



UNIVERSITY EXAMINATIONS

FIRST SEMESTER 2025/2026 ACADEMIC YEAR

**FIRST YEAR EXAMINATION FOR THE DEGREES OF
BACHELOR OF EDUCATION (SCIENCE) AND BACHELOR
OF SCIENCE (GENERAL)**

PHYS 112: MECHANICS

STREAMS: R

TIME: 2 HRS

DAY: FRIDAY [11.30 – 1.30 P.M]

DATE: 30/01/2026

THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

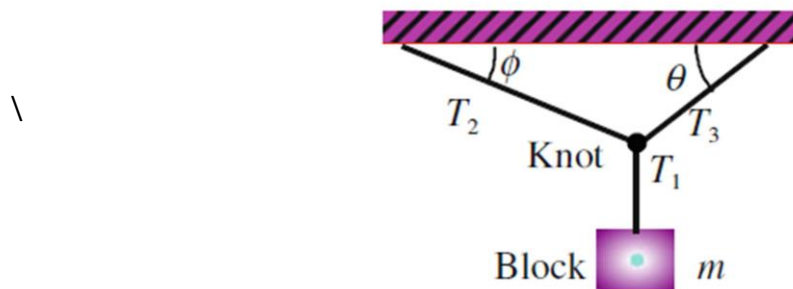
INSTRUCTIONS TO CANDIDATES:

Answer question **ONE** and any **THREE** questions

Question **ONE** carries **30 marks** while all other carry **10 marks**:

QUESTION ONE (30 MARKS)

- (a) State (i) Dimensions of momentum
(ii) Principle of moments **(3 Marks)**
- (b) Distinguish between dynamics and kinematics as used in classical mechanics. **(2 Marks)**
- (c) Suppose the displacement s of an object moving in a straight line under uniform acceleration a is given as a function of time by the equation, $s = ka^mt^n$ where k is a dimensionless constant. Use dimensional analysis to find the values of the powers m and n . **(3 Marks)**
- (d) A speed boat has a constant acceleration of 2 m/s^2 . If the initial velocity of the boat is 6.0 m/s , find its displacement after 8.0 sec . **(2 Marks)**
- (e) A stone of mass 400g is whirled in a vertical circle of radius 0.5m at tangential velocity of 10 m/s . Calculate the tension on the string when the stone is moving upwards at an angle of 30° to the horizontal. **(3 Marks)**
- (f) Calculate the recoil velocity of a gun having mass equal to 5 kg , if a bullet of 25 g acquires the velocity of 500 ms^{-1} after firing from the gun **(3 Marks)**
- (g) Calculate the change in kinetic energy when a car of mass 800 kg is accelerated at 0.3 m/s^2 for a displacement of 50 m **(3 Marks)**
- (h) If the acceleration due to gravity at the moon's surface is 2.50 m/s^2 and its radius is $2.74 \times 10^6 \text{ m}$. Calculate the mass of the moon **(3 Marks)**
- (i) A uniform bar of mass 48kg is supported by two men at 0.8 and 2.4m from one end. If the length of the bar is 3.6m . Find the mass supported by each man. **(3 Marks)**
- (j) A block of mass $m = 21 \text{ kg}$ hangs from three cords as shown in of Figure below. Taking $\sin \theta = 4/5$, $\cos \theta = 3/5$, $\sin \varphi = 5/13$, and $\cos \varphi = 12/13$, find the tensions in the three cord **(5 Marks)**



QUESTION TWO (10 MARKS)

- (a) The velocity of a motorcycle moving on a straight road is given by the equation $v = 3 + 2\sqrt{t}$.
Determine the distance travelled by the motorcycle between $t = 0$ s and $t = 4$ s. **(3 Marks)**
- (b) (i) State one use of projectile motion in our daily life. **(1 Mark)**
- (ii) A body is projected with a velocity of 200 m/s at an angle of 30° above the horizontal. Calculate the time taken to reach the maximum height and its velocity after 16 seconds **(3 Marks)**
- (c) A car moving at 10m/s is accelerated uniformly for 20 S in distance of 300m. If the mass of the car was 1200kg find the accelerating force. **(3 Marks)**

QUESTION THREE (10 MARKS)

- (a) (i) Show that the rate of change of momentum is equal to the force causing acceleration **(2 Marks)**
- (ii) State Newton's law of universal gravitation **(2 Marks)**
- (iii) Show that the period of a satellite in a parking orbit is given by $T = \sqrt{\frac{4\pi^2 R^3}{gr^2}}$ where R is the radius of the parking orbit, r is the radius of the earth and g is gravitational field. **(3 Marks)**
- (b) The rate of energy spend by a dragonfly when it is hovering above a pond depends on the density ρ of the air, the length of the wings l and the upward force on its wings F . If the power it would have to spend hovering above the pond is given by P . Use the method of dimensions to determine how P is related to ρ , l and F . **(3 Marks)**

QUESTION FOUR (10 MARKS)

- (a) (i) Explain why maximum static friction is higher than kinetic friction **(2 Marks)**
- (ii) In moving a 35kg desk from one side of a classroom to another, it is found that a horizontal force of 195N is necessary to keep it in motion with a constant speed. Find the co-efficient of kinetic friction between the desk and the floor. **(2 Marks)**
- (b) A baseball has a mass of 0.2 kg and a speed of 30 m/s. After the batter strikes the baseball, its velocity changed to 50 m/s in the opposite direction. Find the change in momentum of the ball and the impulse of the strike. **(3 Marks)**
- (c) Find the highest tension of a string of 72cm length holding a bob of mass 400g oscillating in a vertical circle at a linear speed of 5m/s. **(3 Marks)**

QUESTION FIVE (10 MARKS)

- (a) Show that the change in kinetic energy of a body is equal to the work done in accelerating the body. **(3 Marks)**
- (b) A bus moves up a hill of inclination of 15° to the horizontal. If the bus attains a velocity of 10 m/s in 40 seconds from rest and the total mass of the bus is 6400 Kg.

- Find (i) Acceleration of the bus **(2 Marks)**
- (ii) Displacement covered in 40 seconds **(2 Marks)**
- (iii) Total work done by the engine **(3 Marks)**