SAMPEL PERCUMA

Trial STPM 2022 Mathematics T Semester 1 Kelantan

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

Section A [45 marks]

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

1. Express $5\cos x + 2\sin x$ in the form $r\cos(x - \alpha)$, where $r > 0$ and $0 < \alpha < 90°$.

   Hence, find the angles x in $0 < x < 360°$, such that $5\cos x + 2\sin x = 4$,

   giving your answers correct to the nearest 0.1°. [8 *marks*]

2. The sum of the first n terms of a sequence $u_1, u_2, u_3, \ldots$ is given by $S_n = 20\,(1 - 2^{-n})$.

   (a) Show that an explicit formula for the nth term, u_n, is $10\,(2^{1-n})$ [3 marks]

   (b) Hence,

   (i) find a recursive formula for u_n. [3 marks]

   (ii) show that the sequence is a geometric sequence and find the sum of the infinite series. [3 marks]

3. Matrix **A** is given by $\mathbf{A} = \begin{pmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 2 \end{pmatrix}$. Find m and n for which $\mathbf{A}^2 + m\mathbf{A} + n\mathbf{I} = \mathbf{0}$,

   where **I** and **0** are 3 X 3 identity and zero matrix respectively.

   Hence, deduce $\mathbf{A}^3$ and $\mathbf{A}^{-1}$. [8 marks]

4. Find the cube root of $w = -\sqrt{3} + i$, giving the roots in Cartesian form. [7 marks]

5. The parametric equations of a conic are given by $x = \dfrac{3t^2 - 4}{2}, y = 3t + 1$

   (a) Find the standard equation of the conic and identify the type of conic [3 marks]

   (b) Determine and sketch the conic [5 marks]

6. A line m, passes through $P\,(5, -3, 10)$ and $Q\,(7, -6, 9)$, and meets the plane $3x - 3y - 2z = 38$ at point R.

   (a) Find the parametric equations of m. [3 marks]

   (b) Determine the coordinates of the point R. [2 marks]

Section B [15 marks]

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

7. A system of linear equations is given by

$$x + 2y + 2z = q$$
$$2x + py + 7z = 4q$$
$$x + 3y + pz = q$$

where p and q are real constants.

(a) Write the augmented matrix for the system above and reduce to row –echelon form. [5 marks]

(b) If the system of linear equations has infinitely many solutions,

(i) Express q in terms of p. [3 marks]

(ii) find the solutions of the system using the value of q and the largest value of p. [4 marks]

(c) Determine the values of p and q such that the system has a unique solution. [3 marks]

8. Given the point A(3,-1,5) and the equation for the line L is r = 8i – k + t(- 6i + j + 4k)

(a) Find the point B which lies on the line L so that AB is perpendicular to L [5 marks]

(b) Given the plane, π is r · (i – j + 3k) = 15

Find the coordinate C where the line L intersects the plane, π [3 marks]

(c) Find the vector which is perpendicular to the plane ABC [4 marks]

(d) Find the angle between the plane, π and ABC [3 marks]

No.	Scheme	Marks	Total
1	$5\cos x + 2\sin x = r\cos(x-\alpha)$ $= r\cos x\cos\alpha + r\sin x\sin\alpha$ By comparison, $r\cos\alpha = 5$ ----- (1) $r\sin\alpha = 2$ ----- (2) $\frac{(2)}{(1)}$: $\frac{r\sin\alpha}{t\cos\alpha} = \frac{2}{5}$ $\tan\alpha = \frac{2}{5}$ $\alpha = 21.8°$ $(1)^2 + (2)^2$, $r^2\cos^2\alpha + r^2\sin^2\alpha = 5^2 + 2^2$ $r^2(\cos^2\alpha + \sin^2\alpha) = 29$ $r = \sqrt{29}$ Therefore, $5\cos x + 2\sin x = \sqrt{29}\cos(x - 21.8°)$	M1 M1 M1 M1 A1	8
	$\sqrt{29}\cos(x - 21.8°) = 4$ $\cos(x - 21.8°) = 0.7428$ $\alpha = 42.03°$ $0° < x < 360°$ $-21.8° < x - 21.8° < 338.2°$ $x - 21.8° = 42.03°, 317.97°$ $x = 63.8°, 339.8°$ (nearest 0.1°)	M1 M1 A1	

2 a) $u_n = S_n - S_{n-1}$ $= 20\,(1-2^{-n}) - 20\,(1-2^{-(n-1)})$ $= 20\,(1 - 2^{-n} - 1 + 2^{1-n})$ $= 20\,(2^{1-n} - 2^{-n})$ $= 20\,[2^{-n}(2-1)]$ $= 10 \times 2 \times 2^{-n}$ $= 10\,(2^{1-n})$ shown	M1 M1 A1
b) (i) Recursive formulae $u_{n+1} = S_{n+1} - S_n$ $= 20\,(1-2^{-(n+1)}) - 20\,(1-2^{-n})$ $= 20\,[1 - 2^{-(n+1)} - 1 + 2^{-n}]$ $= 20\,[2^{-n} - 2^{-(n+1)}]$ $= 20\,[2^{-n}(1-2^{-1})]$ $= 10 \times 2 \times 2^{-n} \times \frac{1}{2}$ $= 10\,(2^{1-n}) \times \frac{1}{2}$ $= \frac{1}{2}u_n$; n = 1, 2, 3,…., $u_1 = 10$	M1 M1 A1
(b) (ii) $\frac{u_{n+1}}{u_n} = \frac{\frac{1}{2}10(2^{1-n})}{10(2^{1-n})}$ Common ratio, r $= \frac{1}{2}$ which is a constant, thus u_n *is a* geometric sequence $S_\infty = \frac{u_1}{1-r} = \frac{10}{1-\frac{1}{2}} = 20$	M1 A1 A1

3)

$\mathbf{A}^2 = \begin{pmatrix}2 & 1 & 1\\ 1 & 2 & 1\\ 1 & 1 & 2\end{pmatrix}\begin{pmatrix}2 & 1 & 1\\ 1 & 2 & 1\\ 1 & 1 & 2\end{pmatrix} = \begin{pmatrix}6 & 5 & 5\\ 5 & 6 & 5\\ 5 & 5 & 6\end{pmatrix}$	B1
$\mathbf{A}^2 + m\mathbf{A} + n\mathbf{I} = \mathbf{0}$ $\begin{pmatrix}6 & 5 & 5\\ 5 & 6 & 5\\ 5 & 5 & 6\end{pmatrix} + \begin{pmatrix}2m & m & m\\ m & 2m & m\\ m & m & 2m\end{pmatrix} + \begin{pmatrix}n & 0 & 0\\ 0 & n & 0\\ 0 & 0 & n\end{pmatrix} =$ $\begin{pmatrix}0 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & 0\end{pmatrix}$ $\begin{pmatrix}6+2m+n & 5+m & 5+m\\ 5+m & 6+2m+n & 5+m\\ 5+m & 5+m & 6+2m+n\end{pmatrix} = \begin{pmatrix}0 & 0 & 0\\ 0 & 0 & 0\\ 0 & 0 & 0\end{pmatrix}$	M1(using his $\mathbf{A}^2$)
$5 + m = 0 \rightarrow m = -5$ $6 + 2m + n = 0 \rightarrow 6 + 10 + n = 0 \rightarrow n = 4$	M1
$m = -5, n = 4$	A1(both correct)
$\mathbf{A}^2 - 5\mathbf{A} + 4\mathbf{I} = \mathbf{0} \rightarrow \mathbf{A}^2 = 5\mathbf{A} - 4\mathbf{I}$ $\mathbf{A}^3 = 5\mathbf{A}^2 - 4\mathbf{A}$ $= 5\begin{pmatrix}6 & 5 & 5\\ 5 & 6 & 5\\ 5 & 5 & 6\end{pmatrix} - 4\begin{pmatrix}2 & 1 & 1\\ 1 & 2 & 1\\ 1 & 1 & 2\end{pmatrix} = \begin{pmatrix}22 & 21 & 21\\ 21 & 22 & 21\\ 21 & 21 & 22\end{pmatrix}$	M1(using his $\mathbf{A}^2$) A1
$\mathbf{A}^2\,\mathbf{A}^{-1} = 5\mathbf{A}\mathbf{A}^{-1} - 4\mathbf{I}\mathbf{A}^{-1} \rightarrow \mathbf{A} = 5\mathbf{I} - 4\mathbf{A}^{-1}$ $\mathbf{A}^{-1} = \frac{1}{4}(5\mathrm{I} - \mathrm{A})$ $= \frac{1}{4}\left[\begin{pmatrix}5 & 0 & 0\\ 0 & 5 & 0\\ 0 & 0 & 5\end{pmatrix} - \begin{pmatrix}2 & 1 & 1\\ 1 & 2 & 1\\ 1 & 1 & 2\end{pmatrix}\right]$	M1
$= \frac{1}{4}\begin{pmatrix}3 & -1 & -1\\ -1 & 3 & -1\\ -1 & -1 & 3\end{pmatrix}$ $\mathbf{A}^{-1} = \begin{pmatrix}\frac{3}{4} & -\frac{1}{4} & -\frac{1}{4}\\ -\frac{1}{4} & \frac{3}{4} & -\frac{1}{4}\\ -\frac{1}{4} & -\frac{1}{4} & \frac{3}{4}\end{pmatrix}$	A1

5.

$y = 3t + 1,\ t = \frac{y-1}{3}$ →1

$x = \frac{3t^2 - 4}{2}$ -→2

Substitute 1 into 2

$x = \frac{3(\frac{y-1}{3})^2 - 4}{2}$

$6x = y^2 - 2y - 11$

$y^2 - 2y = 6x + 11$

$(y-1)^2 = 6x + 11 + 1$

$(y-1)^2 = 6(x+2)$

$(y-1)^2 = 4\left(\frac{3}{2}\right)(x+2)$ A1

The conic is a parabola A1

M1

a) Determine and sketch the conic

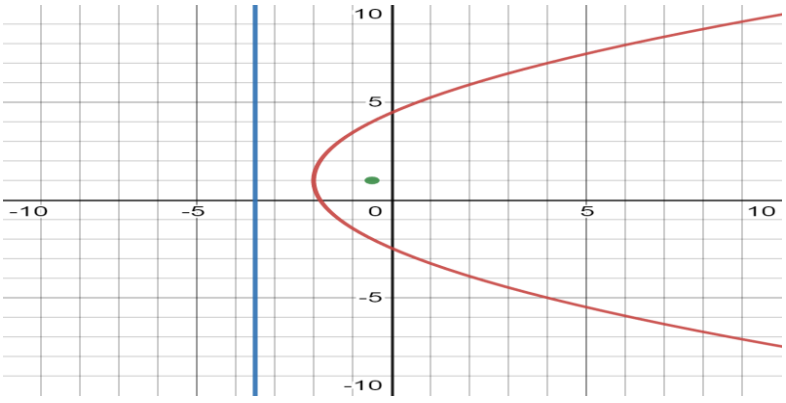
$(y-1)^2 = 4\left(\frac{3}{2}\right)(x+2)$

$a = \frac{3}{2}$

Vertex = $(-2,1)$ A1

Focus= $\left(-2+\frac{3}{2},1\right) = \left(-\frac{1}{2},1\right)$ A1

Equation of directrix, $x = -2 - \frac{3}{2} = -\frac{7}{2} = -3\frac{1}{2}$ A1



D1D1

All correct

6 a) $PQ = \begin{pmatrix} 7 \\ -6 \\ 9 \end{pmatrix} - \begin{pmatrix} 5 \\ -3 \\ 10 \end{pmatrix}$	
$= \begin{pmatrix} 2 \\ -3 \\ -1 \end{pmatrix}$	M1
The equation of m is $r = \begin{pmatrix} 5 \\ -3 \\ 10 \end{pmatrix} + m\begin{pmatrix} 2 \\ -3 \\ -1 \end{pmatrix}$	M1
$r = \begin{pmatrix} 5+2m \\ -3-3m \\ 10-m \end{pmatrix}$	
Hence, the parametric equation of m	
$x = 5 + 2m$, $y = -3 - 3m$, $z = 10 - m$	A1
b) R lies on the plane $3x - 3y - 2z = 38$	
$3(5 + 2m) - 3(-3 - 3m) - 2(10 - m) = 38$	M1
$17m + 4 = 38$	
$m = 2$	
Hence the coordinate of R is	
$x = 5 + 2(2)$	
$x = 9$	
$y = -3 - 3(2)$	
$y = -9$	
$z = 10 - (2)$	
$z = 8$	
$R(9, -9, 8)$	A1

TAMAT SAMPEL

Suka sampel ini?

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