



FACULTY OF SCIENCE

SM	
EM	
FM	

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS
NATIONAL DIPLOMA IN ENGINEERING:
*COMPUTER SYSTEMS, ELECTRICAL, MECHANICAL, MINERALS SURVEYING,
CHEMICAL, INDUSTRIAL, MINING, METALLURGY, EXTRACTION METALLURGY,
APPLIED BUILDING SCIENCE.*

MODULE: MAT1AW1/MAT1YBU
ENGINEERING MATHEMATICS 1

CAMPUS: DFC

JULY EXAMINATION

DATE: 25-JULY-2016

SESSION: 11:30-14:30

ASSESSORS:

MR T PAEPAE
MR MP SELOANE

INTERNAL MODERATOR:

MR EZ MORAPELI

DURATION: 3 HOURS

MARKS: 100

SURNAME AND INITIALS: _____

STUDENT NUMBER: _____

NUMBER OF PAGES: 16

LECTURER	COURSE	MARK (X)
MR IK LETLHAGE	MINING ENGINEERING MINERALS SURVEY	
MR EZ MORAPELI	INDUSTRIAL ENGINEERING	
MR T PAEPAE	ELECTRICAL ENGINEERING	
MR MP SELOANE	MECHANICAL ENGINEERING EXTRACTION/ENGINEERING METALLURGY CHEMICAL ENGINEERING	
DR S SIMELANE	APPLIED BUILDING SCIENCE	

REQUIREMENTS : NON-PROGRAMMABLE SCIENTIFIC CALCULATOR

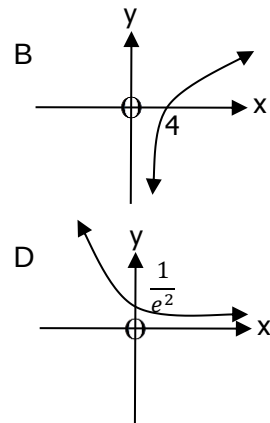
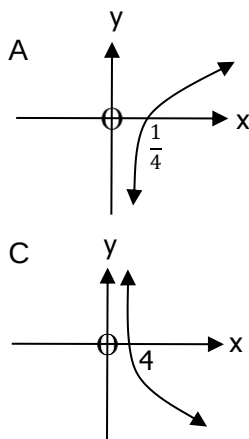
INSTRUCTIONS : ANSWER ALL THE QUESTIONS IN SPACES PROVIDED.
 : USE A PEN (BLUE OR BLACK INK) FOR WRITING AND DRAWING.
 : USE THE BLANK PAGES FOR ROUGH WORK.

SECTION A

INSTRUCTIONS

USE THE TABLE ON PAGE 2 TO MARK THE LETTER (X) CORRESPONDING TO THE CORRECT ANSWER. DO YOUR ROUGH WORK ON THE BLANK PAGES

1. The graph of the inverse of $y = 4e^{-2x}$ is represented by:



2. The fifth term of the binomial expansion $\frac{1}{\sqrt{4-x}}$ is:

A $\frac{35}{65536}x^4$

B $-\frac{35}{65536}x^4$

C $-\frac{5}{2048}x^4$

D $\frac{5}{2480}x^3$

3. The graph of $f(x) = (x - 3)^2 - 1$ has an axis of symmetry at:

A $y = 3$

B $y = -3$

C $x = 3$

D $x = -1$

4. If $\begin{vmatrix} \cot^{-1} \sqrt{8} & 7 \\ 0 & \operatorname{cosec}^3 1.32 \end{vmatrix} = 2^x$, then x is equal to:

A 1.42

B -1.42

C 0.37

D 0.42

5. If $\ln(4 - x)^2 - e = 0$, then x is equal to:

A 0.11

B 2.64

C 7.89

D 0.11 & 7.89

6. The value of $\lim_{x \rightarrow \infty} \frac{e^{2x}}{e^{2x} + 1}$ is equal to:
- A 0
C 1
- B ∞
D undefined
7. The gradient of the normal to the curve $y = 2 \cot 2x$ is:
- A $0.25 \cos^2(2x)$
C $0.25 \sin^2(x)$
- B $0.25 \cos^2(x)$
D $0.25 \sin^2(2x)$
8. Consider the wave equation $y = \sqrt{2} \sin \pi(5t + \sqrt{5})$, the phase angle is equal to:
- A 7.02
C 15.71
- B 1.41
D 0.14
9. The complex number $\frac{-2j}{2j+4}$ can be written as:
- A $0.2 + 0.4j$
C $0.2 - 0.4j$
- B $-0.2 - 0.4j$
D $-0.2 + 0.4j$
10. $\int \frac{x^2 \cos 4x + 5 \cos 4x}{5+x^2} dx$ is equal to:
- A $0.25 \cos 4x + C$
C $0.25 \sin 4x + C$
- B $0.25 \tan 4x + C$
D $-0.25 \sin 4x + C$

[20]

1.	A	B	C	D	6.	A	B	C	D
2.	A	B	C	D	7.	A	B	C	D
3.	A	B	C	D	8.	A	B	C	D
4.	A	B	C	D	9.	A	B	C	D
5.	A	B	C	D	10.	A	B	C	D

SECTION B**INSTRUCTIONS**

GIVE ONLY THE FINAL SIMPLIFIED ANSWER (CORRECT TO TWO DECIMAL PLACES WHERE APPLICABLE) IN THE SPACE PROVIDED. DO YOUR ROUGH WORK ON THE BLANK PAGES. USE A PEN

11. Use the Binomial Theorem to expand the following to its **first three simplified** terms: $\sqrt[3]{x - \frac{1}{x}}$ (3)

12. Make neat sketch graphs of the following. **Show all intercepts with axes**, if any.

12.1 $10 = 4x^2 - 5y^2$ (2)

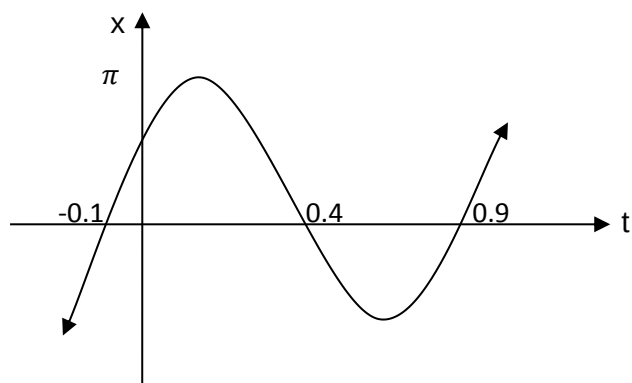
12.2 $3x^2 = 27 - 9y^2$ (2)

12.3 $y = -3^{1-3x}$

(2)



13. From the graph of $x = R \sin(\omega t \pm \alpha)$ below, find the:



13.1 angular velocity

(1)

13.2 frequency

(1)

13.3 length of the vector

(1)

13.4 equation of the graph

(2)

14. Solve for x in each case:

14.1 $e^x - e^{-x} = e^{-x}$

(2)

14.2 $\operatorname{cosec} x - 2 \sec x = 0; x \in [0; 2\pi]$

(2)

15. Find the following in their simplest forms:

15.1 $f'(x)$ if $f(x) = \frac{e^{2\ln\sqrt{x}}}{ax^2+b}$

(2)

15.2 $f''(x)$ if $f(x) = \sin^2 2x$

(2)

16. Evaluate the following:

16.1 $\int \frac{dx}{2\sqrt{2x^3}}$

(2)

16.2 $\int \frac{e^{\sqrt{x}}}{\sqrt{x}} dx$

(2)

[26]

INSTRUCTIONS

17. Use Cramer's rule to solve for z only:

$$\begin{aligned} y &= -2x \\ 4x + z - 6 &= 0 = z - 4y \end{aligned} \tag{5}$$

[illegible]

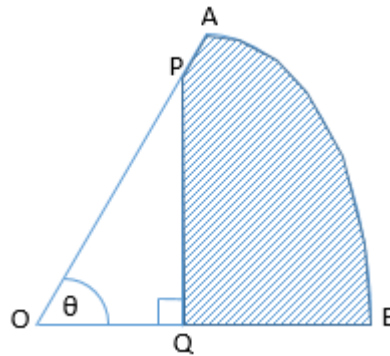
$$18.1 \quad \sqrt{3} \sin(1.3 + x) + 1.3 = 0 \quad 0 \leq x \leq 2\pi \quad (3)$$
[illegible]

$$18.2 \quad 3^{-x} \cdot e^{2x+1} = 3 \quad (3)$$

[illegible]

$$T = \frac{z^4 \sin^{-1}(x-\theta)}{k} \quad (3)$$
[illegible]

20. The diagram below shows a sector of a circle, centre O . The point P lies on OA , the point Q lies on OB and PQ is perpendicular to OB . The length of OP is 9 cm and $\angle AOB = \frac{\pi}{6} \text{ rad}$. Given that $OP : OA = 3 : 5$



20.1 Show that $PA = 6 \text{ cm}$

(1)

[illegible]

(5)

[illegible]

(4)

[illegible]

$$\left[\frac{3.1(\cos 125^\circ - j \sin 125^\circ)}{2.4(\cos 0.61 + j \sin 0.61)} \right]^3 \text{ (Answer in exponential form).} \quad (5)$$
[illegible]

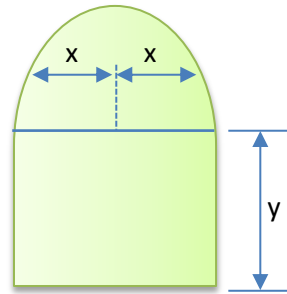
[illegible]

$$23.1 \quad f'(x) \text{ if } f(x) = \frac{1 - \sec x}{\tan x} \quad (3)$$
[illegible]

23.2 $f'(x)$ if $f(x) = e^{\sqrt{1-x^2}}$ (3)

[illegible]

24. An architect wants to design a window in the shape of a rectangle capped by a semicircle as shown in the figure below.



If the perimeter of the window is constrained to be 24 cm, what dimensions should the architect choose for the window to admit the greatest amount of light? **Hint:** maximum amount of light will be admitted when the area of the window is at its maximum. (5)

[illegible]

$$25.1 \quad \int (x + \sqrt[3]{x})^{-1} dx \quad (3)$$
[illegible]

$$25.2 \quad \int_0^1 \frac{x}{x+1} dx \quad (4)$$

[illegible]

- [illegible]

AVAILABLE MARKS: 103[illegible]