

SM	
EM	
FM	

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS			
NATIONAL DIPLOMA: EXTRACTION METALLURGY ENGINEERING METALLURGY			
	MAT2AE2 ENGINEERING MATHEMATICS 2 DFC		
	NOVEMBER EXAMINATION		
DATE 07/11/2015		SESSION	08:30 – 10:30
ASSESSOR		MR MP S	ELOANE
INTERNAL MODERATOR		MR IK LE	TLHAGE
DURATION 2 HOURS		MARKS	70
SURNAME AND INITIALS:			
STUDENT NUMBER:			
CONTACT NO:			
NUMBER OF PAGES: 16			

REQUIREMENTS : INFORMATION BOOKLET : NON-PROGRAMMABLE SCIENTIFIC CALCULATOR

INSTRUCTIONS : ANSWER ALL THE QUESTIONS.

- : ENSURE THAT YOUR PAPER HAS ALL THE PRINTED PAGES.
- : USE THE BLANK PAGES AT THE BACK TO DO ROUGH WORK AND INDICATE IT AS SUCH.
- : NO PAGES SHOULD BE REMOVED FROM THIS PAPER.
- : IF YOU RUN OUT OF SPACE FOR WRITING, USE THE BACK OF THE PREVIOUS PAGE TO COMPLETE YOUR ANSWER. NUMBER YOUR ANSWER CORRECTLY.

(4)

: USE ONLY BLUE OR BLACK INK TO WRITE. NO PENCIL

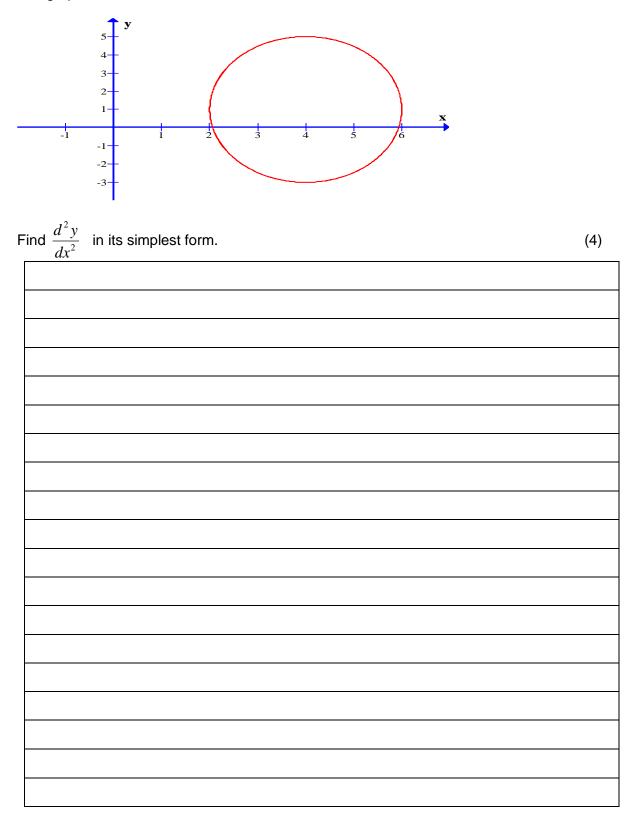
QUESTION 1 [18]

1.1 Let
$$y = \frac{x}{\sqrt{9-x^2}} - \sin^{-1}\left(\frac{x}{3}\right)$$
. Find $\frac{dy}{dx}$ in its simplest form, writing the final answer as a

single term.

1.2 Find
$$\frac{dy}{dx}$$
, in its simplest form, if $y = \frac{x^{2^x} \cdot \sqrt[6]{x^2 - 8}}{\ln x}$ (5)

1.4 Consider the function defined by the parametric equations $x = 4 + 2\cos t$, $y = 1 - 4\sin t$. The graph is shown below.



QUESTION 2 [17]

2.1 A function z = f(x, y) is said to be **harmonic** if it satisfies **Laplace's equation**:

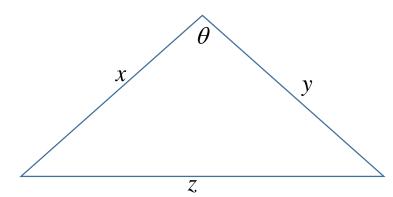
$$\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = 0.$$

Show that the function $z = \tan^{-1}\left(\frac{y}{x}\right)$ is harmonic.

(5)

2.2 The Law Of Cosines

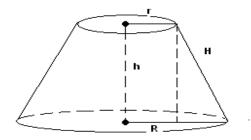
For any triangle with sides of lengths *x*, *y* and *z*, we have $z^2 = x^2 + y^2 - 2xy\cos\theta$. The triangle is shown below.



Suppose that x is increased from 10 cm to 10.1 cm, y changes from 15 cm to 14.8 cm and θ remains unchanged at $\frac{\pi}{3}$. Use the small increment method to find the change in z. State if this change represents an increase or a decrease. Give a reason for your answer. (6)



2.3 A frustum of a cone, shown below, is the portion of a cone that lies between two parallel planes cutting it.



The volume of the frustum is given by $V = \frac{1}{3}\pi h (R^2 + Rr + r^2)$, where *R* is the lower

base radius, *r* is the upper base radius and *h* is the height of the frustum. Use partial derivatives to calculate the rate of change of *V* if *R* is changing at the rate of 0.5 cm/s, *r* is changing at the rate of -1 cm/s and *h* is changing at -1.25 cm/s at the instant when R = 35 cm, r = 22 cm and h = 42 cm. (6)



QUESTION 3 [27]

Evaluate the following integrals. Show all the integration steps and, where applicable, give answers correct to 2 decimal places.

3.1
$$\int_{0}^{1} \frac{1}{7+3e^{2x}} dx$$
 (3)

$$3.2 \int \frac{x^2}{(x^2 - 4)(x^2 + 4)} dx$$

(7)

3.3 $\int x^2 \sin x dx$

$3.4 \quad \int_{0}^{\frac{\pi}{2}} \sin 2x \cos 5x dx$

3.5 $\int \sin^2 \theta \cos^2 \theta d\theta$

(4)

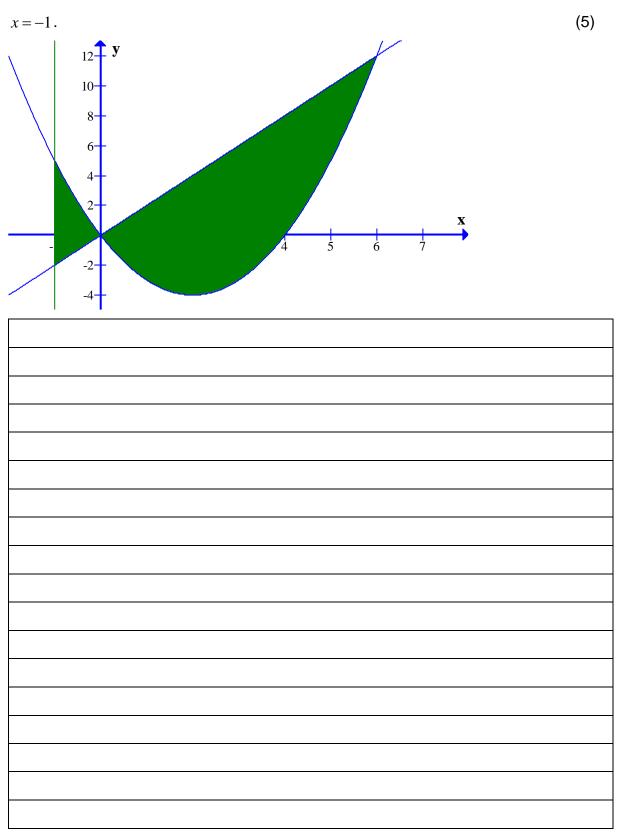
(3)

$$3.6 \int \frac{(2x+1)}{\sqrt{7-6x-x^2}} dx$$
(5)

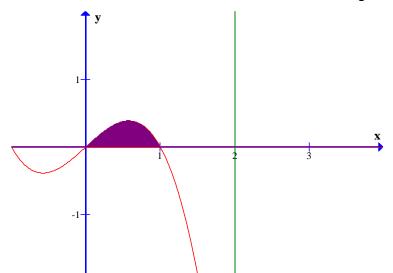
L	

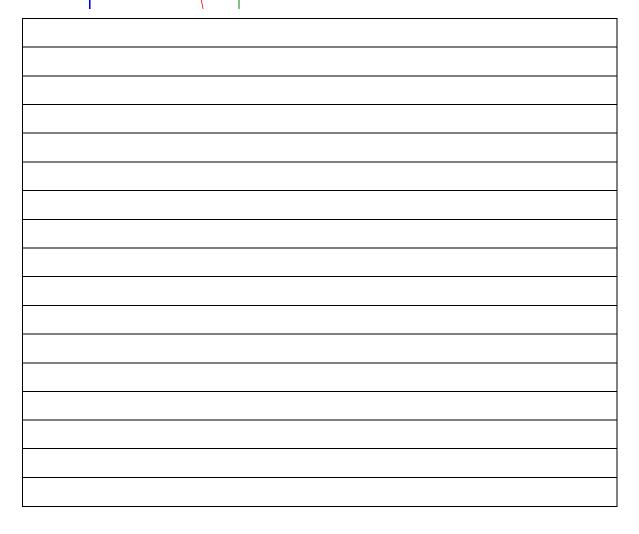
QUESTION 4 [9]

4.1 Calculate the area of the region bounded by the curves y = 2x, $y = x^2 - 4x$ and



4.2 The region bounded by the curves $y = x - x^3$ and y = 0, $0 \le x \le 1$, is revolved about the line x = 2. Calculate the volume of the resulting solid. (4)





TOTAL MARKS : 70

AVAILABLE MARKS : 71

USE THIS SPACE TO RE-DO ANY QUESTION YOU MAY HAVE CANCELLED