**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**

# BBM20043: CALCULUS FOR ENGINEERING TECHNOLOGY

**TARIKH : 16 JUN 2025**
**MASA : 9.00 PAGI – 12.00 T/HARI (3 JAM)**

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Kertas ini mengandungi **LAPAN (8)** halaman bercetak.

Struktur (5 soalan)

Dokumen sokongan yang disertakan : Formula

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**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN**

(CLO yang tertera hanya sebagai rujukan)

**INSTRUCTION:**

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

***ARAHAN :***

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

**QUESTION 1**

***SOALAN 1***

CLO1 (a) Calculate the following limit:

*Kirakan had yang berikut:*

$$\lim_{x \to 9} \frac{\sqrt{x+7}-4}{x-9}$$

[5 marks]

[*5 markah*]

CLO2 (b) Solve the following limit:

*Selesaikan had yang berikut:*

$$\lim_{x \to \infty} \frac{20x^4 - 7x^3}{2x + 9x^2 + 5x^4}$$

[5 marks]

[*5 markah*]

CLO2 (c) Show that $f(x)$ is continuous at $x = 2$.

*Tunjukkan bahawa* $f(x)$ *berterusan pada* $x = 2$.

$$f(x) = \begin{cases} 4x + 3 & , \quad x \leq 2 \\ 8 - x & , \quad x > 2 \end{cases}$$

[5 marks]

[*5 markah*]

CLO2 (d) Show that $f(x) = \sqrt{9 - x^2}$ is continuous on the closed interval $[-3,3]$.

*Tunjukkan bahawa* $f(x) = \sqrt{9 - x^2}$ *adalah berterusan pada selang tertutup* $[-3,3]$.

[5 marks]

[*5 markah*]

**QUESTION 2**

***SOALAN 2***

CLO1 (a) Show the second derivatives, $\frac{d^2y}{dx^2}$ of the function given with respect to $x$.

*Tunjukkan terbitan kedua,* $\frac{d^2y}{dx^2}$ *bagi fungsi yang diberikan terhadap* $x$.

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

[4 marks]

[4 *markah*]

CLO2 (b) Solve $\frac{dy}{dx}$ for the given functions by using specified method.

*Selesaikan* $\frac{dy}{dx}$ *bagi fungsi-fungsi yang diberi menggunakan kaedah yang dinyatakan.*

i. $y = e^{2x}\cos 3x$ (Product Rule)

(*Petua Hasil Darab*)

[4 marks]

[4 *markah*]

ii. $y = \frac{x^2-1}{2x+3}$ (Quotient Rule)

(*Petua Hasil Bahagi*)

[4 marks]

[4 *markah*]

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

*Selesaikan semua pembezaan separa peringkat kedua bagi fungsi berikut.*

$$z = x^3y^2 - \frac{4y^6}{x^3}$$

[8 marks]

[*8 markah*]

**QUESTION 3**

***SOALAN 3***

CLO3 (a) Given the curve equation $y = x^3 - 2x + 5$. Construct normal equation at point $x = 2$.

*Diberi persamaan lengkung* $y = x^3 - 2x + 5$. *Bina persamaan normal pada titik* $x = 2$.

[6 marks]

[6 *markah*]

CLO3 (b) Assume $s(t) = t^3 - 12t^2 + 30t$ is the vector position of one particle in meters after $t$ seconds. Calculate the velocity of the particle when its acceleration is zero.

*Andaikan* $s(t) = t^3 - 12t^2 + 30t$ *adalah kedudukan vektor bagi satu zarah dalam meter selepas* $t$ *saat. Kirakan kelajuan zarah tersebut apabila pecutannya adalah sifar.*

[6 marks]

[6 *markah*]

CLO3 (c) An object is dropped into a sea and the ripples form a concentric circle which expands. The radius of the circle is increasing at the rate of $0.4\ ms^{-1}$. Find the rate at which the area of one of these circles is increasing when the diameter of the circle is 6 meters.

*Sebuah objek jatuh ke dalam laut dan riak membentuk bulatan sepusat yang mengembang. Jejari bulatan tersebut semakin meningkat pada kadar* $0.4\ ms^{-1}$. *Carikan kadar luas bulatan ini bertambah apabila diameter bulatan tersebut adalah 6 meter.*

[8 marks]

[8 *markah*]

**QUESTION 4**

***SOALAN 4***

CLO1 (a) Show the integration for the following function with respect to $x$.

*Tunjukkan pengamiran bagi fungsi berikut terhadap $x$.*

$$\int \frac{1}{4x^2} + e^{(2x+1)} + \cos(3x+1)\ dx$$

[6 marks]

[6 *markah*]

CLO2 (b) Solve the following integration using partial fraction technique.

*Selesaikan kamiran berikut menggunakan teknik pecahan separa.*

$$\int \frac{4}{x^2 + 5x - 14}\ dx$$

[7 marks]

[7 *markah*]

CLO2 (c) Calculate the following function:

*Kirakan fungsi berikut:*

$$\int_0^1 \int_{-y}^{y^2} 84x^2\ dx\ dy$$

[7 marks]

[7 *markah*]

**QUESTION 5**

***SOALAN 5***

CLO3 (a) A car starts in the state of rest and has accelerated at given time, $t$ through the equation at $a = 3t^2 - 2$ in $m/s^2$. Calculate the velocity of the car at $t = 4$ seconds.

*Sebuah kereta bermula dalam keadaan rehat dan memecut pada masa diberi, $t$ menerusi persamaan $a = 3t^2 - 2$ dalam $m/s^2$. Kirakan halaju kereta tersebut pada $t = 4$ saat.*

[5 marks]

[*5 markah*]

CLO3 (b) Figure 5(b) shows a shaded region bounded by the curve $y = (x + 2)^2$ and the straight line $y = x + 4$. Calculate area of the shaded region.

*Rajah 5(b) menunjukkan rantau berlorek dibatasi oleh lengkung $y = (x + 2)^2$ dan garis lurus $y = x + 4$. Kirakan luas rantau berlorek.*

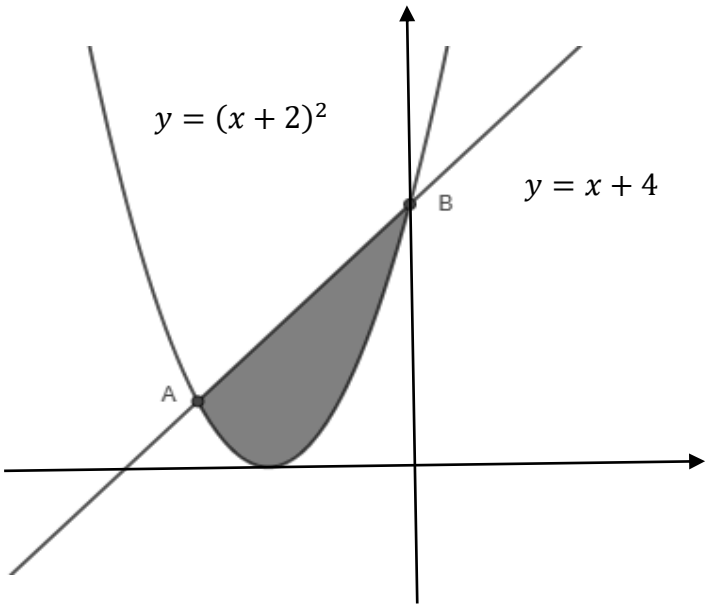


Figure 5(b) / Rajah 5(b)

[7 marks]

[*7 markah*]

CLO3 (c) Figure 5(c) shows a shaded region bounded by the curve $y = -x^2 + 2x$. Find the volume generated when the shaded region is rotated $360°$ at $x$-axis.

*Rajah 5(c) menunjukkan rantau berlorek dibatasi lengkung* $y = -x^2 + 2x$. *Cari isipadu yang dijana apabila rantau berlorek diputar* $360°$ *pada paksi-* $x$.

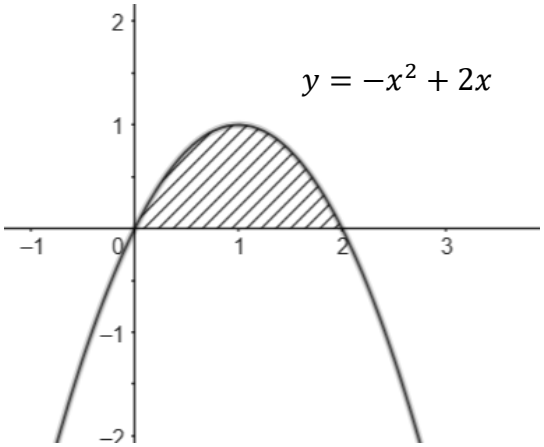


Figure 5(c) / Rajah 5(c)

[8 marks]

[*8 markah*]

**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

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

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

$$\cos ec^2 x = 1 + \cot^2 x$$

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

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

## DIFFERENTIATION

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

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

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

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

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

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

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

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

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

## INTEGRATION

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

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

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

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

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

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

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

$$\int \cos ec^2 u\ du = \frac{-\cot u}{du/dx} + C$$

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

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

| 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** |
| $A = \int_a^b y dx$<br>$A = \int_a^b x dy$ | $V = \pi \int_a^b y^2 dx$<br>$V = \pi \int_a^b x^2 dy$ |
| **INTEGRATION BY PART** | |
| $\int u\,dv = uv - \int v du$ | |