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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	TECHNICAL MATHEMATICS II
COURSE CODE	:	DAS 11103
PROGRAMME	:	1 DAB /1 DAJ /1 DAR / 1 DAK
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	A) ANSWER ALL QUESTIONS IN **PART A** B) ANSWER **THREE (3)** QUESTIONS IN **PART B**

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

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PART A

Q1 (a) Determine whether the following integration is improper or proper integral. Give your reason.

$$\int_{1}^{\infty} \frac{3}{x^2 - 1}\, dx$$

(3 marks)

(b) Evaluate the following integral by using substitution

$$\int_{0}^{1} \frac{2x + 5}{(x^2 + 5x + 3)^3}\, dx$$

(10 marks)

(c) Evaluate

$$\int x^2 \ln x \, dx$$

by using integration by parts

(7 marks)

Q2 (a) Solve the following integral by using Trapezoidal's rule, using $h = 0.125$. Write the answer to 3 decimal places

$$\int_{0}^{1} \sqrt{\frac{x}{1 + x}}\, dx$$

(9 marks)

(b) Determine the area of the region bounded by the curve and line

$$y = 2 + x - x^2\,,\; y + x + 1 = 0$$

(11 marks)

PART B

Q3 (a) Sketch the graph and determine the domain and range.

(i) $y = x^3 + x + 7$

(3 marks)

(ii) $y = -\dfrac{1}{(x+5)}$

(3 marks)

(iii) $y = e^{2x}$

(3 marks)

(iv) $y = -\sqrt{x-5}$

(3 marks)

(b) Given $f(x) = \sqrt{x-5} + 3$, $g(x) = \dfrac{2x^2}{3}$ and $h(x) = 2x - 1$. Calculate

(i) $f \circ g$

(3 marks)

(ii) f^{-1}

(2 marks)

(iii) $f \circ g \circ h^{-1}$

(3 marks)

Q4 (a) Compute the following limits.

(i) $\lim\limits_{x \to 0} \dfrac{e^{2x} + e^{x} - 2}{e^{x} - 1}$

(4 marks)

(ii) $\lim\limits_{x \to 1} \dfrac{x-1}{\sqrt{x} - 1}$

(4 marks)

(iii) $\lim_{x \to 3} \frac{x-3}{x^2-7x+12}$

(4 marks)

(iv) $\lim_{x \to \infty} \frac{\sqrt{3x^4+x}}{x^2-8}$

(4 marks)

(b) Given: $f(x) = \begin{cases} x^2-1, & x<3 \\ 2ax, & x \geq 3 \end{cases}$.

Find a, so that $f(x)$ continuous at every value of x.

(4 marks)

Q5 (a) Find $\frac{dy}{dx}$ of the following:

(i) $y = \left(\frac{x-5}{2x+1}\right)^3$.

(5 marks)

(ii) $xy = x + \cos y$

(5 marks)

(b) Given $x = t^3 - 8t$ and $y = 5 - t^4$. Calculate $\frac{dy}{dx}$ when $t = 2$.

(5 marks)

(c) If $y = Ax + Bx^2$, where A and B are constants, show that

$$x^2 \frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 0$$

(5 marks)

Q6 (a) Using L'Hôspital's Rule, find

(i) $\lim_{x \to 0} \frac{x - \sin x}{x^2}$

(ii) $\lim_{x \to \infty} \frac{x - 8x^2}{12x^2 + 5x}$

(6 marks)

(b) A boat travels with a variable speed. Its displacement at any time t is given by

$$s = 2t^3 - 8t^2 + 8t.$$

(i) Find t if the displacement is maximum and determine its displacement at that point.

(10 marks)

(ii) Find t if the velocity is minimum and determine its velocity at that point.

(4 marks)

Q7 (a) From **Figure Q7 (a)**, find the area of the region enclosed by the curve

$$y^2 = 4x \text{ and } y = 2x - 4.$$

(7 marks)

(b) Use cylindrical shells to find the volume of the solid that results when the region enclosed by $y^2 = 4x$, $y = 2$ and $x = 4$ is revolved about the y – axis. Refer from **Figure Q7 (b)**.

(6 marks)

(c) Find the arc length of the curve $y = \frac{1}{3}\left(x^2 + 2\right)^{3/2}$ from $x = 0$ to $x = 3$.

(7 marks)

- END OF QUESTION-

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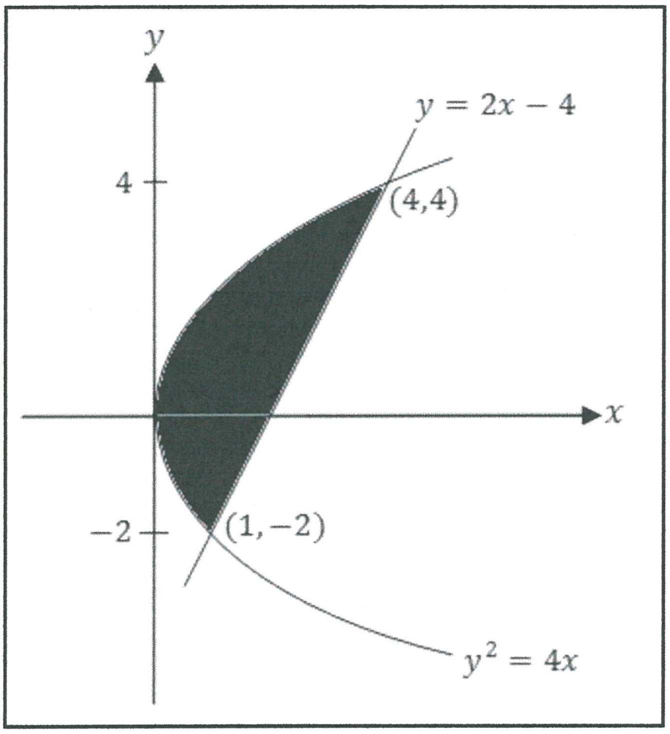

Figure Q7 (a)

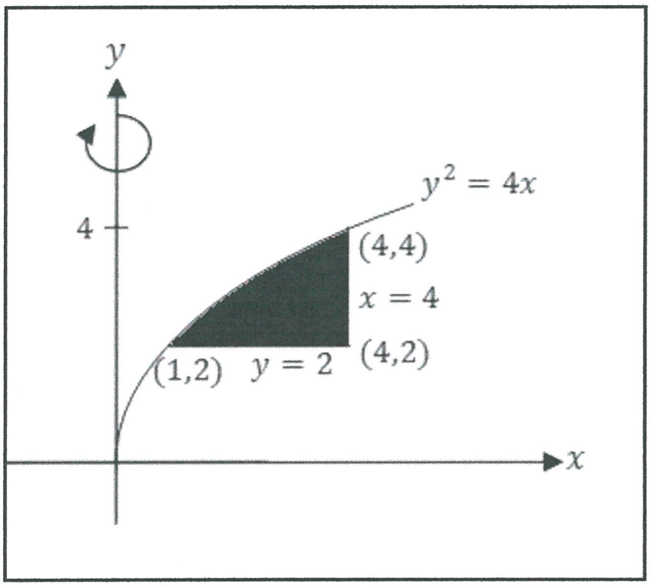

Figure Q7 (b)

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FORMULAE

Differentiation

$$\frac{d}{dx}(ax^n) = nax^{n-1}$$

$$\frac{d}{dx}(u^n) = nu^{n-1}\frac{du}{dx}$$

$$\frac{d}{dx}\left(\frac{1}{\sqrt{u}}\right) = \frac{1}{2\sqrt{u}}\frac{du}{dx}$$

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

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

$$\frac{d}{dx}(ku) = k\frac{du}{dx}$$

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

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

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

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

$$\frac{d}{dx}(uv) = uv' + vu'$$

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{vu' - uv'}{v^2}$$

Basic Integration

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

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

$$\int \sin x\,dx = -\cos x + C$$

$$\int \cos x\,dx = \sin x + C$$

Integration by Parts

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

Trapezoidal Rule

$$\int_a^b f(x)dx \approx \frac{h}{2}[f(a) + f(b) + 2\sum_{i=1}^{n-1} f(a+ih)$$

Area

$$A = \int_a^b [f(x) - g(x)]\,dx$$

$$A = \int_c^d [u(y) - v(y)]\,dy$$

Volume

$$V = 2\pi\int_a^b x\,f(x)\,dx$$

Arch Length

$$\int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2}\,dx$$