UNIVERSITI KUALA LUMPUR

MALAYSIAN INSTITUTE OF CHEMICAL AND BIO-ENGINEERING TECHNOLOGY

FINAL EXAMINATION

OCTOBER 2025 SEMESTER

COURSE CODE	:	CQB19203
COURSE TITLE	:	MATHEMATICS 1
PROGRAMME NAME	:	TECHNICAL FOUNDATION - BACHELOR
DATE	:	28 JANUARY 2026
TIME	:	2:00PM - 5:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of ONE sections.
4. Section A consist of five questions. Answer FOUR (4) questions only.
5. Please write your answer on the answer booklet provided.
6. Please answer all questions in English only.
7. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

SECTION A (Total: 100 marks)

Answer FOUR (4) questions.

Please use the answer booklet provided.

Question 1

Answer the following questions.

(a) Determine the gradient of the function below at a point Q(1, 2) by using First Principle's method.

$$f(x) = 2x^2 + 5$$

(10 marks)

(b) Determine the derivative of the following function:

$$g(x) = 4x(x-1)^3$$

by applying the Product Rule.

(8 marks)

(c) Determine the second derivative of the following function:

$$h(x) = 2x^7 - 5x^5 + x^4 - 2x^3 + 3x^2 - 5e^{5x} + 20x - 26$$

(7 marks)

Question 2

Answer the following questions.

(a) A batch of vacuum-packaged smoked fish is found to be contaminated with a psychrotrophic spoilage fungus (*Penicillium spp.*) during a routine quality check. Initial testing at the time of packaging (t = 0) shows a concentration of 1,000 colony-forming units (CFU) per gram.

Four hours later, due to a temperature abuse incident during transport, a follow-up test reveals the count has risen to 2,500 CFU/g.

The exponential growth model is

$$N(t) = N_o e^{rt}$$

where:

$N(t)$ = population at time (CFU/g)
N_o = initial population = 1,000 CFU/g
r = specific growth rate (per hour)
t = time in hours.

i. Calculate the quadrupling period (the time required for the microbial population to increase four-fold) for this fungus under these conditions.

(8 marks)

ii. If the abusive temperature conditions persist, predict the microbial count after a total of 12 hours from the initial measurement.

(2 marks)

(b) A food processing plant has developed a new ultraviolet light treatment to reduce microbial load on fresh produce without damaging the product. The plant's Daily Quality-Improvement Value (Q) (measured in Quality-Adjusted Savings in dollars) is modelled as a function of the exposure time (t) (measured in seconds).

The model is given by:

$$Q(t) = 18t - 0.045t^2$$

where t is the exposure time in seconds.

i. Determine the optimal exposure time (t) that will maximize the Quality-Improvement Value.

(5 marks)

ii. Calculate the maximum Quality-Improvement Value achievable.

(2 marks)

iii. Identify the type of mathematical function represented by Q(t).

(1 marks)

iv. Describe the shape of the graph of the function Q(t).

(2 marks)

v. Sketch the graph of the function Q(t).

(5 marks)

Question 3

Answer the following questions.

(a) Solve the following indefinite integral by using integration by parts.

$$\int 3x^2 \sin x \, dx$$

(10 marks)

(b) Solve the following definite integral by using substitution method.

$$\int_0^2 (2x+5)(x^2+5x)^4 \, dx$$

(8 marks)

(c) Solve the following indefinite integral.

$$\int 14x^6 - 5x^4 + 8x^3 - 6x^2 + 20x - 5e^{5x} + 26 \, dx$$

(7 marks)

Question 4

Answer the following questions.

(a) Given that

$$\frac{2x^2+5x-1}{x^3+x^2-2x} = \frac{2x^2+5x-1}{x(x-1)(x+2)} = \frac{A}{x} + \frac{B}{(x-1)} + \frac{C}{(x+2)}$$

Evaluate the values of *A*, *B*, and *C*.

(10 marks)

(b) Determine the integral below by using partial fractions from part (a).

$$\int \frac{2x^2+5x-1}{x^3+x^2-2x}\,dx$$

(8 marks)

(c) Given that

$$\frac{10x-2}{x^3+x^2-x-1} = \frac{10x-2}{(x-1)(x+1)^2} = \frac{2}{(x-1)} - \frac{2}{(x+1)} + \frac{6}{(x+1)^2}$$

Determine

$$\int \frac{10x-2}{(x-1)(x+1)^2}\,dx$$

(7 marks)

Question 5

Answer the following questions.

(a) Given that

$$\frac{x^2+12x-5}{x^3-5x^2-13x-7} = \frac{x^2+12x-5}{(x-7)(x+1)^2} = \frac{\alpha}{(x-7)} + \frac{\beta}{(x+1)} + \frac{\gamma}{(x+1)^2}$$

Evaluate the values of α, β, and γ.

(10 marks)

(b) Determine the integral below by using partial fractions from part (a).

$$\int \frac{x^2+12x-5}{(x-7)(x+1)^2}\,dx$$

(8 marks)

(c) Given that

$$\frac{9x^2-4x-4}{x(x-2)(x+2)} = \frac{1}{x} + \frac{3}{(x-2)} + \frac{5}{(x+2)}$$

Determine

$$\int \frac{9x^2-4x-4}{x(x-2)(x+2)}\,dx$$

(7 marks)

END OF EXAMINATION PAPER

APPENDIX

DIFFERENTIATION RULES			
First Principles $f'(x) = \lim_{h\to 0} \frac{f(x+h)-f(x)}{h}$			
1.	$\frac{d}{dx}(k) = 0, \quad k = \text{constant}$	9.	$\frac{d}{dx}\sin x = \cos x$
2.	$\frac{d}{dx}(ax^n) = nax^{n-1}$	10.	$\frac{d}{dx}\cos x = -\sin x$
3.	$\frac{d}{dx}e^{ax} = ae^x$	11.	$\frac{d}{dx}\tan x = \sec^2 x$
4.	$\frac{d}{dx}a^x = a^x \ln a$	12.	$\frac{d}{dx}\sec x = \sec x \tan x$
5.	$\frac{d}{dx}\ln x = \frac{1}{x}$	13.	$\frac{d}{dx}\csc x = -\csc x \cot x$
6.	$\frac{d}{dx}\ln ax = \frac{1}{x}$	14.	$\frac{d}{dx}\cot x = -\csc^2 x$
7.	$\frac{d}{dx}(\log_a x) = \frac{1}{x \ln a}$	15.	Product Rule $\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$
8.	$\frac{d}{dx}e^{ax+b} = ae^{ax+b}$	16.	Quotient Rule $\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$

INTEGRATION RULES			
1.	$\int x^n dx = \frac{x^{n+1}}{n+1} + c$	7.	$\int \tan x \, dx = \ln\lvert\sec x\rvert + c$
2.	$\int e^{ax} dx = \frac{e^{ax}}{a} + c$	8.	$\int \frac{1}{a^2+x^2} dx = \frac{1}{a}\tan^{-1}\frac{x}{a} + c$
3.	$\int \frac{1}{x} dx = \ln x + c$	9.	$\int_a^a f(x)dx = 0$
4.	$\int \frac{1}{ax} dx = \frac{1}{a}\ln x + c$	10.	$\int_b^a f(x)dx = -\int_a^b f(x)\,dx$
5.	$\int \sin x \, dx = -\cos x + c$	11.	$\int_b^a f(x)dx + \int_c^b f(x)dx = \int_a^c f(x)dx$
6.	$\int \cos x \, dx = \sin x + c$	12.	Integration by parts $\int udv = uv - \int vdu$