SAMPEL PERCUMA

Trial STPM 2019 Mathematics T Semester 1 Negeri Sembilan (KGV)

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** questions in this section.

1. Sketch on the same coordinates axes, the graphs of $y = |x - 2|$ and $y = \sqrt{x + 4}$, $x \geq -4$. Hence, solve the inequality $|x - 2| > \sqrt{x + 4}$. [5 marks]

2. Expand $\sqrt{\frac{1+2x}{1-x}}$ as a series in ascending powers of x, up to and including the term in x^2. State the range of x for which the expansion is valid. By taking $x = 0.02$, use the first three non-zero terms of the series to estimate $\sqrt{13}$ correct to four significant figures. [7 marks]

3. a) Determine the value of a so that matrix $\begin{pmatrix} 2b+1 & a & c-2 \\ 2c & a^2 & bc \\ 8 & 6 & 2c+1 \end{pmatrix}$ is a symmetric matrix.

[2 marks]

b) Find the value of b if matrix $\begin{pmatrix} -2 & 1 & b \\ 1 & 3 & 0 \\ -1 & 11 & -6 \end{pmatrix}$ is a singular matrix. [3 marks]

4. Express $\sqrt{3} + i$ in the polar form. [3 marks]
Use de Moivre's theorem, show that $\left(\sqrt{3} + i\right)^{12} + \left(\sqrt{3} - i\right)^{12} = 2^{13}$. [4 marks]
Hence, find the roots of $2z^3 - \left[\left(\sqrt{3} + i\right)^{12} + \left(\sqrt{3} - i\right)^{12}\right] i = 0$ in the Cartesian form.
[3 marks]

5. The parametric equations of a conic are $x = 4\sin\theta + 5$ and $y = 3\cos\theta - 2$ and $0 \leq \theta \leq 2\pi$.
   a) Find the standard form for the equation of the conic, and identify the type of conic.
   [3 marks]
   b) Find the centre and foci of the conic. [3 marks]
   c) Sketch the conic and indicate its centre and foci. [2 marks]

6. The planes π_1 and π_2 have equations $3x - y - z = 2$ and $x + 5y + z = 14$ respectively. Show that the point (4, 0, 10) lies in both planes. Show that the line of intersection, l_1 of π_1 and π_2 has equation $\boldsymbol{r} = 4\boldsymbol{i} + 10\boldsymbol{k} + \lambda(\boldsymbol{i} - \boldsymbol{j} + 4\boldsymbol{k})$. [5 marks]
The line l_2 has equation $\boldsymbol{r} = 3\boldsymbol{j} + 9\boldsymbol{k} + \mu(\boldsymbol{i} - 3\boldsymbol{j} - \boldsymbol{k})$.
   a) Show that l_1 and l_2 are perpendicular. [2 marks]
   b) Find the coordinates of the point of intersection Q, between l_2 and π_1. [3 marks]

Section B

[15 marks]

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

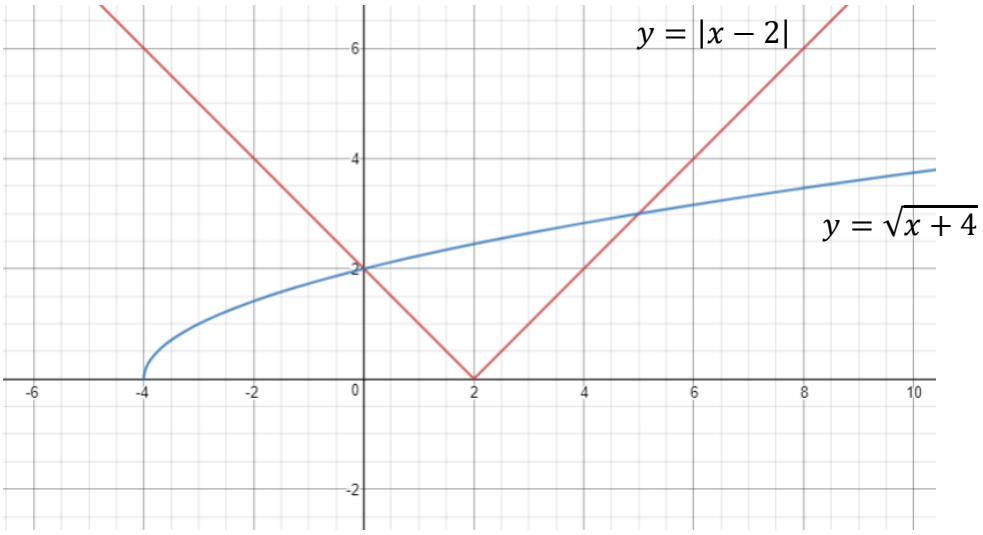
7. The polynomial $p(x) = ax^3 - (1 + 6a)x^2 + 2(8a - b)x - 27$ where a and b are real constants, has a factor $(x - 3)$.
   a) Show that $7a - 2b = 12$. [2 marks]
   b) Write $p(x)$ in terms of a and x. Find the quotient in terms of a and x when $p(x)$ is divided by $(x - 3)$. [3 marks]
   c) When $p(x)$ is divided by $(x - 4)$, it leaves a remainder of 13, find the value of a. [2 marks]
   d) With this value of a,
      i) show that $p(x) = 0$ has only one real root. Find the set of values of x for which $p(x) > 0$. [4 marks]
      ii) express $\frac{4x-9}{p(x)}$ in partial fractions. [4 marks]

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

$$3x + 2y + z = 1$$
$$9x + 6y + 4z = k^2$$
$$6x + 4y - 2z = k$$

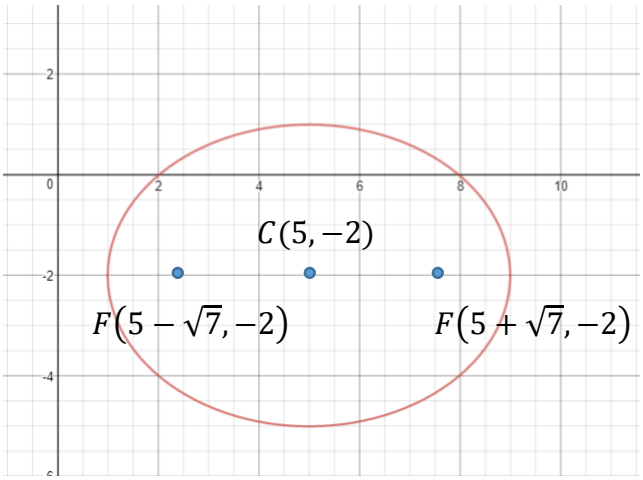
   where k is a real constant.
   a) Write a matrix equation for the system of linear equations. [1 mark]
   b) Reduce the augmented matrix to row-echelon form. [4 marks]
   c) Determine the values of k for which the system of linear equations has infinitely many solutions, and find the solutions in the case when k is negative. [7 marks]
   d) Find the set of values of k for which the system of linear equation is inconsistent. [3 marks]

Marking scheme for Mathematics 954/1 2019

1		D1 D1
	$x - 2 = \sqrt{x+4}$ or $-(x-2) = \sqrt{x+4}$	M1
	$x = 0{,}5$	A1
	$\{x: x < 0, x > 5\}$	A1
		5

2	$\sqrt{\frac{1+2x}{1-x}} = (1+2x)^{\frac{1}{2}}(1-x)^{-\frac{1}{2}}$	
	$(1+2x)^{\frac{1}{2}} = \left[1 + \frac{1}{2}(2x) + \frac{\frac{1}{2}\left(-\frac{1}{2}\right)}{2!}(2x)^2 + \cdots\right]$ OR	M1
	$(1-x)^{-\frac{1}{2}} = \left[1 + \left(-\frac{1}{2}\right)(-x) + \frac{-\frac{1}{2}\left(-\frac{3}{2}\right)}{2!}(-x)^2 + \cdots\right]$	
	$= \left[1 + \frac{1}{2}(2x) + \frac{\frac{1}{2}\left(-\frac{1}{2}\right)}{2!}(2x)^2 + \cdots\right]\left[1 + \left(-\frac{1}{2}\right)(-x) + \frac{-\frac{1}{2}\left(-\frac{3}{2}\right)}{2!}(-x)^2 + \cdots\right]$	M1
	$= \left(1 + x - \frac{1}{2}x^2 + \cdots\right)\left(1 + \frac{1}{2}x + \frac{3}{8}x^2 + \cdots\right)$	
	$= 1 + \frac{1}{2}x + \frac{3}{8}x^2 + x + \frac{1}{2}x^2 - \frac{1}{2}x^2 + \cdots$	
	$= 1 + \frac{3}{2}x + \frac{3}{8}x^2 + \cdots$	A1
	for $\lvert 2x\rvert < 1$, $\lvert x\rvert < \frac{1}{2}$ and for $\lvert x\rvert < 1$	
	Expansion is valid for $\lvert x\rvert < \frac{1}{2}$	A1
	$\sqrt{\frac{1+2(0.02)}{1-(0.02)}} \approx 1 + \frac{3}{2}(0.02) + \frac{3}{8}(0.02)^2$	M1
	$\sqrt{\frac{52}{49}} \approx 1.0302$	M1
	$2\sqrt{13} \approx 7(1.0302)$	
	$\sqrt{13} \approx 3.6057$	
	= 3.606 (4 significant figures)	A1
		7

4	Let $z = \sqrt{3} + i$	
	$\lvert z\rvert = \sqrt{(\sqrt{3})^2 + 1^2} = 2$ and $\text{Arg}\, z = \tan^{-1}\frac{1}{\sqrt{3}} = \frac{\pi}{6}$	M1 M1
	$z = 2\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)$	A1
	$(\sqrt{3}+i)^{12} = \left[2\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)\right]^{12}$ OR $(\sqrt{3}-i)^{12} = \left[2\left(\cos\left(-\frac{\pi}{6}\right) + i\sin\left(-\frac{\pi}{6}\right)\right)\right]^{12}$	M1
	$(\sqrt{3}+i)^{12} + (\sqrt{3}-i)^{12} = \left[2\left(\cos\frac{\pi}{6} + i\sin\frac{\pi}{6}\right)\right]^{12} + \left[2\left(\cos\left(-\frac{\pi}{6}\right) + i\sin\left(-\frac{\pi}{6}\right)\right)\right]^{12}$	M1
	$= 2^{12}\left[\cos\frac{12\pi}{6} + i\sin\frac{12\pi}{6}\right] + 2^{12}\left[\cos\left(-\frac{12\pi}{6}\right) + i\sin\left(-\frac{12\pi}{6}\right)\right]$	M1
	$= 2^{12}[\cos 2\pi + i\sin 2\pi] + 2^{12}[\cos(-2\pi) + i\sin(-2\pi)]$	
	$= 2^{12}[1 + i(0)] + 2^{12}[1 + i(0)] = 2^{13}$	A1
	$2z^3 - \left[(\sqrt{3}+i)^{12} + (\sqrt{3}-i)^{12}\right]i = 0$	
	$2z^3 - 2^{13}i = 0 \Rightarrow \quad 2z^3 = 2^{13}i \quad \Rightarrow \quad z^3 = 2^{12}i$	M1
	$z^3 = 2^{12}(0+i) = 2^{12}\left(\cos\frac{\pi}{2} + i\sin\frac{\pi}{2}\right)$	
	$z = (2^{12})^{\frac{1}{3}}\left[\cos\left(\frac{\pi}{2} + 2k\pi\right) + i\sin\left(\frac{\pi}{2} + 2k\pi\right)\right]^{\frac{1}{3}}$	M1
	$z = 16\left[\cos\left(\frac{\pi}{6} + \frac{2k\pi}{3}\right) + i\sin\left(\frac{\pi}{6} + \frac{2k\pi}{3}\right)\right]$, k = 0, 1, 2	
	$k = 0, z = 16\left[\cos\left(\frac{\pi}{6}\right) + i\sin\left(\frac{\pi}{6}\right)\right] = 16\left(\frac{\sqrt{3}}{2} + i\frac{1}{2}\right) = 8(\sqrt{3}+i)$	
	$k = 1, z = 16\left[\cos\left(\frac{5\pi}{6}\right) + i\sin\left(\frac{5\pi}{6}\right)\right] = 16\left(-\frac{\sqrt{3}}{2} + i\frac{1}{2}\right) = 8(-\sqrt{3}+i)$	
	$k = 2, z = 16\left[\cos\left(\frac{3\pi}{2}\right) + i\sin\left(\frac{3\pi}{2}\right)\right] = 16(0-i) = -16i$	
	The roots are $8(\sqrt{3}+i)$, $8(-\sqrt{3}+i)$ and $-16i$.	A1
		10

5a)	$x = 4\sin\theta + 5$ and $y = 3\cos\theta - 2$	
	$\sin\theta = \frac{x-5}{4}$ or $\cos\theta = \frac{y+2}{3}$	M1
	Using $\sin^2\theta + \cos^2\theta = 1$	
	$\left(\frac{x-5}{4}\right)^2 + \left(\frac{y+2}{3}\right)^2 = 1$	
	$\frac{(x-5)^2}{16} + \frac{(y+2)^2}{9} = 1$	A1
	This is an ellipse.	A1
b	$a = 4, b = 3$	
	$c^2 = 4^2 - 3^2 \quad \Rightarrow c = \sqrt{7}, -\sqrt{7}$	M1
	Centre $(5, -2)$	A1
	Foci $(5 + \sqrt{7}, -2)$ and $(5 - \sqrt{7}, -2)$	A1
c)		Label – D1 Shape – D1
		8

6	When $x = 4$, $y = 0$, $z = 10$	
	$3x - y - z = 3(4) - 0 - 10 = 2$ or $x + 5y + z = 4 + 5(0) + 10 = 14$	M1
	Hence, the point (4, 0, 10) lies in both planes	A1
	$\boldsymbol{n}_1 = normal\ to\ \pi_1 = \begin{pmatrix} 3 \\ -1 \\ -1 \end{pmatrix}$ or $\boldsymbol{n}_2 = normal\ to\ \pi_2 = \begin{pmatrix} 1 \\ 5 \\ 1 \end{pmatrix}$	
	$\boldsymbol{n}_1 \times \boldsymbol{n}_2 = \begin{vmatrix} \boldsymbol{i} & \boldsymbol{j} & \boldsymbol{k} \\ 3 & -1 & -1 \\ 1 & 5 & 1 \end{vmatrix} = (-1 + 5)\boldsymbol{i} - (3 + 1)\boldsymbol{j} + (15 + 1)\boldsymbol{k}$ $= 4\boldsymbol{i} - 4\boldsymbol{j} + 16\boldsymbol{k}$	M1
	$\Rightarrow$ Direction of line of intersection is $\boldsymbol{i} - \boldsymbol{j} + 4\boldsymbol{k}$	M1
	Since point (4, 0, 10) lies in both planes, therefore (4, 0, 10) lies on the line of intersection.	M1
	Equation of line of intersection between the two planes is $\boldsymbol{r} = 4\boldsymbol{i} + 10\boldsymbol{k} + \lambda(\boldsymbol{i} - \boldsymbol{j} + 4\boldsymbol{k})$ [Shown]	A1
a)	$l_1: \boldsymbol{r} = 4\boldsymbol{i} + 10\boldsymbol{k} + \lambda(\boldsymbol{i} - \boldsymbol{j} + 4\boldsymbol{k})$ and $l_2: \boldsymbol{r} = 3\boldsymbol{i} + 9\boldsymbol{k} + \lambda(\boldsymbol{i} - 3\boldsymbol{j} - \boldsymbol{k})$	
	$\begin{pmatrix} 1 \\ -1 \\ 4 \end{pmatrix} \cdot \begin{pmatrix} 1 \\ -3 \\ -1 \end{pmatrix} = 1 + 3 - 4 = 0$	M1
	Hence, l_1 and l_2 are perpendicular.	A1
b)	$l_2: \boldsymbol{r} = \begin{pmatrix} 0 \\ 3 \\ 9 \end{pmatrix} + \mu \begin{pmatrix} 1 \\ -3 \\ -1 \end{pmatrix}$ and $\pi_1: \boldsymbol{r} \cdot \begin{pmatrix} 3 \\ -1 \\ -1 \end{pmatrix} = 2$	
	$\begin{pmatrix} \mu \\ 3 - 3\mu \\ 9 - \mu \end{pmatrix} \cdot \begin{pmatrix} 3 \\ -1 \\ -1 \end{pmatrix} = 2$	M1
	$3\mu - 3 + 3\mu - 9 + \mu = 2 \Rightarrow \mu = 2$	M1
	$\begin{pmatrix} 2 \\ 3 - 3(2) \\ 9 - 2 \end{pmatrix}$ Coordinates of Q = (2, -3, 7)	A1
		10

TAMAT SAMPEL

Suka sampel ini?

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- 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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