Section D (Mathematics 1)

Answer all the questions.

Answer these questions in a separate answer book, showing clearly the section chosen.

D1. Differentiate with respect to \( x \):

\[
y = \frac{\cos x}{1 - \sin x}, \quad x \neq (2n + \frac{1}{2})\pi.
\]

Simplify your answer as far as possible. 3

D2. Use Gaussian elimination to solve

\[
\begin{align*}
x + y + z &= 3 \\
2x - y + z &= 0 \\
x + y + \frac{1}{2}x &= 1.
\end{align*}
\]

4

D3. Express in partial fractions

\[
\frac{3x^2 + 2}{(x + 2)^2},
\]

where \( x \neq -2 \). 5

D4. Expand \((3x - 2y)^4\). Hence find the term in the expansion of \((3x - \frac{2}{x})^4\) which is independent of \( x \). 3

D5. (a) Integrate \( \frac{2e^x}{1 + e^x} \) with respect to \( x \).

(b) Use the substitution \( u = 1 - \sin x \) to evaluate \( \int_0^{\pi/2} \frac{\cos x}{(1 - \sin x)^{3/2}} dx \). 2

D6. The function \( f \) is defined by \( f(x) = \frac{x^3 - 8x^2 + 16x + 4}{x^3 - 8x + 16} \), for \( x \neq 4 \).

(a) Show that \( y = f(x) \) can be written in the form

\[
ax + \frac{b}{(x - b)^2},
\]

stating the values of \( a \) and \( b \).

Hence write down equations for the asymptotes. 2

(b) Find the coordinates of the turning point of \( y = f(x) \) and justify its nature. 4

(c) Given that the only root of \( f(x) = 0 \) lies between \(-1\) and \(0\), sketch the graph of \( y = f(x) \) showing all its main features. 1

[END OF SECTION D]

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