P510/1/2 PHYSICS

AUGUST 2025

UGANDA ADVANCED CERTIFICATE OF EDUCATION

S.5 PHYSICS HOLIDAY WORK TERM II 2025

INSTRUCTIONS

- ✓ **Attempt all questions in the Physics Holiday Package book**
- ✓ **A fee of Ugshs 10,000 will be payable to class teacher on reporting day**

ITEM ONE

On a straight road near your school, a student is walking at a constant speed of $1.5\ ms^{-1}$ towards a parked minibus. At the same moment, the minibus starts moving away from the student with a uniform acceleration of $1.2\ ms^{-2}$ from rest. You are tasked by the road safety club to analyse the situation and determine whether the student will ever catch up to the minibus or how close he can get before it moves too far.

Tasks:

a) Formulate expressions for the displacement of the student and the displacement of the minibus after time t seconds
b) Determine the minimum distance between the student and the minibus and the time at which it occurs
c) Find the relative velocity between the student and the minibus after 4 seconds. Intepret what this value means in terms of their motion.

ITEM TWO

Paul, a science teacher at Chemwania Secondary School, set up a Physics Laboratory experiment for his students to investigate how different materials respond to changes in temperature. He explained that thermometric properties are physical characteristics of substances that vary with temperature and can be used to construct thermometers. To demonstrate this, he used a Platinum Resistance Thermometer, which relies on the fact that the electrical resistance of Platinum changes with temperature. The thermometer was calibrated such that its resistance was:

$$R_0 = 100.0\Omega \; at \; 0^0C \; (The \; ice \; point)$$

$$R_{100} = 138.5\Omega \; at \; 100^0C \; (The \; steam \; point)$$

Later, Paul immersed the thermometer into a hot liquid and recorded a resistance of $R = 123.1\Omega$

Tasks:

a) Explain the term thermometric property, and give all the other example apart from resistance.
b) Using the resistance values provided, derive a formula to calculate the temperature θ in degrees Celsius in terms of resistance R.
c) Calculate the temperature of the hot liquid
d) Convert the temperature obtained in part (c) to;
   (i) Degrees Fahrenheit
   (ii) Kelvin
a) Describe how a temperature scale is established using a liquid-in-glass thermometer.
b) State one advantage of using a platinum resistance thermometer over a mercury in glass thermometer.

ITEM THREE

A group of students at a vocational college is designing a solar-powered periscope system that allows users to observe distant objects near the ground without bending. The system uses a glass prism to bend light from outside into the user's eye through total internal reflection and controlled refraction. They use a 60^0 glass prism (n=1.5) and aim for minimum deviation of the sunlight rays entering the prism. During testing, they noticed that when viewing objects in a tank of water (n=1.33) through a glass window as it struck at an angle of 30^0 inside the water, the object appear shifted or bent. Which left them confused.

Task:

a) Help the team to determine the angle of refraction when sunlight enters the glass prism from air at an angle of incidence of 40^0
b) Find the angle of minimum deviation of the prism they used

c) Determine the angle of refraction of glass and account for the apparent shift of objects seen through the tank wall

ITEM FOUR

During a scientific investigation in studying transvers waves and superposition, two waves A and B were created and they had the following equations:

Wave A: $y = \text{asin}\left(100\pi t - \frac{10}{9}\pi x\right)$

Wave B: $y = \text{asin}\ (100\pi t + \frac{10}{9}\pi x)$

a) There was need to understand what happens when these two waves overlap.
b) Some terms such as frequency, wavelength, and amplitude were used. Define them
c) Use the principle of superposition to find the resultant wave equation when wave A and wave B overlap.
d) Describe the type of interference that occurs between wave A and wave B
e) An observer moving between two identical stationary sources of sound along a straight line hears beats at a rate of $5ms^{-1}$. If the frequencies of the sources are 600Hz and the velocity of sound in air is $330ms^{-1}$, calculate the velocity at which the observer is moving.

ITEM FIVE

A boarding secondary school in Uganda is planning to install a backup power system using a generator to ensure continuous supply of electricity during outages. The school electrician connects a 240V generator to several classroom lighting systems and laboratory appliances using long aluminum wires. Each classroom uses a total resistance of 60Ω when all bulbs and sockets are on. After a few weeks of use, the electrician notices that the wires heat up, especially those going to the laboratory block. Concerned about energy loss and safety, they are puzzled on how they can investigate the situation.

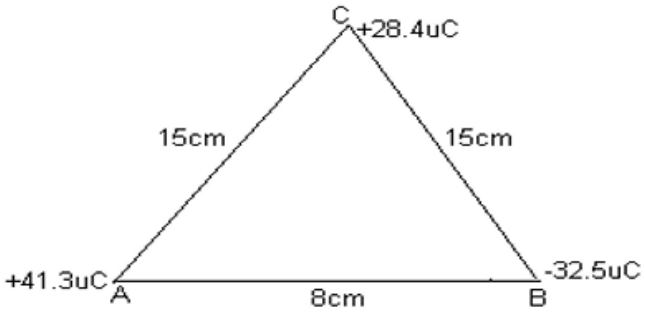
Tasks:

a) Help the electrician determine the current flowing through the classroom circuit when the full 240V is applied across a 60Ω resistance

b) How much power dissipated in the classroom circuit, and suggest two practical methods the school can apply to reduce energy loss
c) If the circuit is used for 5 hours each day, how much electrical energy is consumed in kilowatt-hours (KWh)
d) Explain the heating effect observed in the aluminum wires, and how it relates to the current and resistance of the wires

ITEM SIX

A business man who imports second hand car and sales them, of recently acquired a garage where the cars can be spray painted so that the cars look good to the customers. Before the garage could start spray painting the cars, the businessman consulted an engineer who told him that during spray painting, paint particles repel each other but are attracted to the cars' body and wondered if this would not waste the spray paint. The businessman was also told that the body of the car must be earthed during the spray painting. In one of the tests done by the engineer using an electronic microscope it was found that three paint particle from the nozzle of the spray were at one time arranged in a shape of a triangle ABC and carrying charge as shown in the figure below.



Tasks:

Using your knowledge of electrostatics, help the business man;

a) Understand the law that governs charged particles
b) Know how an electrostatic paint spray work
c) Determine the electrostatic force experienced by the charge at point C
d) Understand how the body of the car could be charged and yet remains at zero potential.

END