area in *diagram 2*. **(5)**

(d) Given that the scale in *diagram 2* is 1 unit = 10cm, write down the area of the end-section in **square centimetres**. **(1)**

(e) Hence calculate the volume of water this trough can hold when full, given that the trough has a length of 6 metres. **Express your answer in litres**. **(2)**

6. The luminosity, L units, emitting from a pulsing light source is given by the formula

$$L = \cos 36t^\circ + \sqrt{3}\sin 36t^\circ + 2 \ ,$$

where t is the time in seconds from switch on.

(a) Express L in the form $R\cos(36t - \alpha)^\circ + 2$, where $R > 0$ and $0 \le \alpha \le 360$. **(4)**

(b) If $L = 2 \cdot 5$ the light source has the same luminosity as the surrounding light.
When will this **first** occur during this ten second period ?
Give your answer correct to the nearest tenth of a second. **(3)**

END OF QUESTION PAPER