#### **DEPARTMENT OF PHSICS**

### SENIOR FOUR PHYSICS

#### Time allowed; 2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES;

This paper consist of two sections A and B

Section A has three compulsory questions

Section B has four questions. Answer only two questions from this section

Any additional questions will not be marked

### **SECTION A**

### Item 1

The article below was extracted from a newspaper by the ministry of energy and mineral development.

'nuclear energy is the energy in the nucleus or core of an atom. Atoms are tiny units that make up matter in the universe. Nuclear energy can be used to create electricity but it must be released from an atom by a process known as nuclear fission. A radioactive isotope of uranium  $^{235}_{92}U$  which is the most widely used to produce nuclear energy. If a uranium sample of mass 64kg decays to 4kg in 96days by emission of two alpha particles and one beta particle to form thorium (Th), then large amounts of nuclear energy released can be trapped and used to power mega manufacturing industries without directly affecting the environment. The nuclear accidents in history that is the fukushima Daiichi accident of japan in 2011 and the Chernobyl accident in Ukraine in 1986 greatly affected the environment negatively till date.

Nevertheless, the discovery of radioactivity has done a great role in enhancing the fields of medicine, agriculture, industries and archeological sector. Thanks to the scientists Madame Marie curie, Pierre curie and henri Becquerel''

(Source; Wikipedia.org)

#### From the information above;

- (a) What roles has radioactivity played in the medical and industrial sector?
- (b) What dangers are associated with exposure to radioactive materials?
- (c) Write down a well-balanced equation for the decay of uranium-235

(d) Determine the half-life of the uranium isotope

# Item 2

Mr Muyise wishes to use a block and tackle system to move 5bags of cement each of mass 50kg up a tall building he is constructing. The pulley system he hopes to use consists of three pulleys in the fixed block and 2 pulleys in the movable block. His friend Mabeere advised that if the pulley system is 85% efficient, then no energy will be lost (wasted by the machine) but he didn't understand what his friend meant by that statement.

(a) As physics student, what did Mabeere mean by that statement?

(b) Explain to Mr. Muyise how energy is lost or wasted by the machine.

(c) Find out how much energy Mr. Muyise must apply so as to move the cement up the building

# Item 3

A group of students in the laboratory are confused about a couple of things they observed during an experiment. In a ripple tank, glass blocks were put on one side of the tank to make it 30cm deep and the other 60cm deep. A circular rod operating at 50Hz was used to produce ripples on the shallow end of the tank. The learners were cautioned that if the velocity of the ripple exceeded 5m/s, the walls of the tank would eventually break. The distance between successive crests is seen to change from 2cm to 5cm. A coin placed at the bottom of the ripple tank appears to be closer to the top of the water. After lining the walls of the ripple tank with a sponge, the ripple seems to disappear after striking the walls of the tank which is different from what was observed before the walls of the tank.

The students were tasked to establish if it was safe to use a rod producing waves of 50Hz and also explain the causes of other occurrences.

## SECTION B

## Item 4

A known hotel wishes to set up a water tank that can supply warm water to its customers in the lower floors of the hotel at a pressure of about 50000 Pascals. Recently the manager of the hotel claimed that the water from the previously existing tank was too hut and unsuitable for showering. In every 10litres of water in that tank at 20°C, 20 **2** | P a g e

litres of hot water at  $80^{\circ}$ C was added to attain a certain temperature. He said that the final temperature of the mixed water is above  $50^{\circ}$ C, it is not suitable and if it is below  $50^{\circ}$ C, it is recommended for use.

(The hot water is added to raise the temperature of the cold water).

The specific heat capacity of water=4200jkg<sup>-1</sup>k<sup>-1</sup>

Using the knowledge of physics,

- (a) Advise the company to what height the tank should be raised so as to supply the required water pressure.
- (b) Do you think the mixed water would be suitable for use by the customers? Support your answer with an explanation.

# Item 5

A maize grilling company has a machine used to grind maize and chicken feeds in a certain village. Recently customers claimed that they have found small metallic pieces in their floor but the manager has failed to admit it. In its board meeting, the company has failed to come up with an immediate method to prove the customers claim. You have been appointed on behalf of the company to help and come with an immediate device to sort the issue.

- (a) Design a simple device that you would use to prove the customers claim and explain the working principle of the device.
- (b) The device constructed above relies so much on dry cells as the source of the current but they cannot supply large amounts of current for a long period of time and this proved a challenge. Explain to the company board the defects associated with the use of dry cells and provide and alternative source of the e.m.f to use to power the electromagnet.

## Item 6

The head teacher of your school wishes to buy two batteries of emf 6V and internal resistance  $2\Omega$  each to be used on the school lighting system. The lighting system can use a maximum voltage of 6V. The head teacher would also wish to buy the connecting wires. Wire A has a diameter of 0.1mm and costs 1000 shillings per metre and wire B has a diameter of 0.15mm and costs 2500 shillings per metre. He is not sure which wire to buy.

The batteries are to be connected to a bulb of resistance  $4\Omega$ . The bulb may blow up if the current exceeds 3A.

- (a) Advise the head teacher on how best he can arrange the batteries and the type of wire to be used. Conclude by commenting on the advantages of the arrangement chosen and the wire used.
- (b) Prove mathematically if the current produced by the arrangement designed in task (a) above is safe for the bulb.

#### Item 7

Yasin of mass 60kg drove a car from mukono to iganga in order to find the interview he was called for. He drove so fast that he wanted to reach in time. He accelerated the car from rest in mukono up to speed of 50m/s in 10 minutes, he then maintained that speed for another 30 minutes and as he was about to reach, he decelerated the car uniformly to rest in another 25minutes. From the car, he realized that the elevator he was supposed to use was out of service and he had to opt for the staircase. He climbed 64 stairs each of height 16cm till he reached the office. He reached exhausted and breathing heavily. Use your knowledge of physics to find out;

- (a) The distance he travelled by car from mukono up to iganga.
- (b) The deceleration of the car as he reached iganga town.
- (c) How much he did in climbing all the stairs.
- (d) If he had not fastened the seat belt and the vehicle stopped immediately.

#### THE END