



MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF APPLIED SCIENCES

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER EXAMINATION FOR THE BACHELOR OF TECHNOLOGY

APH 107 – ENGINEERING PHYSICS

DURATION: 2 HOURS

DATE: 18TH DECEMBER, 2017

TIME: 2.00 – 4.00 P.M.

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.

Some useful constants

Specific heat capacity of water = 4200 J/Kg K

Specific heat capacity of ice = 2100 J/Kg K

Specific heat capacity of copper = 390 J/Kg K

Specific heat capacity of aluminium = 900 J/Kg K

Latent heat of fusion of ice = 3.6×10^5 J/Kg

Latent heat of vaporization of steam = 2.26×10^6 J/Kg

SECTION ONE - COMPULSORY

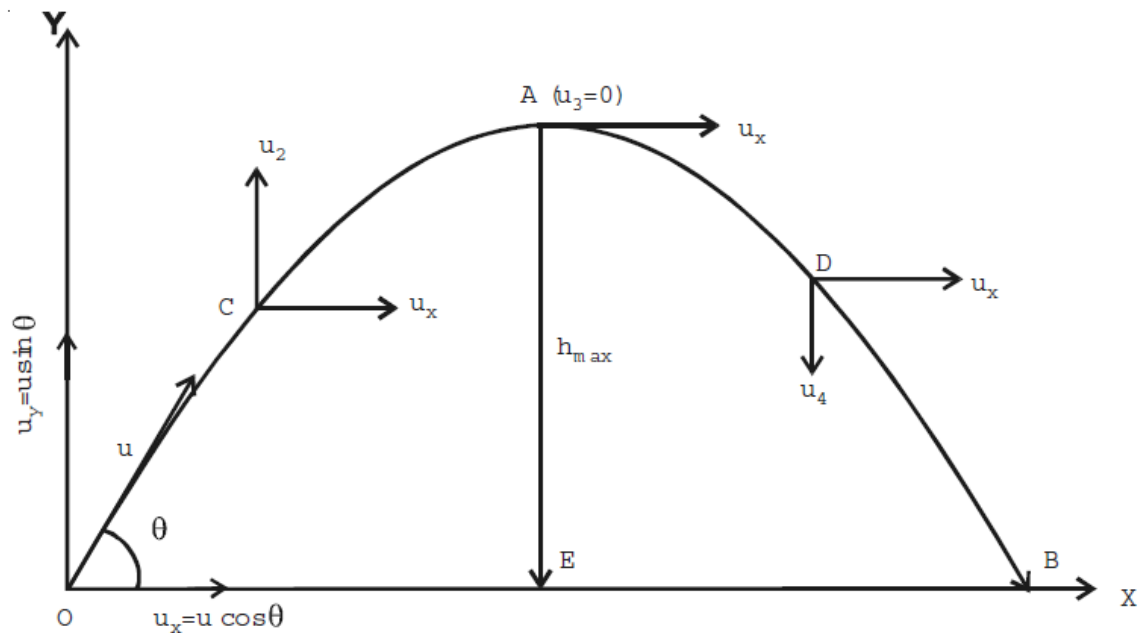
QUESTION ONE

- (a) List three limitations of dimensional analysis (3 marks)
- (b) State the principle of homogeneity of dimensions (1 mark)
- (c) Derive the dimensional formula for heat capacity (4 marks)
- (d) Check the dimensional correctness of the equation $n = \frac{1}{2\pi} \sqrt{\frac{g}{L}}$ where n is frequency, g is acceleration due to gravity and L is length (4 marks)
- (e) Express the polar coordinate (1.5, 300°) as a Cartesian coordinate (3 marks)
- (f) Define the following terms and state their SI units (6 marks)
- i) Work
 - ii) Energy
 - iii) Power
- (g) A car is accelerating uniformly as it passes two checkpoints that are 30m apart, the time taken between the checkpoints is 4 seconds and the car's speed at the first checkpoint is 5m/s. Find the car's acceleration and speed at the second checkpoint (6 marks)
- (h) Define the following terms (3 marks)
- i) Heat
 - ii) Heat capacity
 - iii) Latent heat
- (4 marks)

SECTION TWO – ANSWER ANY TWO QUESTIONS

QUESTION TWO

- (a) The figure below shows a body projected from point O on the surface of the earth with an initial velocity u at an angle θ with the horizontal. Using the figure derive the equation for;
- Maximum height reached by the projectile (3 marks)
 - The time of flight of the projectile (3 marks)



- (b) A stone is thrown straight upwards with an initial speed of 40m/s. It is caught on its way down at a point 8m above where it was thrown.
- How high did it rise? (3 marks)
 - How fast was it moving when it was caught? (3 marks)
 - How long did the trip take (3 marks)
- (c) The horizontal range of a projectile is $4\sqrt{3}$ times its maximum height. Find the angle of projection (5 marks)

QUESTION THREE

- (a) State Newton's laws of motion (3 marks)
- (b) Vicky driving at 35m/s enters a one lane tunnel. He notices a slow moving van 155m ahead traveling at 5m/s. He applies brakes and can only accelerate at -2m/s^2 . Will there be a collision? If yes, determine how far into the tunnel the collision occurs. If no, determine the distance of closest approach between Vicky's car and the van (7 marks)
- (c) An elevator is required to lift a body of mass 70kg. Find the acceleration of the elevator which could cause a reaction of 900N on the floor. Take $g=10\text{N/Kg}$. (5 marks)
- (d) A body of mass 4kg initially at rest is moved by a horizontal force of 1N on a smooth frictionless table. Obtain the work done by the force in 8s and show that this is equal to the change in Kinetic energy of the body (5 marks)

QUESTION FOUR

- (a) Define the following
- Stress
 - Strain
 - Elastic limit (3 marks)
- (b) A metal wire of length 75cm and diameter 0.13cm stretches by 0.035cm when a load of 8kg is hang at its end. Find
- The stress (3 marks)
 - The strain (3 marks)
 - Young's modulus for the wire (2 marks)
- (c) A block has a top area of 15cm^2 and a height of 3cm. When a shearing force of 0.5N is applied to the top surface the upper surface, is displaced by 4mm relative to the bottom surface. What are the shearing stress, shearing strain and shear modulus for the block? (9 marks)

QUESTION FIVE

- (a) A 10 gram bullet is fired into a stationary block of wood of mass 5kg. The relative motion of the bullet stops inside the block. The speed of the bullet-wood combination immediately after collision is 0.6m/s. what was the original speed of the bullet? (6 marks)
- (b) Exactly 3g of carbon was burnt to CO_2 in a copper calorimeter. The mass of the calorimeter is 1500g and there is 2000g of water in the calorimeter. The initial temperature was 20°C and the

final temperature 31°C . Calculate the heat given off per gram of carbon. Neglect heat capacity of carbon and carbon dioxide (6 marks)

(c) State Pascal's law and explain how it is applied in the hydraulic lift. (5 marks)

(d) Convert 317K to Fahrenheit (3 marks)