SAMPEL PERCUMA

Pentaksiran Prestasi STPM 2021 Mathematics T Semester 1, Sekolah Tinggi Kluang

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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954/1 STPM 2021

MATHEMATICS T

PAPER 1

One and a half hours

SEKOLAH TINGGI KLUANG

PENTAKSIRAN PRESTASI STPM 2021 P1

Instruction To Candidates:

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

Answer **all** *questions in Section A.*

Answer **one** *question only in Section B. You may answer all the questions* **but**, *only the first answer will be marked.*

All necessary working should be shown clearly.

Non-exact numerical answers may be given correct to three significant figures, or one decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

Scientific calculator may be used. Progammable and graphic display calculators are prohibited.

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

This question paper consists of 4 printed pages.

Section A
[45 marks]

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

1. A polynomial *p(x)* is defined by $p(x) = x^3 + ax^2 + 15x + b$, where a and b are constants. Given that the remainder when *p(x)* is divided by (*x*+1*)* and (*x*+2) are 0 and - 4 respectively, find the value of a and b. [4 marks]

   Hence, express $\frac{x+7}{p(x)}$. [3 marks]

2. The sum, S_n, of the first *n* terms of an arithmetic progression is given by $S_n = pn + qn^2$. Given also that $S_4 = 20$ and $S_7 = 49$. Determine :

   (a) the value of *p* and *q*. [3 marks]

   (b) an expression for *n*th term and the value of common difference. [5 marks]

3. (a) Determine the value of *r* so that matrix $\begin{pmatrix} 2s+1 & r & t-2 \\ 2t & r^2 & st \\ 8 & 6 & 2t+1 \end{pmatrix}$ is a symmetric matrix. [2 marks]

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

4. The complex number *z* and *w* are given by $z = 1 - i$ and $w = \frac{2-(1+z)i}{1+iz}$.

   (a) Find *w* in the form $a + bi$, where $a, b \in R$. State the real and imaginary parts of *w*. [4 marks]

   (b) Express *w* in polar form. [3 marks]

5. The parametric equations of a curve are $x = t - \frac{1}{t}$ and $y = t + \frac{1}{t}$. By taking $y^2 - x^2$ or otherwise, show that the curve is a hyperbola. [3 marks]

   Find

   (a) The coordinates of the vertices and foci [2 marks]

   (b) The equations of the asymptotes [1 mark]

   (c) Sketch the curve [2 marks]

6. The points *P*, *Q*, *R* and *S* are the vertices of a parallelogram. The position vectors of the points *A*, *B* and *C* are given by $\mathbf{p} = 2\mathbf{i} + 3\mathbf{j} - 4\mathbf{k}$, $\mathbf{q} = 5\mathbf{i} - \mathbf{j} + 2\mathbf{k}$ and $\mathbf{r} = 7\mathbf{i} + \mathbf{j} + 8\mathbf{k}$ respectively. Find

(a) the unit vector parallel to $\overrightarrow{PQ}$. [4 marks]

(b) the area of the parallelogram *PQRS*. [5 marks]

Section B

[15 marks]

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

7. (a) Sketch the graph of $y = \sin 2x$ in the range of $0 \leq x \leq \pi$.

Hence, solve the inequality $|\sin 2x| < \frac{1}{2}$, where $0 \leq x \leq \pi$. [6 marks]

(b) (i) By first expanding $\cos\ (x + 45°)$, then express $\cos\ (x + 45°) - \sqrt{2}\ \sin x$ in the form $R\ \cos(x + \propto)$, where $R > 0$ and $0° < \propto < 90°$. Give the value of R correct to 4 significant figures and the value of $\propto$ correct to 2 decimal places. [5 marks]

(ii) Hence, solve the equation $\cos\ (x + 45°) - \sqrt{2}\ \sin x = 2$, for $0° < x < 360°$. [4 marks]

8. Expand $(1 + x)^{-\frac{1}{2}}$ in ascending powers of *x* up to the term in x^3. [3 marks]

Hence, expand $\frac{2+5x}{\sqrt{1+x}}$ in ascending powers of *x* up to the term in x^3. [5 marks]

By substituting $x = 0.08$, show that the value of $\frac{2+5x}{\sqrt{1+x}}$ is $\frac{4}{3}\sqrt{3}$. [4 marks]

Use your expansion to estimate the value of $\sqrt{3}$ correct to three decimal places. [3 marks]

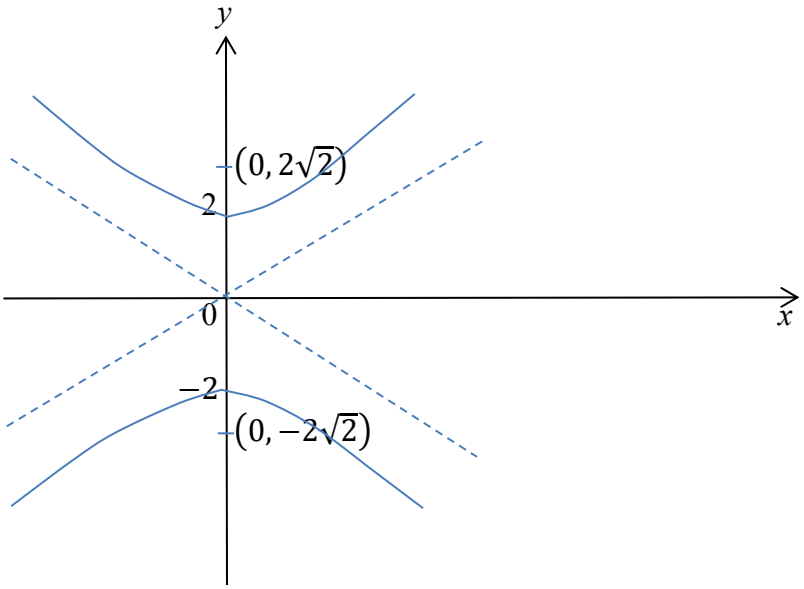
-END OF QUESTION PAPER-

MARKING SCHEME

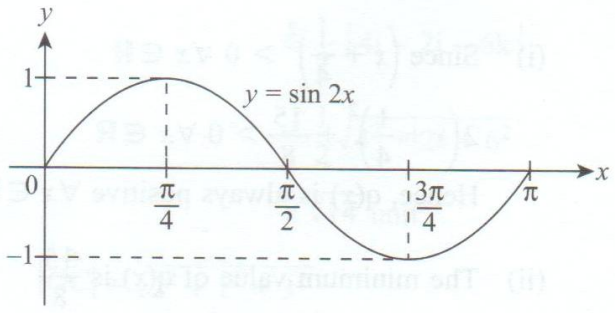
No	Working/Answer	Partial marks
1.	$P(-1) = 0$ $(-1)^3 + a(-1)^2 + 15(-1) + b = 0$ $-1 + a - 15 + b = 0$ $a + b = 16 \ldots\ldots\ldots (1)$	M1
	$P(-2) = -4$ $(-2)^3 + a(-2)^2 + 15(-2) + b = -4$ $-8 + 4a - 30 + b = -4$ $4a + b = 34 \ldots\ldots\ldots (2)$	M1
	$(2) - (1)$: $3a = 18$ $a = 6$	
	$From\ (1)$, $6 + b = 16$ $b = 10$	A1 (both a and b)
	$\therefore P(x) = x^3 + 6x^2 + 15x + 10$	A1
	$P(-1) = 0$ $(x + 1)\ is\ a\ factor\ of\ P(x)$, $x + 1 \overline{)\ x^3 + 6x^2 + 15x + 10}$ $x^2 + 5x + 10$ $x^3 + x^2$ $5x^2 + 15x$ $5x^2 + 5x$ $10x + 10$ $10x + 10$ 0	M1
	$\therefore P(x) = (x + 1)(x^2 + 5x + 10)$	
	$\frac{x + 7}{P(x)} = \frac{x + 7}{(x + 1)(x^2 + 5x + 10)}$ $\equiv \frac{A}{x + 1} + \frac{Bx + C}{x^2 + 5x + 10}$	M1
	$x + 7 \equiv A(x^2 + 5x + 10) + (Bx + C)(x + 1)$	M1
	$Let\ x = -1, 6 = 6A$ $A = 1$	

	$Let\ x = 0, 7 = 10A + C$ $7 = 10(1) + C$ $C = -3$ $Let\ x = 1, 8 = 16A + 2B + 2C$ $8 = 16(1) + 2B + 2(-3)$ $B = -1$ $\therefore \dfrac{x+7}{(x+1)(x^2+5x+10)} = \dfrac{1}{x+1} + \dfrac{-x-3}{x^2+5x+10}$ $= \dfrac{1}{x+1} - \dfrac{x+3}{x^2+5x+10}$	A1
Total		**8**

2.	(a) $S_4 = 20$ $4p + 16q = 20$ $p + 4q = 5$ ……(1) $S_7 = 49$ $7p + 49q = 49$ $p + 7q = 7$ ……(2) (2) – (1) : $3q = 2 \Longrightarrow q = \frac{2}{3}$ $p + 4\left(\frac{2}{3}\right) = 5$ $p = \frac{7}{3}$	M1 M1 A1 (both p and q)
	(b) $S_n = \frac{7}{3}n + \frac{2}{3}n^2$ $S_{n-1} = \frac{7}{3}(n-1) + \frac{2}{3}(n-1)^2$ $T_n = S_n - S_{n-1}$ $= \frac{7}{3}n + \frac{2}{3}n^2 - \frac{7}{3}(n-1) - \frac{2}{3}(n-1)^2$ $= \frac{4n+5}{3}$ $T_{n-1} = \frac{4(n-1)+5}{3}$ $d = T_n - T_{n-1}$ $= \frac{4n+5}{3} - \frac{4(n-1)+5}{3}$ $= \frac{4}{3}$	M1 M1 M1 M1 A1
Total		**8**

5.	$y^2 - x^2 = \left(t + \frac{1}{t}\right)^2 - \left(t - \frac{1}{t}\right)^2$ $= t^2 + 2 + \frac{1}{t^2} - t^2 + 2 - \frac{1}{t^2}$ $= 4$ $\frac{y^2}{4} - \frac{x^2}{4} = 1$ It is a hyperbola	M1 A1 B1
	(a) $a = 2, b = 2,\ c = \sqrt{a^2 + b^2}$ $c = \sqrt{2^2 + 2^2} = 2\sqrt{2}$ Vertices are (0, -2) and (0,2) Foci are $(0, -2\sqrt{2})$ *and* $(0, 2\sqrt{2})$	 B1 B1
	(b) Asymptotes are $y = \pm\frac{a}{b}x$ $y = x$ or $y = -x$	1 (both equations)
	(c)  	1 (Correct shape of hyperbola with vertical transverse axes) 1 (All correct – asymptotes passes through origin)
Total		**8**

6.	(a) $\overrightarrow{PQ} = \boldsymbol{q} - \boldsymbol{b}$ $= \begin{pmatrix} 3 \\ -4 \\ 6 \end{pmatrix}$	B1
	$\lvert PQ \rvert = \sqrt{61}$	B1
	$\therefore$ unit vector // to $\overrightarrow{PQ} = \pm \dfrac{\begin{pmatrix} 3 \\ -4 \\ 6 \end{pmatrix}}{\sqrt{61}}$	M1
	$= \dfrac{3}{\sqrt{61}}i - \dfrac{4}{\sqrt{61}}j + \dfrac{6}{\sqrt{61}}k$ or $-\dfrac{3}{\sqrt{61}}i + \dfrac{4}{\sqrt{61}}j - \dfrac{6}{\sqrt{61}}k$	A1
	(b) $\overrightarrow{QR} = \boldsymbol{r} - \boldsymbol{q}$ $= \begin{pmatrix} 2 \\ 2 \\ 6 \end{pmatrix}$	B1
	$\overrightarrow{PQ}$ X $\overrightarrow{QR} = \begin{vmatrix} i & j & k \\ 3 & -4 & 6 \\ 2 & 2 & 6 \end{vmatrix}$	M1
	$= -36i - 6j + 14k$	A1
	Area of parallelogram = $\sqrt{36^2 + 6^2 + 14^2}$ = 39.09	M1 A1
	Total	**9**

7.	(a)  	D 1- shape D 1- label D 1- all correct
	$\lvert \sin 2x \rvert = \dfrac{1}{2}$ $2x = \dfrac{\pi}{6}, \dfrac{5\pi}{6}, \dfrac{7\pi}{6}, \dfrac{11\pi}{6}$	M 1

TAMAT SAMPEL

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