



ADDITIONAL MATHEMATICS

M²

Subject Number: M132/I

Monday, 7 September

Time Allowed: 2 hrs 30 mins
1.30-4.00 pm

PAPER I

(100 marks)

9

1. This paper contains 4 pages. Please check.
2. Answer **all** seven questions in Section A and any **two** questions from Section B.
3. Section A carries 60 marks and Section B carries 40 marks.
4. Graph paper and four-figure mathematical tables will be provided.
5. Calculators may be used.
6. All necessary working should be shown and any numerical expression being evaluated by calculator or mathematical tables must be clearly stated; otherwise marks for method may be lost.
7. The **final** answer to questions requiring the use of tables or calculators should normally be given to three significant figures.
8. The marks allocated to each question (or part of a question) are shown in brackets at the end of each question (or part of a question).

$$\begin{array}{r} 8010 - \\ 1010 \\ \hline 7000 \end{array} = \left(\frac{7}{8} - 1 \right)$$

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Turn Over

$$\begin{array}{r} 1 + \frac{4}{x} + \frac{4}{x^2} + \frac{4}{x^3} + \frac{4}{x^4} + \frac{4}{x^5} + \frac{4}{x^6} + \frac{4}{x^7} + \frac{4}{x^8} + \frac{4}{x^9} + \frac{4}{x^{10}} + \frac{4}{x^{11}} + \frac{4}{x^{12}} + \frac{4}{x^{13}} + \frac{4}{x^{14}} + \frac{4}{x^{15}} + \frac{4}{x^{16}} + \frac{4}{x^{17}} + \frac{4}{x^{18}} + \frac{4}{x^{19}} + \frac{4}{x^{20}} + \frac{4}{x^{21}} + \frac{4}{x^{22}} + \frac{4}{x^{23}} + \frac{4}{x^{24}} + \frac{4}{x^{25}} + \frac{4}{x^{26}} + \frac{4}{x^{27}} + \frac{4}{x^{28}} + \frac{4}{x^{29}} + \frac{4}{x^{30}} + \frac{4}{x^{31}} + \frac{4}{x^{32}} + \frac{4}{x^{33}} + \frac{4}{x^{34}} + \frac{4}{x^{35}} + \frac{4}{x^{36}} + \frac{4}{x^{37}} + \frac{4}{x^{38}} + \frac{4}{x^{39}} + \frac{4}{x^{40}} + \frac{4}{x^{41}} + \frac{4}{x^{42}} + \frac{4}{x^{43}} + \frac{4}{x^{44}} + \frac{4}{x^{45}} + \frac{4}{x^{46}} + \frac{4}{x^{47}} + \frac{4}{x^{48}} + \frac{4}{x^{49}} + \frac{4}{x^{50}} + \frac{4}{x^{51}} + \frac{4}{x^{52}} + \frac{4}{x^{53}} + \frac{4}{x^{54}} + \frac{4}{x^{55}} + \frac{4}{x^{56}} + \frac{4}{x^{57}} + \frac{4}{x^{58}} + \frac{4}{x^{59}} + \frac{4}{x^{60}} + \frac{4}{x^{61}} + \frac{4}{x^{62}} + \frac{4}{x^{63}} + \frac{4}{x^{64}} + \frac{4}{x^{65}} + \frac{4}{x^{66}} + \frac{4}{x^{67}} + \frac{4}{x^{68}} + \frac{4}{x^{69}} + \frac{4}{x^{70}} + \frac{4}{x^{71}} + \frac{4}{x^{72}} + \frac{4}{x^{73}} + \frac{4}{x^{74}} + \frac{4}{x^{75}} + \frac{4}{x^{76}} + \frac{4}{x^{77}} + \frac{4}{x^{78}} + \frac{4}{x^{79}} + \frac{4}{x^{80}} + \frac{4}{x^{81}} + \frac{4}{x^{82}} + \frac{4}{x^{83}} + \frac{4}{x^{84}} + \frac{4}{x^{85}} + \frac{4}{x^{86}} + \frac{4}{x^{87}} + \frac{4}{x^{88}} + \frac{4}{x^{89}} + \frac{4}{x^{90}} + \frac{4}{x^{91}} + \frac{4}{x^{92}} + \frac{4}{x^{93}} + \frac{4}{x^{94}} + \frac{4}{x^{95}} + \frac{4}{x^{96}} + \frac{4}{x^{97}} + \frac{4}{x^{98}} + \frac{4}{x^{99}} + \frac{4}{x^{100}} \end{array}$$



1. Functions f and g are defined for real values of x by $f: x \rightarrow 3x + 2$ and $g: x \rightarrow mx + 3$

a. Find

(i) $g(-3)$

(2 marks)

(ii) the value of m for which $fg(x) = gf(x)$

(4 marks)

- b. When m takes this value, for what values of x does $f(x) = g(x-1)$

(3 marks)

2. Find the range of values of x for which

a. $2x^2 + 5x - 12 > 0$

$$\frac{6-1}{24} : \frac{2}{3}$$

(4 marks)

b. $1+x < \frac{6}{x}$

$$\frac{144-1}{24} \quad \frac{143}{24}$$

(7 marks)

3. Use binomial theorem to expand $(1 - \frac{x}{2})^6$, hence evaluate $(1.04)^6$ correct to 4 decimal places. (Show all your working).

(5 marks)

Solve the following equations for x for $0^\circ \leq x \leq 360^\circ$.

a. $\cos 2x + 3 \sin x = 2$

(5 marks)

b. $2 \tan^2 x + \sec x = 1$

(5 marks)

A farmer has 200 m of fencing wire with which to form a rectangular enclosure. What dimensions will give him the maximum possible enclosed area?

(4 marks)

6. Differentiate the following with respect to x

a. $(1 - 2x^3)^5$ ✓

b. $\sin x \cos 2x$

c. $x^3 \operatorname{cosec} 2x$

(3 marks)

(3 marks)

(4 marks)

7. Evaluate:

a. $\int_0^{\frac{\pi}{2}} (1 + \sin x)^2 dx$

b. $\int_1^2 (3 + \frac{1}{t^4}) dt$

(6 marks)

(5 marks)
Continued...

Section B (40 marks)

Answer any two questions from this section.

8. a. Find the turning points of the curve $y = 2x^3 + 3x^2 - 12x + 7$ and classify them.

(8 marks)

- b. Find the equation of the normal to the curve $y = x^2(x - 3)$ at the point where it cuts the x -axis

(9 marks)

- c. Sketch the curve $y = \frac{-2}{x+1}$

(3 marks)

9. $f: x \rightarrow \sin \frac{3x}{2}$ and $g: x \rightarrow -2 \cos x$.

- a. Find $f(-\pi)$

(2 marks)

- b. Taking a scale of 2 cm to represent 20° on the horizontal axis and 2 cm to represent 1 unit on the vertical axis, draw the graphs of $f(x)$ and $g(x)$ on the same axis for x $0^\circ \leq x \leq 180^\circ$.

(12 marks)

- c. Use your graph to:

(i) determine the values of x for which $f(x) > 0$

(ii) solve $f(x) = g(x)$

(iii) find the values of x for which $g(x) - \frac{3}{2} < 0$

(6 marks)

10. a. A law of the form $y = ax^n$ connects the variables x and y from a set of reading. Log y is then plotted against log x to give a line of best fit of gradient 4 and intercept 2.3. Deduce the approximate values of a and n .

(5 marks)

b. If $\cos 2x = 2 \cos^2 x - 1$ show that $\cos \frac{x}{2} = \pm \sqrt{\frac{1 + \cos x}{2}}$

(4 marks)

- c. By expressing $\sin^3 x$ in terms of $\sin x$ and $\sin 3x$, show that

$$\int \sin^3 x \, dx = \frac{1}{3} \cos^3 x - \cos x + c$$

(You may use the fact that $\cos 3x = 4 \cos^3 x - 3 \cos x$)

(11 marks)

Continued/...

11. a. A straight line through the origin cuts the curve $y = 4 - x^2$ at the point where $x = 3$.
- Find the equation of the line.
 - Sketch the curve and the line.
 - Calculate the area bounded by the curve and the straight line.

(15 marks)

b.

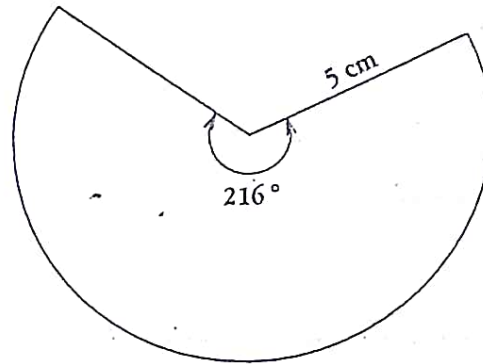


Figure 1

Figure 1 is a sector of a circle of radius 5 cm and has an angle of 216° . If the sector is bent to form a cone, find:

- the radius of the base of the cone.
- the vertical angle of the cone.

(5 marks)

END OF QUESTION PAPER

NB: This paper contains 4 pages.