ABU DHABI POLYTECHNIC
ACADEMIC SUPPORT DEPARTMENT

MATH 1010 – Calculus I

Final Exam
Sem.2 - 2024/2025
2 hours

Calculators are allowed
No additional materials are required

STUDENT NAME	
STUDENT NUMBER	
	DEPARTMENT: ASD

Please circle your CRN#:

Dr. Bassem: 4493, 4512, 4558, 4629 Dr. Georgios: 4275, 4380

Mr. Tinashe: 4336, 4433, 4591 Dr. Yasser: 4628

READ THESE INSTRUCTIONS CAREFULLY

Write your *name*, *number*, *CRN* and department **clearly** in the boxes above.

Answer **all** questions.

Show **all** your working and use appropriate **units.** Otherwise, you may lose marks.

You may use a pencil for all your work.

Answers that are not **clearly readable**, if any, will not be marked.

Part	Score
Part A.I	/21
Part A.II	/12
Part A.III	/6
Part B.I	/20
Part B.II	/10
Part B.III	/11
Total	/80

- **All mobile devices are not allowed during examination.**
- **Abu Dhabi Polytechnic considers cheating or attempting to cheat a serious offense that will result in disciplinary action taken against involved individuals.**

Part A.I: CLOs 2,3 (21 grades)

Find the derivative.

1) $\frac{1}{2}x^8 - \frac{1}{3}x^3$ 1) _____

A) $\frac{1}{2}x^7 - \frac{1}{3}x^2$ B) $4x^9 - x^4$ C) $4x^8 - x^3$ D) $4x^7 - x^2$

Find the derivative of the function.

2) $f(x) = (3x^4 + 8)^2$ 2) _____

A) $6x^4 + 16$ B) $144x^{15} + 96x^3$ C) $72x^7 + 192x^3$ D) $9x^{16} + 64$

Find dy/dx by implicit differentiation. If applicable, express the result in terms of x and y.

3) $7y^2 + 3x^2 - 11 = 0$ 3) _____

A) $\frac{-3x}{7}$ B) $\frac{-3x}{7y}$ C) $\frac{-3x^2}{14y}$ D) $\frac{-6x + 11}{14y}$

Find the indicated derivative of the function.

4) $f'''(x)$ for $f(x) = (x + 1)^{-1}$ 4) _____

A) $6(x + 1)^{-3}$ B) $6(x + 1)^{-4}$ C) $-6(x + 1)^{-3}$ D) $-6(x + 1)^{-4}$

Assume that all variables are implicit functions of time t. Find the indicated rate.

5) $y = 6x^2 - 8x$; $dx/dt = 0.5$ when $x = 8$; find dy/dt. 5) _____

A) 88 B) 44 C) 2 D) 16

Find those values of x for which the given function is increasing and those values of x for which it is decreasing.

6) $y = 7x^2 - 5x$ 6) _____

A) Increasing for $x > \frac{5}{14}$, decreasing for $x < \frac{5}{14}$

B) Increasing for $x < \frac{5}{14}$, decreasing for $x > \frac{5}{14}$

C) Increasing for $x > -\frac{5}{14}$, decreasing for $x < -\frac{5}{14}$

D) Increasing for $x > \frac{5}{7}$, decreasing for $x < \frac{5}{7}$

Find any relative maximum or minimum points of the given function.

7) $y = 4x^2 - 24x + 32$ 7) _____

A) Minimum at $(-4, 3)$ B) Minimum at $(3, -4)$

C) Maximum at $(4, -3)$ D) Maximum at $(-3, 4)$

Part A.II: CLOs 4,5 (12 grades)

Integrate the given expression.

8) $\int (6x^2 + 1)\ dx$ 8) _____

A) $2x^3 + C$ B) $12x + C$ C) $x + C$ D) $2x^3 + x + C$

Find the integral.

9) $\int \sin^3 x \cos x\ dx$ 9) _____

A) $\frac{\sin^4 x}{3} + C$ B) $\frac{\sin^4 x}{4} + C$ C) $\frac{\sin^3 x}{3} + C$ D) $\frac{\sin^3 x}{4} + C$

Integrate the function.

10) $\int x^4 e^{-x^5}\ dx$ 10) _____

A) $e^{-x^5} + C$ B) $-\frac{1}{5}e^{-x^5} + C$ C) $-5e^{-x^6} + C$ D) $-\frac{1}{5}e^{-x^6} + C$

11) $\int \frac{9e^{9x}\ dx}{e^{9x} + 1}$ 11) _____

A) $\ln(e^{9x} + 1) + C$ B) $e^{9x} \ln(e^{9x} + 1) + C$

C) $9 \ln(e^{9x} + 1) + C$ D) $\frac{1}{(e^{9x} + 1)^2} + C$

Part A.III: CLOs 1,6 (6 grades)

Find the exact area under the curve between the indicated values of x.

12) $y = 2x + 7$; between $x = 1$ and $x = 5$ 12) _____

A) 26 B) 18 C) 52 D) 9

Use L'Hospital's rule to find the limit.

13) $\lim_{x \to 0} \frac{\cos 3x - 1}{x^2}$ 13) _____

A) 0 B) $\frac{3}{2}$ C) $-\frac{9}{2}$ D) ∞

Part B.I: CLOs 2, 3 (20 grades)

Question 1 (12 grades)

1) Find the derivative of: $y = x^3 \sin(x)$.

2) Find the derivative of: $y = \ln(e^x - 5)$.

3) Find the expression of acceleration $a(t)$, if the velocity is: $v(t) = \sqrt{t^3 - 2t}$.

4) Find the rate of change of efficiency $E(T) = 100\left(\frac{T}{T+300}\right)$, where T is the temperature.

Question 2 (4 grades)

Find the equation of the tangent line to: $y = \cos(x) + 2x$ at $x = 0$.

Question 3 (4 grades)

A particle moves along a path defined by the parametric equations:

$x(t) = -t^2 + 2t$ and $y(t) = t^2 + 3t$ where $x(t)$ and $y(t)$ are in meters, and t is in seconds.

a) Find the components of the velocity vector $v_x(t)$ and $v_y(t)$ at any time t.

b) Find the magnitude and direction of the velocity at $t = 2$ seconds.

Part B.II: CLOs 4, 5 (10 grades)

Question 1 (6 grades)

Find the integrals below:

1) $\int 5x \cos(x^2)\, dx =$

2) $\int \sqrt{2x+5}\, dx =$

Question 2 (4 grades)

Find the integral $\int \frac{1}{(2x+1)^n}\, dx$ for the value of n below:

a) For $n = 2$:

b) For $n = 1$:

Part B.III: CLO 6 (11 grades)

Question 1 (5 grades)

Find the area bounded by $y = 7x$ and $y = 2x$ from $x = 1$ to $x = 3$.

Question 2 (6 grades)

a) Find the expression of the displacement $s(t)$ if the velocity $v(t) = t^2 + 3\pi$, where the time t is in seconds and $s(t)$ is in meter, given that $s = 7$ when $t = 0$.

b) Find the values of the velocity and displacement at $t = 3$ seconds.

Calculus - I - Formulae

Derivatives	Integrals
$(u^n)' = nu^{n-1}u'$	$\int (du + dv) = u + v + c$
$(\sin u)' = u' \cos u$	$\int u^n du = \frac{u^{n+1}}{n+1} + c \quad (n \neq -1)$
$(\cos u)' = -u' \sin u$	$\int \frac{1}{u} du = \ln \lvert u \rvert + c$
$(\ln u)' = \frac{u'}{u}$	$\int \sin u \, du = -\cos u + c$
$(e^u)' = u' e^u$	$\int \cos u \, du = \sin u + c$
$(u \pm v)' = u' \pm v'$	$\int e^u \, du = e^u + c$
$(u \cdot v)' = u' \cdot v + u \cdot v'$	**Area under the curve** $= \int_a^b y \, dx$
$\left(\frac{u}{v}\right)' = \frac{u' \cdot v - u \cdot v'}{v^2}$	**Area between curves** $= \int_a^b (y_{\text{High}} - y_{\text{Low}}) \, dx$

- **The equation of the line passing through (x_1, y_1) and having a slope m is given by:**

$$y - y_1 = m(x - x_1)$$

- **Magnitude of the resultant of a vector V is given by:**

$$V = \sqrt{V_x^2 + V_y^2}$$

- **Reference angle of the resultant of vector V is given by:**

$$\theta_{\text{ref}} = \tan^{-1} \left| \frac{V_y}{V_x} \right|$$

Quadrant-specific Direction (θ):

$$\theta = \begin{cases} \theta_{\text{ref}} & \text{if Quadrant I } (V_x > 0, V_y > 0) \\ 180^\circ - \theta_{\text{ref}} & \text{if Quadrant II } (V_x < 0, V_y > 0) \\ 180^\circ + \theta_{\text{ref}} & \text{if Quadrant III } (V_x < 0, V_y < 0) \\ 360^\circ - \theta_{\text{ref}} & \text{if Quadrant IV } (V_x > 0, V_y < 0) \end{cases}$$