



FACULTY OF SCIENCE

SM	
EM	
FM	

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS

ELECTRICAL ENGINEERING; INDUSTRIAL ENGINEERING; CHEMICAL ENGINEERING;
MECHANICAL ENGINEERING; MINING ENGINEERING; APPLIED BUILDING SCIENCE;
MINERAL SURVEYING; CIVIL; CONSTRUCTION; PHYSICAL & EXTRACTION
METALLURGY

MODULE: MATE1A1

ENGINEERING MATHEMATICS V1A

CAMPUS: DFC

MAIN EXAMINATION

DATE: 09 JUNE 2018
DURATION: 3 HOURS
ASSESSOR: T PAEPAE
MODERATOR: BP NTSIME

TIME: 12:30 - 15:30
MARKS: 100

INITIALS AND SURNAME: _____

STUDENT NUMBER: _____

NUMBER OF PAGES: 17: ENSURE THAT YOUR PAPER IS COMPLETE

NAME OF LECTURER	GROUP	MARK (X)
MR T PAEPAE	CHEMICAL ENGINEERING; PHYSICAL & EXTRACTION METALLURGY	
MR MP SELOANE	MECHANICAL & INDUSTRIAL ENGINEERING	
MRS H KOTZE	ELECTRICAL ENGINEERING	
MRS R DURANDT	MINING ENGINEERING & MINERAL SURVEYING	
MR EZ MORAPALI	CIVIL & CONSTRUCTION	

INSTRUCTIONS: ANSWER ALL QUESTIONS IN THE SPACES PROVIDED
USE THE BACK OF EACH PAGE FOR ROUGH WORK
USE ONLY A PEN FOR WRITING AND DRAWING (BLACK OR BLUE)

REQUIREMENTS: NON-PROGRAMMABLE CALCULATORS
INFORMATION BOOKLET (PROVIDED)

SECTION A [20 MARKS]**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. Which of the following equations represent the graph of an ellipse?

A $2y^2 = 6x^2 + 2$

B $\pi x = \pi - 2y^2$

C $2x^2 = \pi - 2$

D $x^2 + 4y^2 = 3$

2. The fifth term from the end in the binomial expansion of $(x - 2)^9$ is:

A $2016x^5$

B $-2016x^5$

C $-4032x^4$

D $4032x^4$

3. If $h(x) = x + 9$, $g(x) = \cos x$ and $f(x) = x^2$, then $(f \circ g \circ h)(x) =$

A $\cos^2(x + 9)$

B $\cos(x + 9)$

C $\cos(x + 9)^2$

D $2 \cos(x + 9)$

4. The complex number $\ln(4j - e)$ is equal to:

A $1.576 - 0.597j$

B $1.576 + 2.168j$

C $1.576 - 34.199j$

D $1.576 + 124.199j$

5. If $2 + \log_{\frac{1}{3}}(2x + 1) = 0$, then x is equal to:

A $-\frac{4}{9}$

B -4

C $-\frac{1}{4}$

D 4

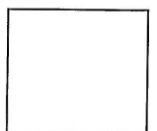
6. The value of $\sec^{-1} 1.28 + \sin^{-1} 0.93$ is equal to:

A 107.06

B 1.904

C 1.869

D undefined



7. If the area of a circle sector is 2.88 m^2 and its arc length is 3.33 m , the radius of the circle (in m) is equal to:

A 1.73

B 1.925

C 0.578

D 0.865

8. The slope of the tangent to the curve $y = \sin(\tan 2x)$ at the point $(e; \pi)$ is equal to:

A 2.018

B 1.942

C -0.905

D 0

9. Given that $f(x) = \ln(\cot 2x)$ then $f'(x)$ is:

A $-2 \operatorname{cosec} 2x$ B $-2 \sec 2x$ C $-4 \operatorname{cosec} 4x$ D $-4 \sec 4x$

10. $\int \frac{\cos\left(\frac{y}{x}\right)}{x} dy$ is equal to:

A $\cos\left(\frac{y}{x}\right) + C$ B $-\sin\left(\frac{y}{x}\right) + C$ C $\sin\left(\frac{y}{x}\right) + C$ D $-\frac{\cos^2\left(\frac{y}{x}\right)}{2x} + C$

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

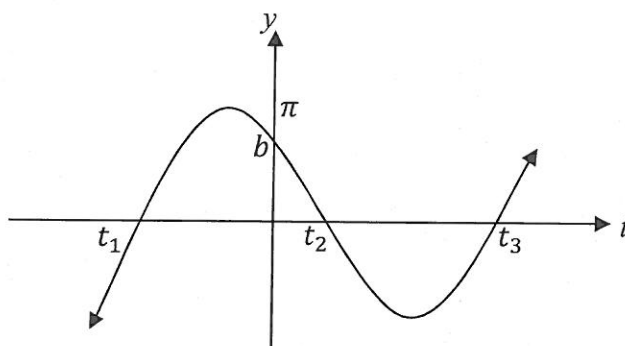


SECTION B [30 MARKS]**INSTRUCTIONS**

GIVE ONLY THE FINAL SIMPLIFIED ANSWER (CORRECT TO THREE DECIMAL PLACES WHERE APPLICABLE) IN THE SPACE PROVIDED

11. Use the binomial theorem to expand $\frac{2}{\sqrt{4-ex}}$ in ascending powers of x as far as the term in x^2 . (3)

12. The diagram shows the wave $y = \pi \sin 2(2t + 1)$. Determine:



- 12.1 The value of b

(1)

- 12.2 The angular velocity

(1)

- 12.3 The frequency of the wave

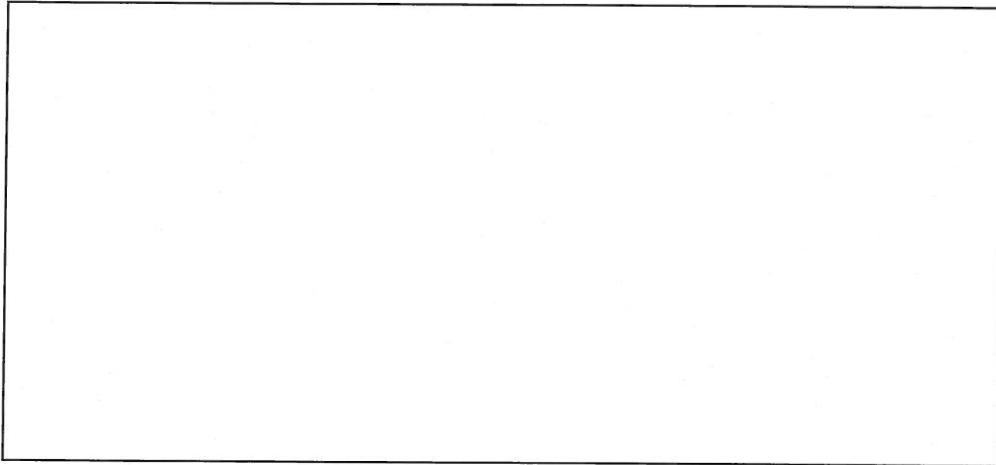
(2)

- 12.4 The values of t_1 , t_2 and t_3

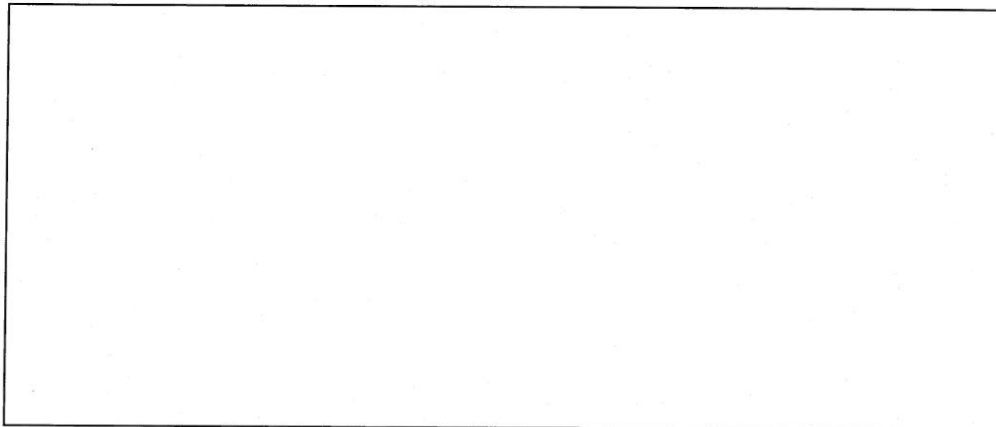
(3)

13. Sketch the graphs of the following functions. Show all intercepts with the axis;

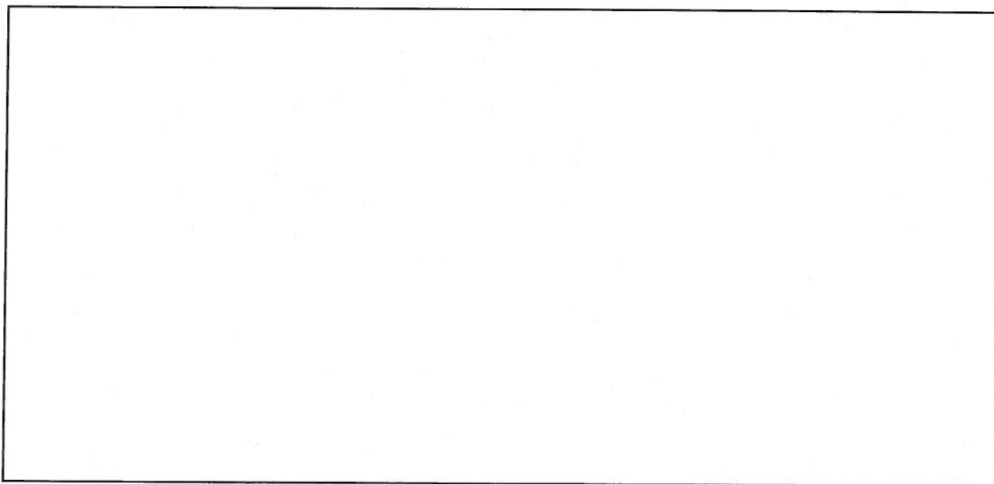
13.1 $2x^2 = 10 + y^2$ (2)



13.2 $f(y) = \frac{y}{3.7}$ (2)



13.3 $y + \log_{0.5} x^3 = 0$ (2)



14. Simplify the following:

14.1 $\frac{1}{1+\sin x} + \frac{1}{1-\sin x}$

(2)

14.2 $\frac{7e^{-2j}}{-3+\sqrt{-5}}$ (answer in rectangular form)

(2)

15. Determine the following derivatives, in their simplest form.

15.1 $f'(x)$ if $f(x) = \sqrt{\sin e^{-x}}$

(2)

15.2 $\frac{dy}{dx}$ if $y = \ln \frac{1-x}{1+x}$

(2)

16. Evaluate the following integrals:

16.1 $\int \frac{\sqrt{1+\sqrt{x}}}{\sqrt{x}} dx$

(2)

16.2 $\int \frac{\ln(\ln t)}{t \ln t} dt$

(2)

16.3 $\int_a^{\pi/4} \left(\frac{1-\sin^2 \theta}{\cos^2 \theta} \right) d\theta$

(2)

SECTION C [52 MARKS]

INSTRUCTIONS

SHOW ALL THE STEPS TAKEN AND GIVE YOUR FINAL ANSWER CORRECT TO TWO DECIMAL PLACES WHERE APPLICABLE. SIMPLIFY YOUR ANSWERS FULLY.

17. Make F the subject of the formula: $A = B \left(C + \frac{D}{n} \right)^{EF}$ (3)

[illegible]

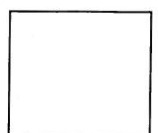
18. Use Cramer's rule to solve the following linear system for y only.

(5)

$$\frac{2x}{3} - y + \frac{2z}{3} = 2$$

$$x + 8y + 3z = -31$$

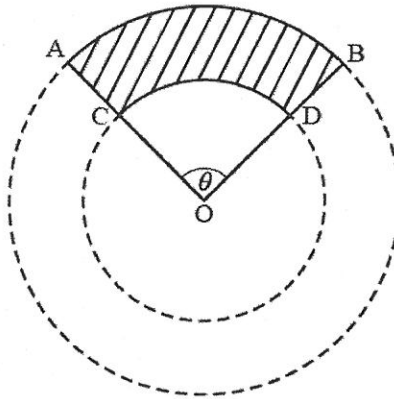
$$\frac{6x}{5} - \frac{4y}{5} + \frac{2z}{5} = -2$$

[illegible]

(5)

[illegible]

20. The diagram below shows two circles which have the same centre O and radii 16 cm and 10 cm respectively. The two **arcs** AB and CD have the same sector angle $\theta = 85^\circ$.

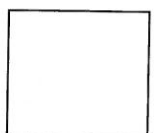


Calculate the area of the shaded region.

(4)



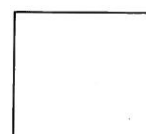
21. Use De Moivre's theorem to evaluate $\left[\frac{e^{0.2j} (j-5)^5}{[4(\cos 3 - j \sin 3)]^4} \right]$ and give the final answer in rectangular form) (5)

[illegible]

22. Determine the following, giving your answer in its simplest form:

22.1 $\frac{d^2 y}{dx^2}$ if $y = e^{\cos^2 x}$ (4)

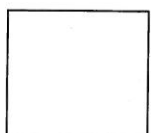
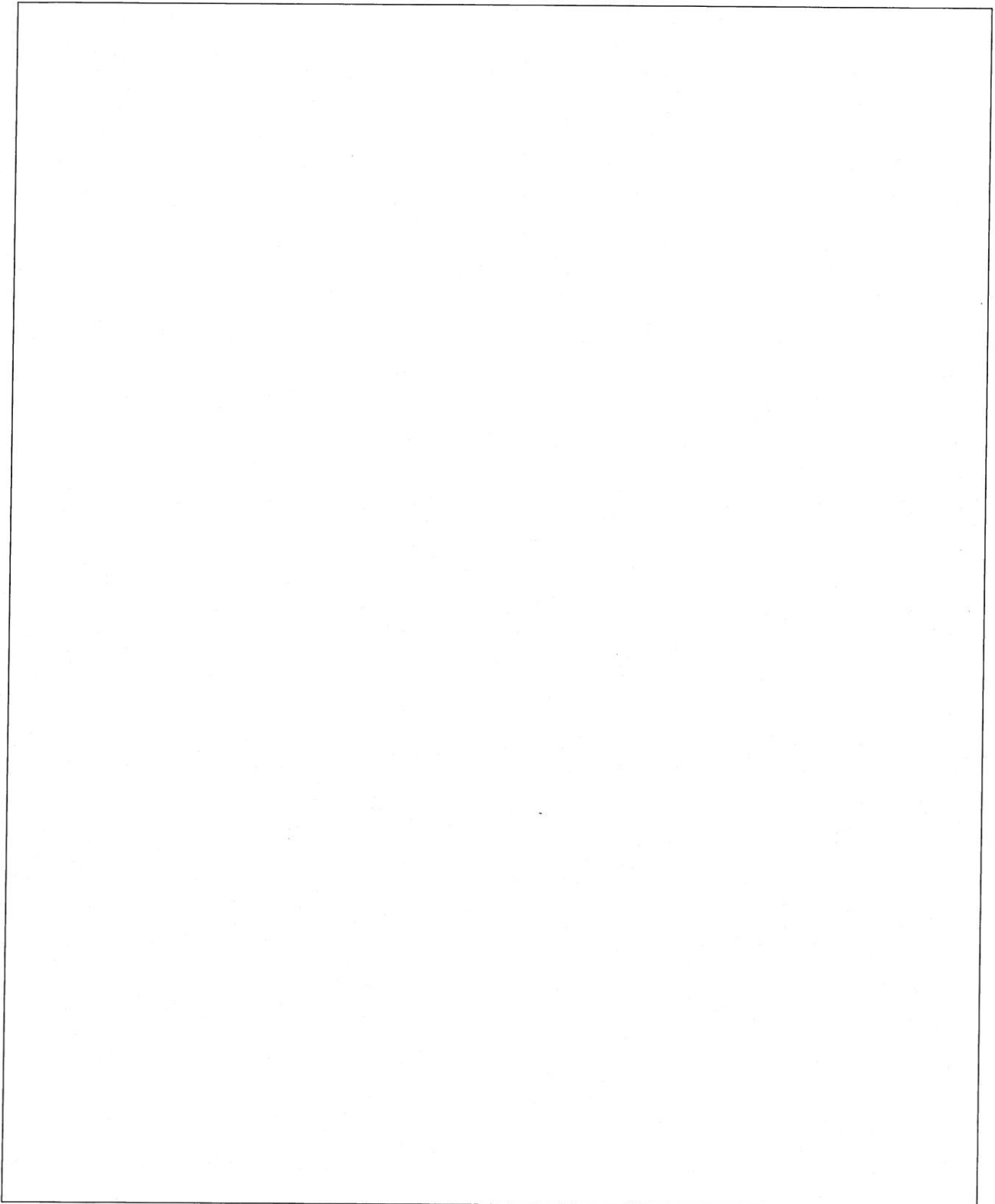
22.2 Given $\lim_{x \rightarrow 0} \frac{\sin x}{x} = 1$, evaluate: $\lim_{x \rightarrow 0} x \cot x$ (3)



23. Sketch the graph of the function below. (Show all intercepts and critical points).

$$f(x) = -x^3 + 6x^2 - 9x$$

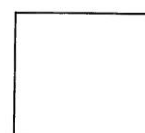
(5)



24. Integrate the following:

24.1 $\int \sqrt{(4x^2 - 12x + 9)^3} dx$ (3)

24.2 $\int \frac{2^{\tan 2x}}{\cos^2 2x} dx$ (2)



25. A particle moves in a straight line from origin with known velocity $v(0) = 2.5 \text{ m/s}$ and acceleration $a = 30 \text{ m/s}^2$. Calculate the displacement this particle undergoes between 2 and 5 seconds. (5)

[illegible]

END OF ASSESSMENT – TOTAL 102 MARKS

Use this space if you want to redo any question(s). Please indicate clearly at the relevant question(s) that the solution is on this page.

[illegible]