



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCE

DEPARTMENT OF APPLIED SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

**FIRST YEAR FIRST SEMESTER EXAMINATION FOR BACHELOR OF
EDUCATION (SCIENCE)**

APH102 – MATHEMATICS FOR PHYSICS

DURATION: 2 HOURS

DATE: 11TH DECEMBER 2017

TIME: 9.00AM – 11.00AM

Instructions to Candidates:

1. Answer **Question 1** and **Any Other Two** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A (Compulsory)

QUESTION ONE (30 Marks)

- a) Find y in terms of x (4 Marks)
- $$5\log_a y - 2\log_a(x + 4) = 2\log_a y + \log_a x$$
- b) Show that $\sin\left(x + \frac{\pi}{3}\right) + \sin\left(x + \frac{2\pi}{3}\right) = \sqrt{3} \cos x$ (6 Marks)
- c) Find the charge stored in a capacitor when a current $I = 15t \sin 3t$ flows for time $t = 0.5$ seconds. (8 Marks)
- d) Determine the probabilities of selecting at random from a crowd containing 20 men and 33 women.
- A man
 - A woman (4 Marks)
- e) Find the moment and the magnitude of the moment of a force of $(i + 2j - 3k)$ newtons about point B having co-ordinates $(0,1,1)$, when the force acts on a line through A whose co-ordinates are $(1,3,4)$ (8 Marks)

SECTION B (Answer any two questions)

QUESTION TWO (20 Marks)

- a) The voltage across the plates of a capacitor at any time t seconds is given by $v = Ve^{-t/CR}$ where V , C , and R are constants. Given $V = 3000$ volts, $C = 0.12 \times 10^{-6} F$ and $R = 4 \times 10^6 \Omega$ find;
- The initial rate of change of voltage (4 Marks)
 - The rate of change of voltage after 0.5 seconds. (3 Marks)
- b) A missile fired from ground level rises x meters vertically upwards in t seconds and $x = 100t - \frac{25}{2}t^2$. Find
- The initial velocity of the missile. (3 Marks)
 - The time when the height of the missile is a maximum. (3 Marks)
 - The maximum height reached. (3 Marks)
- c) Evaluate $f''(\theta)$ when given $f(\theta) = 2 \sec 3\theta$. (4 Marks)

QUESTION THREE (20 Marks)

- a) The volume of a cone of height h and base radius r is given by $V = \frac{1}{3}\pi r^2 h$. Determine;
- $\frac{\partial V}{\partial h}$ (2 Marks)
 - $\frac{\partial V}{\partial r}$ (2 Marks)
- b) The distance x metres travelled by a vehicle in time t seconds after the brakes are applied is given by $x = 20t - \frac{5}{3}t^2$. Determine
- The speed of the vehicle (in km/h) at the instant the brakes are applied. (3 Marks)
 - The distance the car travels before it stops. (5 Marks)
- c) Calculate the work done by a force $F = (-5i + j + 7k)m$ when its point of application moves from $(-2i - 6j + k)m$ to $(i - j + 10k)m$. (4 Marks)
- d) A box contains 74 brass washers, 86 steel washers and 40 aluminum washers. Three washers are drawn at random from the box without replacement. Determine the probability that all the three are steel washers. (4 Marks)

QUESTION FOUR (20 Marks)

- a) Prove the trigonometric identity $\frac{1}{\sqrt{1-\cos^2\theta}} = \operatorname{cosec} \theta$ (4 Marks)
- b) Determine the gradient of the curve $y = \frac{5x}{2x^2+4}$ at the point $(\sqrt{3}, \frac{\sqrt{3}}{2})$ (6 Marks)
- c) Pressure p of a mass of gas is given by $pV = mRT$, where m and R are constants, V is the volume and T the temperature. Find expressions for;
- $\frac{\partial p}{\partial T}$ (3 Marks)
 - $\frac{\partial p}{\partial V}$ (3 Marks)
- d) Determine the indefinite integral (4 Marks)
- $$\int \left(\frac{3x^2 - 5x}{x} \right) dx$$

QUESTION FIVE (20 Marks)

a) Evaluate $Z_2 + \frac{Z_1}{Z_4} + Z_3$ in $a + jb$ form given $Z_1 = 1 + j2, Z_2 = 4 - j3, Z_3 = -2 + j3$

and $Z_4 = 5 - j$ (10 Marks)

b) Calculate the velocity vector and its magnitude for a particle rotating about the Z-axis at an angular velocity of $(3i - j + 2k)rad/s$ when the piston vector of the particle is at

$(i - 5j + 4k)m$ (10 Marks)