

**A Level Mathematics B (MEI)**

**H640/01** MEI Pure Mathematics and Mechanics

**Question Set 5**

1 Show that  $(x-2)$  is a factor of  $3x^3 - 8x^2 + 3x + 2$ . [3]

2 By considering a change of sign, show that the equation  $e^x - 5x^3 = 0$  has a root between 0 and 1. [2]

3 In this question you must show detailed reasoning.

Solve the equation  $\sec^2\theta + 2\tan\theta = 4$  for  $0^\circ \leq \theta < 360^\circ$ . [4]

4 Aleela and Baraka are saving to buy a car. Aleela saves £50 in the first month. She increases the amount she saves by £20 each month.

(a) Calculate how much she saves in two years. [2]

Baraka also saves £50 in the first month. The amount he saves each month is 12% more than the amount he saved in the previous month.

(b) Explain why the amounts Baraka saves each month form a geometric sequence. [1]

(c) Determine whether Baraka saves more in two years than Aleela. [3]

5 (a) Show that  $8\sin^2x\cos^2x$  can be written as  $1 - \cos 4x$ . [3]

(b) Hence find  $\int \sin^2x\cos^2x dx$ . [3]

6 Fig. 6 shows the graph of  $y = (k-x)\ln x$  where  $k$  is a constant ( $k > 1$ ).

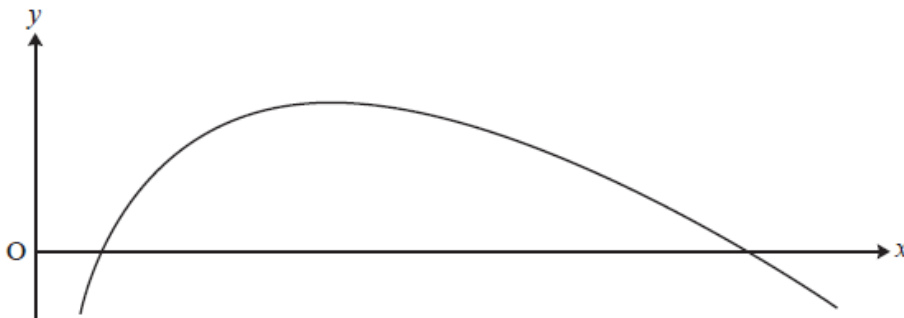


Fig. 6

Find, in terms of  $k$ , the area of the finite region between the curve and the  $x$ -axis.

[8]

7

Fig. 7 shows the circle  $(x-1)^2 + (y+1)^2 = 25$ , the line  $4y = 3x - 32$  and the tangent to the circle at the point A (5, 2). D is the point of intersection of the line  $4y = 3x - 32$  and the tangent at A.

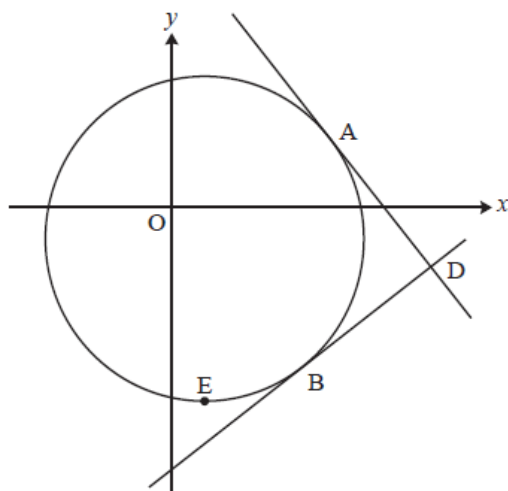


Fig. 7

- (a) Write down the coordinates of C, the centre of the circle. [1]
- (b) (i) Show that the line  $4y = 3x - 32$  is a tangent to the circle. [4]  
(ii) Find the coordinates of B, the point where the line  $4y = 3x - 32$  touches the circle. [1]
- (c) Prove that ADBC is a square. [3]
- (d) The point E is the lowest point on the circle. Find the area of the sector ECB. [5]

8

The function  $f(x)$  is defined by  $f(x) = \sqrt[3]{27 - 8x^3}$ . Jenny uses her scientific calculator to create a table of values for  $f(x)$  and  $f'(x)$ .

$x$	$f(x)$	$f'(x)$
0	3	0
0.25	2.9954	-0.056
0.5	2.9625	-0.228
0.75	2.8694	-0.547
1	2.6684	-1.124
1.25	2.2490	-1.977
1.5	0	ERROR

- (a) Use calculus to find an expression for  $f'(x)$  and hence explain why the calculator gives an error for  $f'(1.5)$ . [3]
- (b) Find the first three terms of the binomial expansion of  $f(x)$ . [3]
- (c) Jenny integrates the first three terms of the binomial expansion of  $f(x)$  to estimate the value of  $\int_0^1 \sqrt[3]{27 - 8x^3} dx$ . Explain why Jenny's method is valid in this case. (You do not need to evaluate Jenny's approximation.) [2]
- (d) Use the trapezium rule with 4 strips to obtain an estimate for  $\int_0^1 \sqrt[3]{27 - 8x^3} dx$ . [3]

The calculator gives 2.921 174 38 for  $\int_0^1 \sqrt[3]{27-8x^3} dx$ . The graph of  $y = f(x)$  is shown in Fig. 8

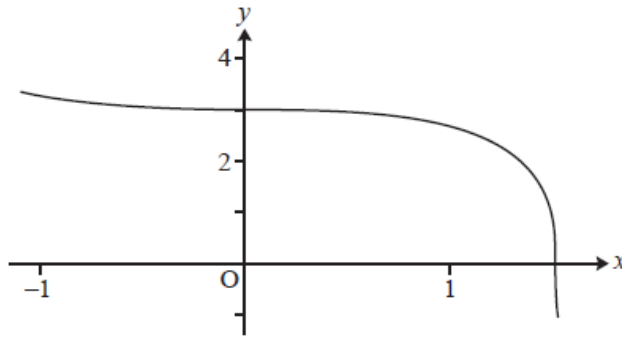


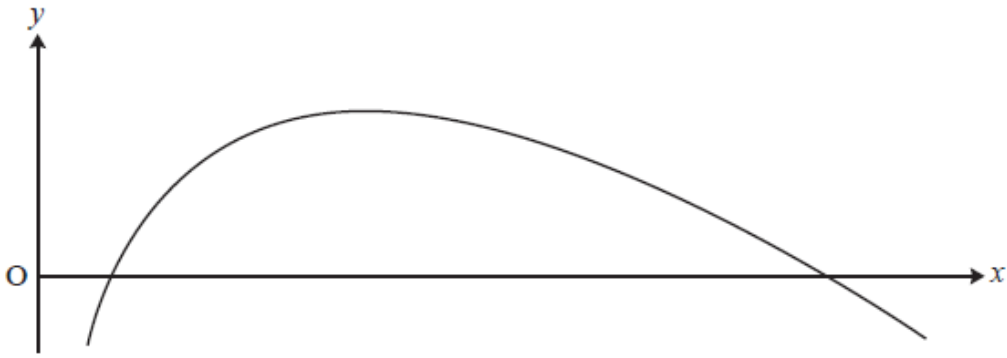
Fig. 8

- (e) Explain why the trapezium rule gives an underestimate. [1]

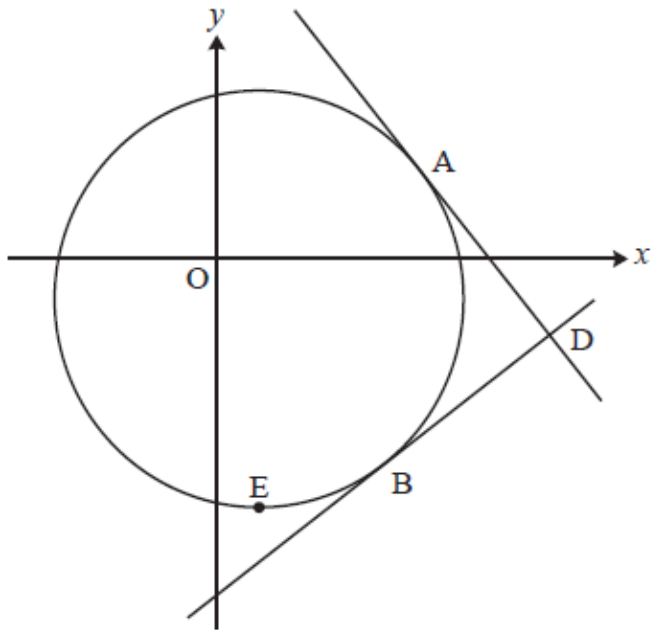
**Total Marks for Question Set 5: 55**

# Resource Materials

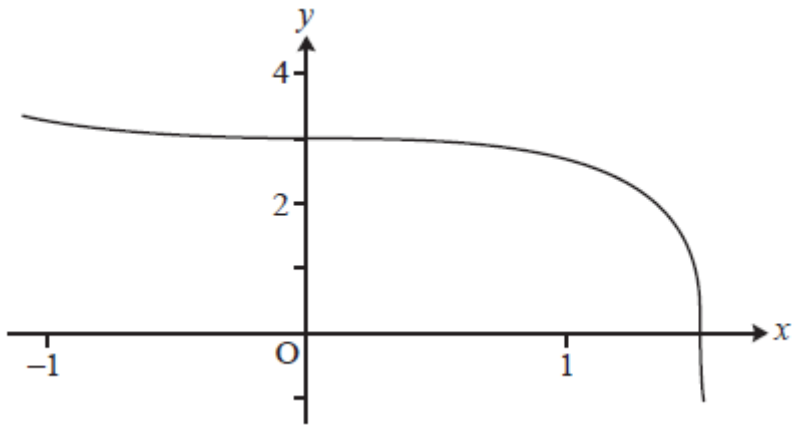
Question Set No: 5 Fig. 6



Question Set No: 5 Fig. 7



Question Set No: 5 Fig. 8



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