SAMPEL PERCUMA

Trial STPM 2018 Mathematics M Semester 1

Set penuh: Kertas Percubaan STPM

Sem 1 · Mathematics M

Sampel ini: 7 muka surat. Set penuh ada:

- 3 fail PDF
- Semester 1: kertas percubaan (trial) negeri, subjek yang dipilih + skema
- Blueprint 30 hari Semester 1 (setiap subjek)
- Semester 3: percubaan 2024, 10 subjek, banyak negeri, soalan + skema dalam satu fail

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Sampel bermula di muka surat sebelah

Section A
[45 marks]

*Answer **all** questions in this section.*

1. Functions *m* and *n* are defined by

$$m(x) = \ln(3x + 2)\,, \qquad x > -\frac{2}{3}$$

$$n(x) = \frac{e^x - 2}{3}, x \in R$$

(a) Show that *m* is a one-to-one function. [2 marks]

(b) Find $(m \circ n)(x)$ and $(n \circ m)(x)$ and hence, state the relationship between the functions *m* and *n*. [5 marks]

(b) On the same axes, sketch the graphs of the functions *m* and *n*. [3 marks]

2. The sum of the first *n* terms of a geometric sequence is given by

$$S_n = 15(1 - 3^{-n})$$

.

Find

(a) The n^{th} term, [2 marks]

(b) The common ratio, [3 marks]

(c) The smallest value of n such that $S_\infty - S_n < 0.01$. [4 marks]

3. If $\boldsymbol{P} = \begin{pmatrix} -1 & 2 & -3 \\ 4 & 1 & 5 \\ 2 & -1 & 6 \end{pmatrix}$ and $\boldsymbol{Q} = \begin{pmatrix} -11 & 9 & -13 \\ 14 & 0 & 7 \\ 6 & -3 & 9 \end{pmatrix}$. Find **PQ** and hence determine the inverse matrix of **P**. [3 marks]

Hence, solve the following system of linear equations:

$$x - 2y + 3z = -4$$
$$4x + y + 5z = -5$$
$$2x - y + 6z = -2$$

[3 marks]

4. Given that $ln\sqrt{xy} = e^{x+y}$, find

   (a) $\frac{dy}{dx}$ in terms of *x* and *y* [4 marks]

   (b) the value of $\frac{dy}{dx}$ at the point (1, -1) [2 marks]

5. Let $I = \int_1^4 \frac{1}{x(4-\sqrt{x})} dx$.

   Use the substitution $u = \sqrt{x}$ to show that $I = \int_1^2 \frac{2}{u(4-u)} du$.

   Hence, find the exact value of *I*. [8 marks]

6. Use the substitution $y = u - 2x$ to find the general solution of the differential equation

$$\frac{dy}{dx} = -\frac{8x + 4y + 1}{4x + 2y + 1}$$

[6 marks]

Section B

[15 marks]

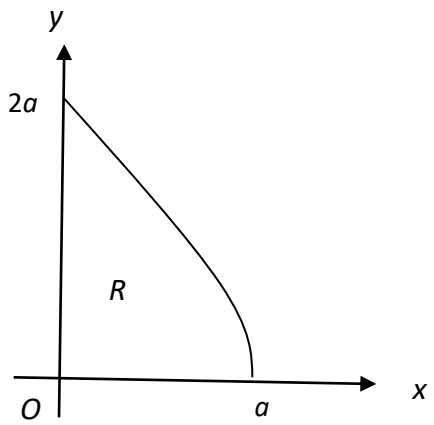
*Answer **one** question only in this section.*

7. (a) The curve $f(x) = 3x^4 + ax^3 + bx^2 + c$ passes through the point (1, -3), cuts the y-axis at $y = 10$ and has stationary point at $x = -1$. Find the values of a, b and c. [5 marks]

(b) Find the coordinates of all the turning points on the curve and determine their nature. [5 marks]

(c) Sketch the graph of $f(x)$. [3 marks]

(d) Find the set of values of k for which the equation $f(x) - k = 0$ has exactly two distinct roots. [2 marks]



8. The diagram shows the region R, which is bounded by the axes and the part of the curve $y^2 = 4a(a - x)$ lying in the first quadrant. Find, in terms of a,

   (a) the area of R, [4 marks]

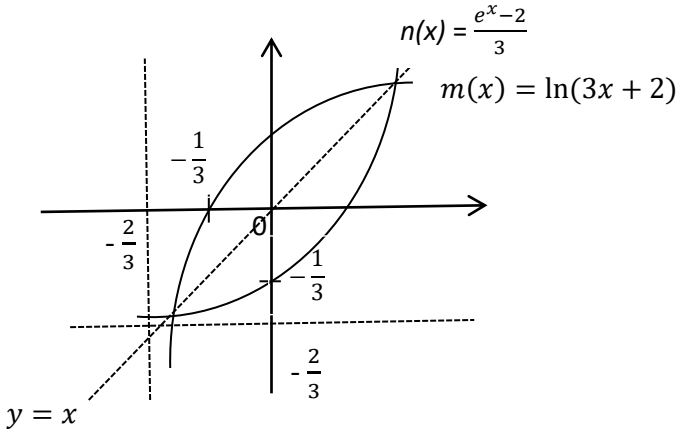
   (b) the volume, V_x , of the solid formed when R is rotated completely about the x-axis. [3 marks]

   (c) the volume of the solid formed when R is rotated completely about the y-axis is V_y . Show that [5 marks]

$$V_y = \frac{8}{15}V_x$$

   (d) The region S, lying in the first quadrant, is bounded by the curve $y^2 = 4a(a - x)$ and the lines $x = a$ and $y = 2a$. Find the value of a if the volume of the solid formed when S is rotated completely about the y-axis is $\frac{126}{5}\pi\ unit^3$. [3 marks]

END OF QUESTION PAPER

No.	Solution	Marks
1	(a) Let $m(x_1) = m(x_2)$ $\ln(3x_1 + 2) = \ln(3x_2 + 2)$ $3x_1 + 2 = 3x_2 + 2$ $3x_1 = 3x_2$ $x_1 = x_2$ $\therefore m$ is a one-to-one function.	M1 A1
	(b) $(m \circ n)(x) = m\left(\frac{e^x-2}{3}\right)$ $= \ln\left[3\left(\frac{e^x-2}{3}\right) + 2\right]$ $= \ln(e^x - 2 + 2) = \ln e^x = x \ln e$ $= x$ $(n \circ m)(x) = n[\ln(3x + 2)]$ $= \frac{e^{\ln(3x+2)}-2}{3}$ $= \frac{3x + 2 - 2}{3}$ $= x$ $\therefore m$ is the inverse of n and vice versa.	M1 A1 M1 A1 A1
	c)  	D1 (graph m) D1 (graph n) D1 (All correct) y = x intercepts asymptotes (10 marks)

2	(a) $T_n = S_n - S_{n-1}$ $= 15(1-3^{-n}) - 15\left(1-3^{-(n-1)}\right)$ $= 15 - 15\cdot 3^{-n} - 15 + 15\cdot 3^{1-n}$ $= -15\cdot 3^{-n} + 15\cdot 3^{1-n}$ $= -15\cdot 3^{-n} + 45\cdot 3^{-n}$ $= 3^{-n}(-15+45)$ $= 30\cdot 3^{-n}$	M1 A1
	(b) $T_1 = a = 30\cdot 3^{-1}$ $= \frac{30}{3}$ =10 $T_2 = 30\cdot 3^{-2}$ $= \frac{30}{3^2} = \frac{30}{9}$ $= \frac{10}{3}$ The common ratio, $r = \frac{T_2}{T_1} = \frac{\frac{10}{3}}{10} = \frac{1}{3}$	B1 $(T_1 or T_2)$ M1A1
	(c) $S_\infty - S_n < 0.01$ $\frac{10}{1-\frac{1}{3}} - 15(1-3^{-n}) < 0.01$ $15 - 15 + 15(3^{-n}) < 0.01$ $15(3^{-n}) < 0.01$ $3^{-n} < \frac{0.01}{15}$ $\log 3^{-n} < \log\left(\frac{0.01}{15}\right)$ $-n\log 3 < \log\left(\frac{0.01}{15}\right)$ $n > \frac{\log\left(\frac{0.01}{15}\right)}{-\log 3}$ > 6.657 $\therefore n = 7$	M1A1 M1 A1 (9 marks)

SECTION B

No	Solution	Marks
7(a)	$y = 3x^4 + ax^3 + bx^2 + c$ $\frac{dy}{dx} = 12x^3 + 3ax^2 + 2bx$ At (0, 10), c = 10 When x = -1, -12 + 3a -2b = 0 3a – 2b = 12……(1) At the point (1, -3), -3 = 3 + a + b + 10 a + b = -16……(2) a = -4 , b = -12	M1 M1 $(\frac{dy}{dx} = 0)$ A1 (eqn 1 or 2) M1 (Solved) A1 (a,b,c all corrects)
(b)	$y = 3x^4 - 4x^3 - 12x^2 + 10$ $\frac{dy}{dx} = 12x^3 - 12x^2 - 24x$ When $\frac{dy}{dx} = 0$, $x(x^2 - x - 2) = 0$ $x(x + 1)(x - 2) = 0$ $x = 0, -1$ or 2 y = 10, 5 or -22 The stationary points are (0,10) , (-1, 5) and (2, -22). $\frac{d^2y}{dx^2} = 36x^2 - 24x - 24$ When x= 0, $\frac{d^2y}{dx^2} = -24, < 0$ $\therefore (0,10) is\ a\ maximum\ point.$ When x = -1, $\frac{d^2y}{dx^2} = 36, > 0$ $\therefore (-1,5)$ is a minimum point. When x = 2, $\frac{d^2y}{dx^2} = 120, > 0$ $\therefore (2,-22)$ is a minimum point.	M1 A1 M1 M1 (test for either one) A1 (all correct)

TAMAT SAMPEL

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