THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

ENTRANCE EXAMINATIONS – 2015

MA003 – ENGINEERING MATHEMATICS

For candidates applying for Applied Physics/Radio Therapy, Mathematics & 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/Radio Therapy
[ ] Mathematics & Computer Science
[ ] Electrical Engineering
[ ] Mechanical Engineering
[ ] Civil Engineering
[ ] Mining Engineering
[ ] Mineral Processing Engineering

SECTION A: Short Answer Questions

Write the correct answer in the spaces provided on the far right for each question. Each part is worth 2 marks.

1. Find the value of n if $\left(1\frac{1}{3}\right)^{-n} - 2\left(1\frac{1}{3}\right) = \frac{28}{27}$. **Ans:**_____

2. Simplify $8\frac{2}{3} - 3\frac{1}{3} \times 1\frac{2}{4} \div \frac{3}{4}$ **Ans:**_____

3. Given an expression $T = 2\sqrt{\frac{-k^2 + h^2}{gh}}$, solve for T when $k = \frac{3}{4}$, $h = -\frac{1}{4}$ and $g = 2$.

Ans:_____

4. Remove the parentheses and simplify $4x\left(x^2 + 3x - 5\right) - 2x\left(3x^2 - 5x + 6\right)$.

Ans:_____

5. Simplify $3\sqrt{a^3} + 2\sqrt{a} - \sqrt{9a^5}$ **Ans:**_____

6. Simplify $\frac{2\sqrt{5}}{3\sqrt{5} - 2\sqrt{2}}$. **Ans:**_____

7. Transpose $Q = \frac{w(H - h)}{T - \sqrt{t}}$ for t. **Ans:**_____

8. Transpose $d = \sqrt{\frac{b(x - b)}{c}}$ for x. **Ans:**_____

9. Given an equation $11^{-(2t-4)} = 121$, solve for t. **Ans:**_____

10. Equate $3\left(x^2 y^2\right) - 2x^3 y$ when $x = -3$ and $y = \frac{1}{3}$. **Ans:**_____

11. Find the number which when added to its square gives a total of 42. **Ans:** _____

SECTION B: Multiple Choice Questions

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

1. A stone is thrown in the air. After t seconds, its height, h, above the sea level is given by the formula $h = 80 + 3t - 5t^2$, what is the value of t when the stone falls into the sea?

   A. 5.2 seconds B. 3.4 seconds C. 4.3 seconds D.14 seconds

2. If $x + y = 5$ and $2x - y = 7$, what is the value of x which satisfies both these equations?

   A. 1 B. 2 C. 3 D. 4

3. A quadrilateral has diagonals of the same length and they bisect at right angles. What is the name of the quadrilateral?

   A. a parallelogram B. a rhombus C. a square D. a rectangle

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

   A. 270^o B. 240^o C. 210^o D. 180^o

5. A motorist made a journey of 192 km. He covered 48 km in 1 hour and for the remainder of the journey, his speed was 72 km/h. Calculate his average speed for the whole journey.

   A. 36 km/h B. 48 km/h C. 54 km/h D. 64 km/h

6. 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

7. The mean weight of five men is 76 kg. The weights of four of the men are 72 kg, 74 kg, 75 kg and 81 kg. What is the weight of the fifth man?

   A. 87 kg B. 78 kg C. 77 kg D. 76 kg

8. The maximum value of the function $y = 2x^3 - 21x^2 + 72x + 5$ is

   A. 4 B. 3 C. 85 D. 86

9. If $y = 5 \times \sqrt[3]{x^2}$, then $\frac{dy}{dx}$ is equal to

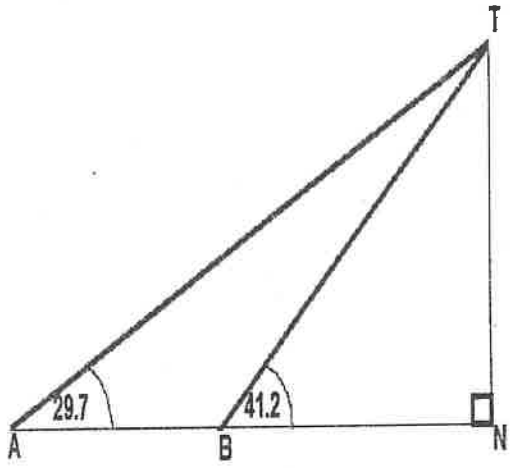
   A. $\frac{15\sqrt{x}}{2}$ B. $\frac{15}{2\sqrt{x}}$ C. $\frac{10}{3 \times \sqrt[3]{x}}$ D. $\frac{10 \times \sqrt[3]{x}}{3}$

Question	1	2	3	4	5	6	7	8	9
Choice									

SECTION C: 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. The angle of elevation to the top of a mountain is measured from two beacons A and B at sea. These angles are shown on the diagram below. If the beacons are 1473 meters apart, how high is the mountain, where T is the mountain top and N is the mountain base?



Ans: _____

2. A rectangle is 72 square meters in area and its perimeter is 34 meters. Find its length

Ans: _____

3. Kambiri and Wiliri share out their collection of 5000 stamps in the ratio 5:3 respectively. Kambiri then shares his stamp with two other friends in the ratio 3:1:1, keeping most for himself.

   (a) How many stamps does Wiliri received? **Ans:** _____

   (b) How many stamps does each of Kambiri's friends received? **Ans:** _____

4. The number of hours required to dig a certain hole is inversely proportional to the number of men available. When 6 men are digging the hole, it takes 4 hours to complete.

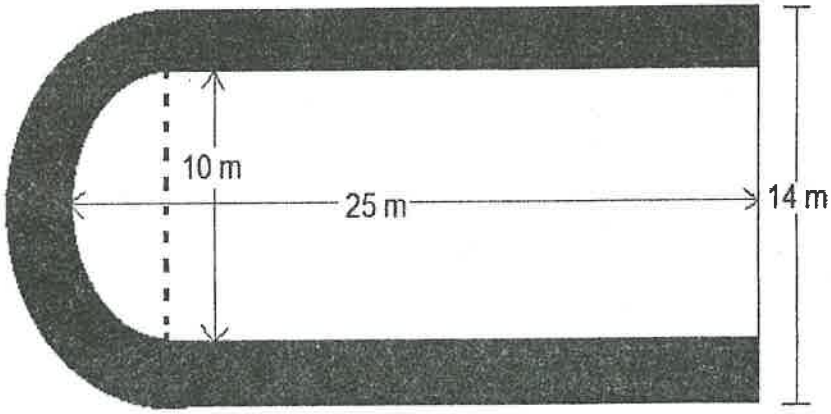
(a) Find the time taken to complete digging the hole if 8 men are available.

Ans:_____

(b) If it takes half an hour to complete digging the hole, how many men are there?

Ans:_____

5. The diagram below shows a lawn (unshaded) surrounded by a path of uniform width (shaded). The curved end of the lawn is a semicircle of diameter 10 meters.



(a) Calculate the area of the lawn.

Ans:_____

(b) Calculate the area of the path. **Ans:**_____

6. Yareakambi who is at the top of a tower of height 15 m sees a man due West of him at an angle of depression 31^0. He sees another man due South at an angle of depression 17^0. Find the distance between the men. **Ans:** _____

7. Given that $y = 60x + 3x^2 - 4x^3$, calculate;

(a) The gradient of the tangent to the curve of y at the point where $x = 1$.

Ans: _____

(b) The value of x for which y has its maximum value. **Ans:** _____