SAMPEL PERCUMA

Trial STPM 2023 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** questions in this section.

1. The function f and g are defined as follows

$$f: x \to 2 + 3e^{-x}, x \in R$$

$$g: x \to \ln\left(\frac{3}{x-2}\right), x > 2$$

(a) Show that $f \circ g$ exist . [2]

(b) Find $f \circ g$. [2]

(c) On the same axes, sketch graphs of f *and* f^{-1} . [3]

2. (a) Use binomial expansions to show $\sqrt{\frac{1+4x}{1-x}} \approx 1 + \frac{5}{2}x - \frac{5}{8}x^2$. [4]

(b) Substitute $x = \frac{1}{11}$ into $\sqrt{\frac{1+4x}{1-x}} \approx 1 + \frac{5}{2}x - \frac{5}{8}x^2$ to obtain an approximation to $\sqrt{6}$. Give your answer as a fraction in its simplest form. [3]

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3. Matrix A = $(-2b \ -4b \ -4c \ 2a-1 \ -6b \ -c \ 2a+b+c \ 2-2c \ 4a)$ is an upper triangular matrix.

(a) Find the values of *a, b* and *c* . [2]

(b) Given $|c \ -b \ -c \ 2a-1 \ -6b \ -c \ 2a+b+c \ 2-2c \ 4a|$ is 24, determine the $|A|$. [2]

(c) Using elementary row operations, find A^{-1}. [5]

4. A complex number w is given by

(a) Express w in polar form. [4]

(b) Using de Moivre's theorem, show that w^4 =

Give your answer in Cartesian form. [3]

5. The parametric equations of a curve are $x = a\cos\theta + 6$ and $y = b\sin\theta - 8$, where a and b are positive constants 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]

(b) If $a = b = 10$, determine and sketch the conic. [3]

6. (a) The position vectors of A and B relative to the origin O are $\mathbf{i} + 2\mathbf{j} + 3\mathbf{k}$ and $3\mathbf{i} + 4\mathbf{j} + 5\mathbf{k}$ respectively. Find the acute angle AOB. [4]

(b) Triangle PQR has vertices $P(2, -3, -1)$, $Q(4, 5, 1)$ and $R(-1, -2, 6)$.

(i) Find a unit vector that is normal to both vectors $\overrightarrow{PQ}$ and $\overrightarrow{PR}$. [3]

(ii) Calculate the area of the triangle PQR. [2]

SECTION B [15 marks]

Answer **one** question only.

7. Given $w = \frac{z-1}{z+i}$ where z is a complex number.

a) If $z = i$,

i) Write w in the polar form.

ii) Hence, find the value of w^{14} [5]

b) Show that in general $w = \frac{(x^2-x+y^2+y)+i(y-x+1)}{x^2+(y+1)^2}$ [4]

c) Find condition under which real part of $w = 1$ [2]

d) State the condition under which w is

i. Real

ii. Purely imaginary [2]

e) Find the modulus of z given that $arg\ arg\ w = \frac{\pi}{4}$
[2]

8. The plane π has equation $3x+2y-z+1=0$. Line l_1 has Cartesian equation $\frac{x-4}{-1} = \frac{y+3}{2} = \frac{z-7}{1}$ and line l_2 has vector equation $r = \begin{pmatrix} 0 \\ 10 \\ 7 \end{pmatrix} + t \begin{pmatrix} 1 \\ 3 \\ 2 \end{pmatrix}$

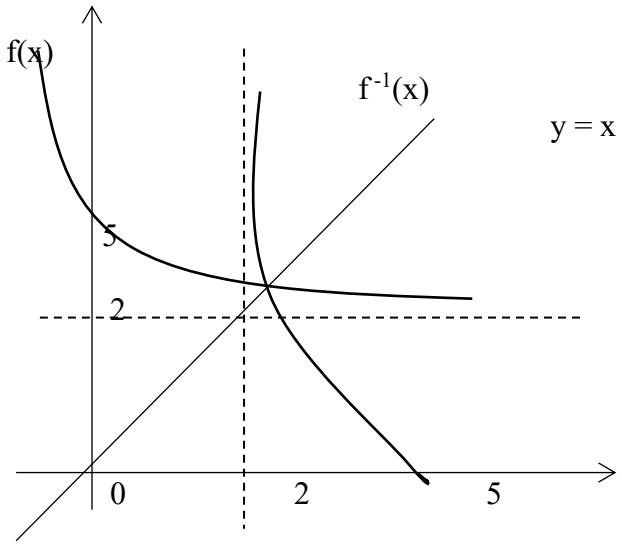
a) Show that l_2 lies on plane π. [3]

b) Find the angle between line l_1 and line l_2. [3]

c) Find the angle between line l_2 and the plane π. [3]

d) Given that l_2 intersect the plane π at point *P*. Find the position vector of *P*. [3]

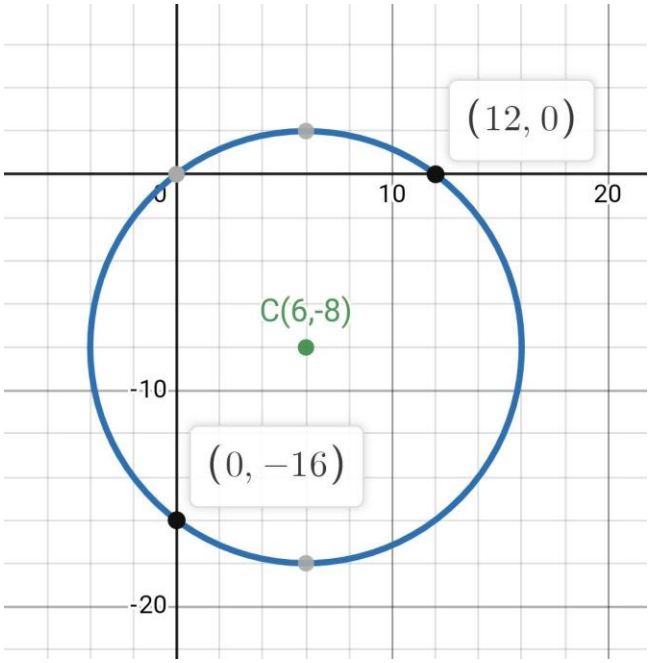
e) Determine the Cartesian equation of another plane passing through *P* and perpendicular to l_1. [3]

1	(a) Domain $f = \{ x : x \in \mathbb{R} \}$ Range $g = \{ y : y \in \mathbb{R} \}$ Since $R_g \subseteq D_f$, therefore $f \circ g$ exist.	M1 A1
	(b) $f \circ g = 2 + 3e^{-ln\left(\frac{3}{x-2}\right)}$ $= 2 + 3e^{ln\left(\frac{3}{x-2}\right)^{-1}}$ $= 2 + 3\left(\frac{3}{x-2}\right)^{-1}$ $fg(x) = x \ , \ x > 2$	 M1 A1
	(c)  	D1 graph f D1 graph f^{-1} D1 all correct

No		Marks	Remarks
2.	(a) $\sqrt{\frac{1+4x}{1-x}} = (1+4x)^{\frac{1}{2}}(1-x)^{-\frac{1}{2}}$		
	$(1+4x)^{\frac{1}{2}} = 1 + \frac{1}{2}(4x) + \frac{\frac{1}{2}(-\frac{1}{2})}{2!}(4x)^2 + \ldots$	M1	
	$= 1 + 2x - 2x^2 + \ldots$		
	$(1\text{-}x)^{-\frac{1}{2}} = 1 + (-\frac{1}{2})(-x) + \frac{(-\frac{1}{2})(-\frac{3}{2})}{2!}(-x)^2 + \ldots$	M1	
	$= 1 + \frac{x}{2} + \frac{3}{8}x^2 + \ldots$		
	$(1+4x)^{\frac{1}{2}}(1-x)^{-\frac{1}{2}} = (1 + 2x - 2x^2 + \ldots)(1 + \frac{x}{2} + \frac{3}{8}x^2 + \ldots)$	M1	His exp. of $(1+4x)^{\frac{1}{2}}$ × his exp of $(1\text{-}x)^{-\frac{1}{2}}$
	$= 1 + \frac{x}{2} + \frac{3}{8}x^2 + 2x + x^2 - 2x^2 + \ldots$		
	$\approx 1 + \frac{5}{2}x - \frac{5}{8}x^2$	A1	
	(b) Let $x = \frac{1}{11}$,		
	$\sqrt{\frac{1+4(\frac{1}{11})}{1-(\frac{1}{11})}} \approx 1 + \frac{5}{2}(\frac{1}{11}) - \frac{5}{8}(\frac{1}{11})^2$	M1	Subs. $\frac{1}{11}$ to **both sides**
	$\sqrt{\frac{\frac{15}{11}}{\frac{10}{11}}} \approx \frac{1183}{968}$		
	$\sqrt{\frac{3}{2}} \approx \frac{1183}{968}$		
	$\sqrt{\frac{3}{2}} \times 2 \approx \frac{1183}{968} \times 2$	M1	
	$\sqrt{6} \approx \frac{1183}{484}$	A1	

4a)	$w = \dfrac{6}{3 - i\sqrt{3}}$ $= \dfrac{6}{3 - i\sqrt{3}} \times \dfrac{3 + i\sqrt{3}}{3 + i\sqrt{3}}$ $= \dfrac{6(3 + i\sqrt{3})}{12}$ $= \dfrac{3 + i\sqrt{3}}{2}$	M1 (His Conjugate) A1
	$\lvert w \rvert = \sqrt{\left(\frac{3}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2}$ $= \sqrt{\frac{9}{4} + \frac{3}{4}}$ $= \sqrt{3}$ **OR** $arg\, w = tan^{-1}\frac{\sqrt{3}}{3}$ $= \frac{\pi}{6}$	M1(Accept 30°)
	$w = \sqrt{3}\left[cos\frac{\pi}{6} + i\, sin\frac{\pi}{6}\right]$ **OR** $\sqrt{3}\boldsymbol{CiS}\left(\frac{\pi}{6}\right)$	A1

b)	$w^4 = \left[\sqrt{3}\,(cos\frac{\pi}{6} + i\, sin\frac{\pi}{6}\right]^4$	M1
	$= 9\, Cis\,(4 \times \frac{\pi}{6})$	M1
	$= 9\, Cis\,(-\frac{1}{2} + \frac{\sqrt{3}}{2})$	
	$= -9\,(\frac{1}{2} - \frac{\sqrt{3}}{2}i\,)$	A1

5(a)	$x = a\cos\theta + 6$ and $y = b\sin\theta - 8$	
	$\cos\theta = \frac{x-6}{a}$ or $\sin\theta = \frac{y+8}{b}$	M1
	$\frac{(y+8)^2}{b^2} + \frac{(x-6)^2}{a^2} = 1$	A1
	Ellipse with centre $(6, -8)$	A1
5(b)	$(x-6)^2 + (y+8)^2 = 100$. It is a circle	B1
		D1 - Circle with centre at 4th quadratic and cutting both axes D1 – Must indicate centre (6, -8) and (12, 0) and (0, -16)

TAMAT SAMPEL

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