THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

ENTRANCE EXAMINATIONS – 2021

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.

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

Section A: Multiple Choice Questions
Circle the correct choice. Each question worth 2 marks.

1. Which of the following is a prime number?
   A. 15 B. 27 C. 39 D. 41

2. 54 is a multiple of
   A. 3 B. 4 C. 5 D. 7

3. Find x if $2^{x+2}=16^{x-7}$
   A. 8 B. 9 C. 10 D. 11

4. A car travels 60 km at an average speed of 30 km/h and for 120 km at an average speed of 40 km/h. For the entire journey, its average speed is
   A. 30 km/h B. 32 km/h C. 34 km/h D. 36 km/h

5. For a function $f(x)=\frac{4x+5}{x+2}$, evaluate $f^{-1}(3)$
   A. -2 B. -1 C. 1 D. 2

6. The maximum value of the curve $y=-x^2+5x+7$ is
   A. $(9,-23)$ B. $(-9,-23)$ C. $(-9,23)$ D. $(9,23)$

7. If $A=\{2,4,6,8,10\}$, $B=\{1,2,3,4,5\}$ and $C=\{2,5,6,7\}$, determine $(A\cap B)\cap C$
   A. $\{2,5\}$ B. $\{2,4\}$ C. $\{2\}$ D. $\{2,4,5\}$

8. A triangle has sides 39.3 cm and 41.5 cm. If the angle between them is 41.5 degrees, its area would be
   A. 640.2 cm^2 B. 580.6 cm^2 C. 550.6 cm^2 D. 540.4 cm^2

9. If a train is travelling at a speed of 30 km/h. How long would it take to travel 500 m?
   A. 2 mins B. 3/50 hrs C. 1 min D. 0.5 hrs

10. If a die is rolled twice, the probability of obtaining a 3 and a 4 in any order would be
    A. 1/6 B. 1/18 C. 1/36 D. 1/9

11. The L.C.M of $a^2+2ab+b^2$ and a^2-b^2 is
    A. $2a^2b^2$ B. $(a^2-b^2)(a^2+2ab+b^2)$ C. $2a^3b^3$ D. $(a-b)(a+b)^2$

12. If a ring has an outside diameter of 8 cm and an inside diameter of 4 cm, then its area would be
    A. $\pi(8^2-4^2)$ cm^2 B. $8\pi-4\pi$ cm^2 C. $\pi(8+4)(8-4)$ cm^2 D. $\pi(4^2-2^2)$ cm^2

13. The value of 4865.355 correct to 2 significant figures is

A. 4865.36 B. 4865.35 C. 4900 D. 49

14. A body moves a distance of s meters in a time of t seconds so that $s = 2t^3 - 5t^2 + 4t + 5$. Find its velocity after 3 seconds

A. 22 m/s B. 24 m/s C. 26 m/s D. 28 m/s

15. A body moves a distance of s meters in a time of t seconds so that $s = 2t^3 - 5t^2 + 4t + 5$. Find its acceleration after 3 seconds

A. 22 m/s^2 B. 24 m/s^2 C. 26 m/s^2 D. 28 m/s^2

16. In a triangle ABC, AB = 3 cm, BC = 4 cm and AC = 5 cm. Then

A. Angle A is 90^0 B. Angle B is 90^0 C. Angle C is 90^0 D. None of the above

17. A cylinder is $\frac{1}{4}$ full of water. After 60 mls of water is added, the cylinder is $\frac{2}{3}$ full. Then, the total volume of the cylinder is

A. 144 mls B. 411 mls C. 104 mls D. 134 mls

18. Over a period of 6 months, a colony of rabbits increase in number by 25% and then by a further 30%. If there were originally 200 rabbits in the colony, how many were there at the end?

A. 235 B. 325 C. 225 D. 315

19. From a place 400 meters north of X, Williri 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

20. Kambiri bought a used car by making a 15% deposit of K6,000. How much does he still have to pay?

A. K30,000 B. K34,000 C: K40,000 D: K44,000

21. 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. $\frac{10 \times \sqrt[3]{x}}{3}$

22. 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

23. How long will it take an investment to double at 10% p.a. compounded yearly?

A. $\frac{\log(2)}{\log(1.1)}$ periods B. $\frac{2}{\log(1.1)}$ periods C. $\frac{\log(1.1)}{\log(2)}$ periods D. $\frac{\log(1.1)}{2}$ periods

24. Yarea Kambiri left his fortune to his 3 sons, 4 daughters and his wife. Each son received twice as much as each daughter. His wife received K6,000, which was a quarter of the money. How much did each son receive?

A. K1,800 B. K2,400 C. K3,600 D. K4,200

25. $\frac{6ab}{c} \times \frac{ad}{2b} \div \frac{4bc}{8cd^2}$ in its simplest term is

A. $\frac{6a^3d^3}{bc}$ B. $\frac{6a^2d^3}{bc}$ C. $\frac{6ad^3}{bc}$ D. $\frac{6a^2d^2}{bc}$

Section B: Workings Required

Show workings and write your final answer clearly. 5 mark each.

1. A train travels for 4 hours at an average speed of 64 km/h. For the first two hours, its average speed is 50 km/h. What is its average speed for the last two hours?

2. A rectangular room is 4 m wider than it is high and it is 8 m longer than it is wide. The total area of the walls is 512 square metres. Calculate the width of the room.

3. **B** is a point due east of **A** on the coast. **C** is another point on the coast and is 6 km due south of **A**. The distance **BC** is 7 km. Calculate the bearing of **C** from **B**.

4. Given the equations
$$2x-y+z=2,$$
$$-x+2y+2z=7,$$
$$x+3y-z=10.$$
Solve for x, y and z.

5. Find the area above the $x-axis$, bounded by the curve $y=1-x^2$.

6. A particle moves along a straight line. The fixed point O lies on this line. The displacement of the particle from O at time t seconds, $t \geq 0$, is s metres, where $s = t^3 - 5t^2 - 8t + 3$. Find the value of t for which the particle is instantaneously at rest.

7. a, b, c and d are 4 integers written in order of size, starting with the smallest integer. If the mean of a, b, c and d is 15 while the sum of a, b and c is 39,
(a) Find the value of d.

(b) Given also that the range of a, b, c and d is 10, work out the median of a, b, c and d.

8. Solid **A** and solid **B** are mathematically similar. Solid **A** has surface area 384 cm^2. Solid **B** has surface area 864 cm^2. Solid **B** has a volume of 2457 cm^3. Calculate the volume of solid **A**.