THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

ENTRANCE EXAMINATIONS – 2018

MA003 – ENGINEERING MATHEMATICS

For candidates applying for Applied Physics, Computer Science, Electrical Engineering, Mechanical Engineering, Civil Engineering, Mining Engineering, and Mineral Processing Engineering.

TIME ALLOWED: 2 HOURS

INFORMATION FOR CANDIDATES

1. Print and sign your name below, and tick a box to indicate the type of course for which you are applying.
2. All answers must be written in this booklet.
3. Show your workings where required.
4. Do not use red ink or pencil to write this exam.
5. **Calculators are allowed in the examination room.**

Surname: _____ First Name: _____

Signature: _____ Date: _____ Venue: _____

Tick the type of course for which you are applying.

[ ] Applied Physics
[ ] Computer Science
[ ] Electrical Engineering
[ ] Mechanical Engineering
[ ] Civil Engineering
[ ] Mining Engineering
[ ] Mineral Processing Engineering

SECTION A: Multiple Choice Questions

Circle the correct choice for each question. Each part is worth 2 marks.

1. How many square centimetres are there in a square metre?

   A. 100 B. 1000 C. 10 000 D. 100 000

2. A mortar mixture is made of cement, sand and water mixed by weight in the ratio 1:3:5 respectively. What weight of sand is contained in 63 kg of the mixture?

   A. 7 kg B. 21 kg C. 35 kg D. 42 kg

3. A cone has a base diameter of 6 cm and a vertical height of 8 cm. Calculate the volume of the cone in cubic centimetres, leaving the answer as a multiplier of π.

   A. 8π B. 24π C. 72π D. 96π

4. If $f:x\to 2x+5$, $g:x\to\frac{1}{2}x$ and $h:x\to 3x-1$. Find $ghf(-2)$.

   A. 2 B. -2 C. 2.5 D. 1

5. If $\frac{4}{16^{y-2}}\times\left(\frac{1}{4}\right)^{y}=64^{-2y-1}$, find the value for y.

   A. 3 B. -3 C. $-\frac{3}{2}$ D. $\frac{3}{2}$

6. Which of the following inequalities is true for the point $(4,-2)$?

   A. $x+y>3$ B. $x<3y$ C. $x-y<10$ D. $2x-3y<12$

7. In a class of 25 members, 15 take history, 17 take geography and 3 take neither subject. How many class members take both subjects?

   A. 10 B. 15 C. 11 D. 14

8. If $X=\{x:9<x<18\}$ and $Y=\{y:10<y<21\}$, what is $n(X\cup Y)$, given that x and y are integers.

   A. 18 B. 14 C. 11 D. 9

9. From the top of a tower, the angle of depression of a boat is 30°. If the tower is 20 metres high, how far is the boat from the foot of the tower?

   A. 40 m B. $10\sqrt{3}$ m C. $20\sqrt{2}$ m D. $20\sqrt{3}$ m

10. From a place 400 metres north of *X*, a man walks eastwards to a place *Y* which is 800 metres from *X*. What is the bearing of *X* from *Y*?

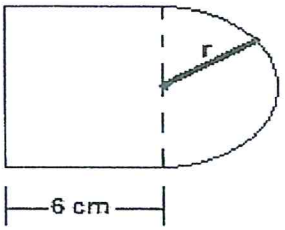
    A. 270° B. 240° C. 210° D. 180°

SECTION B: Workings required

Show workings for each question and write your final answer in the spaces provided on the far right for each question. Each part is worth 3 marks.

1. Figure below shows a template whose area is 50 square centimetres. Find the total length of the template given that r denotes the radius of a semi-circle.

Ans:_____



2. Solve for the variable x for the following equations.

Ans:_____

(a) $\frac{5}{(2)^{x+1}} + 10 = 90$

(b) $58 = 10 + 6\left(\sqrt[3]{\frac{1}{x}}\right)$ **Ans:**_____

(c) $\frac{4^{-x}}{8^{2x-3}} = 16^{3x-1} \times 2$ **Ans:**_____

3. A triangle has the sides of length 4 cm, 6 cm and 8 cm. Find the largest angle in this triangle. **Ans:**_____

4. For the graph of the function $2x^2 + y + 3x - 5 = 0$, answer the following questions;

a) What is the $y-$intercept? **Ans:**_____

b) What are the $x-$intercepts? **Ans:**_____

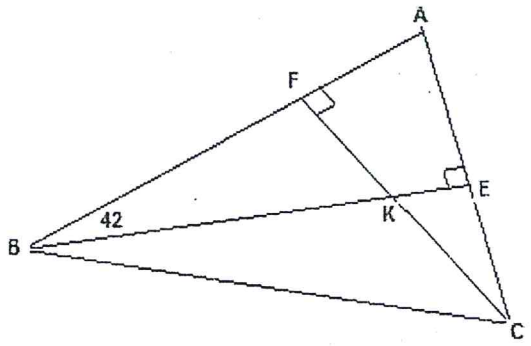
c) What are the coordinates of the turning point? **Ans:**_____

d) Is it a maximum or a minimum-value parabola? **Ans:**_____

5. A rocket is launched vertically into the air and is observed from the tower that is 1.5 kilometers above the ground level. Soon after the launch, the rocket is at an angle of elevation of 25^0 . Later, the rocket has climbed vertically a further 4 kilometers and its angle of elevation from the tower is 66^0. How far is the observer from the launched site? [Assuming that the base of the tower and the launched site is on the perfectly horizontal ground level]. **Ans:**_____

6. In the figure below, $BE \perp AC$, $CF \perp AB$ and $\angle ABE = 42^0$. Find $\angle BAE + \angle BKC + \angle ECK$.

Ans:_____



7. Answer the following questions:

(a) Find the equation of the straight line which passes through the point $(-1,3)$ and is parallel to the straight line joining the points $(2,1)$ and $(5,5)$. **Ans:**_____

(b) Find the equation of the straight line which passes through the point of intersection of $5x-y-3=0$ and $2x-y=0$ and is perpendicular to the straight line $4x+3y-2=0$. **Ans:**_____

8. Answer the following questions:

(a) The height h metres of a cricket ball after being struck by a batsman is given by the equation $h=1+x-\frac{x^2}{40}$ where x metres is the horizontal distance travelled by the ball from the bat. How far would the ball travel before it hits the ground?

Ans:_____

(b) What must be the length of a rectangle to have an area of 125 m^2 and a perimeter of 60 m? **Ans:**_____

(c) In a right triangle, the hypotenuse is 15 cm. If the second side is twice the length of the third side, calculate the *exact* length of the shortest side. **Ans:**_____

(d) The sum of the squares of two consecutive integers is 145. What are the integers?

Ans:_____

9. Given the function $y = x^3 - 3x^2 - 9x + 2$, answer the following questions:

(a) Find the stationary points. **Ans:**_____

(b) At what point does the maximum turning point occur? **Ans:**_____

10. Answer the following questions:

(a) Write down the next three terms of the sequence 5, 8, 11, 14, 17, ___, ___, ___.

(b) The flow of water from a pipe is 20 gal/min. How long will it take to fill a tank with a capacity of 70 gallons? **Ans:**_____