SULIT

KEMENTERIAN PENDIDIKAN TINGGI
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN MATEMATIK, SAINS DAN KOMPUTER

PEPERIKSAAN AKHIR

SESI II: 2024/2025

BBM20133: CALCULUS FOR ENGINEERING TECHNOLOGY

TARIKH : 17 JUN 2025
MASA : 9.00 PAGI – 12.00 T/HARI (3 JAM)

Kertas soalan ini mengandungi **SEMBILAN (9)** halaman bercetak.

Struktur (5 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

INSTRUCTION:

This section consists of **FIVE (5)** structured questions. Answer **ALL** the questions.

ARAHAN:

*Bahagian ini mengandungi **LIMA (5)** soalan berstuktur. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1 (a) Calculate the following limit of function.

Kirakan fungsi had berikut.

$$\lim_{x\to 3} \frac{\sqrt{x+1}-2}{x^2-9}.$$

[4 marks]

[*4 markah*]

CLO2 (b) Solve the following limit of infinity.

Selesaikan had infiniti yang berikut.

i. $\lim_{x\to\infty} \frac{x+5}{2x^2+1}$

[3 marks]

[*3 markah*]

ii. $\lim_{x\to\infty} \frac{2x^2+3x+1}{3x^2-5x+2}$

[3 marks]

[*3 markah*]

CLO2

(c) A function is defined as:

Suatu fungsi ditakrif sebagai:

$$f(x)=\begin{cases} 2x & , \quad x<1 \\ cx^2 & , \quad 1\le x\le 2 \\ 4x & , \quad x>2 \end{cases}$$

i. Calculate the value of *c* if the function $f(x)$ is continuous at $x=1$.

Kirakan nilai c jika fungsi $f(x)$ *adalah berterusan pada* $x=1$.

[3 marks]

[*3 markah*]

ii. Determine whether the function $f(x)$ is continuous at $x=2$.

Tentukan sama ada fungsi $f(x)$ *adalah berterusan pada* $x=2$.

[3 marks]

[*3 markah*]

iii. Sketch the graph of function $f(x)$ for domain $0\le x\le 2$.

Lakarkan graf bagi fungsi $f(x)$ *untuk julat* $0\le x\le 2$.

[4 marks]

[4 *markah*]

QUESTION 2

SOALAN 2

CLO2

(a) Solve the first derivative of the following function by using an appropriate method.

Selesaikan terbitan pertama bagi fungsi berikut dengan menggunakan kaedah yang sesuai.

i. $f(x) = x\ln(9x)$

[4 marks]

[*4 markah*]

ii. $f(x) = \dfrac{\tan 2x}{\cot x}$

[4 marks]

[*4 markah*]

CLO2

(b) i. Given that $x = 2 + t$ and $y = t^2 - 1$ are the parametric equations. Solve the $\dfrac{d^2y}{dx^2}$.

Diberi bahawa $x = 2 + t$ *dan* $y = t^2 - 1$ *ialah persamaan parametrik. Selesaikan nilai* $\dfrac{d^2y}{dx^2}$.

[4 marks]

[4 *markah*]

ii. Solve $\dfrac{\partial^2 z}{\partial x^2}$, $\dfrac{\partial^2 z}{\partial y^2}$ and $\dfrac{\partial^2 z}{\partial x \partial y}$ for the following equation.

Selesaikan $\dfrac{\partial^2 z}{\partial x^2}$, $\dfrac{\partial^2 z}{\partial y^2}$ *dan* $\dfrac{\partial^2 z}{\partial x \partial y}$ *bagi persamaan yang berikut.*

$$z = x^2y^3 + 2x\cos y$$

[8 marks]

[*8 markah*]

QUESTION 3

SOALAN 3

CLO3 (a) Given a curve $y = x + \frac{1}{x}$, find the equation of the tangent to the curve at $x = 2$.

Diberi satu lengkung $y = x + \frac{1}{x}$, *cari persamaan tangen kepada lengkung tersebut pada titik koordinat* $x = 2$.

[4 marks]

[*4 markah*]

CLO3 (b) Given a curve:

Diberi suatu persamaan lengkung:

$$y = x^3 - 10x^2 + 25x + 4$$

i. Solve all the coordinates of stationary points on the curve above.

Selesaikan semua koordinat bagi titik pegun untuk persamaan lengkung di atas.

[3 marks]

[*3 markah*]

ii. Sketch the curve of stationary point.

Tentukan sifat titik-titik pegun Lakarkan persamaan lengkung di atas berdasarkan titik-titik pegun

[5 marks]

[*5 markah*]

CLO3

(c) The surface area of a sphere decreases at the rate of $6cm^2s^{-1}$ at the instant when its radius is 12cm. Solve the rate at which the volume of the sphere is decreasing at that instant.

[The surface of the Area and Volume of the Sphere is $4\pi r^2$ and $\frac{4}{3}\pi r^3$].

Luas permukaan sfera semakin berkurangan pada kadar $6cm^2s^{-1}$ pada saat itu juga jejari sfera itu adalah 12cm.

[Luas Permukaan dan Isipadu Sfera ialah $4\pi r^2$ dan $\frac{4}{3}\pi r^3$].

[8 marks]

[*8 markah*]

QUESTION 4

SOALAN 4

CLO1

(a) Show each of the following function.

Tunjukkan setiap yang berikut.

i. $\int \left(9\cos x - 8x^3 + 2\right)\, dx$

[3 marks]

[*3 markah*]

ii. $\int_1^3 \frac{5x^6 + 6x^3 - x^2}{x^2}\, dx$

[3 marks]

[*3 markah*]

CLO2

(b) Calculate $\int \frac{3x^2}{2x^3 + 1}\, dx$ by using substitution method.

Hitungkan $\int \frac{3x^2}{2x^3 + 1}\, dx$ *dengan menggunakan kaedah penggantian*.

[7 marks]

[*7 markah*]

CLO2

(c) Solve the following integration by using suitable integration techniques.

Selesaikan yang berikut menggunakan teknik pengamiran yang sesuai.

$$\int_1^2 \int_0^3 x^2 y \; dxdy$$

[7 marks]

[*7 markah*]

QUESTION 5

SOALAN 5

CLO3

(a) A particle is moving on the x-axis. At time $t = 0$, the particle is at the point where $x = 5$. The velocity of the particle at time *t* second is $v = 6t - t^2$. Solve the distance of the particle when $t = 6$.

Suatu zarah sedang bergerak pada paksi -x. Pada masa $t = 0$*, zarah berada pada titik x = 5. Halaju zarah pada masa t saat adalah* $v = 6t - t^2$*. Selesaikan jarak bagi zarah itu apabila* $t = 6$.

[6 marks]

[*6 markah*]

CLO3

(b) Figure 5(b) shows a curve and a straight line with respective equations $y = x^2 - 8x + 17$ and $y = 10$. The points *A* and *B* are the points of intersection between the straight line and the curve. Calculate the area of shaded region.

Rajah 5(b) menunjukkan garis lengkung dan garis lurus dengan persamaan masing-masing $y = x^2 - 8x + 17$ *dan* $y = 10$*. Di mana titik A dan titik B ialah titik persilangan antara garis lengkung dan garis lurus. Hitungkan luas kawasan yang berlorek.*

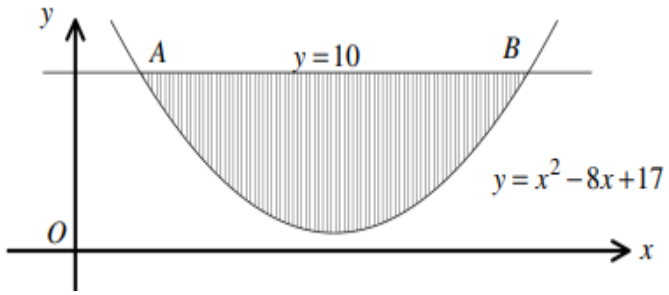

Figure 5(b)/ *Rajah 5(b)*

[6 marks]

[*6 markah*]

CLO3

(c) Figure 5(c) shows the curve, $y = 4 - x^2$. Calculate the volume of the solid generated when the shaded region *R* is revolved through 360^o about the x-axis.

Rajah 5(c) menunjukkan graf lengkung, $y = 4 - x^2$. *Kira isipadu yang dijana apabila kawasan berlorek R diputarkan melalui* 360^o *pada paksi-x.*

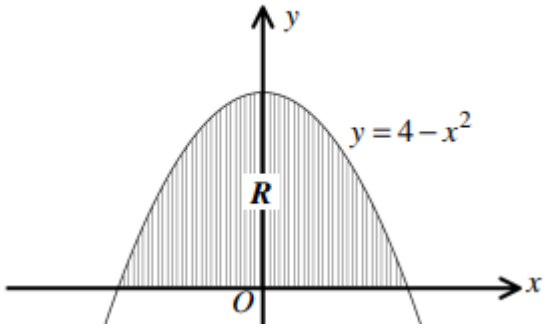

Figure 5(c)/ *Rajah 5(c)*

[8 marks]

[*8 markah*]

SOALAN TAMAT

FORMULA BBM20133: CALCULUS FOR ENGINEERING TECHNOLOGY

LIMIT AND FUNCTION

$$\lim_{x\to a} c = c$$

$$\lim_{x\to a} x^n = a^n$$

$$\lim_{x\to a}\left[f(x)\pm g(x)\right] = \lim_{x\to a} f(x) \pm \lim_{x\to a} g(x)$$

$$\lim_{x\to a}\left[f(x)\cdot g(x)\right] = \lim_{x\to a} f(x)\cdot \lim_{x\to a} g(x)$$

$$\lim_{x\to a}\left[\frac{f(x)}{g(x)}\right] = \frac{\lim_{x\to a} f(x)}{\lim_{x\to a} g(x)}, \lim_{x\to a} g(x) \neq 0$$

$$\lim_{x\to a}\left[cf(x)\right] = c\lim_{x\to a} f(x)$$

DIFFRENTIATION

$$\frac{dy}{dx} = \frac{dy}{du}\times\frac{du}{dx}$$

$$\frac{d}{dx}(u\cdot v) = u\frac{dv}{dx} + v\frac{du}{dx}$$

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\dfrac{du}{dx} - u\dfrac{dv}{dx}}{v^2}$$

$$\frac{dy}{dx} = \frac{dy}{dt}\times\frac{dt}{dx}$$

TRIGONOMETRIC IDENTITIES

$$\cos^2 x + \sin^2 x = 1$$

$$\sec^2 x = 1 + \tan^2 x$$

$$\operatorname{cosec}^2 x = 1 + \cot^2 x$$

$$\begin{aligned}\sin 2x &= \cos^2 x - \sin^2 x\\ &= 1 - 2\sin^2 x\\ &= 2\cos^2 x - 1\end{aligned}$$

$$\tan 2x = \frac{2\tan x}{1-\tan^2 x}$$

DIFFERENTIATION

$$\frac{d}{dx}(k) = 0;\ k = \text{constant}$$

$$\frac{d}{dx}\left(x^n\right) = nx^{n-1}$$

$$\frac{d}{dx}\left(\ln|u|\right) = \frac{1}{u}\cdot\frac{du}{dx}$$

$$\frac{d}{dx}\left(e^u\right) = e^u\cdot\frac{du}{dx}$$

$$\frac{d}{dx}(\cos u) = -\sin u\cdot\frac{du}{dx}$$

$$\frac{d}{dx}(\sin u) = \cos u\cdot\frac{du}{dx}$$

$$\frac{d}{dx}(\tan u) = \sec^2 u\cdot\frac{du}{dx}$$

$$\frac{d}{dx}(\cot u) = -\operatorname{cosec}^2 u\cdot\frac{du}{dx}$$

$$\frac{d}{dx}(\sec u) = \sec u\tan u\cdot\frac{du}{dx}$$

INTEGRATION

$$\int k\,dx = kx + C\ ;\ k = \text{constant}$$

$$\int x^n\,dx = \frac{x^{n+1}}{n+1} + C\ ;\ n \neq -1$$

$$\int \frac{1}{u}\,du = \frac{\ln|u|}{du/dx} + C$$

$$\int e^u\,du = \frac{e^u}{du/dx} + C$$

$$\int \sin u\,du = \frac{-\cos u}{du/dx} + C$$

$$\int \cos u\,du = \frac{\sin u}{du/dx} + C$$

$$\int \sec^2 u\,du = \frac{\tan u}{du/dx} + C$$

$$\int \operatorname{cosec}^2 u\,du = \frac{-\cot u}{du/dx} + C$$

$$\int \sec u\tan u\,du = \frac{\sec u}{du/dx} + C$$

$$\int \operatorname{cosec} u\cot u\,du = \frac{-\operatorname{cosec} u}{du/dx} + C$$

TANGENT LINE EQUATION	NORMAL LINE EQUATION
$y - y_1 = m(x - x_1)$	$y - y_1 = -\frac{1}{m}(x - x_1)$
AREA BOUNDED BY AXIS	**VOLUME REVOLVED AROUND AXIS**
$A = \int_a^b y dx$ $A = \int_a^b x dy$	$V = \pi \int_a^b y^2 dx$ $V = \pi \int_a^b x^2 dy$
INTEGRATION BY PART	
$\int u\,dv = uv - \int v du$	