PAPUA NEW GUINEA UNVERSITY OF TECHNOLOGY

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

FIRST SEMESTER EXAMINATIONS - 2022

FIRST YEAR GEOGRAPHICAL INFORMATION SCIENCE AND SURVEYING

MA117 – MATHEMATICS 1 SV (A+B)

TIME ALLOWED: 3 HOURS

INSTRUCTIONS FOR CANDIDATES

1. You have 10 minutes to read this paper. You are **not** to write during this time.
2. This examination consists of two sections:

   Part A – 10 Multiple Choice Questions worth 1 mark each to give a total of 10 marks.

   Part B – 6 Long Answer Questions worth 15 marks each to give a total of 90 marks.
3. Write ALL answers in the answer booklet provided.
4. For **Multiple Choice**, organise first page (page 1) of your answer booklet by numbering 1 – 10 and write the correct letter of your answer next to question number.
5. There are ten (10) multiple choice questions and you are to write the letter A, B, C or D of the correct answer onto the first page (page 1) of the answer booklet provided.
6. There are six (6) long answer questions. Start long questions on page 2 of the answer booklet.
7. Start each question of Part B (Long Answer Questions) on a new page and clearly write its question number at the top of the page.
8. Show all necessary working out in the booklet provided.
9. Scientific and business calculators are allowed.
10. Write your name and ID number clearly on the examination answer booklets and sign off.
11. **Mobile phones** must be **switched off** during the examination period.

Marking Scheme

Marks are as indicated at the beginning of each question.

Total Mark is **100**

PART A – MULTIPLE CHOICE: Write the correct letter **A, B, C** or **D** next to question number on the first page (page 1) of your examination answer booklet.

Question 1 If the two equal sides of a right triangle measures 9 cm, then the hypotenuse will be:

A 9 cm **B** $9\sqrt{2}$ cm **C** $9\sqrt{3}$ cm **D** $18\sqrt{2}$ cm

Question 2 If the sine and cosine of an angle are both negative; which quadrant will this angle lie?

A 1st quadrant **B** 2nd quadrant **C** 3rd quadrant **D** 4th quadrant

Question 3 If the bearing of Q from P is $\mathbf{225^o}$, this is the same as:

A $S45^oE$ **B** $S45^oW$ **C** $N45^oE$ **D** $N45^oW$

Question 4 If $\boldsymbol{\alpha}$ is an acute angle and $\sin \alpha = \frac{\sqrt{3}}{2}$; express $\boldsymbol{\alpha}$ it in terms of $\boldsymbol{\pi}$ radians.

A $\frac{\pi^c}{3}$ **B** $\frac{\pi^c}{4}$ **C** $\frac{\pi^c}{5}$ **D** $\frac{\pi^c}{6}$

Question 5 What would be the value of x^c expressed in term of π if $\cos\frac{\pi^c}{6} = \sin x^c$?

A $\frac{\pi^c}{6}$ **B** $\frac{\pi^c}{4}$ **C** $\frac{\pi^c}{3}$ **D** $\frac{\pi^c}{2}$

Question 6 If $f(x) = 2x^2 - 1$; what will be value of $f'(2)$?

A 5 **B** 6 **C** 7 **D** 8

Question 7 If $\frac{dy}{dx} = 5x^2 - 2x$; find $\frac{d^2y}{dx^2}$.

A 5x - 2 **B** 10x - 2 **C** 10x - 2x **D** 5x - 2

Question 8 The integral of $y = 2e^{2x}$ is:

A $e^{2x} + c$ **B** $2\,e^{2x} + c$ **C** $4\,e^{2x} + c$ **D** $4e^{x} + c$

Question 9 Evaluate $\int_0^{\frac{\pi}{2}} (2\cos x)dx$.

A 0 **B** 1 **C** 2 **D** 3

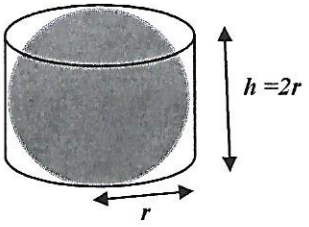
Question 10 In the Polar coordinate system, tan θ when expressed in Cartesian coordinate system is?

A $\frac{1}{x}$ **B** $\frac{1}{y}$ **C** $\frac{x}{y}$ **D** $\frac{y}{x}$

PART B. Write question number on a new page in the answer booklet and show all necessary working out.

Question 11 [6+6+3= 15 marks]

A sphere of radius (r) with volume $\frac{4000\pi}{3}$ cm^3 fits into a cylinder such that the top of the sphere is level with the height (h) of the cylinder. Find the volume of the cylinder and express it in terms of π.



(a) Find the value of r using volume of sphere formula

(b) Express volume of the cylinder in terms of r.

(c) Find the volume of the cylinder and express it in terms of π.

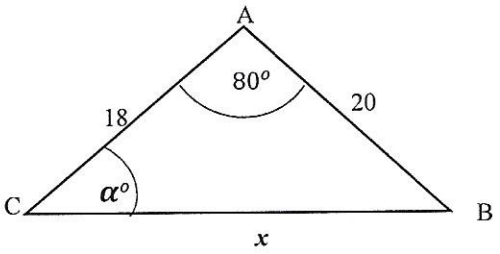
Question 12 [5+5+5 = 15 marks]

The sides of the triangle (*see opposite*) are in centimetres and its angles are in degrees. Find the following and give your answers correct to one decimal place.

(a) The area of triangle ABC.

(b) Side x.

(c) Angle α.



Question 13 [3+4+4+4 = 15 marks]

A light airplane flies due south, then turns and flies 20 kilometres due east. The light airplane then has a bearing of 150° from its starting point.

(a) Represent the above information in a diagram form.

(b) Find the distance the light aircraft flew due south correct to one decimal place.

(c) What distance is the light airplane from the starting point?

(d) Find the bearing of the starting point from the plane at that time.

Question 14 [5+5+5 = 15 marks]

(a) Sketch the graph of $y = 9 - x^2$ and $y = 0$ on the same axis and shade the region enclosed by these graphs.

(b) Find the points of intersection of $y = 9 - x^2$ and $y = 0$.

(c) Calculate the area of the region bounded by the curve $y = 9 - x^2$ and $y = 0$.

Question 15 [8+7 = 15 marks]

(a) If $\boldsymbol{u = 2x - e^{-2x}}$ and $\boldsymbol{v = 5 - e^{sinx}}$; find $\frac{dy}{dx}(uv)$.

(b) Find the equation of a curve that passes through (2, 3) and its slope is given by $\frac{\boldsymbol{dy}}{\boldsymbol{dx}} = \boldsymbol{3x^2 - 4x}$ at any point.

Question 16 [10+5 = 15 marks]

(a) Find the Cartesian coordinate equation for $\theta = \frac{2\pi}{3}$ and sketch it.

(b) Find the Polar coordinate equation for $2x + y = 4$ by expressing it in term of r. Find r if $= \frac{\pi}{2}$.

.....End of Semester 1 Examination .....

MA 117 SEMESTER 1 EXAMINATION FORMULA SHEET 2022

Function: f(x)	Standard derivatives: dy/dx = f '(x)	Standard integrals: $\int f(x)dx = F(x)$
$f(x) = ax^n$ Power rule	$f'(x) = anx^{n-1}$	$F(x) = \frac{ax^{n+1}}{n+1} + c$
$f(x) = c$	$f'(x) = 0$	$F(x) = cx + c$
$F(x) = (ax + b)^n$	$f'(x) = na(ax + b)^{n-1}$	$F(x) = \frac{(ax+b)^{n+1}}{a(n+1)}$
$f(x) = uv$ Product rule	$f'(x) = v\frac{du}{dx} + u\frac{dv}{dx}$	$F(x) = uv - \int vdu$
$f(x) = \frac{u}{v}$ Quotient Rule	$f'(x) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$	
Chain Rule	$f'(x) = \frac{dy}{du}x\frac{du}{dx}$	
$f(x) = a \sin bx$	$f'(x) = ab \cos bx$	$F(x) = -\frac{a}{b}\cos bx + c$
$f(x) = a \cos bx$	$f'(x) = -ab \sin bx$	$F(x) = \frac{a}{b}\sin bx + c$
$f(x) = a \tan bx$	$f'(x) = ab \sec^2 bx$	$F(x) = \frac{a}{b}\ln(\sec bx) + c$

Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Discriminant

$$\Delta = b^2 - 4ac$$

Pythagoras Theorem

$$c^2 = a^2 + b^2$$

The sum of the squares of the two shorter sides equals the square of the hypotenuse

Sine Rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Are of a triangle: $\frac{1}{2}ab \sin C = \frac{1}{2}bc \sin A = \frac{1}{2}ac \sin B$

Cosine Rule: $a^2 = b^2 + c^2 - 2bc \cos A$ or $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$

Polar Coordinate System

$x = r \cos\theta$ $\quad tan\theta = \frac{sin\theta}{cos\theta}$ $\quad \sin^2\theta + \cos^2\theta = 1$

$y = r \sin\theta$ $\quad tan\theta = \frac{y}{x}$

$r^2 = x^2 + y^2$ $\quad r = \sqrt{x^2 + y^2}$

Mensuration

Shape or Solid	Perimeter	Area	Surface Area	Volume
Regular Pentagon	P = 5 x side	A = ½ bh + ½ (a+b)h		
Regular Hexagon	P = 6 x side	A = (a+b)h		
Circle	C= 2πr = πd	A= πr²= ¼ πd²		
Sphere			SA = 4πr²	V = $\frac{4\pi r^3}{3}$
Cylinder (closed)			SA = 2πr² + 2πrh	V= πr²h
Any solid			SA= sum of areas around the shape	V = cross-section Area x length