535/1

PHYSICS

Paper 1

(Theory)

PHYSICS DEPARTMENT

Uganda certificate of education

S.3 PHYSICS PAPER 1

ITEM 1

One hot afternoon, a group of learners walked along a tarmac road in the westward direction to check on the new swimming pool. On the road, they noticed what looked like water near a car in the distance, but the "water" disappeared when they reached the spot and reappeared farther ahead. Later, the weather changed, and there was a light drizzle while the sun was still bright. Looking eastward, they observed a semi-circular distribution of colours in the sky (a rainbow). They finally reached the swimming pool, where the pool attendant warned them that the pool might appear shallow when filled with water

Meanwhile, one of the learners was curious about how light behaves and decided to perform an experiment involving refraction. They directed a ray of light from air into a glass block at an angle of incidence of 30°. Given that the refractive index of the glass is 1.5, that the speed of light in air is approximately 3.0×10^8 m/s

SUPPORT

Task

Using your knowledge of physics, assist the learners to understand:

(a) The process that leads to what they observed on the tarmac road

(b) The process that leads to what they observed in the sky

(c) Why the swimming pool appears shallow when filled with water

(d) For the experiment with the glass block:

i. Calculate the angle of refraction inside the glass.

ii. Calculate the speed of light within the glass.

ITEM 2

Two dressing mirrors in one of the school dormitories broke due to carelessness of the learners. For fear of the teacher discovering the damage they caused, they picked two curved glasses from an old car parked in the school compound, each of focal length 50 cm. The glasses were silvered on one side and nailed on the walls, one in a room congested with beds and mattresses, and another in an empty room.

They were surprised to hear a prolonged sound of the hammer in the empty room, which was not the case in the congested room. They also realized that the mirrors they made produce only tiny images of any individual standing in front of them, regardless of the distance. The learners realized that the mirrors made were not dressing mirrors but they could not identify them.

Furthermore, the light in the corridor was replaced by a yellow floodlight, but the learners were surprised to see that their green and blue uniforms with red

sweaters changed to different colors. The learners have approached you for assistance.

Task:

(a) Help them to understand the type of mirrors they made and use an illustration/ray diagram to describe how it works.

(b) By drawing to scale, determine the height and magnification of a person of height 150 cm standing 2000 mm from the mirror.

(c) Explain the colors of their uniforms and sweaters under the yellow floodlight.
(d) Briefly explain two applications of the type of mirrors made.

ITEM 3

In a certain country, a Television (TV) reporter was reporting live near the ocean during nighttime. Viewers in another country were watching the live broadcast of the news bulletin during daytime. The viewers wondered how it could be day and night at the same time, how the event in one country could be watched live on TV in another country, and how the phases of the Moon are related to events on Earth.

Task:

Using your knowledge of physics, help the viewers to understand:

(a) The possibility of it being day in one place and night in another place.

(b) The occurrence of high ocean tides.

(c) The phases of the Moon and their relationship to events on Earth.

ITEM 4

Two motorists P and Q have been selected to represent their motor club in a racing competition. Before the final selection, they must first participate in a prequalification driving test.

The rules of the test state that any motorist who covers at least 500 m in a time not exceeding 30 s will receive a reward of 25 litres of fuel. In addition, the motorists must undergo a written interview to assess their scientific awareness before they are allowed to represent their club.

During the driving test, both motorists started from the same point and at the same time. They accelerated uniformly from rest. Motorist P attained a maximum velocity of 30 m s^{-1} after 10 s, while motorist Q attained a maximum velocity of 40

m s^{-1} in the same time.

After reaching their maximum velocities, both motorists maintained those velocities for 10 s. They then applied brakes and retarded uniformly until they came to rest. Motorist P took 5 s to stop completely, whereas motorist Q took 8 s to stop.

As a safety measure, all participating vehicles had their radiator fins painted black and used only water for cooling the engines whenever overheating occurred.

The interview panel requires the motorists to provide scientific explanations and calculations based on the information above.

Tasks

a) Explain the meaning of the underlined term velocity.
b) Present their velocity-time graph on the same axes.
c) Hence determine whether each motorist qualified to receive the 25 litres of fuel. Give reasons for your answer.
d) Explain why radiator fins are painted black and why water is suitable for cooling an overheated engine.

END