

PART II

Choose only *one (01)* item from this part

ITEM 5

At a meteorological research station on Mt. Elgon, researchers study atmospheric electricity, particularly during thunderstorms common in the region. The scientists use specialised equipment to measure electrostatic fields in the atmosphere and correlate them with the weather patterns. One of the researchers on internship observed bright flashes in the sky and these were shortly followed by a loud sound but lacked scientific information for this phenomenon and was amused why he observed the flashes just before the sound. He consulted his supervisor who told him that the flashes and sound were caused by a physical process that can also be utilised in the operation of the Photocopier. He further informed him that that process can be dangerous and precautions were needed to keep one safe during the occurrence. He then requested you to help the researcher on internship understand the processes that lead to the occurrence of the flashes of light and loud sound, how one can stay safe during the process and the application of the process in the operation of the photocopier. As you were explaining, your keys with a steel key holder accidentally fell but did not reach the ground as they were attracted to a substance in form of a metal bar as they were falling. The researcher was amused the more and requested you to provide a clear explanation for his observation.

Task:

As a learner with a knowledge of Physics, respond to the request of the;

- supervisor.
- researcher on internship.

ITEM 6

A group of senior five students in a Physics innovation club are tasked to design a simple electric heater using locally available materials. They choose a 1.0m long nichrome wire of diameter 0.72mm and wind it into a coil. The coil is fully immersed in 200cm^3 of water, both initially at 25°C . A steady current of 5.0A is passed through the coil. The students observe that just after 8 minutes , the water just begins to boil at 100°C . They assume that all the electrical energy supplied by the coil is used to heat the water and there are no heat losses.

One of the students is concerned about the why the wire becomes hot when a current flows through it. Some group members argue that this is due to the drift velocity of the electrons in the wire and are asked to derive the expression for the drift velocity but they are unable to do so.

The students are required to determine the initial resistance of the nichrome coil at 25°C , the total electrical energy supplied during heating and the mean temperature coefficient of resistance of nichrome between 0°C and 100°C .

The design requirement for the heater states that the resistance of the wire used should not exceed 5.25Ω at 25°C , the heat energy supplied should not be less than 63000J and the temperature coefficient of resistance should not be less than 2.2×10^{-3} .

The students are also confused about why some materials have positive temperature coefficient of resistance while others have a negative one. In addition, they don't know how the temperature coefficient of resistance of the nichrome wire can be determined experimentally in a school laboratory setting. Although, they sought guidance from the laboratory technician, they still failed to understand the procedure.

Task:

Analyse the scenario and help the students to;

- (a) determine whether the nichrome wire meets the requirements of the heater and address all the concerns in the scenario.
- (b) explain the concepts and laboratory procedures that the students have failed to understand.

*****END*****