

P510/1
PHYSICS
Theory
Paper 1
August 2025
2 hours



ASK INTEGRATED TEACHER'S EXAMINATIONS BUREAU LTD
Uganda Advanced Certificate of Education
S.5 END OF TERM II EXAMS 2025
PHYSICS PAPER 1
(Theory)
2 Hours

INSTRUCTIONS

*This paper consists of **four** examination items.*

Attempt all items.

Begin each item on a fresh page.

Be neat.

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ITEM ONE

- (a) A construction worker attempts to lift a uniform beam off the floor and raise it to a vertical position. The beam is 2.50 m long and weighs 500N. at a certain instant the worker holds the beam momentarily at rest with one end at a distance 1.50 m above the floor. Given that the floor is rough. There is a need to obtain the force exerted by beam on floor and the force exerted by worker on ladder and the coefficient of friction between floor and beam in order to analyze its stability and prevent it from slipping.

As a learner of physics address the need

- (b) A fresh Mechanical engineer wanted a job at Ministry of works and transport and the Principal Human Resource Management gave him an interview as below;

ITEM 2

A 75 kg window cleaner uses a 10 kg ladder that is 5.0 m long. He places one end on the ground 2.5 m from a wall, rests the upper end against a cracked window and climbs the ladder. He is 3.0 m up along the ladder when the window breaks. Neglect the friction between ladder and window and assume that the base of the ladder doesn't slip. When the window is on the verge of breaking. He will be given the job if he determines the magnitude of force from window from ladder and magnitude of force on ladder from ground and Angle of relative to horizontal of that force on the ladder

Task

Help the fresh engineer to get the job

Item 3

- (a) An astrophysicist designing a communication satellite that will orbit the earth. The satellites velocity must be calculated correctly to ensure it remains in a stable orbit. The following were to be verified first

Fundamental and derived quantities needed to describe the motion of satellite

Use dimensionally analysis to verify equation of orbital velocity $V = \sqrt{\frac{GM}{r}}$ where G is gravitational constant with SI units $\text{Nm}^2 \text{kg}^{-2}$, M is the mass of earth and r is orbital radius.

Importance of using correct dimension in space mission planning.

Help the astrophysicist verify and understand his concerns

- (b) A biomedical engineer working on the designing device to measure blood pressure. The velocity of blood flow in arteries must be calculated accurately for diagnosing heart conditions

- (i) Use dimensional analysis to verify the Bernoulli equation $P + \rho \frac{v^2}{2} + \rho gh = \text{constant}$ where P is pressure, ρ is blood density, V is velocity, g is gravitational acceleration and h, is height
 - (ii) Explain why checking dimensional consistency is crucial in medical device development.
- (c) When an automobile moving with a speed of 36kmh^{-1} reaches an upward inclined road of an angle 30° , its engine is switched off. If the automobile moves a distance of 8.5 m before coming to rest, determine coefficient of friction between the road and the automobile

Item 4

- a) A 1000 kg automobile is at rest at a traffic signal. At the instant the light turns green, the automobile starts to move with a constant acceleration of 4.0ms^{-2} . at the same time a 2000kg truck travelling at constant speed of 8.0ms^{-1} overtakes and passes automobile.
 - (i) Determine how long and how far did the truck overtake the automobile
 - (ii) How far is combination after $t = 3$ seconds
 - (iii) Determine the velocity of combination at $t = 3$ seconds
- b) A shell is shot with an initial velocity of 20ms^{-1} at an angle of 60° to the horizontal. At the top of trajectory, the shell explodes into two fragments of equal mass, one fragment whose speed immediately after explosion is zero falls vertically. How far from the gun does the other fragment land neglecting air drag
 - (i) Determine the time taken to the point of explosion
 - (ii) Speed with which the other fragment just land on the ground

Item 5

- (a) In a game of pool, the cue ball strikes another ball of the same mass and initially at rest. After collision the cue ball moves at 350 m/s along a line making an angle of 22° with the cue ball original direction of motion and the second ball has a speed of 2.0 m/s. determine the angle between direction of motion of second ball and original direction of cue ball

Determine the original speed of cue ball and whether kinetic energy is conserved

- (b) A railroad freight car of mass $3.18 \times 10^4\text{kg}$ collides with a stationary caboose car . they couple together and 27% of initial kinetic energy is transferred to thermal energy and sound vibrations. Determine the mass of caboose car
- (c) In air track system a cart of mass 0.600 kg resting on smooth horizontal table at a distance 0. 500 m from the edge of table. The cart is connected by a cord to a freely hanging block of mass 0.400 kg which is 0.100 m above the ground. The cart is released from rest and both moves until the cart hit the pulley.

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Determine the tension in cord, acceleration of the system and velocity with which the cart hits the pulley

Item 6

(a) Balls P, Q and R of masses m_1 , m_2 and m_3 lie on a smooth horizontal surface in a straight line. The balls are initially at rest. Ball P is projected with a velocity u_1 towards Q and makes an elastic collision with Q. If Q makes a perfectly inelastic collision with R. show that R moves with velocity $V_2 = \frac{2m_1m_2u_1}{m_1+m_2)(m_3+m_2)}$

(b) A bullet of mass 40 g is fired from a gun at 200 m/s and strikes a block of wood of mass 2 kg which is suspended by a light vertical string 2m long. If the bullet embeds into the wooden block and composite body raised to vertical position. The main intension was to achieve vertical height of composite of 4m

Determine whether the intension was achieved

Determine the maximum angle the string makes with vertical

END