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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2017/2018

COURSE NAME	:	TECHNICAL MATHEMATICS II
COURSE CODE	:	DAS 11103
PROGRAMME CODE	:	DAK / DAJ
EXAMINATION DATE	:	JUNE / JULY 2018
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS IN PART A AND **THREE (3)** QUESTIONS IN PART B

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THIS QUESTION PAPER CONSISTS OF **9 (NINE)** PAGES

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PART A

Q1 (a) **Figure Q1(a)** shows that the region T bounded by $x = y^2 - y - 6$ and $x = 2y + 4$.

(i) Find the coordinate of points P and Q.

(4 marks)

(ii) Find the area of the shaded region, T.

(4 marks)

(b) By using the cylindrical shells method, find the volume of the region bounded by the curves $x = (y-2)^2$ and $x = y$ when it is revolved about the $x-$axis.

(5 marks)

(c) Find the arc length of the curve, $y = \frac{2}{3}(x-1)^{\frac{3}{2}}$ when $1 \le x \le 2$.

(7 marks)

Q2 (a) Evaluate

(i) $\int 5x^2 - 8x + 5 \, dx$.

(2 marks)

(ii) $\int_{-1}^{2} t^2 + 3t^3 \, dt$.

(3 marks)

(b) By using substitution method, find $\int_{0}^{1} x\sqrt{1+x^2}\, dx$.

(7 marks)

(c) Solve $\int \sin x \ \ln(\cos x) \, dx$ by using integration by parts.

(8 marks)

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PART B

Q3 (a) By using Trapezoidal rule, solve the following integral with $h = 0.6$.

Write the answer to 4 decimal places.

$$\int_{-2}^{4} \sin\left(x^2+2\right)\,dx.$$

(6 marks)

(b) By using Simpson's rule, solve the following integral with $n=12$. Write the answer to 4 decimal places.

$$\int_{0}^{4} \sqrt[3]{x^4+6}\,dx.$$

(7 marks)

(c) Solve the following integral using partial fraction.

$$\int_{3}^{4} \frac{4x+1}{x^2-x-2}\,dx.$$

(7 marks)

Q4 (a) Given the function of $y = x^4 - 8x^2$.

(i) Find the extrema and the inflection points.

(10 marks)

(ii) Hence, sketch the graph.

(3 marks)

(b) A spherical balloon is being inflated in such a way that its volume is increasing at a constant rate of $180\text{cm}^3\text{s}^{-1}$. At time t seconds, the radius of the balloon is r cm. Find

(i) $\frac{dr}{dt}$ when r=30.

(4 marks)

(ii) the rate of increase of the surface area of the balloon when its radius is 30 cm. [Hint: $A = 4\pi r^2$].

(3 marks)

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

(i) $y = \sin(2x) + \frac{3}{\sqrt{x}} + \frac{2}{\sqrt{x^3}}$.

(3 marks)

(ii) $y = 2e^x(3 + 4x - x^2)$.

(4 marks)

(b) By using chain rule, differentiate $g(t) = -t^{-5} + \left(\frac{4}{t^3} - 7t\right)^3$.

(7 marks)

(c) By using implicit differentiation, find $\frac{dy}{dx}$ of the function $y^5 + x^2y^3 = 1 + x^4y$ when $x = 1$ and $y = 2$.

(6 marks)

Q6 (a) The graph of $f(x)$ is shown in **Figure Q6(a)**. Using the properties of continuity, determine whether the function is continuous when

(i) $x = 1$.

(4 marks)

(ii) $x = 4.5$.

(4 marks)

(b) Given that $f(x) = \begin{cases} x^3 & , \quad x < -1 \\ ax + b & , \quad -1 \le x < 1 \\ x^2 + 2 & , \quad x \ge 1 \end{cases}$. If $f(x)$ is a continuous function, find the values of a and b.

(5 marks)

(c) Find

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

(3 marks)

(ii) $\lim_{x \to 0} \frac{x(1 - 2x)}{1 - \sqrt{x + 1}}$.

(4 marks)

Q7 (a) The function $f(x)$ is given by

$$f(x)=\begin{cases} 4 & , \quad x\le -2 \\ x^2 & , \quad -2<x<2. \\ x+2 & , \quad x\ge 2 \end{cases}$$

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

(4 marks)

(ii) State the domain and range of $f(x)$.

(2 marks)

(iii) Find the value of $f(x)$ when $x=-4$, $x=1$ and $x=6$.

(3 marks)

(b) The functions $h(x)$ and $g(x)$ are defined by

$$g(x)=\frac{1}{x+3} \text{ and } h(x)=\frac{2}{x-4}.$$

(i) Find $g^{-1}(x)$.

(3 marks)

(ii) Find and simplify the composite function $g\circ h$.

(4 marks)

(iii) Find an expression for $(g\circ h)^{-1}(x)$.

(4 marks)

–END OF QUESTIONS–

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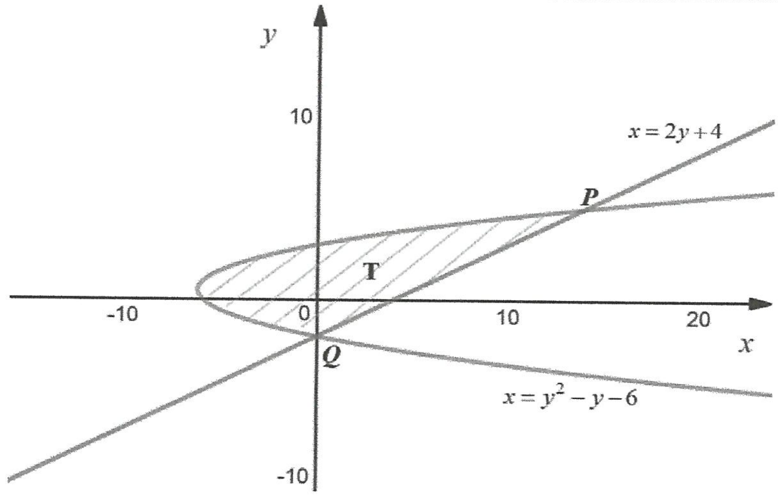

Figure Q1(a)

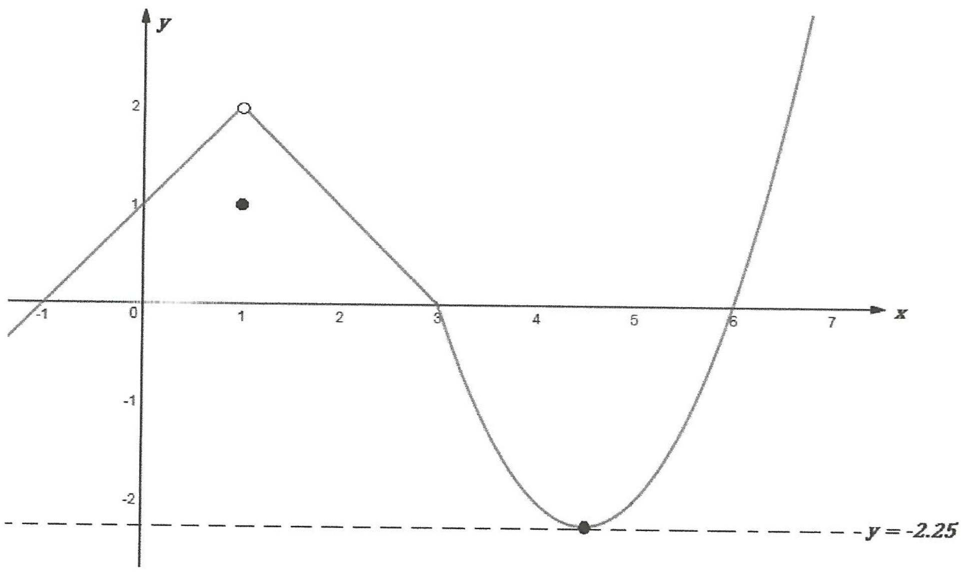

Figure Q6(a)

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Table 1: Differentiation

General Rule

$\frac{d}{dx}(ax^n) = nax^{n-1}$	$\frac{d}{dx}(\sin x) = \cos x$
$\frac{d}{dx}(e^x) = e^x$	$\frac{d}{dx}(\sin u) = \cos u\left(\frac{du}{dx}\right)$
$\frac{d}{dx}(e^{ax+b}) = ae^{ax+b}$	$\frac{d}{dx}(\cos x) = -\sin x$
$\frac{d}{dx}(a^x) = a^x \ln a$	$\frac{d}{dx}(\tan x) = \sec^2 x$
$\frac{d}{dx}(\ln x) = \frac{1}{x}$	$\frac{d}{dx}(\operatorname{cosec} x) = -\operatorname{cosec} x \cdot \cot x$
$\frac{d}{dx}(\ln u) = \frac{1}{u}\left(\frac{du}{dx}\right)$	$\frac{d}{dx}(\cos^{-1} x) = -\frac{1}{\sqrt{1-x^2}}$
$\frac{d}{dx}(\log_b x) = \frac{1}{x}\log_b e$	$\frac{d}{dx}(\cot x) = -\operatorname{cosec}^2 x$

Product and Quotient Rule

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

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

Chain Rule

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

$$\frac{dy}{dx} = \frac{dy}{dm} \cdot \frac{dm}{dn} \cdot \frac{dn}{dx}$$

Parametric Differentiation

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

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Table 2: Integration

General Rules:

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

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

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

$$\int \frac{1}{ax+b}\,dx = \frac{1}{a}\ln|ax+b| + C$$

$$\int e^x\,dx = e^x + C$$

$$\int e^{ax+b}\,dx = \frac{1}{a}e^{ax+b} + C$$

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

$$\int \sin(ax+b)\,dx = -\frac{1}{a}\cos(ax+b) + C$$

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

$$\int \cos(ax+b)\,dx = \frac{1}{a}\sin(ax+b) + C$$

Definite Integral:

$$\int_a^b f(x)\,dx = F(b) - F(a)$$

Integration by Parts:

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

Partial Fraction:

$$\frac{a}{x^2-1} = \frac{A}{x+1} + \frac{B}{x-1}$$

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Table 3: Integration

Trapezoidal Rule

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

Simpson's Rule

$$\int_a^b f(x)\,dx \approx \frac{h}{3}\left[f(a)+f(b)+4\sum_{\substack{i=1\\ i\text{ odd}}}^{n-1} f(a+ih)+2\sum_{\substack{i=1\\ i\text{ even}}}^{n-1} f(a+ih)\right]$$

Area

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

$$A=\int_c^d [f(y)-g(y)]\,dy$$

Volume in Cylindrical Shells

$$V=2\pi\int_a^b x[f(x)-g(x)]\,dx$$

$$V=2\pi\int_c^d y[f(y)-g(y)]\,dy$$

Arc Length

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

$$L=\int_c^d \sqrt{1+\left(\frac{dx}{dy}\right)^2}\,dy$$

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