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 : 2022/2023

BBM20043: CALCULUS FOR ENGINEERING TECHNOLOGY

TARIKH : 14 JUN 2023
MASA : 8:30 AM – 11:30 AM (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)

SULIT

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) Solve the limits of functions for the following expressions:

Selesaikan fungsi bagi had untuk ungkapan yang berikut:

i. $\lim_{x \to 2} 2x$

[1 mark]

[*1 markah*]

ii. $\lim_{x \to \frac{1}{4}} (4x - 1)$

[2 marks]

[*2 markah*]

iii. $\lim_{x \to 1} \frac{1}{1-3x}$

[2 marks]

[*2 markah*]

CLO2 (b) Solve the limits of infinity for the following expressions:

Selesaikan infiniti bagi had untuk ungkapan yang berikut:

i. $\lim_{x\to\infty} \frac{8}{5-2x^3}$

[2 marks]

[*2 markah*]

ii. $\lim_{x\to+\infty} \frac{5x^2-7}{3x^2+x}$

[3 marks]

[*3 markah*]

CLO2 (c) Determine that $f(x) = \frac{x-1}{x^2+2x}$ is continuous on the open interval $(-2,0)$ and $(0,+\infty)$.

Tentukan bahawa $f(x) = \frac{x-1}{x^2+2x}$ *adalah berterusan pada selang terbuka* $(-2,0)$ *dan* $(0,+\infty)$.

[10 marks]

[*10 markah*]

QUESTION 2

SOALAN 2

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

Ungkapkan terbitan kedua bagi yang berikut:

i. $f(x) = \sqrt{x}$.

[2 marks]

[*2 markah*]

ii. $f(x) = \sin 2x$

[2 marks]

[*2 markah*]

CLO2 (b) Solve the following $\frac{dy}{dx}$ by using specified method:

Selesaikan $\frac{dy}{dx}$ *yang berikut dengan menggunakan kaedah yang dinyatakan:*

i. $y = e^{1-\cos x}$ (Chain rule)

(*Petua rantai*)

[3 marks]

[*3 markah*]

ii. $y = \frac{\ln(x+1)}{x^7}$ (Quotient rule)

(*Petua hasil bahagi*)

[5 marks]

[*5 markah*]

CLO2 (c) If $y = e^x \sin 3x$, determine that $\frac{d^2y}{dx^2} - 2\,\frac{dy}{dx} + 10y = 0$.

Jika $y = e^x \sin 3x$, *tentukan bahawa* $\frac{d^2y}{dx^2} - 2\,\frac{dy}{dx} + 10y = 0$.

[8 marks]

[*8 markah*]

QUESTION 3

SOALAN 3

CLO3 (a) The point Q $(1, -5)$ lies on the curve $y = 3x^2 - 8x$.

Titik Q $(1, -5)$ *terletak pada lengkung* $y = 3x^2 - 8x$.

i. Calculate the gradient of the tangent to the curve at point Q.

Kira kecerunan tangen kepada lengkung itu di titik Q.

[2 marks]

[2 *markah*]

ii. Solve the equation of the normal to the curve at point Q.

Selesaikan persamaan normal kepada lengkung itu di titik Q.

[4 marks]

[4 *markah*]

CLO3 (b) A particle is moving in a straight line. At time t seconds, its displacement, x metre from a fixed point O on the line is given by equation $x = 2t^3 - 8t$. Calculate:

Satu zarah bergerak dalam garis lurus. Pada masa t saat, sesarannya, x meter dari titik tetap O pada garis yang diberikan oleh persamaan $x = 2t^3 - 8t$. *Kirakan:*

i. The velocity of the particle when $t = 3$ seconds.

Halaju zarah apabila $t = 3$ *saat.*

[3 marks]

[3 *markah*]

ii. The acceleration of the particle when $t = 2$ seconds.

Pecutan zarah apabila $t = 2$ *saat.*

[3 marks]

[3 *markah*]

CLO3 (c) The radius, $r\ cm$ of a spherical balloon increases at the rate of $0.4\ cms^{-1}$. The radius of the balloon is $8\ cm$, calculate the rate of change of its

Jejari, $r\ cm$ sebuah belon berbentuk sfera bertambah pada kadar $0.4\ cms^{-1}$. Jejari belon itu ialah $8\ cm$, kirakan kadar perubahan

i. volume ($V_s = \frac{4}{3}\pi r^3$)

isipadu

[4 marks]

[4 *markah*]

ii. surface area ($A_s = 4\pi r^2$)

luas permukaan

[4 marks]

[4 *markah*]

QUESTION 4

SOALAN 4

CLO1 (a) Express each of the following integrals:

Ungkapkan setiap kamiran berikut:

i. $\int \left(\sqrt{x} + \frac{1}{3\sqrt{x}}\right) dx$

[3 marks]

[3 *markah*]

ii. $\int \frac{8}{x} - \frac{5}{x^2} + \frac{6}{x^3}\ dx$

[3 marks]

[3 *markah*]

CLO2 (b) Solve the following functions.

Selesaikan fungsi berikut.

i. $\int_1^3 \int_0^2 (xy + x^2y^3)\ dy\ dx$

[6 marks]

[6 *markah*]

ii. $\int_0^{\frac{\pi}{4}} 4x \cos 4x\ dx$ (Integration by Parts)

(*Kamiran Bahagian Demi Bahagian*)

[8 marks]

[8 *markah*]

QUESTION 5

SOALAN 5

CLO3 (a) A particle moves along a straight line which passes through a fixed point, O, with a velocity of $18\ ms^{-1}$. Its acceleration, $a\ ms^{-2}$, $t\ (s)$ after leaving O is given by $a = 3 - 2t$. Calculate the maximum velocity of the particle.

Satu zarah bergerak sepanjang garisan lurus dan melepasi titik tetap O dengan halaju $18\ ms^{-1}$. Pecutan, $a\ ms^{-2}$, $t\ (s)$ selepas meninggalkan O adalah diberi $a = 3 - 2t$. Kirakan halaju maksimum zarah.

[5 marks]

[*5 markah*]

CLO3 (b) Given Figure 5(b). Calculate the area of the shaded region.

Diberi Rajah 5(b). Kira luas pada kawasan berlorek.

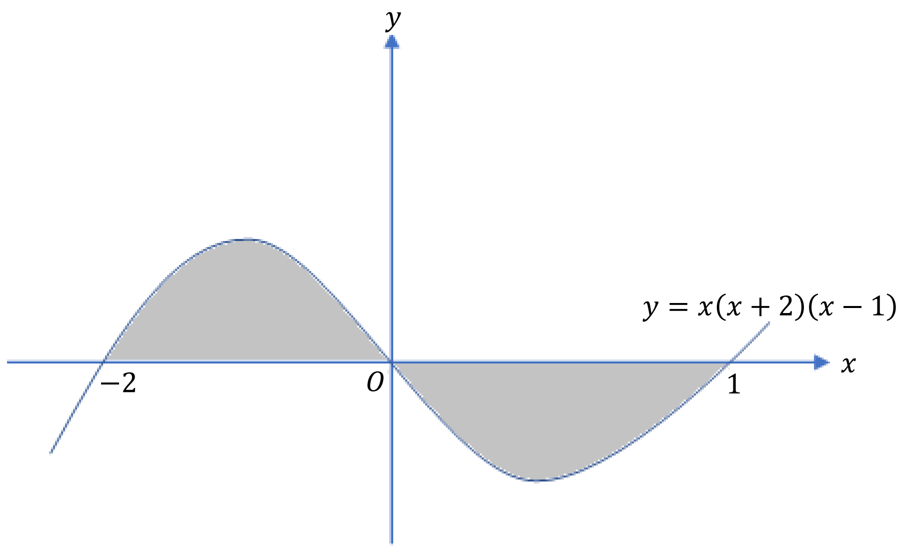

Figure 5(b)

Rajah 5(b)

[7 marks]

[*7 markah*]

CLO3 (c) Figure 5(c) shows a shaded region enclosed by the curve $y = \frac{10}{x}$ and the straight lines $x = 2$ and $y = \frac{5}{3}$. Calculate the volume generated when the shaded region is rotated through 360° at:

Rajah 5(c) menunjukkan kawasan berlorek yang disertakan dengan lengkuk $y = \frac{10}{x}$ *dan garis lurus* $x = 2$ dan $y = \frac{5}{3}$. *Kirakan isipadu janaan apabila kawasan berlorek diputarkan 360° pada:*

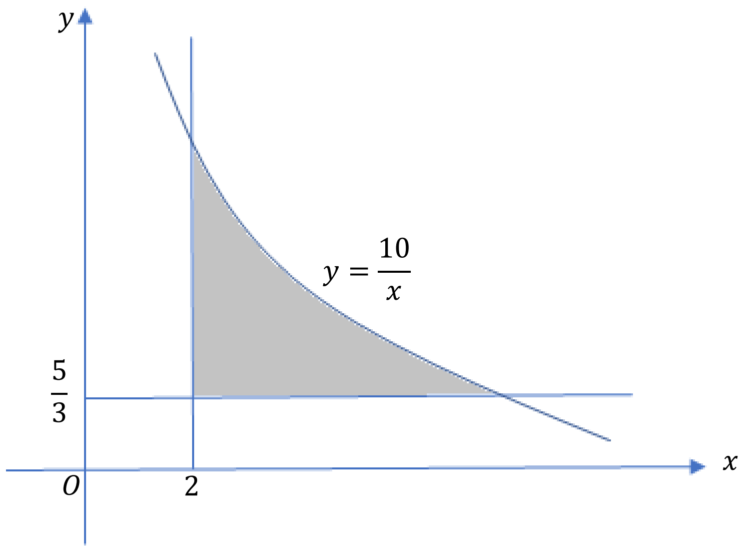

Figure 5(c)

Rajah 5(c)

i. x-axis

paksi x

[4 marks]

[*4 markah*]

ii. y-axis

paksi y

[4 marks]

[*4 markah*]

SOALAN TAMAT

FORMULA BBM20043 CALCULUS FOR ENGINEERING TECHNOLOGY

LIMIT & FUNCTION

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

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

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

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

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

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

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

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

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

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

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

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

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

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

DIFFERENTIATION

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

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

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

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

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

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

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

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

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

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

INTEGRATION

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

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

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

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

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

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

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

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

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

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

FORMULA BBM20043 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**
$A = \int_a^b y\,dx$ $A = \int_a^b x\,dy$	$V = \pi \int_a^b y^2\,dx$ $V = \pi \int_a^b x^2\,dy$

INTEGRATION BY PART
$\int u\,dv = uv - \int v\,du$