A LEVEL PHYSICS PRACTICE SCENARIO ITEMS

LINEAR MOTION

On a straight road near your school, a student is walking at a constant speed of 1.5 m/s towards a parked minibus. At the same moment, the minibus starts moving away from the student with a uniform acceleration of 1.2 m/s^2 from rest.

You are asked 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.

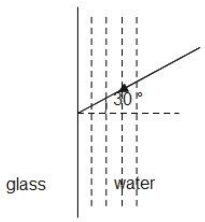
Tasks:

(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. Interpret what this value means in terms of their motion.

LIGHT

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° glass prism (n = 1.5) and aim for minimum deviation of the sunlight rays entering the prism. During testing, they also notice that when viewing objects in a tank of water (n = 1.33) through a glass window as its struck at an angle of 30° inside the water, the objects appear shifted or bent. Which left them confused.



Tasks:

As a physics student

(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°.
(b) Find the angle of minimum deviation of the prism they used.
(c) Determine the angle of refraction in the glass and account for the apparent shift of objects seen through the tank wall.

By **KASOZI RATTIBU**

CURRENT ELECTRICITY

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 240 V generator to several classroom lighting systems and laboratory appliances using long aluminium wires. Each classroom uses a total resistance of 60 Ω 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:

As a physics student

(a) Help the electrician determine the current flowing through the classroom circuit when the full 240 V is applied across a 60 Ω 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 in consumed in kilowatt-hours (KWh).
(d) Explain the heating effect observed in the aluminium wires, and how it relates to the current and resistance of the wires.

MAGNETISM

A village in eastern Uganda has no connection to the national electricity grid. A group of local innovators plans to build a simple wind-powered generator using locally available materials that include soft iron rods, coils of copper wire, and permanent magnets. Their aim is to produce electricity to power a few LED bulbs and charge mobile phones.

They use an old bicycle wheel to rotate a shaft that spins a coil inside a magnetic field. After testing the generator, they observe that the bulb glows faintly and the charging is very slow. The generator produces an output of 4.8 V and supplies a current of 0.25 A to a bulb. They consult you, for help on how improve the design and understand the science behind it.

Tasks:

As a physics student

(a) Explain how the magnetic properties of the materials used (soft iron and copper) contribute to the operation of the generator.
(b) Describe how magnetism and current are linked in the generation of electricity in this device.
(c) Suggest two modifications the innovators can make to increase the output voltage and current from their generator. Justify your suggestions using relevant physics principles.
(d) Determine the power output of the generator and the energy produced in 30 minutes of operation.

By **KASOZI RATTIBU**