SAMPEL PERCUMA

Trial STPM 2020 Mathematics T Semester 1 (Horley Methodist)

Set penuh: Kertas Percubaan STPM

Sem 1 · Mathematics T

Sampel ini: 6 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

2020-1-PER-HORLEY METHODIST

1. The functions g dan h are defined by

$g : x \rightarrow \ln x \ , \ x \in R, \ x > 0$

$h : x \rightarrow 1 + x, \ x \in R, \ x > -1$

(a) It is given that the function f is difined as

$f(x) = gh(x), x \in R, x > -1$

Sketch the graph of y = f(x) and state the range of f(x). [4]

(b) Find the functions $g^{-1}(x) \ and \ h^{-1}(x).$ [2]

(c) Hence, determine the function $g^{-1}h^{-1}(x)$ and sketch the graph of $y = g^{-1}h^{-1}(x)$. [3]

2. The first term of a geometry series is 3 and the common ratio is 2.
If the sum of the first n term is denoted by G_n.

(a) write an expression in terms of n for G_n. [2]

(b) show that $\sum_{n=1}^{N} G_n = 2G_N - 3N$ [4]

3. A system of linear equations is given by

x + y + z = k
x – y + z = 0
4x + 2y + λ z = 3

where λ and k are real numbers. Show that the augmented matrix for the system may be reduced to

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & k \\ 0 & -2 & 0 & k \\ 0 & 0 & \lambda - 4 & 3 - 3k \end{array}\right)$$ [4]

Hence, determine the values of λ and k so that the system of linear equations has

(a) a unique solution, [1]
(b) infinitely many solutions, [1]
(c) no solution. [1]

4. (a) Solve the equation w^2 - 6w + 36 = 0. [3]

(b) Given that w is either of the roots found in part (a), deduce the exact value of w^{-3}. [5]

5. A parabola has its vertex at (3, 2) and focus at (0, 2).
(a) Sketch the graph. Show clearly the directrix of the parabola. [3]
(b) Find the equation of the parabola. [2]
(c) Find the coordinates of the y-intercepts. [2]

6. Lines $\iota_1, \iota_2 \ and \ \iota_3$ have vector equations

$\iota_1 : r = (5i - j - 2k) + s(-6i + 8j - 2k),$

$\iota_2 : r = (3i - 8j) + t(i + 3j + 2k),$

$\iota_3 : r = (2i + j + 3k) + u(3i + cj + k)$

(a) Given ι_1 is parallel to ι_3, find the value of c. [2]

(b) Given instead that ι_2 and ι_3 intersect, find the value of c and the point of intersection. [6]

Section B [15 marks]
Answer **any one** question in this section.

7. Express cos θ - 2 sin θ in the form R cos (θ + α), where R > 0 and $0 < \alpha < \frac{\pi}{2}$. [3]

Hence, for $0 < \theta < 2\pi$,

(a) Solve the equation cos θ -2 sin θ = 2. [3]

(b) Sketch the curve y = cos θ -2 sin θ, and deduce the range of values of θ such that cos θ -2 sin θ $\geq$ 2. [4]

(c) State the smallest and greatest values of $\frac{1}{\cos\theta - 2\sin\theta + 3}$ and find the corresponding values of θ when these occurs. [5]

8. The position vectiors, $a = i + j + k, b = i + 2j + 3k \ and \ c = i - 3j + 2k$

(i) Find a unit vector parallel to $\underset{\sim}{a}+\underset{\sim}{b}+\underset{\sim}{c}$. [3]

(ii) Calculate the acute angle between $\underset{\sim}{a}$ and $\underset{\sim}{a}+\underset{\sim}{b}+\underset{\sim}{c}$ to the nearest 0.1^0. [3]

(iii) Find the vector of the form which is perpendicular to both $\underset{\sim}{a}$ and $\underset{\sim}{b}$. [2]

(iv) Determine the position vector of the point D which is such that ABCD is parallelogram. [3]

(v) Calculate the area of the parallelogram. [4]

2020-1-PER-HORLEY METHODIST-MARKING SCHEME

1. The functions g dan h are defined by

$g : x \rightarrow \ln x \ , \ x \in R, \ x > 0$

$h : x \rightarrow 1 + x, \ x \in R, \ x > -1$

(a) It is given that the function f is difined as

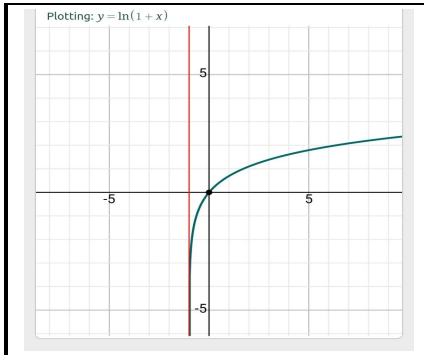
$f(x) = gh(x), x \in R, x > -1$

Sketch the graph of y = f(x) and state the range of f(x). [4]

(b) Find the functions $g^{-1}(x) \ and \ h^{-1}(x).$ [2]

(c) Hence, determine the function $g^{-1}h^{-1}(x)$ and sketch the graph of $y = g^{-1}h^{-1}(x)$. [3]

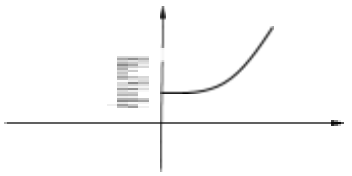
(a) $f(x) = gh(x)$ $= g(1+x)$ $= \ln(1+x), x \in R, x > -1$ $f : x \rightarrow \ln(1+x), x \in R, x > -1$	**1**	
	1	Intersection at x=0 and line x = -1
	1	Overall correct

		
R_f = ($-\infty, \infty$) or $\{f(x) \in R\}$	**1**	

(b)

$g^{-1} : x \rightarrow e^x, x \in R$	**1**	
$h^{-1} : x \rightarrow x - 1, x > 0$	**1**	

(c)

$g^{-1}h^{-1} : x \rightarrow e^{x-1}, x > 0$	**1**	
	**1** **1**	Intersection at y = $\frac{1}{e}$ Overall correct

2. The first term of a geometry series is 3 and the common ratio is 2.
If the sum of the first n term is denoted by G_n.

(a) write an expression in terms of n for G_n. [2]

(b) show that $\sum_{n=1}^{N} G_n = 2G_N - 3N$ [4]

(a) $G_n = \frac{3(2^n-1)}{2-1}$	1	
$= 3(2^n-1)$	1	

(b) $\sum_{n=1}^{N} 3(2^n-1)$		
$= 3\sum_{n=1}^{N} 2^n - \sum_{n=1}^{N} 3$	1	
$= 3(2^1+2^2+2^3+\ldots+2^N) - 3N$	1	
$= 3\left(\frac{2(2^n-1)}{2-1}\right) - 3N$	1	
$= 6(2^n-1) - 3N$		
$= 2G_n - 3N$	1	

3. A system of linear equations is given by

$x + y + z = k$

$x - y + z = 0$

$4x + 2y + \lambda z = 3$

where λ and k are real numbers. Show that the augmented matrix for the system may be reduced to

$$\left(\begin{array}{ccc|c} 1 & 1 & 1 & k \\ 0 & -2 & 0 & k \\ 0 & 0 & \lambda-4 & 3-3k \end{array}\right)$$

[4]

Hence, determine the values of λ and k so that the system of linear equations has

(a) a unique solution, [1]

(b) infinitely many solutions, [1]

(c) no solution. [1]

$\left(\begin{array}{ccc|c} 1 & 1 & 1 & k \\ 1 & -1 & 1 & 0 \\ 4 & 2 & \lambda & 3 \end{array}\right)$	1	
$\xrightarrow[R_3 - 4R_1 \; R_3]{R_3 - R_1 \to R_2} \left(\begin{array}{ccc|c} 1 & 1 & 1 & k \\ 0 & -2 & 0 & -k \\ 0 & -2 & \lambda-4 & 3-4k \end{array}\right)$	1	Operate to obtained **0** at (2, 1) and (3, 1)
$\xrightarrow{R_3 - R_2 \to R_3} \left(\begin{array}{ccc|c} 1 & 1 & 1 & k \\ 0 & -2 & 0 & -k \\ 0 & 0 & \lambda-4 & 3-3k \end{array}\right)$	1	Operate to obtained **0** at (3, 2)
	1	

(a) $\lambda - 4 \neq 0$ $\lambda \neq 4$	1	
(b) $\lambda - 4 = 0, \; 3 - 3k = 0$ $\lambda = 4 \quad , \; k = 1$	1	
(c) $\lambda - 4 = 0, \; 3 - 3k \neq 0$ $\lambda = 4 \quad , \; k \neq 1$	1	

4. (a) Solve the equation $w^2 - 6w + 36 = 0$. [3]

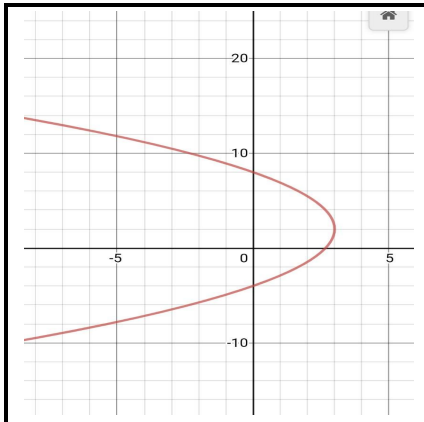
(b) Given that w is either of the roots found in part (a), deduce the exact value of w^{-3}. [5]

(a) $w = \frac{6 \pm \sqrt{6^2 - 4(1)(36)}}{2(1)}$	1	
$w = 3 + 3\sqrt{3}\,\mathbf{i}$	1	
$w = 3 - 3\sqrt{3}\,\mathbf{i}$	1	

(b) w = 3 + 3 $\sqrt{3}$ i |w|=6	1 1	
arg w = $\frac{\pi}{3}$	1	
$z^{-3} = \left(6cis\frac{\pi}{3}\right)^{-3}$ $= 6^{-3}cis(-\pi)$	1	
$= -\frac{1}{216}$	1	

5. A parabola has its vertex at (3, 2) and focus at (0, 2).
   (a) Sketch the graph. Show clearly the directrix of the parabola. [3]
   (b) Find the equation of the parabola. [2]
   (c) Find the coordinates of the y-intercepts. [2]

(a)	1 1 1	Vertex (3,2) Directrix x=6 Overall (shape)



$(y-2)^2 = 4(-3)(x-3)$ **$(y-2)^2 = -12(x-3)$**	**1** **1**	Standard form
∴ (0 , 8) ∴ (0, -4)	**1** **1**	

6. Lines l_1, l_2 *and* l_3 have vector equations

$l_1 : \underset{\sim}{r} = (5\underset{\sim}{i} - \underset{\sim}{j} - 2\underset{\sim}{k}) + s(-6\underset{\sim}{i} + 8\underset{\sim}{j} - 2\underset{\sim}{k}),$

$l_2 : \underset{\sim}{r} = (3\underset{\sim}{i} - 8\underset{\sim}{j}) + t(\underset{\sim}{i} + 3\underset{\sim}{j} + 2\underset{\sim}{k}),$

$l_3 : \underset{\sim}{r} = (2\underset{\sim}{i} + \underset{\sim}{j} + 3\underset{\sim}{k}) + u(3\underset{\sim}{i} + c\underset{\sim}{j} + \underset{\sim}{k})$

(a) Given l_1 is parallel to l_3, find the value of c. [2]

(b) Given instead that l_2 and l_3 intersect, find the value of c and the point of intersection. [6]

(a) $(-6\underset{\sim}{i} + 8\underset{\sim}{j} - 2\underset{\sim}{k}) = \lambda(3\underset{\sim}{i} + c\underset{\sim}{j} + \underset{\sim}{k})$	**1**	
c = -4	**1**	

(b) $\begin{cases} 3 + t = 2 + 3u \\ -8 + 3t = 1 + cu \\ 2t = 3 + u \end{cases}$	**2**	Any 2
t = 2	**1**	
u = 1	**1**	
c = - 3	**1**	
(5, -2, 4)	**1**	

7. Express $\cos\theta - 2\sin\theta$ in the form $R\cos(\theta + \alpha)$, where R > 0 and $0 < \alpha < \frac{\pi}{2}$. [3]

Hence, for $0 < \theta < 2\pi$,

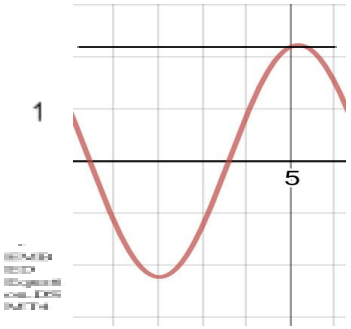
(a) Solve the equation $\cos\theta - 2\sin\theta = 2$. [3]

(b) Sketch the curve $y = \cos\theta - 2\sin\theta$, and deduce the range of values of θ such that $\cos\theta - 2\sin\theta \geq 2$. [4]

(c) State the smallest and greatest values of $\frac{1}{\cos\theta - 2\sin\theta + 3}$ and find the corresponding values of θ when these occurs. [5]

(a) $\cos\theta - 2\sin\theta = R\cos(\theta + \alpha)$ $= R(\cos\theta\cos\alpha - \sin\theta\sin\alpha)$ $\alpha = 1.107$ rad $R = \sqrt{5}$ $\sqrt{5}\cos(\theta + 1.107)$	 **1** **1** **1**	
(b) $\sqrt{5}\cos(\theta + 1.107) = 2$ $\theta + 1.107 = 0.4637, 5.8195$ *or* $\theta = 0.1476\pi, 1.8524\pi$	**1** **1**	
$\theta = 1.795\pi, 1.5\pi$	**1**	

(b)	**1** **1** **1**	Curve y=2 overall

		
$\{x : 1.5\pi \le x \le 1.795\pi\}$	**1**	
(c) $-1 \le \cos(x+1.107) \le 1$ $-\sqrt{5} \le \sqrt{5}\cos(x+1.107) \le \sqrt{5}$ $-\sqrt{5}+3 \le \sqrt{5}\cos(x+1.107)+3 \le \sqrt{5}+3$ $\frac{1}{-\sqrt{5}+3} \le \frac{1}{\sqrt{5}\cos(x+1.107)+3} \le \frac{1}{\sqrt{5}+3}$ The smallest value $= \frac{1}{-\sqrt{5}+3}, \cos(\theta+1.107) = -1$ $\theta = 0.6476\pi$ The greatest value $= \frac{1}{\sqrt{5}+3}, \cos(\theta+1.107) = 1$ $\theta = 1.4865\pi$	**1** **1** **1** **1** **1**	

8. The position vectiors, $\underset{\sim}{a} = \underset{\sim}{i} + \underset{\sim}{j} + \underset{\sim}{k}, \underset{\sim}{b} = \underset{\sim}{i} + 2\underset{\sim}{j} + 3\underset{\sim}{k}$ and $\underset{\sim}{c} = \underset{\sim}{i} - 3\underset{\sim}{j} + 2\underset{\sim}{k}$

(a) Find a unit vector parallel to $\underset{\sim}{a} + \underset{\sim}{b} + \underset{\sim}{c}$. [3]

(b) Calculate the acute angle between $\underset{\sim}{a}$ and $\underset{\sim}{a} + \underset{\sim}{b} + \underset{\sim}{c}$ to the nearest 0.1^0. [3]

(c) Find the vector of the form which is perpendicular to both $\underset{\sim}{a}$ and $\underset{\sim}{b}$. [2]

(d) Determine the position vector of the point D which is such that ABCD is parallelogram. [3]

(e) Calculate the area of the parallelogram. [4]

(a) $\underset{\sim}{a} + \underset{\sim}{b} + \underset{\sim}{c} = 3\underset{\sim}{i} + 6\underset{\sim}{k}$	**1**	
Unit vector = $\frac{3\underset{\sim}{i} + 6\underset{\sim}{k}}{\sqrt{9+36}}$	**1**	
$= \frac{3}{\sqrt{45}}\underset{\sim}{i} + \frac{6}{\sqrt{45}}\underset{\sim}{k}$	**1**	

(b) $\begin{pmatrix}1\\1\\1\end{pmatrix}.\begin{pmatrix}3\\0\\6\end{pmatrix} = \sqrt{3}\sqrt{45}\cos\theta$	**1**	

TAMAT SAMPEL

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