

Higher Still Mathematics

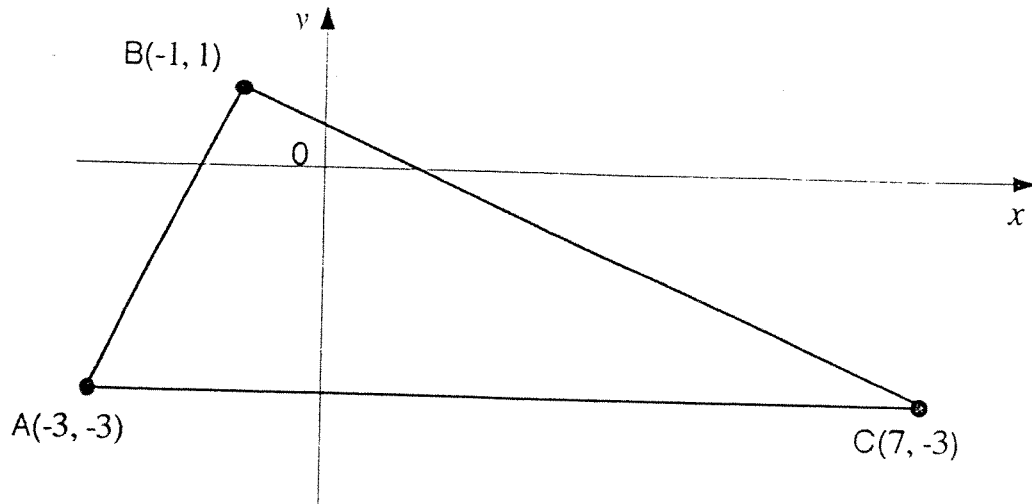
HIGHER GRADE
Paper II

November Prelim
60 minutes

All questions should be attempted

Marks

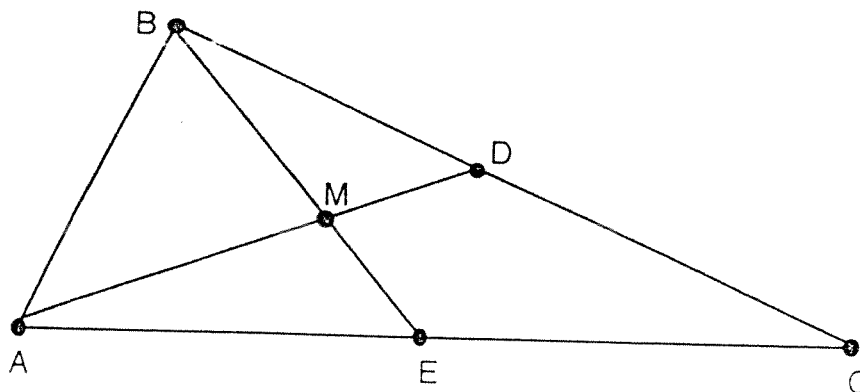
- 1 A triangle has vertices $A(-3, -3)$, $B(-1, 1)$ and $C(7, -3)$.



- (a) Show that the triangle ABC is right-angled at B.

(3)

- (b) The medians AD and BE intersect at M.



- (i) Find the equations of AD and BE.
(ii) Hence find the coordinates of M.

(5)

(3)

- 2 A function f is defined by $f(x) = 2x + 3$, where $x \in \mathbf{R}$ and a second function g is defined by $g(x) = \frac{x^2 + 25}{x^2 - 25}$, where $x \in \mathbf{R}$, $x \neq \pm 5$.

The function H is given by the formula $H(x) = g(f(x))$.
For which real values of x is the function H **undefined**?

(4)

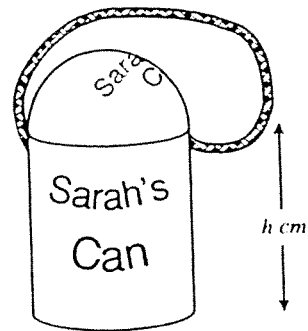
3. A doctor injects 50 units of a drug into a patient at 10.00 am.

The body dissipates $12\frac{1}{2}\%$ of the drug every hour.

- (a) What is the drug level in the patient's body at 2.00pm? (2)

- (b) The course of treatment involves repeat injections containing 50 units of drug every 4 hours over a long period. However, the drug is considered unsafe at levels of 125 units or more. Is the treatment safe for the patient? (4)

4. A child's drinking beaker is in the shape of a cylinder with a hemispherical lid and a circular flat base. The radius of the cylinder is r cm and the height is h cm. The volume of the cylinder is 400 cm^3 .



- (a) Find an expression for h in terms of r . (1)

- (b) Hence or otherwise, show that the surface area of plastic, $A(r)$, needed to make the beaker is given by:

$$A(r) = 3\pi r^2 + \frac{800}{r} \quad (2)$$

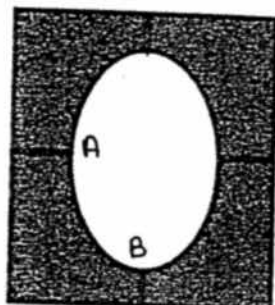
Note: The curved surface area of a hemisphere of radius r is $2\pi r^2$

- (c) Find the value of r which ensures that the surface area of plastic is minimised. (6)

[Turn over

- 5 The makers of "OLO", the square mint with the not-so-round hole, commissioned an advertising agency to prepare an illustration to the specification described in (i) to (iii) below.

The finished illustration will look like this.



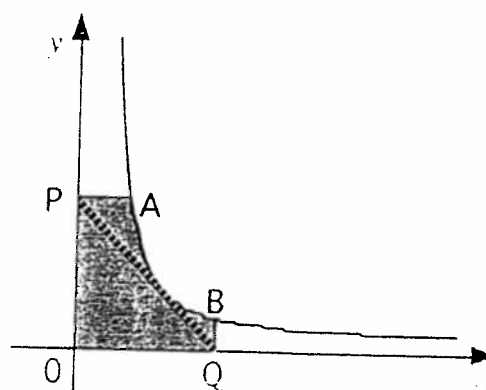
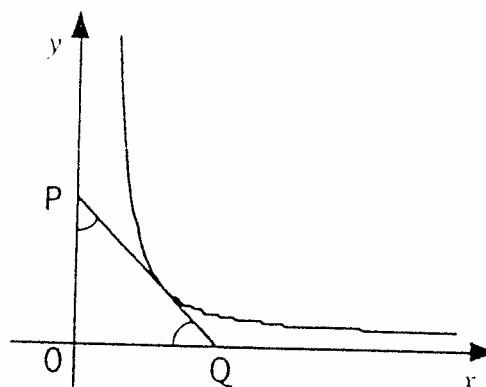
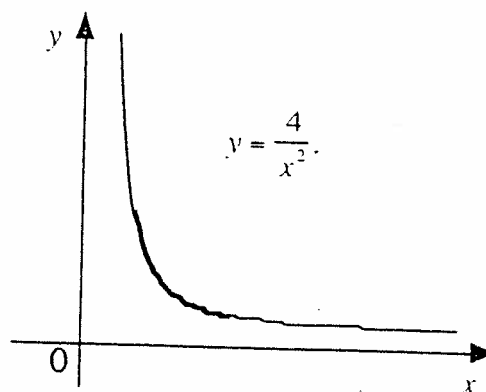
- (i) The curve AB in the illustration above is to be part of the curve with equation

$$y = \frac{4}{x^2}.$$

- (ii) A tangent to this curve, making equal angles with the x -axis and the y -axis, is to be drawn as shown opposite by PQ.

- (iii) Straight lines perpendicular to the axes are to be drawn from P and Q to the curve as shown.

The region OPABQ forms one quarter of the complete illustration.



- (a) State the gradient of PQ and hence find the point of contact of the tangent PQ with the curve.

(5)

- (b) Find the equation of PQ and the coordinates of A and B.

(4)

[END OF QUESTION PAPER]

