DIOCESE OF KABGAYI
COLLEGE SAINTE MARIE REINE KABGAYI
END OF TERM I EXAMINATIONS, 2025-2026
SUBJECT: MATHEMATICS
CLASS: SENIOR 6 PCB

Names: .....
Class: .....

PART I. Circle the correct answer: Attempt all questions (Each question is out of 5 marks)

1. Which identity is correct
   a) $sin^2x + cos^2x = 2$
   b) $sin^2x - cos^2x = 1$
   c) $sin^2x + cos^2x = 1$
   d) $tan^2x + 1 = cos^2x$
2. Cos2x may be written as:
   a) $sin^2x - cos^2x$
   b) $1 - 2cos^2x$
   c) $1 - 2sin^2x$
   d) All of the above are correct
3. A matrix with determinant 0 is called:
   a) Singular
   b) Identity
   c) Scalar
   d) Invertible
4. A building casts a shadow of 20 m when the sun's angle of elevation is 30°. The height of the building is:
   a) 10 m
   b) 20 m
   c) $20\sqrt{3}\ m$
   d) $\frac{20}{\sqrt{3}}\ m$
5. If $A = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}, find\ \alpha\ and\ \beta\ so\ that (\alpha I + \beta A)^2 = A, where\ I\ is\ the\ identity\ matrix$
   a) $\alpha = \frac{1}{\sqrt{2}}\ and\ \beta = \frac{1}{\sqrt{2}}$
   b) $\alpha = -\frac{1}{\sqrt{2}}\ and\ \beta = -\frac{1}{\sqrt{2}}$
   c) $\alpha = 1\ and\ \beta = 2$
   d) $\alpha = -1\ and\ \beta = 1$
6. From the following data of marks in Mathematics and Physics obtained by four students out of thirty. Calculate the coefficient of variation:

Mathematics	14	45	27	38
Physics	35	40	20	21

   a) Coefficient of variation of Mathematics is 3.83% and the one of physics is 9.96%
   b) Coefficient of variation of Mathematics is 37.83% and the one of physics is 29.96%

c) Coefficient of variation of Mathematics is 33.25% and the one of physics is 29.96%
d) Coefficient of variation of Mathematics is 37.83% and the one of physics is 75.96%

7. The tangent to the graph of the function $f(x) = \frac{x^2+mx-3}{(m-1)x+1}$ at x=0 is parallel to the line y=5x-4. Find the value of m
   a) m= 5
   b) m=2
   c) m=3
   d) m=-1
8. A national commission of the young artisans is composed of 7 girls and 5 boys. 4 delegates chosen at random from the commission have an audience with MINICOM. What is the probability that at least one girl is chosen?
   a) Probability is $\frac{490}{495}$
   b) Probability is $\frac{49}{45}$
   c) Probability is $\frac{495}{490}$
   d) Probability is 0.12
9. Simplify: a) $\left(\frac{1}{2} + i\frac{\sqrt{3}}{2}\right)^{2001}$ b) $\frac{(1-i\sqrt{3})^4}{(1+i)^3}$

10. Determine the resistance and series inductance (or capacitance) for each of the following impedances, assuming a frequency of 50 Hz: a) 4+j7Ω b) 12 cis(-60^0)Ω

PART II. ATTEMPT any 2 QUESTIONS (EACH QUESTION IS OUT OF 10 MARKS)

11. Consider a real valued numerical function defined as f: $R \to F: x \to \frac{1}{2}x^2 e^{x+1}$

a) Find the domain of definition f(x)

b) Find the intersection with axis of coordinates

c) Find the asymptotes

d) Discuss the first and second derivatives of f(x)

e) Sketch the graph of f(x)

12. Solve the following:

a) $\begin{cases} 5x + 3y = 12 \\ 7x + 2y = 19 \end{cases}$

b) $(x+3)(x-2)>0$

c) $\begin{cases} y = x^2 \\ y = x + 12 \end{cases}$

13. a) Consider the population of bacteria described by the function $f(t) = 200e^{0.02t}$, where t is measured in minutes

i) How many bacteria are present in the population after 5 hours?

ii) When does the population reach 100 000 bacteria?

b) A 25-year-old student is offered an opportunity to invest some money in a retirement account that pays 5% annual interest compounded continuously. How much does the student need to invest today to have 1 million when she retires at age of 65? What if she could earn 6% annual interest compounded continuously instead?

c)Assume a population of fish grows exponentially. A pond is stocked initially with 500 fish. After 6 months, there are 1000 fish in the pond. The owner will allow his friends and neighbors to fish on his pond after the fish population reaches 10 000. When will the owner's friends be allowed to fish?