SAMPEL PERCUMA

Trial STPM 2020 Mathematics T Semester 1 Johor (Muar)

Set penuh: Kertas Percubaan STPM

Sem 1 · Mathematics T

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

2020-1-JOH-MUAR

Section A [45 *marks*]*Answer* **all** *questions in this section*.

1. Given that $f : x \to 4x^2 + 6x - 6$, find the exact coordinates of the minimum point of $f(x)$. Hence, factorise $f(x)$ into exact linear factor. [6 *marks*]

2. An arithmetic progression has first term a and common difference 10. The sum of the first n terms of the progression is 10000. Express a in terms of n, and show that the n^{th} term of the progression is

$$\frac{10000}{n} + 5(n-1).$$

Given that the n^{th} term is less than 500, show that $n^2 - 101n + 2000 < 0$, and hence, find the largest possible value of n. [9 *marks*]

3. The variables x, y and z satisfy the system of linear equations

$$\begin{aligned} 2x - 5y + 5z &= -7 \\ x - 2y + 3z &= -1 \\ -x + 3y &= 10 \end{aligned}$$

Write a matrix equation for the system of linear equations. By using Gaussian elimination, find the variables x, y and z. [7 *marks*]

4. An ellipse has vertices at (5, -1) and (-3, -1) and $c = 3$. Find the equation of this ellipse and sketch the ellipse.

[6 *marks*]

5. Express $1 + i\sqrt{3}$ in the form of $r(\cos\theta + i\sin\theta)$. Use De Moivre's Theorem or otherwise, show that $\left(1 + i\sqrt{3}\right)^8 + \left(1 - i\sqrt{3}\right)^8 = -2^8$.

Hence, find z^4 in polar form given $z^4 + \left(1 + i\sqrt{3}\right)^8 i + \left(1 - i\sqrt{3}\right)^8 i = 0$. [7 *marks*]

6. The points A, B, C have position vectors $\mathbf{i} + 2\mathbf{j} + 2\mathbf{k}$, $2\mathbf{i} + \mathbf{j} + 2\mathbf{k}$ and $2\mathbf{i} + 2\mathbf{j} + \mathbf{k}$ respectively, with respect to the origin O.

(a) Find the vector equation of the line BC. [2 *marks*]

(b) Find the cartesian equation of the plane S that passes the point A and perpendicular to OA.

[2 *marks*]

(c) Show that *BC* is parallel to the plane *S*. [2 *marks*]

(d) A circle with centre *O* passes through the points *A* and *B*. Find, in three significant figures, the length of the minor arc *AB*. [4 *marks*]

Section B [15 *marks*]

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

7. By using the formula for $\cos(A+B)$, show that $\cos^2 x = \frac{1}{2}(1+\cos 2x)$, and find a similar expression for $\sin^2 x$. [3 *marks*]

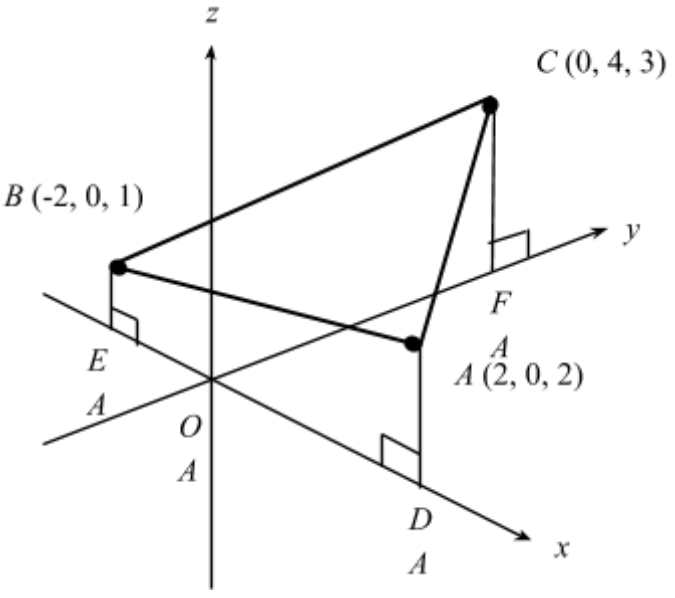
Given that $f(x) = 10\cos^2 x + 2\sin^2 x + 6\sin x \cos x$, express $f(x)$ in the form $Q + R\sin(2x+\alpha)$ where Q, R are constants and $\tan\alpha = S$. [7 *marks*]

Hence,

(a) find the greatest and least values of $f(x)$, [2 *marks*]

(b) sketch the graph of $y = f(x)$ for $0 \le x \le 2\pi$. [3 *marks*]

8. As part of sculpture, an artist erects a flat triangular sheet *ABC* in his garden. The vertices are attached to vertical poles *DA*, *EB* and *FC*. The coordinate axes O_x and O_y are horizontal, and O_z is vertical. The coordinates of the triangle are *A*(2, 0, 2), *B*(-2, 0, 1) and C(0, 4, 3), with units in metres.



(a) Find the length of the side AC. [2 *marks*]

(b) Find the scalar product $AB \cdot AC$, and the angle BAC. [4 *marks*]

(c) Show that $2\mathbf{i}+3\mathbf{j}-8\mathbf{k}$ is perpendicular to the lines AB and AC. Hence, find the Cartesian equation of the plane ABC. [4 *marks*]

(d) The artist decides to erect another vertical pole GH based at the point $G(1, 1, 0)$. Calculate the height of the pole if H is to lie in the plane ABC. [5 *marks*]

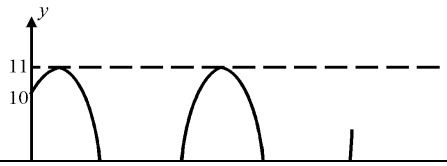
2020-1-JOH-MUAR-MARKING SCHEME

1	$f : x \to 4x^2 + 6x - 6$ $f(x) = 4\left[x^2 + \frac{6}{4}x - \frac{6}{4}\right]$ $= 4\left[x^2 + \frac{3}{2}x + \left(\frac{3}{4}\right)^2 - \left(\frac{3}{4}\right)^2 - \frac{3}{2}\right]$ $= 4\left[\left(x + \frac{3}{4}\right)^2 - \frac{33}{16}\right]$ $= 4\left(x + \frac{3}{4}\right)^2 - \frac{33}{4}$ Minimum point = $\left(-\frac{3}{4}, -\frac{33}{4}\right)$ $f(x) = 4\left(x + \frac{3}{4}\right)^2 - \frac{33}{4} = \left[2\left(x + \frac{3}{4}\right)\right]^2 - \left(\frac{\sqrt{33}}{2}\right)^2$ $= \left[2\left(x + \frac{3}{4}\right) + \frac{\sqrt{33}}{2}\right]\left[2\left(x + \frac{3}{4}\right) - \frac{\sqrt{33}}{2}\right]$ $= \left(2x + \frac{3}{2} + \frac{\sqrt{33}}{2}\right)\left(2x + \frac{3}{2} - \frac{\sqrt{33}}{2}\right)$ $= \left(2x + \frac{3+\sqrt{33}}{2}\right)\left(2x + \frac{3-\sqrt{33}}{2}\right)$	B1 M1 A1 A1 M1 A1	6
2	$S_n = \frac{n}{2}\left[2a + (n-1)d\right] = 10000$ $2a + 10(n-1) = \frac{20000}{n}$ $2a = \frac{20000}{n} - 10(n-1)$ $a = \frac{10000}{n} - 5(n-1)$ $T_n = a + (n-1)d = \frac{10000}{n} - 5(n-1) + 10(n-1)$ $= \frac{10000}{n} + 5(n-1)$	B1 M1 A1 M1 A1	

	Given $T_n < 500$, $\therefore \frac{10000}{n} + 5(n-1) < 500$ $\frac{2000}{n} + (n-1) - 100 < 0$ $2000 + n^2 - 101n < 0$ If $n^2 - 101n + 2000 = 0$, $n = \frac{101 \pm \sqrt{101^2 - 4(2000)}}{2}$ $= \frac{1}{2}\left(101 \pm \sqrt{2201}\right)$ $= 73.96$ or 27.04 $\therefore 27.04 < n < 73.96$ Largest possible $n = 73$	B1 A1 M1 A1	9
3	$\begin{pmatrix} 2 & -5 & 5 \\ 1 & -2 & 3 \\ -1 & 3 & 0 \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} -7 \\ -1 \\ 10 \end{pmatrix}$	B1 B1 M1 for attempt M1 M1 M1	

	(shape) [all correct with $F_1(4, -1)$ and $F_2(-2, -1)$]	D1 D1	6
5	$z = 1 + i\sqrt{3}, \quad r = \lvert z \rvert = \sqrt{1^2 + \left(\sqrt{3}\right)^2} = 2$ $\tan\theta = \sqrt{3} \Rightarrow \quad \theta = \frac{\pi}{3}, \ \therefore \arg z = \frac{\pi}{3}\text{rad}$ $z = 1 + i\sqrt{3} = 2\left(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right)$ $\left(1+i\sqrt{3}\right)^8 = 2^8\left[\cos\frac{\pi}{3} + i\sin\frac{\pi}{3}\right]^8 = 2^8\left[\cos\left(8\times\frac{\pi}{3}\right) + i\sin\left(8\times\frac{\pi}{3}\right)\right]$ $= 2^8\left[\cos 480° + i\sin 480°\right]$ $= 2^8\left[\cos 120° + i\sin 120°\right]$ $= 2^8\left[-\cos 60° + i\sin 60°\right]$ $= 2^8\left[-\frac{1}{2} + \frac{\sqrt{3}}{2}i\right]$ $\left(1-i\sqrt{3}\right)^8 = 2^8\left[\cos(-480°) + i\sin(-480°)\right] = 2^8\left[\cos(-120°) + i\sin(-120°)\right]$ $= 2^8\left[-\cos 60° - i\sin 60°\right]$ $= 2^8\left[-\frac{1}{2} - \frac{\sqrt{3}}{2}i\right]$ $\left(1+i\sqrt{3}\right)^8 + \left(1-i\sqrt{3}\right)^8 = 2^8\left[-\frac{1}{2} + \frac{\sqrt{3}}{2}i\right] + 2^8\left[-\frac{1}{2} - \frac{\sqrt{3}}{2}i\right] = 2^8\left[-\frac{1}{2} + \frac{\sqrt{3}}{2}i + -\frac{1}{2} - \frac{\sqrt{3}}{2}i\right]$ $= 2^8(-1) = -2^8$	M1 A1 M1 A1 M1 A1 A1	

7	$\cos(A+B)=\cos A\cos B-\sin A\sin B$ $\cos(x+x)=\cos 2x=\cos^2 x-\sin^2 x$ $\cos 2x=\cos^2 x-(1-\cos^2 x)=2\cos^2 x-1$ $\therefore\ 2\cos^2 x=1+\cos 2x$ $\cos^2 x=\frac{1}{2}(1+\cos 2x)$ $\cos 2x=(1-\sin^2 x)-\sin^2 x=1-2\sin^2 x$ $\sin^2 x=\frac{1}{2}(1-\cos 2x)$ $f(x)=10\cos^2 x+2\sin^2 x+6\sin x\cos x$ $=10\left(\frac{1}{2}(\cos 2x+1)\right)+2\left(\frac{1}{2}(1-\cos 2x)\right)+6\sin x\cos x$ $=5\cos 2x+5+1-\cos 2x+3(2\sin x\cos x)$ $=4\cos 2x+6+3\sin 2x$ $=6+4\cos 2x+3\sin 2x$	B1 A1 B1 M1 A1	

7	$f(x)=6+4\cos 2x+3\sin 2x=6+R\sin(2x+\alpha)$ $\Rightarrow 4\cos 2x+3\sin 2x=R\sin(2x+\alpha)=R(\sin 2x\cos\alpha+\cos 2x\sin\alpha)$ $4=R\sin\alpha \quad 3=R\cos\alpha$ $R=\sqrt{3^2+4^2}=5$ $\frac{\sin\alpha}{\cos\alpha}=\frac{4}{3}\Rightarrow\tan\alpha=\frac{4}{3}$ $\therefore f(x)=6+4\cos 2x+3\sin 2x=6+5\sin(2x+\alpha),\ \tan\alpha=\frac{4}{3}$ (a) greatest value of $f(x)$ = 6 + 5 = 11 when $\sin(2x+\alpha)=1$ Least value of $f(x)$ = 6 - 5 = 1 when $\sin(2x+\alpha)=-1$ (b)  (shape)	B1 A1(both) B1 B1 A1 A1 A1 D1	

TAMAT SAMPEL

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