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 I : 2024/2025

BBM20043: CALCULUS FOR ENGINEERING TECHNOLOGY

TARIKH : 07 JANUARI 2025
MASA : 9.00 PG – 12.00 TGH (3 JAM)

Kertas 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.

$$\lim_{x\to 2}\frac{3-\sqrt{5x-1}}{x-2}$$

[5 marks]

[*5 markah*]

CLO2

(b) Solve the limit of infinity for the given function expression.

Selesaikan had infiniti bagi setiap fungsi ungkapan yang diberikan.

$$\lim_{x\to+\infty}\frac{12x+7}{1+\sqrt{9x^2-4}}$$

[5 marks]

[*5 markah*]

CLO2 (c) Given that the function:

Suatu fungsi ditakrif sebagai:

$$f(x)=\begin{cases} x^2+4x+m, & -2\le x<1 \\ n-x, & 1\le x<4 \\ 3, & x\ge 4 \end{cases}$$

i. If $f(x)$ is continuous at $x=1$ and $x=4$, determine the values of *m* and *n*.

Jika $f(x)$ *adalah berterusan pada* $x=1$ *dan* $x=4$, *tentukan nilai bagi m dan n.*

[6 marks]

[*6 markah*]

ii. Sketch the graph of $f(x)$.

Lakarkan graf bagi $f(x)$.

[4 marks]

[*4 markah*]

QUESTION 2

SOALAN 2

CLO1 (a) Express the second derivative of the following.

Ungkapkan terbitan kedua bagi yang berikut.

$$f(x) = \frac{3}{7x^2} + 2e^{5x} - \sin(3x - 1)$$

[4 marks]

[*4 markah*]

CLO2 (b) Determine the first order derivative for the given function by using appropriate rules.

Tentukan pembezaan peringkat pertama bagi fungsi yang diberikan dengan menggunakan kaedah yang sesuai:

$$y = \frac{\ln(5 - 2x)}{(3x - 1)^4}$$

[8 marks]

[*8 markah*]

CLO2 (c) Determine the second order partial derivatives of the following function.

Tentukan terbitan separa tertib kedua bagi fungsi berikut.

$$z = x^4 \cos(3y) - 2y \sin(x)$$

[8 marks]

[*8 markah*]

QUESTION 3

SOALAN 3

CLO3 (a) A tangent and normal is drawn to the curve $y = x\sqrt{8-2x}$ at $x = -4$. Find the value of $\frac{dy}{dx}$ at $x = -4$ and the equation of the tangent.

Satu tangen dan normal dilukis pada lengkung $y = x\sqrt{8-2x}$ *pada* $x = -4$. *Cari nilai* $\frac{dy}{dx}$ *pada* $x = -4$ *dan persamaan tangen tersebut.*

[6 marks]

[*6 markah*]

CLO3 (b) A particle moves along a straight line so that its displacement, s metre from a fixed point 0 at t seconds is given by $s = t^3 - 5t^2 - 8t + 12$, where $t \geq 0$. Calculate the velocity, v and acceleration, a of the particle in terms of t. Hence determine the instantaneous velocity, in ms^{-1} and instantaneous acceleration, in ms^{-2} of the particle when $t = 2$.

Suatu zarah bergerak di sepanjang garis lurus. Sesarannya, s meter, dari satu titik tetap O dalam masa, t, diberi oleh $s = t^3 - 5t^2 - 8t + 12$, *dimana* $t \geq 0$. *Kirakan halaju, v dan pecutan, a bagi zarah itu dalam sebutan t. Seterusnya, tentukan halaju zarah dalam* ms^{-1} *dan pecutan zarah dalam* ms^{-2} *apabila* $t = 2$.

[6 marks]

[6 *markah*]

CLO3

(c) An inverted conical tank with a radius of 2m and height 3m is filled with water. Water is leaking from the vertex of the tank at a rate of $0.1m^3$ per minute. At the instant when the height of water is 1m, calculate the water level rate of change and the rate of change of water surface radius in metre per minute.

Sebuah tangki kon terbalik dengan jejari 2m dan tinggi 3m diisi sepenuhnya dengan air. Air bocor dari puncak tangki pada kadar $0.1m^3$ *seminit. Pada ketika ketinggian air ialah 1m, kirakan kadar perubahan paras air dan kadar perubahan jejari permukaan air dalam meter per minit.*

[8 marks]

[*8 markah*]

QUESTION 4

SOALAN 4

CLO1

(a) Integrate the following functions:

Kamirkan fungsi yang berikut:

$$\int \frac{2x^2}{\sqrt[3]{x}} + \sin(3x+1) - \frac{1}{3-2x}\, dx$$

[6 marks]

[6 *markah*]

CLO2

(b) Integrate each of the given integral by using suitable integration technique:

Kamirkan setiap yang berikut menggunakan teknik pengamiran yang sesuai:

i. $\int \frac{x+26}{x^2+3x-10} dx$

[6 marks]

[*6 markah*]

ii. $\int (3t + t^2 - 1)\sin 2t \; dt$

[8 marks]

[*8 markah*]

QUESTION 5

SOALAN 5

CLO3

(a) The acceleration of an object moving in a straight line passed through a fixed point O is given by $a(t) = 12t - 6$. The velocity of the object after 1 second is $10ms^{-1}$. Determine the velocity of the object at $t = 5$ seconds.

Pecutan bagi suatu objek bergerak di sepanjang garis lurus melalui satu titik tetap O diberi oleh $a(t) = 12t - 6$. *Halaju objek berkenaan selepas 1 saat ialah* $10ms^{-1}$. *Tentukan halaju objek apabila* $t = 5$ *saat.*

[5 marks]

[*5 markah*]

CLO3

(b) Figure 5(b) shows a shaded region bounded by the curve $y = x^2 - 4x + 7$ and straight line $y = 7 - x$. Determine the coordinates of P and Q. Then, find the area of shaded region.

Rajah 5(b) menunjukkan kawasan berlorek yang bersempadan dengan lengkung $y = x^2 - 4x + 7$ *dan garis lurus* $y = 7 - x$. *Tentukan koordinat titik P dan Q. Seterusnya cari luas kawasan berlorek.*

[7 marks]

[*7 markah*]

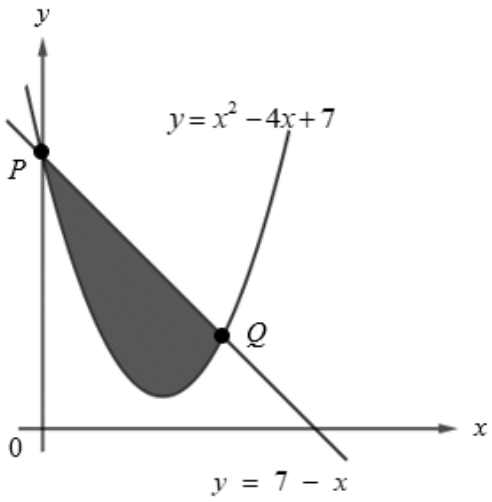

Figure 5(b)/ *Rajah 5(b)*

CLO3

(c) Figure 5(c) shows the graph of the curve, $x = y^2 - 1$ which intersects the straight line, $8y = 3x$ at point A. Calculate the volume generated when the shaded region is revolved through 360^o on the y-axis.

Rajah 5(c) menunjukkan graf lengkung, $x = y^2 - 1$ *bersilang dengan garis lurus,* $8y = 3x$ pada titik A. *Kira isipadu yang dijana apabila rantau berlorek diputarkan melalui* 360^o *pada paksi-y.*

[8 marks]

[*8 markah*]

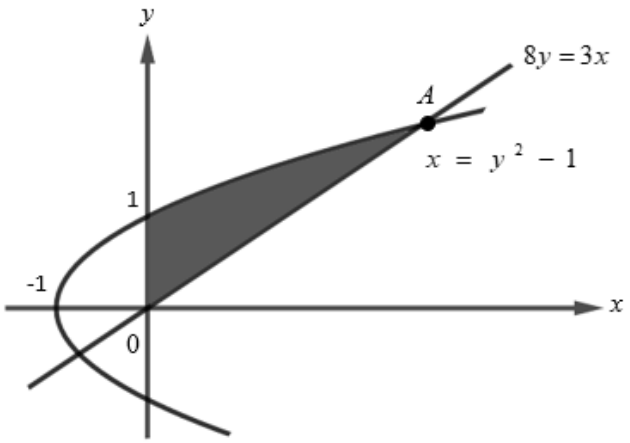

Figure 5(c)/ *Rajah 5(c)*

SOALAN TAMAT

FORMULA BBM20043 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

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

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

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

$$\sin 2x = 2\sin x\cos x$$

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

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

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	
$\int u\,dv = uv - \int v du$	