

PHYSICS

535/1

$2\frac{1}{2}$ HOURS

ITEM	ELEMENT OF CONSTRUCT	TOPICS COVERED	CLASS
Section A; compulsory			
Item one	Light and waves	Nature of light	S.1
		Reflection of light at plane surfaces	S.1
		Reflection of light at curved surfaces	S.2
		Refraction of light, dispersion and color	S.3
		Lenses and optical instruments	S.3
		General wave properties	S.3
		Sound waves	S.3
Item two	Atomic and nuclear physics	Atomic models	S.4
		Nuclear processes	S.4
Item three	Earth and space physics, digital electronics	The solar system	S.2
		Stars and galaxies	S.3
		Satellites and communication	S.3
		Digital electronics	S.4
Section B			
	Part I(answer any one item)		
Item three and four	Mechanics and heat	Measurements in physics	S.1
		States of matter	S.1
		Effects of forces	S.1
		Work, energy and power	S.2
		Turning effect of forces, centre of gravity and stability	S.2
		Pressure in solids and fluids	S.2
		Mechanical properties of materials and Hooke’s law	S.2
		Linear and non-linear motion	S.3
		Temperature measurements	S.1
		Heat transfer	S.1
		Expansion and contraction of solids, liquids and gasses	S.1
		Heat quantities and vapors	S.3
	Part II (attempt any one item)		
Item six and seven	Electricity and magnetism	Magnets and magnetic fields	S.2
		Electromagnetic effects	S.4
		Electrostatics	S.2
		Introduction to current electricity	S.4
		Voltage resistance and Ohm’s law	S.4
		Electric energy distribution and consumption	S.4

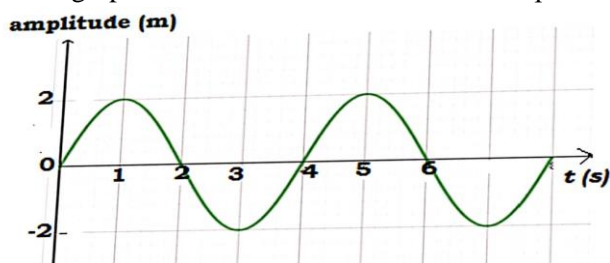
PHYSICS**535/3&4****2 hours**

ITEM	Topics
Item one or two (attempt only one)	Mechanics
	Optics
	Electricity

LIGHT AND WAVES

1. A war erupted in a certain mountainous area surrounded by small water bodies where soldiers only communicated by throwing a stone in water to alert their colleagues of danger ahead; but this alerted their enemies. One of the soldiers had small sizable plane mirrors and a torn paper box in his bag. Their leader sent spies to peep behind hills to see where the enemies were hiding but many spies were captured and killed. They totally lacked the knowledge on how to solve this problem. The enemy troops had a radio call that was used for communication and wave forms were produced on the receiver's computer clearly. One afternoon it threatened to rain and bright colours of different kind spread in skies. This scared the soldiers more.

Hint: a graph obtained from the receiver's computer.



Task;

As a physics student, help the soldiers to;

- Understand why throwing the stone in water always alerted their enemies.
- The best way they could reduce the rate at which their spies were being captured.
- Understand the strange appearance of the skies that sent them to hide outs.
- Determine the frequency at which the waves reached the receiver at the home base of the enemy.

ATOMIC AND NUCLEAR PHYSICS

2. A certain town experienced an atomic bomb blast, many people were killed in the incidence and others survived with severe injuries, the government advised those who survived to re-locate to other places of the country because that town was not safe for them. The scientist carried out a scientific investigation using detectors of radiations and found out that the environment was still radioactive as shown in the table.

Time(days)	0	22	42	62	82	102	122	142	162
Count rate (min^{-1})	106	83	66	56	47	36	31	26	15

The scientist recommended that the environment will be safe for use again when obtained half-life less than 60 days and they will need like 1 year (365days) for the environment to be free from radioactive wastes and materials.

Use your knowledge of physics to;

- a) Help the people know the value of the half-life and advise them accordingly.
 - b) Sensitize the people about the risk associated with radioactive materials and how they should be handled.
 - c) Help the people to understand the value of the number of neutrons of a nuclide Y formed when a radioactive substance X of mass number 208 and atomic number 104 decays by emitting 3 alpha particles, 4 beta particles and gamma rays.
3. In a hospital, a patient came with a suspected broken bone in their arm and another patient is scheduled for a dental examination. Your x-ray machine produces electromagnetic waves with a frequency of $6 \times 10^{18} \text{ Hz}$. Your supervisor asks you to;
- i) Take an x-ray image of the patient's arm to confirm the bone fracture diagnosis.
 - ii) Take a dental x-ray to examine the patient's teeth and jaw alignment.

Hint:

Wavelength of x-rays	$5 \times 10^{-11} \text{ m}$	$5 \times 10^{-10} \text{ m}$	$5 \times 10^{-9} \text{ m}$
Image resolution	High	Medium	Low

As a learner of physics;

- a) Comment on the resolution of the image of the patients' arm and bone fracture.
- b) Explain how the frequency and wavelength relate to the penetrating power of the x-rays and how this affects your choice of settings for the arm and dental exams.
- c) Suggest possible precautions taken while dealing with x-rays.

DIGITAL ELECTRONICS

4. As a physics student, you are tasked to design a home security light control circuit, the light should be activated by either manually pressing a switch or automatically by a light sensor. The sensor works as follows; when there is sunlight outside, it switches off the light but when there is darkness, it switches on the light. Draw a logic circuit diagram and a truth table for all the possible operations.
5. A greenhouse farmer has two sensors in his green house; a temperature sensor and a humidity sensor. The plants in his green house can't give good yields if the temperatures are above 35°C or if the humidity is high. He wants an alarm to be sounded if the plants are not having appropriate conditions for giving good yields. Using logic circuits, describe how this can be achieved.

MECHANICS AND HEAT

6. Workers at a construction site are meant to raise pieces of scrap of mass 6 kg through a height of 15 m . Their boss always complains that the workers do the work slowly, especially in the afternoon when the temperatures are high and in the morning when it is cold. In response, the workers claim their hands are burnt by the hot metals which slows them down. One of the workers suggested they use a pulley of velocity ratio 4 and efficiency of 80%. The string they used had a mass of 120 g and a specific heat capacity of $2510 \text{ J kg}^{-1} \text{ K}^{-1}$, and the work done to lift the load would be converted to heat energy in the string at the contact point of the pulley and the string would break if its temperature reaches 28°C .

- a) Explain why the metals are very cold in the morning and hot in the afternoon.
 - b) Draw a design of the required pulley and explain how it can be used to solve their problem.
 - c) Determine the minimum force required to ensure an efficiency of 80% is achieved.
 - d) Determine if the string suggested above will be suitable for the purpose.
 - e) Suggest ways in which the efficiency of the pulley system can be improved.
7. During holidays, a boy of mass 50kg went to a play resort near the lake shores on a certain beach and sat on one side of the see-saw at a distance of 2.4m from its pivot. It was very hot that day and the diurnal temperatures were above 42°C ; afterwards he decided to enter the lake and swim to cool himself. He was wearing heavy black shorts and a white vest. After swimming, he was left puzzled and wondering why his heavy black shorts dried quicker than the white vest and the beach cottages roofed with grass were cooler than those roofed with iron sheets.

Hint: specific heat capacity of human body is $3.5\text{kJkg}^{-1}\text{K}^{-1}$.

As a physics student;

- a) Help the guide at the play resort to determine if another boy of mass 40kg will restore equilibrium in the see-saw if he sits at a distance 3m from the pivot.
- b) Assist the boy to understand what has made him puzzled.
- c) Determine the quantity of heat lost by the boy if his temperature in the lake was 22°C

ELECTRICITY AND MAGNETISM

8. A certain household has a set of appliances as listed in the table below.

Appliance	Power rating	Time of use
4 bulbs	20W each	13 hours every day
Cooker	2500W	4 hours every day
Flat iron	1500W	5 hours every week
Electric fence of low resistance wire	2200W	10 hours every day

While making the budget, the owner of the household was confused of how much money would be required every week to cater for the electricity bill. He was also confused on how the sockets for the appliances should be connected to ensure high current flow and why low resistance wire is used instead of high resistance wires. The owner intends to spend sh.50000 on electricity every week and each unit of electricity costs shs.600.

Use the knowledge of physics to;

- a) Determine if sh.50000 would be enough to cater for the electricity bill for the week.
 - b) Explain how the sockets of the appliances should be connected to ensure maximum current flows.
 - c) Explain why low-resistance wires are used for the electric fence.
 - d) Suggest measures on how to reduce the electricity bill.
9. During a science project, learners are told that electricity at a sub-station is transmitted at 13kV with a current of 0.05A using thick aluminium wires for use inside a house at a voltage of 240V . The house has two television sets that operate on direct current but should be connected such that they receive maximum current and function properly. The learners, however, couldn't get an explanation of the issues mentioned.

Use your knowledge of physics to;

- a) Understand how the voltage is changed from $13kV$ to $240kV$.
- b) Why thick aluminum wires are used during power transmission.
- c) Determine the current in the house if 20% of the electrical energy is lost during voltage change.
- d) Account for the energy losses as the voltage changes and how these losses can be reduced.
- e) Understand how the current used in the TV is changed from alternating current(AC) to direct current (DC)
- f) How the television set should be connected to ensure they receive maximum current and function properly.