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PERCUBAAN STPM 2010

**MATHEMATICS T (MATEMATIK T)****PAPER 1 (KERTAS 1)****Three hours (Tiga jam)****PEPERIKSAAN PERCUBAAN BERSAMA  
SIJIL TINGGI PERSEKOLAHAN MALAYSIA (STPM) 2010****ANJURAN BERSAMA  
JABATAN PELAJARAN KEDAH DARUL AMAN  
DAN  
PERSIDANGAN KEBANGSAAN PENGETUA-PENGETUA  
SEKOLAH MENENGAH MALAYSIA (PKPSM) KEDAH****Instructions to candidates**

*Answer all questions. Answers may be written in either English or Malay.*

*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, unless a different level of accuracy is specified in the question.*

*Mathematical tables, a list of Mathematical formulae, and graph paper are provided.*

**Arahan kepada calon**

*Jawab semua soalan. Jawapan boleh ditulis dalam Bahasa Inggeris atau Bahasa Melayu.*

*Semua kerja yang perlu hendaklah ditunjukkan dengan jelas.*

*Jawapan berangka tak tepat boleh diberikan betul hingga tiga angka bererti, atau satu tempat perpuluhan dalam kes sudut dalam darjah, kecuali aras kejituan yang lain ditentukan dalam soalan.*

*Sifir Matematik, senarai rumus Matematik, dan kertas graf dibekalkan.*

**This question paper consists of 7 printed pages and 1 blank page.  
(Kertas soalan ini terdiri daripada 7 halaman bercetak dan 1 halaman kosong.)**

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\*Kertas soalan ini SULIT sehingga peperiksaan kertas ini tamat.

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1. Find the solution set of the inequality

$$|x + 1| \leq |2x + 1| \quad [4 \text{ marks}]$$

2. Given point  $A(2, k)$  lies on the curve  $x^3 + 2y^3 + 3xy = 0$ , find the value of  $k$ .  
Find also the gradient and equation of the normal to the curve at point A. [6 marks]

3. Express  $U_r = \frac{3r+4}{r(r+1)(r+2)}$  in partial fractions. [3 marks]  
Hence or otherwise, find

(a)  $\sum_{r=1}^n U_r$  [2 marks]

(b)  $\sum_{r=1}^{\infty} U_r$  [2 marks]

4. Three points have coordinates  $A(2, 9)$ ,  $B(4, 3)$  and  $C(2, -5)$ . The line through C with gradient  $\frac{1}{2}$  meets the straight line AB produced at D.

Find

- (a) the coordinates of D [3 marks]  
(b) the equation of the line through D perpendicular to the line  $5y - 4x = 17$  [3 marks]

5. Given that complex numbers  $3 + 2i$ ,  $5 - i$  and  $4 - 6i$  are the first three terms of geometric progression.

Find

- (a) the common ratio, [2 marks]  
(b) the fifth term, [3 marks]  
(c) the sum of the first 6 terms of this geometric progression. [2 marks]

6. Evaluate  $\int_0^{\frac{\pi}{4}} x^2 \cos 2x \, dx$ .

Give your answer in terms of  $\pi$ . [7 marks]

7. The parametric equations of a curve are  $x = 4t$ ,  $y = \frac{4}{t}$ , where the parameter  $t$  takes all non-zero values. The points A and B on the curve have parameters  $t_1$  and  $t_2$  respectively,
- (a) Write down the coordinates of the midpoint of the chord AB in terms of  $t_1$  and  $t_2$ . [1 mark]
- (b) Given that the gradient of AB is  $-2$ , show that  $t_1 t_2 = \frac{1}{2}$ . [3 marks]
- (c) Find the coordinates of the points on the curve at which the gradient of the normal is  $\frac{1}{2}$ . [4 marks]

8. Functions  $f$  and  $g$  are defined by
- $$f: x \rightarrow x^2 - 2x + 2, x \in \mathbb{R}, 0 \leq x \leq 1 \text{ and}$$
- $$g: x \rightarrow \frac{x+2}{x+1}, x \in \mathbb{R}, 1 \leq x \leq 2 \text{ respectively.}$$

- (a) Determine the range and inverse function of  $f$ . [4 marks]
- (b) Given function  $h = gf$ , determine the range of  $h$ . [3 marks]
- (c) State why  $h^{-1}$  exists. [1 mark]

9. (a) The matrices  $A$  and  $B$  are given by

$$A = \begin{pmatrix} 2 & 3 & 4 \\ 4 & 3 & 1 \\ 1 & 2 & 4 \end{pmatrix}, \quad B = \begin{pmatrix} -10 & 4 & 9 \\ 15 & -4 & -14 \\ -5 & 1 & 6 \end{pmatrix}.$$

State with reason whether matrix  $A$  is singular.

Find the matrix  $AB$ , and hence, deduce  $A^{-1}$ . [5 marks]

- (b) Using the result in (a), solve the system of linear equations.

$$\begin{aligned} 2y + 4z &= -x + 2, \\ 2x + 3y &= -1 - 4z, \\ 4x + z - 3 &= -3y. \end{aligned}$$

[5 marks]

10. A curve is defined parametrically by  $x = 2t - 1$ ,  $y = t^3$  and P is the point on the curve when  $t = 2$ .
- (a) Obtain an expression for  $\frac{dy}{dx}$  in terms of  $t$  and calculate the gradient of the curve at P. [3 marks]
- (b) Find  $\frac{d^2y}{dx^2}$  in terms of  $t$ . [3 marks]
- (c) Determine a Cartesian equation of the curve, expressing your answer in the form  $y = f(x)$ . [3 marks]
- (d) Find the  $x$  and  $y$  intercepts of the curve. [1 mark]

11. Show that

- (a)  $\int_0^{\frac{\pi}{2}} x \sin x \, dx = 1$ , [2 marks]
- (b)  $\int_0^{\frac{\pi}{2}} \sin^2 x \, dx = \frac{1}{4}\pi$ . [Hint: Use identity  $\cos 2A = 1 - 2 \sin^2 A$ ] [3 marks]

Find the area of the region bounded by the  $x$ -axis, the curve  $y = x - \sin x$  and the line  $x = \frac{1}{2}\pi$ . [3 marks]

Hence, show that the volume of the solid generated when the region bounded by the  $x$ -axis, the curve  $y = x - \sin x$  and the line  $x = \frac{1}{2}\pi$  is rotated through  $360^\circ$  about the

$x$ -axis is  $\frac{1}{24}(\pi^4 + 6\pi^2 - 48\pi)$   $unit^3$ . [4 marks]

12. Given  $p(x) = 6x^4 + ax^3 + bx^2 + x - 1$ , where  $a$  and  $b$  are real constants. If  $(2x - 1)$  is a factor of  $p(x)$  and  $(x - 1)$  is a factor of  $p'(x)$ ,
- (a) Find the values of  $a$  and  $b$ , factorise  $p(x)$  completely, and hence solve the equation  $p(x) = 0$ . [8 marks]
- (b) Given that  $p(x) = (3x + 1)\left[2x^3 + 1 - q(x)\right]$ , find  $q(x)$ . Sketch the graph of  $q(x)$  and determine the range of  $q(x)$  when  $x \in [0, 5]$ . [7 marks]