SAMPEL PERCUMA

Trial STPM 2022 Mathematics T Semester 1 Terengganu

Set penuh: Kertas Percubaan STPM

Sem 1 · Mathematics T

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- 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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JABATAN PENDIDIKAN NEGERI TERENGGANU

STPM 2022

PEPERIKSAAN PERCUBAAN
SEMESTER 1

MATHEMATICS (T)

Nama :.....

Kelas :.....

DIBIAYAI OLEH KERAJAAN NEGERI TERENGGANU

Tidak dibenarkan menyunting atau mencetak mana-mana bahagian dalam modul ini
tanpa kebenaran Pengarah Pendidikan Negeri Terengganu

Section A [45 marks]

Answer **all** questions in this section

1. Express $5\ sin\theta + 12\ cos\theta$ in the form $R\ sin(\theta + \alpha)$, where $R > 0$ and $0^0 < \alpha < 90^0$.
Sketch the graph in the range $0^0 < \theta < 180^0$. [6 marks]
Hence, find the maximum and minimum values of the expression $\frac{1}{5\ sin\theta + 12\ cos\theta\ + 15}$.
[3 marks]

2. Expand $\sqrt{\frac{1+x}{1-x}}$ in ascending powers of x up to including the terms in x^2 where $|x| < 1$. By assuming $x = \frac{1}{9}$ in the series, show that $\sqrt{5}$ is a approximately equal to $\frac{1629}{729}$ [7 marks]

3. A system of linear equations is given by

$$\begin{aligned} x + 2z &= k \\ 6x - y + 2z &= 27 \\ 3x - 2y + \lambda z &= 0 \end{aligned}$$

where λ and k are real constants.

a) Write the augmented matrix for the system of linear equations. [1 mark]

b) By using the elementary row operations, show that the augmented matrix in (a) can be reduced to

$$\left(\begin{array}{ccc|c} 1 & 0 & 2 & k \\ 0 & 1 & 10 & 6k-27 \\ 0 & 0 & 14+\lambda & 9k-54 \end{array}\right)$$

i) If the system of linear equations has no solution, find the values of λ and k.

ii) If the system of linear equations has infinite number of solutions, find the values of λ and k.

iii) If the system of linear equations has a unique solution with $\lambda = -5$ and $k = 13$, find the values of x, y and z. [8 marks]

4. Given that $2z + 3iz = 5 + i$.

a) Find z in the polar form. [6 marks]

b) Use the de Moivre's theorem, show that $z^8 = 16$ [3 marks]

5. Find the standard equation for the equation of conic with the parametric equations

$$x = 3 + 2\cos\theta \;\; ; y = \; 2 + \sin\theta.$$

Hence identify the type of conic and sketch the curve. [6 marks]

6. The position vectors of the point **A, B** and **C** are given by

$\boldsymbol{a = 2i + 3i - 4k}$, $\boldsymbol{b = 5i - j + 2k}$ $\boldsymbol{and}$ $\boldsymbol{c = 7i + j + 8k}$ respectively. Find

a) the position vector of the point **D** such that **ABCD** is a parallelogram. [3 marks]

b) the area of the parallelogram. [2 marks]

Section B [15 marks]

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

7. a) Determine the values of a, b and c so that matrix $\begin{pmatrix} b & b^2 & 2a-1 \\ 2b & a & a+b \\ a^2 & bc-1 & c-1 \end{pmatrix}$ is a symmetric matrix.

[5 marks]

b) Given that $M = \begin{pmatrix} 1 & 2 & 4 \\ 4 & 3 & 8 \\ -4 & -4 & -9 \end{pmatrix}$

i) Show that $M^2 + 4M = -3I$. Hence deduce M^{-1}. [5 marks]

Ii) Using the result above, solve the system of linear equations [5 marks]

$2x + 4y + 8z = 18;\;\; 4x + 3y + 8z = 3;\;\; 4x + 4y + 9z = 6$

8. The plane π_1 and the line L have equations $r \bullet (2i + 5j + k) = -9$ and $r = (4i + 2j) + t(i + j + 2k)$ respectively, where t is a parameter.

a) Find the position vector of the point of intersection of plane π_1 and the line L.

[4 *marks*]

b) Find the shortest distance from the origin to line L. [6 *marks*]

c) The plane π_2 passes through the origin and contains the line L. Verify that the vector $-2i + 4j - k$ is perpendicular to π_2. Hence, calculate the acute angle between the planes π_1 and π_2 to the nearest 0.1^0. [5 *marks*]

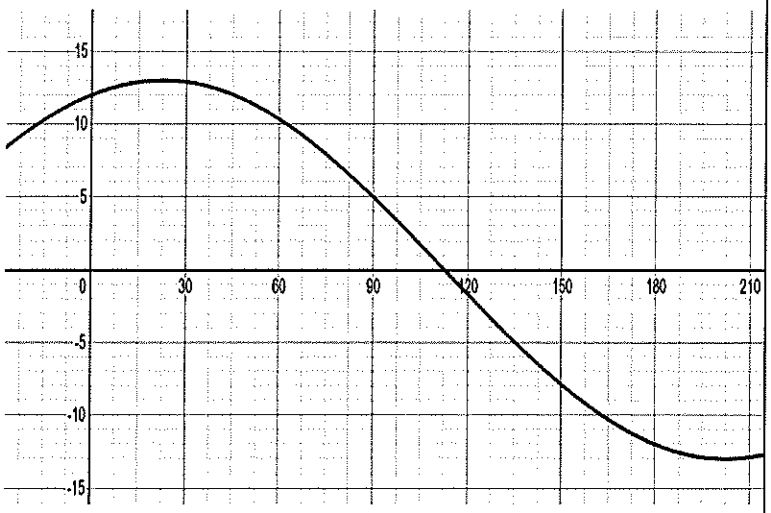
----------END OF QUESTIONS----------

SECTION A

1. **Express $5\ sin\theta + 12\ cos\theta$ in the form $R\ sin(\theta + \alpha)$, where $R > 0$ and $0^0 < \alpha < 90^0$.**

Sketch the graph in the range $0^0 < \theta < 180^0$. **[6 marks]**

Hence, find the maximum and minimum values of the expression $\frac{1}{5\ sin\theta + 12\ cos\theta\ + 15}$. **[3 marks]**

Q	Answer	Marks	Guidance
1(a)	$5\ sin\theta + 12\ cos\theta = R\sin\theta\cos\alpha + R\cos\theta\sin\alpha$ $R\cos\alpha = 5, R\sin\alpha = 12$ $R^2 = 5^2 + 12^2, \quad tan\alpha = \frac{12}{5}$ $R = 13, \quad \alpha = 67.38^0$ $5\ sin\theta + 12\ cos\theta = 13\sin(\theta + 67.38^0)$	B1 M1 A1	Both Both
	$(22.62^\circ, 13)$ maximum point		
		D1 D1 D1	Correct curve in range Intercept point at y-axis and x-axis All correct
	$\frac{1}{5\ sin\theta + 12\ cos\theta\ + 15} \cdot = \frac{1}{13\sin(\theta + 67.38^0) + 15}$	M1	
	$-1 < \sin(\theta + 67.38) < 1$		
	Maximum value$= \frac{1}{13(-1)+15} = \frac{1}{2}$ Minimum value$= \frac{1}{13(1)+15} = \frac{1}{28}$	M1 A1	METHOD EITHER OR ANSWERS CORRECT BOTH
	TOTAL MARKS	***9***	

2. Expand $\sqrt{\frac{1+x}{1-x}}$ in ascending powers o x up to including the term in x^2 where $|x| < 1$. By assuming $x = \frac{1}{9}$ in the series, show that$\sqrt{5}$ is a approximately equal to $\frac{1629}{729}$ [7 marks]

Q	Answer	Marks	Guidance
2(a)	$\sqrt{\frac{1+x}{1-x}} = (1+x)^{\frac{1}{2}}(1-x)^{-\frac{1}{2}}$		
	$(1+x)^{\frac{1}{2}} = 1 + \frac{1}{2}x - \frac{1}{8}x^2 \ldots\ldots\ldots\ldots$	B1	
	$(1-x)^{-\frac{1}{2}} = 1 + \frac{1}{2}x + \frac{3}{8}x^2 \ldots\ldots\ldots\ldots$	B1	
	$\sqrt{\frac{1+x}{1-x}} \approx \left(1 + \frac{1}{2}x - \frac{1}{8}x^2\right)\left(1 + \frac{1}{2}x + \frac{3}{8}x^2\right)$	M1	
	$\approx 1 + x + \frac{1}{8}x^2$	A1	
	Substituting $x = \frac{1}{9}$		
	$\sqrt{\frac{1+\frac{1}{9}}{1-\frac{1}{9}}} \approx 1 + \frac{1}{9} + \frac{1}{8}\left(\frac{1}{9}\right)^2$	M1	Correct substitute $x = \frac{1}{9}$
	$\therefore \sqrt{5} \approx 2 \times \frac{1629}{1458}$	M1	
	$\approx \frac{1629}{729}$	A1	
	MARKS	***7***	
	TOTAL MARKS	***7***	

3. **A system of linear equations is given by**

$$x + 2z = k$$
$$6x - y + 2z = 27$$
$$3x - 2y + \lambda z = 0$$

where λ and k are real constants.

a) **Write the augmented matrix for the system of linear equations.** **[1 mark]**

b) **By using the elementary row operations, show that the augmented matrix in (a) can be reduced to**

$$\left(\begin{array}{ccc|c} 1 & 0 & 2 & k \\ 0 & 1 & 10 & 6k-27 \\ 0 & 0 & 14+\lambda & 9k-54 \end{array}\right)$$

i) **If the system of linear equations has no solution, find the values of λ and k.**

ii) **If the system of linear equations has infinite number of solutions, find the values of λ and k.**

iii) **If the system of linear equations has a unique solution with $\lambda = -5$ and $k = 13$, find the values of x, y and z.** **[8 marks]**

	$= 1 - i$	A1	
	$\|z\| = \sqrt{(1)^2 + (-1)^2}$		
	$= \sqrt{2}$	A1	
	$Arg\ z == -\tan^{-1} 1$		
	$= -\frac{\pi}{4}$	A1	
	$z = \sqrt{2}\left[\cos\left(-\frac{\pi}{4} + i\sin\left(-\frac{\pi}{4}\right)\right)\right]$	M1	
	$= \sqrt{2}\left[\cos\frac{\pi}{4} - i\sin\frac{\pi}{4}\right]$	A1	
	MARKS	***6***	
4(b)	$z^8 = \left\{\sqrt{2}\left[\cos\left(-\frac{\pi}{4} + i\sin\left(-\frac{\pi}{4}\right)\right)\right]\right\}^8$	M1	
	$= 16\left[\cos 8\left(-\frac{\pi}{4}\right) + i\sin 8\left(-\frac{\pi}{4}\right)\right]$	M1	
	$= 16[\cos(-2\pi) + i\sin(-2\pi)]$		
	$= 16[1 - 0]$		
	$=16$	A1	
	MARKS	***3***	
	TOTAL MARKS	***9***	

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5. Find the standard equation for the equation of conic with the parametric equations

$$x = 3 + 2\cos\theta \ ; y = \ 2 + \sin\theta.$$

Hence identify the type of conic and sketch the curve. [6 marks]

Q	Answer	Marks	Guidance
5(a)	$\frac{x-3}{2} = \cos\theta;$ $y - 2 = \sin\theta.$	M1	
	From the identity $\sin^2\theta + \cos^2\theta = 1$		Or another method
	$(y-2)^2 + (\frac{x-3}{2})^2 = 1$		
5(b)	$\frac{(y-2)^2}{1^2} + \frac{(x-3)^2}{2^2} = 1$	A1	
	Ellipse	B1	
	$centre = (3,2)$	B1	Either centre, foci or vertices correct
	$c = \sqrt{3}$		
	$Foci = (3+\sqrt{3},2), (3-\sqrt{3},2)$		
	$Vertices = (5,2), (1,2)$		

SECTION B

7. a) **Determine the values of a, b and c so that matrix** $\begin{pmatrix} b & b^2 & 2a-1 \\ 2b & a & a+b \\ a^2 & bc-1 & c-1 \end{pmatrix}$ **is a symmetric matrix.**

[5 marks]

b) **Given that** $\mathbf{M} = \begin{pmatrix} 1 & 2 & 4 \\ 4 & 3 & 8 \\ -4 & -4 & -9 \end{pmatrix}$

i) **Show that** $M^2 + 4M = -3I$ **. Hence deduce** M^{-1}. **[5 marks]**

Ii) **Using the result above, solve the system of linear equations** **[5 marks]**

$2x + 4y + 8z = 18;\ 4x + 3y + 8z = 3;\ 4x + 4y + 9z = 6$

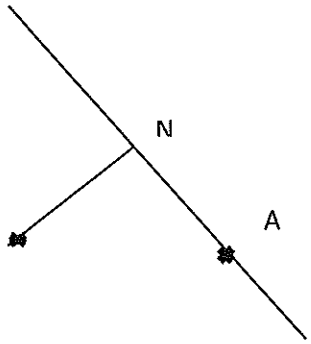
Q	Answer	Marks	Guidance
7(a)	$a^2 = 2a - 1$ ...(1)	M1	At least 2 correct
	$b^2 = 2b$ ...(2)		
	$bc - 1 = a + b$ ...(3)		
	From (1), $a^2 - 2a + 1 = 0$		
	$(a-1)^2 = 0$		
	$a = 1$	A1	
	From (2), $b^2 - 2b = 0$		
	$b(b-2) = 0$		
	$b = 0$ or $b = 2$	A1	
	When b = 0, From (3), $0 - 1 \neq 1 + 0,\ \therefore b \neq 0$		
	When b = 2, From (3), $2c - 1 = 1 + 2,\ c = 2$	M1	
	$a = 1,\ b = 2,\ c = 2$	A1	
	MARKS	***5***	
7(b)	$M = \begin{pmatrix} 1 & 2 & 4 \\ 4 & 3 & 8 \\ -4 & -4 & -9 \end{pmatrix}$		
	$M^2 + 4M = \begin{pmatrix} 1 & 2 & 4 \\ 4 & 3 & 8 \\ -4 & -4 & -9 \end{pmatrix}\begin{pmatrix} 1 & 2 & 4 \\ 4 & 3 & 8 \\ -4 & -4 & -9 \end{pmatrix} + 4\begin{pmatrix} 1 & 2 & 4 \\ 4 & 3 & 8 \\ -4 & -4 & -9 \end{pmatrix}$	M1	
	$= \begin{pmatrix} -3 & 0 & 0 \\ 0 & -3 & 0 \\ 0 & 0 & -3 \end{pmatrix} = -3I$	A1	
	$M(M + 4I) = -3I$	M1	

8. The plane π_1 and the line L have equations $r \bullet (2i+5j+k) = -9$ and $r = (4i+2j)+t(i+j+2k)$ respectively, where t is a parameter.

a) **Find the position vector of the point of intersection of plane π_1 and the line L.** **[4 *marks*]**

b) **Find the shortest distance from the origin to line L.** **[6 *marks*]**

c) **The plane π_2 passes through the origin and contains the line L. Verify that the vector $-2i+4j-k$ is perpendicular to π_2. Hence, calculate the acute angle between the planes π_1 and π_2 to the nearest 0.1^0.** **[5 *marks*]**

Q	Answer	Marks	Guidance
8(a)	π_1 *and L intersect,* $\begin{pmatrix}4+t\\2+t\\2t\end{pmatrix}\cdot\begin{pmatrix}2\\5\\1\end{pmatrix}=-9$	M1	
	$8+2t+10+5t+2t=-9$	M1	
	$t=-3$	A1	
	Position vector of the point intersection of plane π_1 and line L is $i-j-6k$	A1	
	MARKS	***4***	
8(b)			
	$O\,(0,0,0), N(4+t, 2+t, 2t), A\,(4, 2, 0)$	B1 –	both
	$\overrightarrow{ON}=\begin{pmatrix}4+t\\2+t\\2t\end{pmatrix}, \overrightarrow{AN}=t\begin{pmatrix}1\\1\\2\end{pmatrix}$	or	
	$t\begin{pmatrix}1\\1\\2\end{pmatrix}.\begin{pmatrix}4+t\\2+t\\2t\end{pmatrix}=0$	M1	
	(t = 0 – rejected) ,		

TAMAT SAMPEL

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- 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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