O'LEVEL PHYSICS SEMINAR ON 26TH JUNE 2022 HELD AT ST. JOSEPH'S S.S.S. NAGGALAMA

DISCUSSION QUESTIONS

Where necessary assume

Acceleration due to gravity=$10ms^{-2}$

Density of water =$1000kgm^{-3}$

Density of mercury=$13600kgm^{-3}$

Speed of sound in air =$340ms^{-1}$

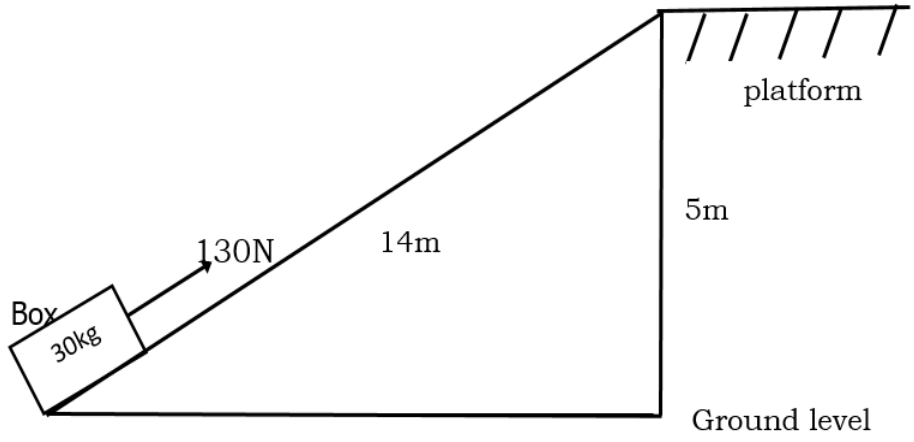
MECHANICS

1. (a) (i) What is a force? (01 mark)

(ii) Give two differences between mass and weight. (02 marks)

(iii) Explain why the weight of a body changes if it is taken from the equator towards one of the poles. (02 marks)

(b) The figure below shows a box of 30kg pushed with a force of 130N up an inclined track of length 14m onto a platform at a height of 5m from the ground.



Calculate the frictional force between the box and the track.

(05 marks)

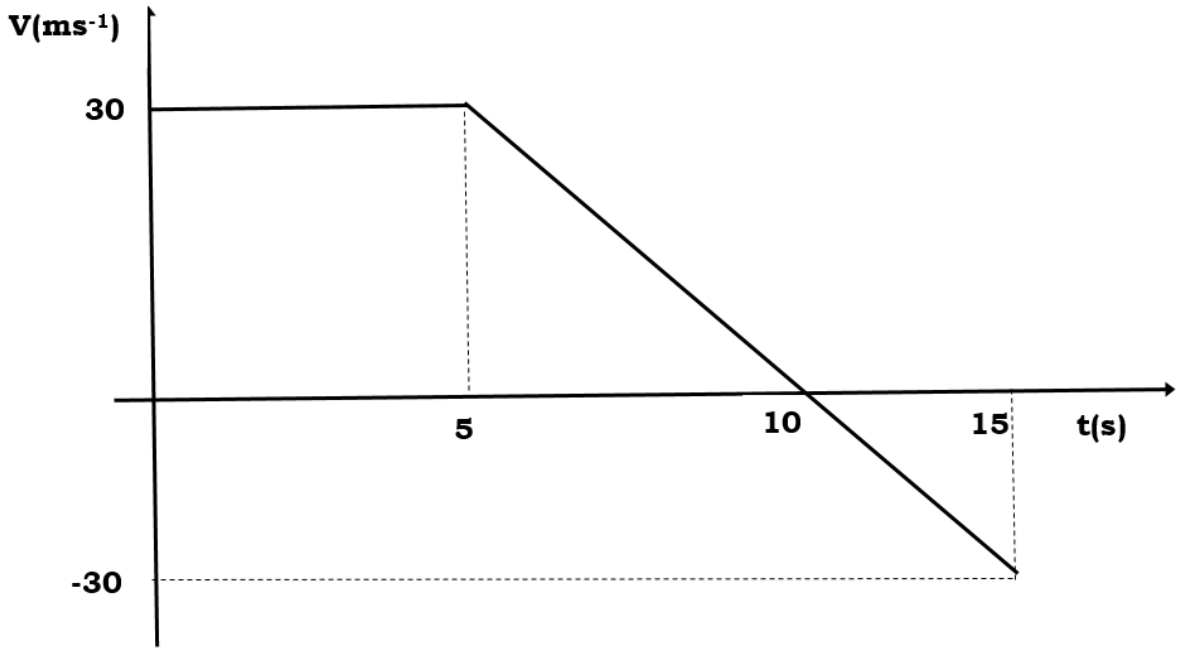
(c) (i) What is meant by Brownian motion? (01 marks)

(ii) Why is it that a needle may float on clean water but sinks when some detergent is added to the water? (01 marks)

(d) Briefly describe how you would estimate the size of an oil molecule. (04 marks)

2. a) What is meant by uniform deceleration? (01 mark)

(b) The figure shows a velocity-time graph for a body.



i. Describe the motion of the body. (03 marks)

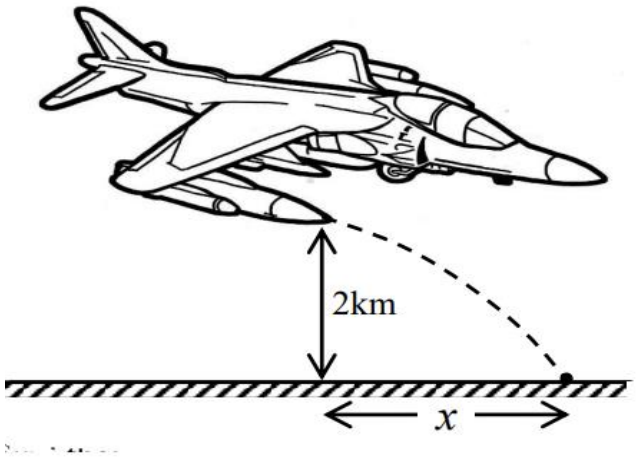
ii. Calculate the total distance covered by the body in 15s. (03 marks)

(c) (i) Define the term pressure. (01 mark)

(ii) Show that pressure, P at a depth, h in a liquid of density, ρ isgiven by P= $h\rho g$,where g is acceleration due to gravity. (03 marks)

(e) A simple barometer reads 760mmHg at the foot of the mountain which is 430m high. What is the barometer reading at the top of the mountain? Given that the average density of air is 1.25kgm^{-3} and density of mercury is 13600kgm^{-3}. (05 marks)

(f) A bomb is released vertically down wards from a fighter jet moving at a horizontal velocity of 100ms^{-1} and 2km high as shown in figure



Find the;

(i) distance x moved by the bomb. (01 mark)

(ii) velocity with which the bomb is moving on striking the ground. (02 marks)

3. a. What is meant by;

(i) Velocity ratio of a machine. (01 mark)

(ii) Pitch of a screw. (01 mark)

b. A screw jack with a lever arm of 40cm and pitch 2.0cm is used to raise a heavy load.

(i) Find the velocity ratio of the screw jack. (02 marks)

(ii) State two practical applications of block and tackle pulley systems. (02 marks)

c. (i) State the principle of moments. (01 mark)

(ii) Describe an experiment to verify the principle of moments. (05marks)

d. (i) State the law of flotation. (01 mark)

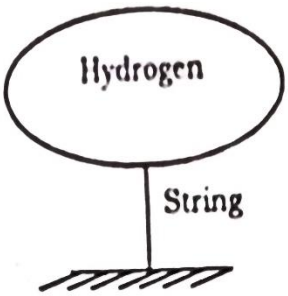
(ii) A swimmer of weight 600N dives into water in a swimming pool and displaces 200N of water. Find the weight of the swimmer when fully under water. (02 marks)

(iii) State any 2 applications of the law of flotation. (01 mark)

4. (a) i) State Archimedes principle. (01 mark)

ii) Describe an experiment to verify Archimedes principle. (04 marks)

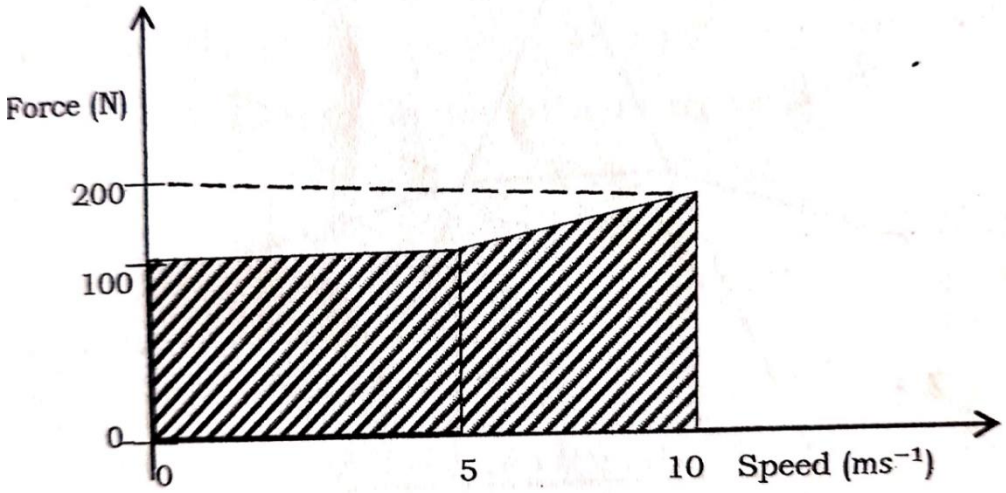
iii) A balloon of negligible mass and of volume $100m^3$ is filled with hydrogen gas of density $0.18kgm^{-3}$. The balloon is held stationary by rope holding it to the ground as shown below.



If the density of air is 1.2 kgm^{-3} find the tension in the string.
(03 marks)

b) i) Define a joule. (1 mark)

ii) The figure below shows force-speed graph for a particular body moving in a straight line.



Find the rate at which work is done on the particle.
(03 marks)

iii) Describe how a hydrometer is used to measure the relative density of a liquid (02 marks)

5. a) (i) Distinguish between stable and neutral equilibrium.
(02 marks)

(ii) Explain why a half filled jerry can of water is more stable than an empty jerry can of the same dimensions and material when standing upright. (02 marks)

(iii) A box of mass 80kg is tied at one end of a uniform piece of timber resting on two supports 1m from each end as shown below.

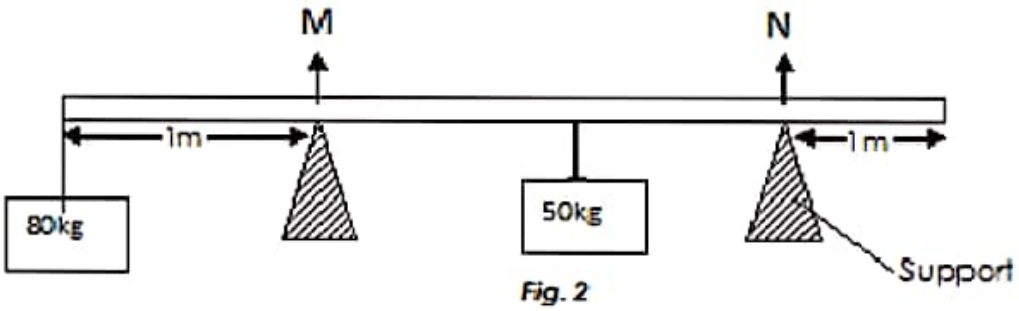
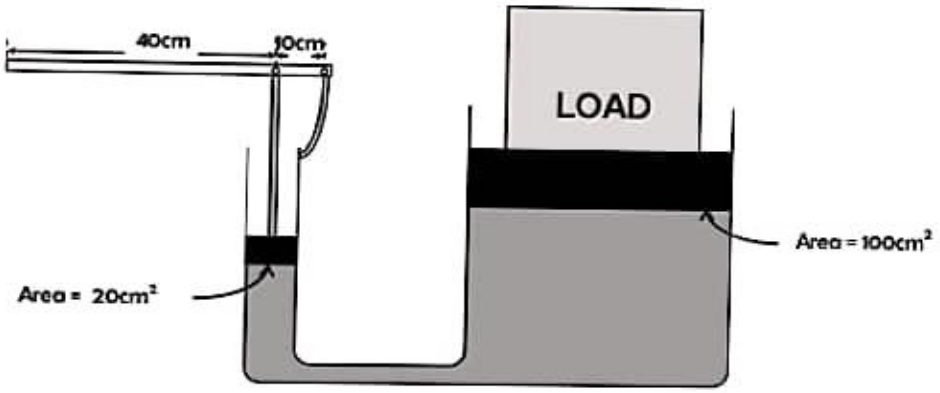


Fig. 2

If the piece of timber is 10m long and has a mass 50kg. Find the forces **M** and **N**. (03 marks)

b) (i) Define the terms **Efficiency** and **Mechanical advantage**. (02 marks)

(ii) A hydraulic machine shown below has an efficiency of **98.0%**



What effort will be required to lift load of 20,000N? (03 marks)

c) (i) You are provided with a container, beam balance and measuring cylinder. Describe how you would use the above set of apparatus to measure the density of a liquid. (03 marks)

(ii) State one practical application of density. (01 marks)

LIGHT

6. (a) (i) State the laws of reflection of light. (02 marks)

(ii) Describe an experiment to verify the laws stated in a (i) above. (04 marks)

(b) A concave mirror has a focal length of 3.0cm and an object 1.0cm tall is placed at 4.0cm from the pole of the mirror. By means of an accurate scale diagram, find the position and magnification of the image formed. (05 marks)

(c) (i) What is meant by total internal reflection? (01 mark)

(ii)State two applications of total internal reflection.

(02 marks)

(d) Find the critical angle of a medium of refractive index 1.65.

(02marks)

7. a) (i) Define a virtual image (01 mark)

(ii)Use a ray diagram to show the formation of a virtual image of finite object using a plane mirror (02 marks)

(iii)Explain briefly why parabolic mirrors are used in search lights.

(02marks)

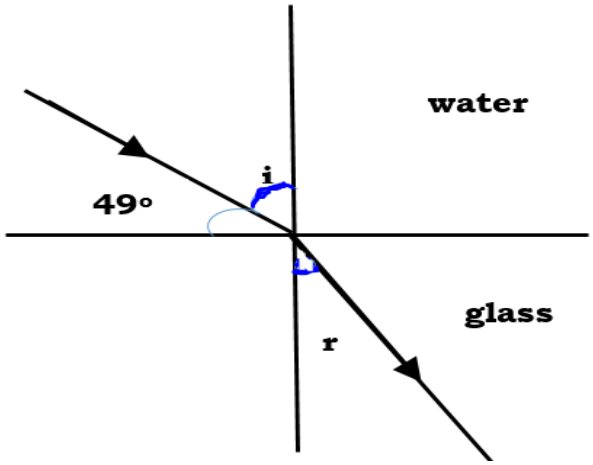
(b) With the aid of a labelled diagram, describe a simple experiment to determine the focal length of a converging lens using an illuminated object and plane mirror. (04 marks)

c)(i) What is meant by accommodation? (01 mark)

ii)State **one** eye defect and its correction. (01 mark)

d) (i) Describe briefly the formation of a mirage. (02 marks)

(ii) The diagram below shows a ray of light incident on water-glass boundary at angle of incidence **i.**.



Calculate the angle of refraction, **r** if the refractive indices of water and glass are 1.33 and 1.50 respectively. (02 marks)

8. a) i. Define the term power of a lens and state its SI units. (2 marks)

ii. Draw a well labelled diagram of a projector and state the functions of its essential parts. (6 marks)

b) i. Distinguish between primary and secondary colours. (2 marks)

ii. Describe an experiment to determine the focal length of a concave mirror using an illuminated object. (04 marks)

c) A converging lens has a focal length of 5cm. what is the power of the lens? (2 marks)

9. a) i. Define the term refractive index? (1 mark)

ii. The speed of infrared radiations is $2x10^8 ms^{-1}$ in a transparent material, determine the refractive index of the material. (2 marks)

iii. Describe an experiment to determine the refractive index of glass block. (4marks)

(b) i. Define the terms **focal length** and **principal focus** of a lens. (2 marks)

ii. A finite object is placed between the optical center and the principal focus of a converging lens, using a ray diagram, state any three properties of the image formed. (3 marks)

iii.Determine the power of a diverging lens of focal length 20cm. (1 mark)

d) Explain the appearance of a green object in yellow light. (2 marks)

MODERN PHYSICS

10. a) (i)What is meant by the term isotopes of an element. (1 mark)

(ii) Describe the composition of the nuclide $^{14}_{6}C$ (1 mark)

b) (i) State **one** difference between alpha and gamma radiations. (1marks)

(ii) state **one** precaution taken when handling radioactive materials. (1 mark)

c) (i) The nuclide $^{60}_{27}Co$ decays by emitting a beta particle and gamma photon to an element M. Write down the balanced equation and determine the mass number and atomic number of the final nuclide M. (02 marks)

(ii) State two dangers of radioactive emissions. (1 marks)

d(i)Draw a well labelled diagram of cathode ray oscilloscope and describe its main parts . (05 marks)

(ii)

X

y

The diagram above shows traces of the cathode ray beam on the screen of a cathode-ray tube. State how each one may be obtained. (02 marks)

11. (a) (i) What are x-rays? (01 mark)

(ii) With the aid of a well labelled diagram, describe how x-rays are produced. (04 marks)

(iii) State two biological uses of x-rays. (02 marks)

(b) (i) Distinguish between nuclear fusion and nuclear fission. (02marks)

(ii)Account for the energy released in nuclear fission. (02 marks)

(iii) Describe how electricity is generated from the nuclear reactor. (03 marks)

(c) In 168 seconds, the activity of thoron falls to one-eighth of its original value. What is its half-life? (02 marks)

12. a) What is meant by photo electric emission. (01 mark)

b (i) State the condition necessary for photo electric effect to occur. (02 marks)

(ii) With aid of a labelled diagram, describe how an alternating current can be fully rectified. (05 marks)

c) (i) State the function of the fluorescent screen in a cathode ray oscilloscope. (01 mark)

(ii) Give three applications of cathode ray oscilloscope. (03 marks)

d) A radioactive nuclide $^{226}_{88}X$ emits an alpha particle and turns into another nuclide. Y

(i) Write a balanced equation to represent this nuclear change (02 marks)

(ii) How would the nuclide X be affected if a beta particle was emitted instead of an alpha particle? (02 mark)

13. (a) What is meant by;

(i) Thermionic emission (01mark)

(ii) Cathode rays (01mark)

(b)Briefly describe how thermionic emission occurs (02marks)

(c) State the energy changes that take place in an x-ray tube. (02 marks)

(d) (i) Explain how intensity and penetrating power of rays produced in an x-ray tube may be varied. (03marks)

(ii) Briefly describe how x-rays may be used to locate the broken part of a bone. (03marks)

e) Uranium decays according to the nuclear equation below

$$^{235}_{92}\mathrm{U} + {}^{1}_{0}\mathrm{n} \longrightarrow {}^{x}_{56}\mathrm{Ba} + {}^{92}_{y}\mathrm{Kr} + 3{}^{1}_{0}\mathrm{n}$$

Find the values of x and y. (03marks)

(f) Give one advantage of a Cathode Ray Oscilloscope (C.R.O) as a voltmeter. (01mark)

MAGNETISM

14. (a) Define the following;

i. Magnetic saturation. (01 mark)

ii. Magnetic shielding (01 mark)

(b) (i) Describe briefly how a magnet can be demagnetized by electrical method. (03 marks)

(iii) Sketch the magnetic field pattern near a bar magnet with its axis in the magnetic meridian and its south pole pointing north. (02 marks)

(c) (i) Draw a fully labelled diagram of an a.c generator and state how the device is modified to produce a direct current. (03 marks)

(iii) What are the advantages to be gained by using a.c at high voltage when electrical power is to be transmitted over a long distance?

(2 marks)

(d) A moving-coil galvanometer has a resistance of 40Ω and gives a full-scale deflection of 2mA.

i. What is the potential difference across its terminals when this current is flowing? (02 marks)

ii. How can the galvanometer be converted into a voltmeter? (02 marks)

15. a) (i) State the domain theory of magnets. (01 mark)

(ii) Explain briefly how the arms of the clock can be shielded from the effect of the external magnetic field. (03 marks)

(iii) Explain what is observed when a magnet is freely suspended in air. (02 marks)

b) Define the following terms

i. Ferromagnetic materials (01 mark)

ii. Diamagnetic materials (01 mark)

iii. Neutral point (01 mark)

c) With the aid of a labelled diagram, explain how an electric bell works. (04 marks)

d) i. A moving coil galvanometer has a coil of resistance 4Ωand gives a full-scale deflection when a current of 25mA passes through it. Calculate the value of resistance required to connect into an ammeter which reads 15A at full-scale deflection. (02 marks)

ii.State two ways of minimizing energy loss in a transformer. (01marks)

16. a) i. State the law of magnetism. (01 mark)

ii. Describe how you would determine the magnetic flux patterns of a bar magnet by the plotting compass method. (5 marks)

b) i. Draw the magnetic field pattern of a solenoid carrying electric current. . (03 marks)

ii. Name two factors which determine the strength of an electro magnet. (02marks)

c) With the aid of a diagram describe the operation of a magnetic relay. (05marks)

17. a) State the laws of electromagnetic induction. (2 marks)

b) (i) Describe an experiment using a coil, a magnet and a galvanometer to demonstrate electromagnetic induction. (03 marks)

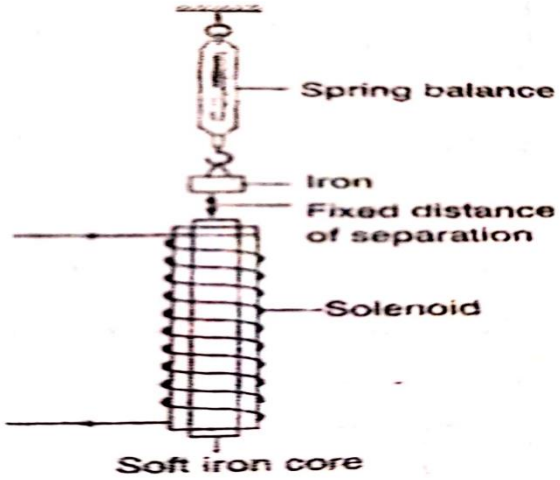
(ii) Define the term mutual induction. (01 marks)

(iii) Describe the construction and working of the a.c transformer. (05 marks)

(iv) Explain why a piece of broken bar magnet is referred to as a weak magnet. (01 marks)

c) State the Fleming's left handle rule. (01 marks)

(d) The figure below shows an arrangement that may be used to investigate how electromagnetic force varies with current.



i. Why is current passed through the solenoid? (01 marks)

ii. What happens to the iron suspended from the spring balance when current is passed through the solenoid? (01 marks)

iii. What is observed on the spring balance when the current is increased. (01 mark)

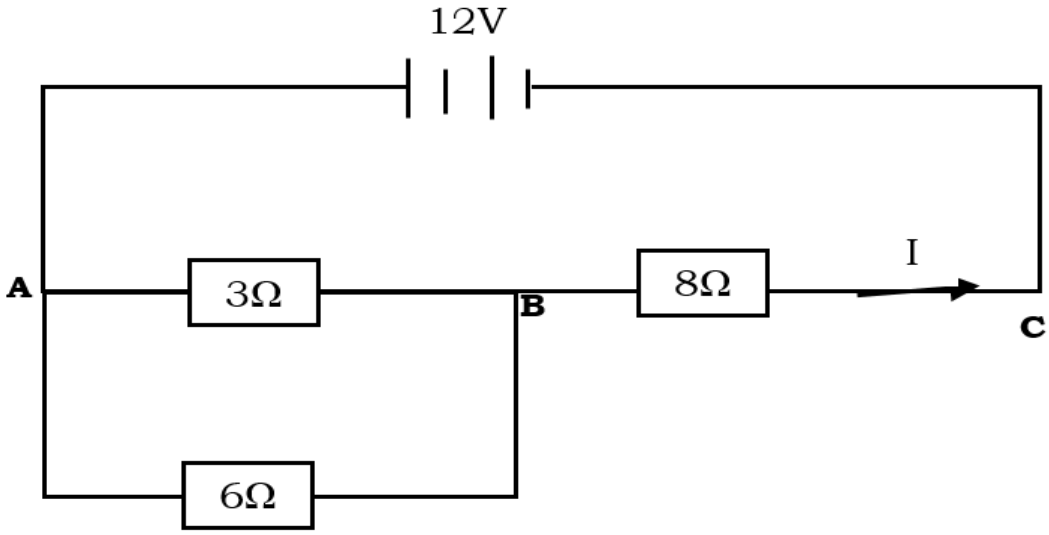
ELECTRICITY

18. (a) (i) Define the terms: **terminal p.d, "lost volts"** and **internal resistance of a cell**. (03 marks)

(ii) Describe a simple experiment to measure internal resistance of a cell. (03 marks)

(b) (i) State ohm's law. (01 mark)

(ii) The figure below shows a battery of 12V and negligible internal resistance connected to three resistors **3Ω, 6Ω *and* 8Ω.**



Find the main current **I** and p.d across AB (04 marks)

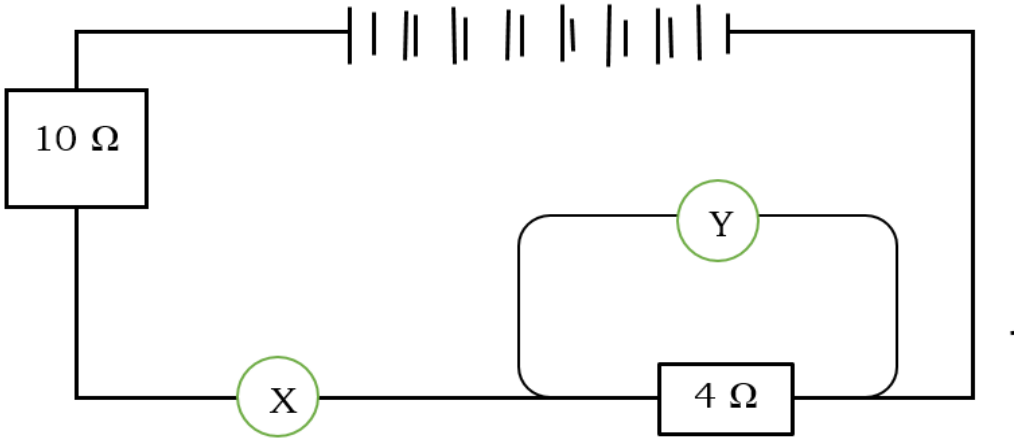
(c) Explain why elements of electric fires are made of nichrome alloy. (01 marks)

(d) State the two defects of a simple cell and state how each is minimized. (04 marks)

19. a) (i) Define emf of a battery. (01 marks)

(ii) Describe an experiment to verify ohm's law. (05 marks)

b) In the figure, the emf of each cell is 2.0v, and the internal resistance of each cell is 0.5Ω.



i. Name the instrument labelled X and Y. (02 marks)

ii. Calculate the reading of X and Y. (04 marks)

c) Explain why electric lamps are connected in parallel. (02 mark)

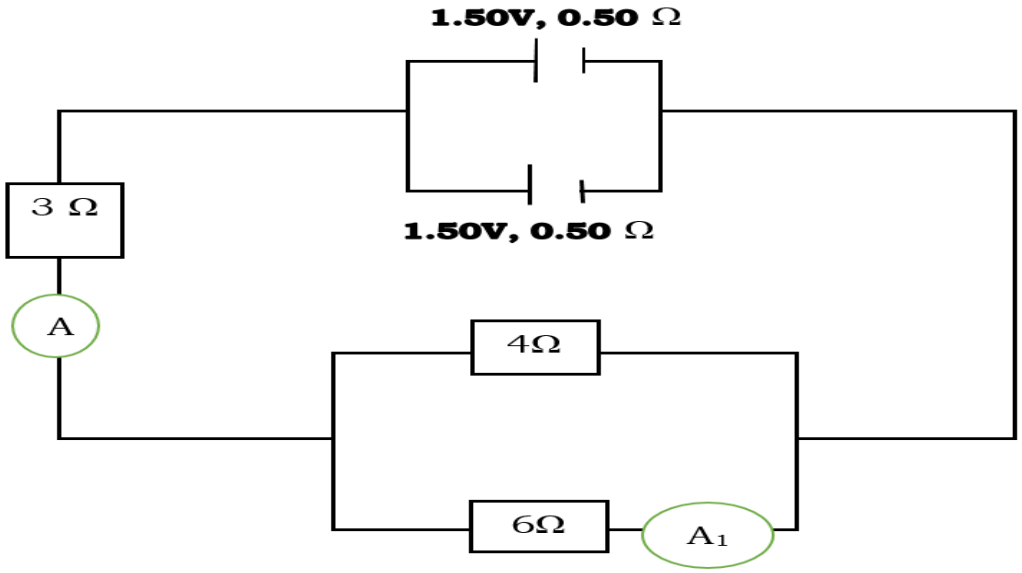
d) State two advantages of fluorescent tubes over filament lamps. (02marks)

20. a) i. State any two precaution taken to prolong the life span of a lead acid accumulator. (1 mark)

ii. Describe how lead acid accumulator can be charged. (3 marks)

b) Describe an experiment to determine in E.M.F of a battery using graphical analysis. (4 marks)

c) The figure below shows two identical cells of e.m.f 1.50V and of internal resistance 0.5Ω each connected in parallel (across each other) as shown



Determine the

i. Ammeter reading A. (3 marks)

ii. Ammeter reading A_1 (2 marks)

d) An electric appliance is rated "1800W and 200V"

i. What is the meaning of this statement? (1 mark)

ii. Calculate the cost of using the appliance 2hours and 15minutes a day if the cost of a unit of electricity is Ushs 850. (2 marks)

21. a) (i)Distinguish between an electrical conductor and an insulator. (2 marks)

(ii) Describe an experiment to determine the resistance of a conductor. (4 marks)

(iii) State two example of a non Ohmic conductor. (1 mark)

b) When a cell is connected across a 5 Ωresistor, the p.d across is2V. When the same cell is connected across an 8Ω resistor, the p.d across it is 2.4V. Find the internal resistance of the cell. (3 marks)

c) (i) Explain how power loss is minimized in electric transmission. (02 marks)

(ii) State the two precaution taken when wiring a house (02 marks)

d) Draw a current - voltage graph for ohmic conductor. (02 marks)

WAVES

22.(a) (i) Distinguish between mechanical waves and electromagnetic waves. (02 marks)

(ii) Give two examples of electromagnetic waves. (01 mark)

(iii) A radio wave has a wavelength of 150m. Calculate its frequency. (02 marks)

(b) (i) The speed of sound in air is $330ms^{-1}$. What is meant by this Statement. (01 mark)

(ii) Describe an experiment to determine the speed of sound in air by resonance method. (05 marks)

(c) Ultrasonic sounds are used to scan the unborn babies. Explain why the echo's height on the screen is less than that of the outgoing pulse. (02 marks)

(d) A boy standing 100m from the foot of a high wall claps his hands and the echo reaches him 0.6s later. Calculate the velocity of sound in air using these observations. (03 marks)

23.a) i. Define sound. (01 mark)

ii. Why does sound travel faster in solids than in air. (02 marks)

iii. Explain why an open pipe is preferred to a closed pipe when used in producing different notes. (02 marks)

iv. The frequency of the third harmonic in closed pipe is 260Hz. Find the length of the air column in the pipe. (speed of sound in air is $320ms^{-1}$. (03 marks)

b) (i) Distinguish between period and frequency of a wave. How do they relate to each other? (02 marks)

(ii) A man standing mid-way between two cliffs makes a loud sound and hears the first echo after 3seconds. Calculate the distance between the two cliffs if the velocity of sound in air is $330ms^{-1}$. (02 marks)

c) Describe an experiment to measure the speed of sound in air using the echo method. (04 marks)

24.a) i. Distinguish between longitudinal and transverse waves.

(2 marks)

ii. Draw a diagram to show the reflection of incident straight waves from a convex reflector. (3 marks)

b) i. List two industrial and two medical uses of ultrasonic sound. (2 marks)

ii. Briefly explain how an echo sounder is used to measure the depth of the sea. (4 marks)

c) i. State 2 factors which affect the frequency of a vibrating string. (2 marks)

iii. Stationary waves are set up in a long thin wire using a vibrator of frequency 50Hz. The distance between two successive motionless points is 47.0cm. Calculate the velocity of the transverse waves in the wire. (4 marks)

25. a) Define the following terms applied to waves.

i. Amplitude. (1 mark)

ii. Antinode (1 mark)

b) i. What is meant by interference of waves? (1 mark)

ii. Using a labelled diagram, show how a plane water waves are refracted from a convex lens. (2 marks)

c) i. Use a labeled diagram to show the band of electromagnetic spectrum. (2 marks)

ii. What is a band as applied to electromagnetic spectrum? (1marks)

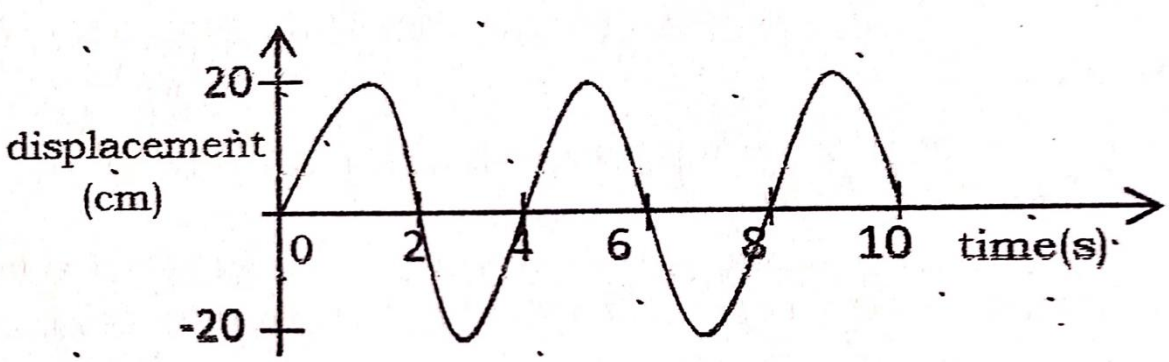
d) i. Explain why sound is clearer at night than during day. (2 marks)

ii. Describe an experiment to show that sound requires a material medium for its transmission. (4marks)

iii. Distinguish between sound waves and electromagnetic waves. (2marks)

26. a) (i) Define the term wavelength. (1 mark)

(ii)



The figure above shows the variation of displacement with time. If the speed of the wave is 20cms^{-1}. Find the wavelength of the wave. (03 marks)

b) (i) State two difference between stationary and progressive wave. (2 marks)

(ii) An open pipe has a length of 20cm if the speed of sound in air is 340ms^{-1} sketch the diagram to show the mode of vibration when it's producing a fundamental note and determine the fundamental frequency. (4 marks)

c) Sketch the diffraction pattern of straight wave fronts incident on a barrier into; a narrow slit and a wide slit. (4marks)

d) (i) What are beats? (1 mark)

(ii) State one application of beats? (1 mark)

HEAT

27.a) Differentiate between conduction and convection (2 marks)

b) Describe an experiment to compare rates of conduction between copper, iron and wood. (5marks)

c) i. Draw a labelled diagram of a vacuum flask. (2 marks)

ii. Explain why snacks are packed in silvered plate. (2 marks)

d) i)Convert-220^{0}C to kelvins (2 marks)

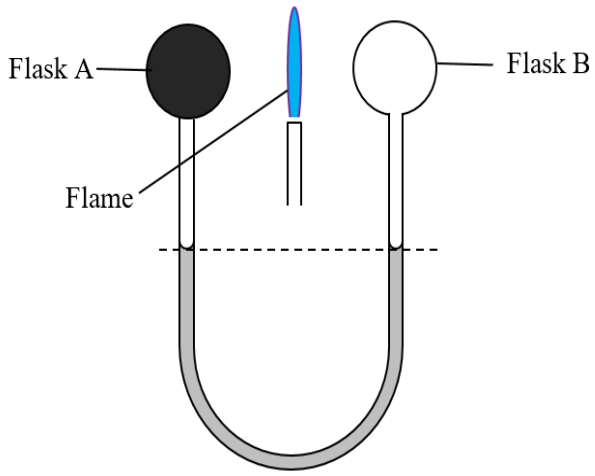
ii)Describe an experiment to determine ice point of water. (3 marks)

28 a) Mention four reasons for not using water as a thermometric liquid.

(2 marks)

(b) Define radiation as applied to heat. (01 mark)

(c) Two flasks are connected to a manometer containing ether as shown below. Flask A is painted black while flask B is polished white. A flame is then placed midway between them.



(i) State what is observed. (01 mark)

(ii) Explain your observation. (03 marks)

(d) (i) What is bimetallic strip? (01 mark)

(ii) State two applications of bi-metallic strip. (01 mark)

(iii) A bimetallic strip of brass and iron, 10 cm long and at 20^0C is held horizontally with the iron uppermost. When heated from below with a Bunsen flame, the temperature of brass is 820^0C and that of iron is 770^0C. Calculate the difference in new lengths of iron and brass.

(Linear expansivity of brass is 1.9×10^{-5} K^{-1} and linear expansivity of iron is 1.2×10^{-5} K^{-1}) (03 marks)

(e) i) Explain why car radiator cooling fins are painted black

(2 marks)

ii) Explain why water is preferred as a coolant in car engines.

(2 marks)

END