954/1 **STPM 2021**

JABATAN PELAJARAN NEGERI TERENGGANU

MATHEMATICS (T)

PAPER 1 (KERTAS 1)

One and a half hours
(Satu jam setengah)

SIJIL TINGGI PERSEKOLAHAN MALAYSIA
(MALAYSIA HIGHER SCHOOL CERTIFICATE)

Instruction to candidates:

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

Answer **all** *questions in Section A and any* **one** *question in Section B*

Answers may be written in either English or Bahasa Malaysia.

All necessary working should be shown clearly.

Scientific calculators may be used. Programmable and graphic display calculators are prohibited.

A list of mathematical formulae is provided on page of this question paper.

Arahan kepada calon:

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU UNTUK BERBUAT DEMIKIAN.

Jawab **semua** *soalan dalam Bahagian A dan mana-mana* **satu** *soalan dalam Bahagian B.*

Jawapan boleh ditulis dalam bahasa Inggeris atau Bahasa Malaysia.

Semua kerja yang perlu hendaklah ditunjukkan dengan jelas.

Kalkulator sainstifik boleh digunakan. Kalkulator boleh atur cara dan kalkulator paparan grafik tidak dibenarkan.

Senarai rumus matematik dibekalkan pada halaman dalam kertas soalan ini.

Section A [45 marks]

Answer **all** questions in this section

1. (a) Solve the inequality $|2x - 5| > 3|2x + 1|$ [4 marks]

   (b) Express $(\sqrt{6}\sin x + \cos x)$ in the form $R\sin(x + \alpha)$, where $R > 0$ *and* $0 < \alpha < 90°$. State the exact value of R and give α correct to 3 decimal places [4 marks]

2. (a) Verify the identity $\frac{2r-1}{r(r-1)} - \frac{2r+1}{r(r+1)} \equiv \frac{2}{(r-1)(r+1)}$. [2 marks]

   (b) Hence, using the method of differences to prove that

   $\sum_{r=2}^{n} \frac{2}{(r-1)(r+1)} = \frac{3}{2} - \frac{2n+1}{n(n+1)}$ [4 marks]

   (c) Deduce the sum of the infinite series

   $\frac{1}{1\times3} + \frac{1}{2\times4} + \frac{1}{3\times5} + \cdots + \frac{1}{(n-1)(n+1)} + \cdots$ [2 marks]

3. Matrix A is defined by

   $A = \begin{pmatrix} 2 & 1 & 4 \\ -3 & p & 2 \\ -1 & -2 & 5 \end{pmatrix}$, where $p \in R$.

   (a) Given that the determinant of A is 3, find the value of p [3 marks]

   Matrix B is defined by $B = \begin{pmatrix} 0 & 1 \\ q & 3 \\ 4 & 0 \end{pmatrix}$, where $q \in R$.

   (b) Find $\boldsymbol{AB}$ [1 mark]

   (c) Explain why $\boldsymbol{AB}$ does not have an inverse. [1 mark]

4. The complex number **z** is given $z = 1 + \sqrt{3}\,i$.

   (a) Find $|\mathbf{z}|$ and **arg z** and express **z** in polar form. [2 marks]

   (b) Using De Moivre's Theorem, show that $z^5 = 16 - 16\sqrt{3}\,i$. [3 marks]

   (c) Express $\frac{z^4}{z^*}$ in the form of $\boldsymbol{x + yi}$, where $\mathbf{z}^*$ is the conjugate of **z** and $x, y \in \boldsymbol{R}$ [3 marks]

5. The parametric equations of a curve are $x = t(t + 2)$ *and* $y = 4(t + 1)$.

   (a) Find the Cartesian equation of the conic [3 marks]

   (b) State the type of conic and sketch the curve. [3 marks]

6. A line passes through the points P (1 , 2, 4) and Q (-2, 3 , 1), and the plane π has equation

$$r = \begin{pmatrix}6\\3\\1\end{pmatrix} + \lambda\begin{pmatrix}1\\5\\1\end{pmatrix} + \mu\begin{pmatrix}0\\2\\1\end{pmatrix}, \quad \lambda, \mu \in \mathbb{R}$$

(a) Find the Cartesian equation of the plane π. [3 marks]

(b) Verify whether the line L and plane π are parallel. [2 marks]

(c) Find the point of intersection between the line **L** and the plane π. [3 marks]

(d) Calculate the acute angle between the line **L** and the plane π. [2 marks]

Section B [15 marks]

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

7. The function f is defined by $f(x) = \frac{3x+2}{5x-1}, x \neq \frac{1}{5}$.

(a). Determine the vertical and horizontal asymptotes of $f(x)$. [3 marks]

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

(c). State the domain of $f(x), D_f$ and range of $f(x), R_f$. [2 marks]

(d). Show that $f(x)$ has an inverse function , $f^{-1}(x)$ and find f^{-1}. Hence, state the relationship between the graphs of $f(x)$ and $f^{-1}(x)$. [7 marks]

8. Given $M = \begin{bmatrix}1 & 1 & t\\ t & 1 & 1\\ 1 & t & 1\end{bmatrix}$.

(a) Use the properties of the determinant to show that $|M| = (t+2)(t-1)^2$.

[5 marks]

(b) Find the range of values of x such that *matrix* M is non-singular. [2 marks]

(c) If $t = 2$,

(i) use elementary row operations to find the inverse M^{-1}. [5 marks]

(ii) Solve

$$x + y + tz = 2$$
$$tx + y + z = 5$$
$$x + ty + z = 3$$ [3 marks]

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

	$= \frac{2r^2 - r + 2r - 1 - 2r^2 + 2r - r + 1}{r(r-1)(r+1)}$	M1	
	$= \frac{2r}{r(r-1)(r+1)}$ $= \frac{2}{(r-1)(r+1)}$ [verified]	A1	
	MARKS	***2***	
2(b)	$\sum_{r=2}^{n} \frac{2}{(r-1)(r+1)}$ $= \sum_{r=2}^{n} \left[\frac{2r-1}{r(r-1)} - \frac{2r+1}{r(r+1)}\right]$	M1	
	$= \sum_{r=2}^{n} [f(r) - f(r+1)]$ $= f(2) - f(n+1)$	M1	
	$= \frac{2(2)-1}{2(1)} - \frac{2(n+1)-1}{(n+1)(n+1-1)}$	M1	Sub value
	$= \frac{3}{2} - \frac{2n+1}{n(n+1)}$	A1	
	MARKS	***4***	
2(c)	$\frac{1}{2}\sum_{r=2}^{\infty} \frac{2}{(r-1)(r+1)}$		
	$= \frac{1}{2} \lim_{n\to\infty} \left[\frac{3}{2} - \frac{2n+1}{n(n+1)}\right]$	M1	
	$= \frac{1}{2} \lim_{n\to\infty} \left[\frac{3}{2} - \frac{\frac{2}{n} + \frac{1}{n^2}}{1 + \frac{1}{n}}\right]$		
	$= \frac{1}{2}\left(\frac{3}{2} - 0\right) = \frac{3}{4}$	A1	
	MARKS	***2***	
	TOTAL MARKS	***8***	

3. Matrix A is defined by

$$A = \begin{pmatrix} 2 & 1 & 4 \\ -3 & p & 2 \\ -1 & -2 & 5 \end{pmatrix}, \text{ where } p \in R.$$

(a) Given that the determinant of A is 3, find the value of p **[3 marks]**

(b) Matrix B is defined by $B = \begin{pmatrix} 0 & 1 \\ q & 3 \\ 4 & 0 \end{pmatrix}$, **where** $q \in R$.

(i) Find AB **[1 mark]**

(ii) Explain why AB does not have an inverse. **[1 mark]**

Q	Answer	Marks	Guidance
3(a)	$2\begin{vmatrix} P & 2 \\ -2 & 5 \end{vmatrix} - 1\begin{vmatrix} -3 & 2 \\ -1 & 5 \end{vmatrix} + 4\begin{vmatrix} -3 & p \\ -1 & -2 \end{vmatrix} = 3$ or $2(5p+4) - 1(-13) + 4(6+p) = 3$	B1	
	$14p + 45 = 3$	M1	Equate 3
	$p = -3$	A1	
3b(i)	$\begin{pmatrix} q+16 & 5 \\ -3q+8 & -12 \\ -2q+20 & -7 \end{pmatrix}$ @ $\begin{pmatrix} q+16 & 5 \\ pq+8 & -3+3p \\ -2q+20 & -7 \end{pmatrix}$	B1	
3b(ii)	***AB*** is not a square matrix	A1	
	Notes: 1. A general statement about square matrices could take the following form: ➢ Only square matrices have an inverse ➢ Only square matrices have a determinant ➢ Only square matrices have an identity or unit matrix		
	TOTAL MARKS	***5***	

4. The complex number z is given $z = 1 + \sqrt{3}\,i$.

(a) Find $|z|$ and arg z and express z in polar form. **[2 marks]**

(b) Using De Moivre's Theorem, show that $z^5 = 16 - 16\sqrt{3}\,i$. **[3 marks]**

(c) Express $\frac{z^4}{z^*}$ in the form of $x + yi$, where z^* is the conjugate of z and $x, y \in R$ **[3 marks]**

Q	Answer	Marks	Guidance
4(a)	$z = 1 + \sqrt{3}\,i$ $\|z\| = \sqrt{1^2 + \sqrt{3}^2} = 2$ $\text{Arg z} = tan^{-1}\frac{\sqrt{3}}{1} = \frac{\pi}{3}$	B1	Either modulus or argument
	$z = 2\,(\cos\frac{\pi}{3} + i\sin\frac{\pi}{3})$	A1	
	MARKS	***2***	

Q	Answer	Marks	Guidance
8(a)	$\begin{bmatrix}1 & 1 & t\\ t & 1 & 1\\ 1 & t & 1\end{bmatrix} = \begin{bmatrix}2 & 1 & t\\ t+1 & 1 & 1\\ t+1 & t & 1\end{bmatrix} = \begin{bmatrix}t+2 & 1 & t\\ t+2 & 1 & 1\\ t+2 & t & 1\end{bmatrix}$	M1	Properties of determinant add 2 columns
	$= (t+2)\begin{bmatrix}1 & 1 & t\\ 1 & 1 & 1\\ 1 & t & 1\end{bmatrix}$	M1	Properties factorise
	$= -(t+2)\begin{bmatrix}1 & 1 & t\\ 1 & 1 & 1\\ 1 & t & 1\end{bmatrix}$	M1	Properties two rows are interchanged
	$= -(t+2)\begin{bmatrix}1 & 1 & t\\ 0 & 1-t & t-1\\ 0 & 0 & t-1\end{bmatrix}$	M1	
	$= -(t+2)(1-t)(t-1) = (t+2)(t-1)^2$	A1	
	MARKS	***5***	
8(b)	Non singular $M \neq 0$ $(t+2)(t-1)^2 \neq 0$	B1	$\neq 0$ *seen*
	$\{x: x \in \boldsymbol{R}, x \neq -2, x \neq 1\}$	A1	
	MARKS	***2***	
8(c)	$\left(\begin{array}{ccc\|ccc}1 & 1 & 2 & 1 & 0 & 0\\ 2 & 1 & 1 & 0 & 1 & 0\\ 1 & 2 & 1 & 0 & 0 & 1\end{array}\right)$	B1	
	$\xrightarrow[R_3 \to R_3 - R_1]{R_2 \to -2R_2 + R_1} \left(\begin{array}{ccc\|ccc}1 & 1 & 2 & 1 & 0 & 0\\ 0 & -1 & -3 & -2 & 1 & 0\\ 0 & 1 & -1 & -1 & 0 & 1\end{array}\right)$	M1	2 zeros C1
	$\left(\begin{array}{ccc\|ccc}1 & 1 & 2 & 1 & 0 & 0\\ 0 & 1 & -1 & -1 & 0 & 1\\ 0 & 0 & 1 & \frac{3}{4} & -\frac{1}{4} & -\frac{1}{4}\end{array}\right)$	M1	upper triangular echelon row
	$\left(\begin{array}{ccc\|ccc}1 & 0 & 0 & -\frac{1}{4} & \frac{3}{4} & -\frac{1}{4}\\ 0 & 1 & 0 & -\frac{1}{4} & -\frac{1}{4} & \frac{3}{4}\\ 0 & 0 & 1 & \frac{3}{4} & -\frac{1}{4} & -\frac{1}{4}\end{array}\right)$	M1	Identity matrix form
	$\boldsymbol{M^{-1}} = \begin{pmatrix}-\frac{1}{4} & \frac{3}{4} & -\frac{1}{4}\\ -\frac{1}{4} & -\frac{1}{4} & \frac{3}{4}\\ \frac{3}{4} & -\frac{1}{4} & -\frac{1}{4}\end{pmatrix}$	A1	
	MARKS	***5***	-1 marks use "=" or "→ " not seen

8(d)	t = 2, $\begin{pmatrix}1&1&2\\2&1&1\\1&2&1\end{pmatrix}\begin{pmatrix}x\\y\\z\end{pmatrix}=\begin{pmatrix}2\\5\\3\end{pmatrix}$	B1	
	$\begin{pmatrix}1&1&2\\2&1&1\\1&2&1\end{pmatrix}=\begin{pmatrix}-\frac{1}{4}&\frac{3}{4}&-\frac{1}{4}\\-\frac{1}{4}&-\frac{1}{4}&\frac{3}{4}\\\frac{3}{4}&-\frac{1}{4}&-\frac{1}{4}\end{pmatrix}\begin{pmatrix}2\\5\\3\end{pmatrix}$ *or* $\begin{pmatrix}x\\y\\z\end{pmatrix}=-\frac{1}{4}\begin{pmatrix}1&-3&1\\1&1&-3\\-3&1&1\end{pmatrix}\begin{pmatrix}2\\5\\3\end{pmatrix}$	M1	His M^{-1}
	$\begin{pmatrix}x\\y\\z\end{pmatrix}=\begin{pmatrix}\frac{5}{2}\\\frac{1}{2}\\-\frac{1}{2}\end{pmatrix}$ $x=\frac{5}{2}, \quad y=\frac{1}{2}, \quad z=-\frac{1}{2}$	A1	
	MARKS	***3***	
	TOTAL MARKS	***15***	

Suka sampel ini?

Kertas Percubaan STPM

Sem 1 · Mathematics T

- 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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