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**

# BBM20133: CALCULUS FOR ENGINEERING TECHNOLOGY

**TARIKH : 31 DISEMBER 2024**
**MASA : 9.00 PAGI – 12.00 TENGAH HARI**
**(3 JAM)**

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Kertas ini mengandungi **SEMBILAN (9)** 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 struktur. Jawab semua soalan*

**QUESTION 1**

***SOALAN 1***

CLO1 (a) Calculate the following limits:

*Kirakan had fungsi yang berikut:*

$$\lim_{x\to 6}\left(\frac{\frac{3x}{7}+3}{x^2+7x}\right)$$

[4 marks]

[4 *markah*]

CLO2 (b) Solve the following limits of infinity:

*Selesaikan had infiniti yang berikut:*

i.

$$\lim_{x\to\infty}\left(\frac{3x+4}{x-1}\right)$$

[3 marks]

[3 *markah*]

ii.

$$\lim_{x\to\infty}\left(\frac{x^3+2}{6x^2-5}\right)$$

[3 marks]

[3 *markah*]

CLO2 (c) A function is defined as :

*Suatu fungsi ditakrif sebagai :*

$$f(x)=\begin{cases} x^2-m, & x<2 \\ mx+3, & 2\le x<5 \\ 3x-2, & x\ge 5 \end{cases}$$

i. Calculate the value of $m$ if the $f$ function is continuous.

*Kirakan nilai bagi $m$ jika fungsi $f$ adalah selanjar.*

[3 marks]

[3 *markah*]

ii. Determine whether the $f$ function is continuous at $x = 5$.

*Tentukan sama ada fungsi $f$ selanjar pada $x = 5$.*

[4 marks]

[4 *markah*]

iii. Sketch the graph of $f$ function for domain $2 \le x < 6$.

*Lakarkan graf bagi fungsi $f$ untuk domain $2 \le x < 6$.*

[3 marks]

[3 *markah*]

**QUESTION 2**

***SOALAN 2***

CLO2

(a) Determine $\frac{dy}{dx}$ for the following functions by using appropriate method:

*Tentukan* $\frac{dy}{dx}$ *bagi fungsi berikut menggunakan kaedah yang sesuai:*

i. $y = x(\sin 3x)$

[4 marks]

[4 *markah*]

ii. $y = \frac{\cos 4x}{4x}$

[4 marks]

[4 *markah*]

CLO2

(b) i. Solve the second derivative of $\frac{d^2y}{dx^2}$ with respect to $x$:

*Selesaikan terbitan kedua* $\frac{d^2y}{dx^2}$ *terhadap x:*

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

[4 marks]

[4 *markah*]

ii. Determine $\frac{\partial^2 z}{\partial x \partial y}$ and $\frac{\partial^2 z}{\partial y \partial x}$ for the following equation:

*Tentukan* $\frac{\partial^2 z}{\partial x \partial y}$ *dan* $\frac{\partial^2 z}{\partial y \partial x}$ *bagi persamaan berikut:*

$$z = \frac{x^2}{y} + e^{5x}$$

[8 marks]

[8 *markah*]

**QUESTION 3**

***SOALAN 3***

CLO3 (a) Given that:

*Diberi bahawa:*

$$y = x(x + 2) + 1$$

Solve the equation of normal to the curve at $x = 2$

*Selesaikan persamaan normal kepada lengkung pada x = 2*

[4 marks]

[4 *markah*]

CLO3 (b) Given a curve :

*Diberi satu lengkung:*

$$y = 2 + 3x^2 - x^3$$

i. Calculate coordinate of the stationary points on the curve above.

*Kira koordinat titik-titik pegun pada lengkung di atas.*

[3 marks]

[3 *markah*]

ii. Sketch the curve above based on the stationary points.

*Lakarkan lengkung di atas berdasarkan titik-titik pegunnya.*

[5 marks]

[5 *markah*]

CLO3 (c) An object is dropped into the sea and the ripples form concentric circles that expand. The circle's radius is increasing at the rate of 0.5 $ms^{-1}$. Calculate the increasing rate of the area of the circle when the diameter is 5m. (Ignore other possible factors).

*Sebuah objek dijatuhkan ke dalam laut dan riak membentuk bulatan sepusat yang mengembang. Jejari bulatan tersebut semakin meningkat pada kadar* $0.5\ ms^{-1}$. *Kirakan kadar keluasan bulatan ini bertambah apabila diameter bulatan tersebut adalah* $5\ m$. *(Abaikan faktor-faktor lain yang mungkin berlaku).*

[8 marks]

[8 *markah*]

**QUESTION 4**

***SOALAN 4***

CLO1 (a) Express each of the following integrals:

*Ungkapkan setiap kamiran berikut:*

i. $\int \frac{5x^6-3x^2}{x^3}\, dx$ [3 marks]

[3 *markah*]

ii. $\int_0^1 5 + e^x\, dx$ [3 marks]

[3 *markah*]

CLO2 (b) Solve the following integral by using suitable method:

*Selesaikan kamiran berikut menggunakan kaedah yang sesuai.*

$$\int \frac{7 + 4x^3}{x^4 + 7x}\, dx$$

[7 marks]

[7 *markah*]

CLO2 (c) Solve:

*Selesaikan:*

$$\int_0^2 \int_0^1 4xy\, dxdy$$

[7 marks]

[7 *markah*]

**QUESTION 5**

***SOALAN 5***

CLO3 (a) A toy car starts from point O and moves in a straight line with a velocity $v$ ms$^{-1}$ given by $v = 20 - 4t$ where $t$ is time in second after passing through O. Calculate the maximum displacement of the toy car.

*Satu kereta mainan bermula dari titik O dan bergerak dalam garis lurus dengan halaju* $v\ ms^{-1}$ *diberikan oleh* $v = 20 - 4t$ *di mana t ialah masa dalam saat selepas melalui O. Hitung sesaran maksimum kereta mainan itu.*

[6 marks]

[6 *markah*]

CLO3 (b)

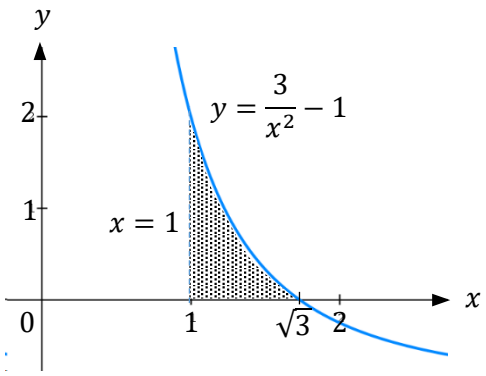


Figure 5(b)

*Rajah 5(b)*

Figure 5(b) shows a shaded region bounded by the curve $y = \frac{3}{x^2} - 1$, the line $x = 1$, point $(\sqrt{3}, 0)$ and the $x$-axis. Calculate the area of the shaded region.

*Rajah 5(b) menunjukkan rantau berlorek dibatasi oleh lengkung* $y = \frac{3}{x^2} - 1$, *garis* $x = 1$, *titik* $(\sqrt{3}, 0)$ *dan paksi-x. Kirakan luas rantau berlorek.*

[6 marks]

[6 *markah*]

CLO3 (c)

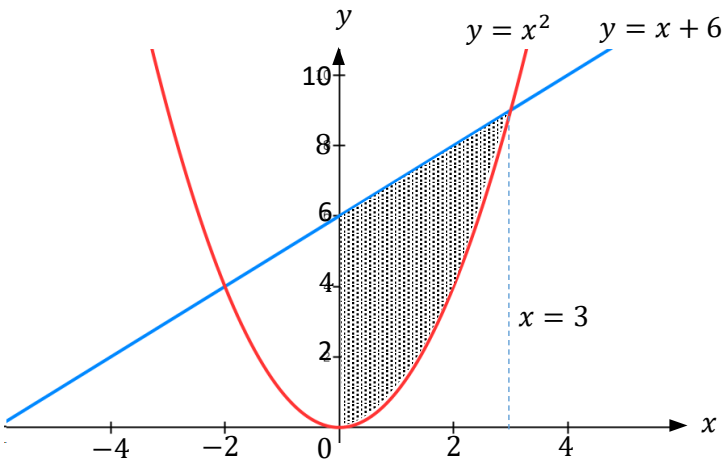


Figure 5(c)

*Rajah 5(c)*

Figure 5(c) shows a shaded region bounded by the curve $y = x^2$, the line $y = x + 6$ and $x = 3$. Calculate the volume generated when the shaded region is rotated $360°$ at $x$-axis.

*Rajah 5(c) menunjukkan rantau berlorek dibatasi lengkung* $y = x^2$, *garis* $y = x + 6$ *dan* $x = 3$. *Kirakan isipadu yang dijana apabila rantau berlorek diputar* $360°$ *pada paksi-*$x$.

[8 marks]

[8 *markah*]

**SOALAN TAMAT**

**FORMULA BBM20133 CALCULUS FOR ENGINEERING TECHNOLOGY**

## LIMIT & FUNCTION

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

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

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

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

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

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

## DIFFERENTIATION

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

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

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

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

## TRIGONOMETRIC IDENTITIES

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

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

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

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

$$\cos 2x = \cos^2 x - \sin^2 x$$

$$= 1 - 2\sin^2 x$$

$$= 2\cos^2 x - 1$$

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

## DIFFERENTIATION

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

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

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

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

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

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

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

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

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

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

## INTEGRATION

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

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

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

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

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

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

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

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

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

**FORMULA BBM20133 CALCULUS FOR ENGINEERING TECHNOLOGY**

| 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** | |
| $\int u \ dv = uv - \int v \ du$ | |
| **HYPERBOLIC FUNCTION** | |
| $\sinh x = \frac{e^x - e^{-x}}{2}$<br>$\cosh x = \frac{e^x + e^{-x}}{2}$<br>$\tanh x = \frac{e^x - e^{-x}}{e^x + e^{-x}}$<br>$\cos ech\, x = \frac{2}{e^x - e^{-x}}, x \neq 0$<br>$\sec h\, x = \frac{2}{e^x + e^{-x}}$<br>$\coth x = \frac{e^x - e^{-x}}{e^x + e^{-x}}, x \neq 0$ | |