ST. JOSEPH'S SSS NAGGALAMA

'O' LEVEL PHYSICS SEMINAR HELD ON SATURDAY 1ST JULY 2023

MODERN PHYSICS

1. (a) (i) Define the terms: **Half – life** and **radioactivity.** (02 mks)

(ii) Study the table below showing count-rates recorded from a Geiger Muller tube during the decay of uranium.

Time (s)	0	10	20	30	40	50	70
Co8nrates(s^{-1})	650	400	300	225	175	125	75

Using graphical method and the data in the table above, find the half – life of uranium (04 mks)

(b) Cobalt – 60 ($^{60}_{27}C$) decayed by emitting an alpha particle, a beta particle and gamma rays

to form a new element Y,

(i) Write a balanced equation for the decay (1 ½ mks)

(ii) Describe the composition of element Y (1 ½ mks)

(c) (i) What are **cathode rays**? (01 mk)

(ii) Describe an experiment to show the production of cathode rays. (04 mks)

(d) (i) Explain why alpha particle have the greatest ionising power. (01 mk)

(ii) State **one** reason why a vacuum is needed in the cathode ray tube. (01 mk)

2. (a) Define the following terms:

(i) Atomic number (01 mk)

(ii) Radio – isotopes (01 mk)

(b) (i) Distinguish between **alpha particles** and **beta particles.** (02 mks)

(ii) Uranium nucleus $^{235}_{92}U$ is bombarded with a neutron and splits to form barium-$^{141}_{56}Ba$ and element x, producing 3 neutrons and a lot energy. Write a balanced equation for the nuclear reaction and name the type of reaction. (02 mks)

(c) (i) Describe how cathode ray oscilloscope is used to measure peak voltage of the alternating current. (04 mks)

(ii) State two advantages of cathode ray oscilloscope as a voltmeter. (04 mk)

(d) (i) What is meant by the term **photo – electric effect**? (01 mk)

(ii) You are provided with a zinc plate and a negatively charged gold leaf Electroscope. Describe an experiment to demonstrate photo – electric effect. (03 mks)

3. (a) Define the following:

(i) Gamma rays (01 mk)

(ii) X – rays (01 mk)

(b) (i) What is meant by the tem **thermionic emission**? (01 mk)

(ii) Describe how x – rays are produced in an x – ray tube and state one precautionary measure taken while operating the x – ray tube. (05 mks)

(c) Describe the modifications made to vary the intensity of x – rays produced and its penetrating power and state the types of x – rays. (04 mks)

(d) (i) What is **rectification?** (01 mk)

(ii) With the aid of a labelled diagram, describe how full-wave rectification is done (03 mks)

HEAT

4(a) (i) State **Charles' law** (01 mk)

(ii) Using Kinetic theory, explain what happens to a gas when it is cooled to a temperature of -273^0C.

(b) Describe an experiment to show the relationship between volume of fixed mass of a gas and temperature at constant pressure (05 mks)

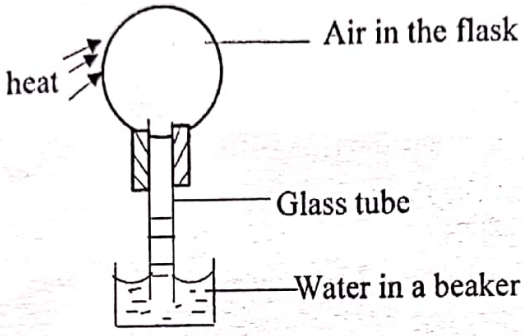
(c) A litre of gas at 0^0C and 10^5Nm^{-2} pressure is suddenly compressed to ¼ of its original value, the temperature becomes 273^0C. Find the new pressure of the gas (03 mks)

(d) State **three** differences between **ideal gases** and **real gases**. (03 mks)

5(a) (i) Define **conduction of heat**. (01 mk)

(ii) Describe an experiment to show that water is a poor conductor of heat. (04 mks)

(b) Air was trapped in around bottomed flask as shown below. The flask is inverted in a beaker of water and then gently heated.



(i) State what was observed when flask is heated (02 mks)
(ii) Explain your observation in (a) above (02 mks)

(c) In un calibrated thermometer, the length of mercury above the bulb, is 22mm at lower fixed point and 134mm at upper fixed point. When the thermometer is placed in a hot liquid, the length of the mercury thread above the bulb is 68mm. Calculate the temperature of hot liquid. (03 mks)

(d) (i) Explain why the sea remains cooler than land during:
daytime and warmer than land at night (03 mks)
(ii) state two qualities of a good thermometric property. (01 mk)

6(a) (i) Distinguish between **specific heat capacity** and **latent heat**. (02 mks)

(ii) State the meaning of specific heat capacity of water being $4200JKg^{-1}K^{-1}$ (01 mk)

(b) Calculate the specific heat capacity of paraffin if 22000 joules of heat are required to raise the temperature of 2000g of paraffin from 20^0C to 30^0C. (03 mks)

(c) Describe an experiment to determine specific heat capacity of a solid by

method of mixtures. (05 mks)

(d) (i) Define saturated **vapour pressure**

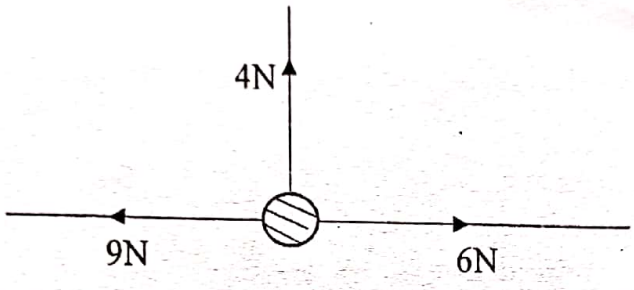
(ii) Explain the effect of temperature on unsaturated vapour pressure. (02 mks)

(iii) State any 2 differences between evaporation and boiling. (02 mks)

MECHANICS

7(a) Distinguish between **scalar** and **vector** qualities, giving one example of each. (03 mks)

(b) The figure below shows three forces of magnitude 6N, 9N and 4N acting on a stationary body of mass 10kg



(i) Find the acceleration of the body

(ii) How far will the body be after 20 seconds? (06 mks)

(c) (i) State the principle of conservation of linear momentum (01 mk)

(ii) Give two practical applications of the law of conservation of linear momentum (02 mks)

(d) Describe briefly, how acceleration due to gravity can be determined using a small mass, a piece of thread, a stop clock, a metre rule, a clamp and a stand. (04 mks)

8(a) (i) Distinguish between **force** and **pressure** (02 mks)

(ii) State two factors on which pressure in solids depends (01 mk)

(b) Explain why one feels more pain when pricked with a needle than when pricked with a nail. (02 mks)

(c) (i) What is meant by **atmospheric pressure**? (01 mk)

(ii) State two applications of atmospheric pressure. (01 mk)

(iii) With the aid of a diagram, describe the action of a force pump. (05 mks)

(d) The air pressure at the base of a mountain is 75.0cm of mercury and at the top is 60.0cm of mercury. Given that the average density of air of $1.25Kg^{-3}$ and the density of mercury is $13600Kgm^{-3}$, calculate the height of the mountain. (04 mks)

9(a) State:

(i) Archimedes' principle (01 mk)

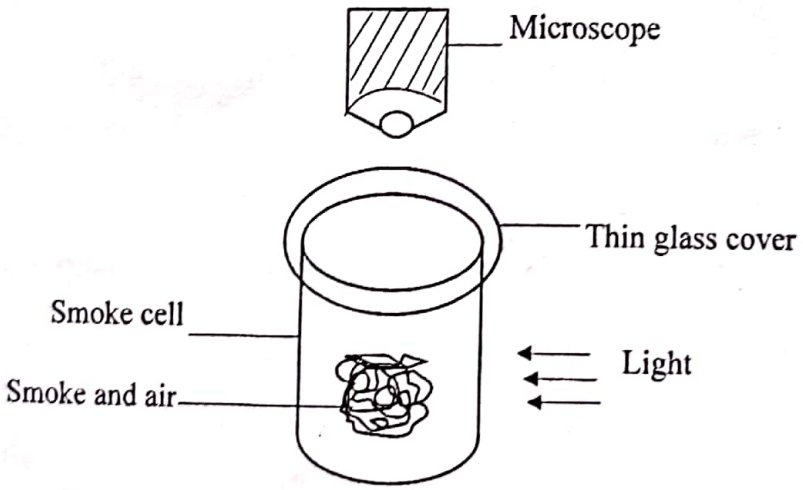
(ii) The law of flotation (01 mk)

(b) (i) A solid weighs 237.5g in air and 212.5g when completely immersed in a certain liquid. When completely immersed in water, it weighs 206.3g. Find the density of the liquid and the density of the solid. (04 mks)

(ii) Explain why a ship is able to float on water in spite of being made of metals. (02 mks)

(c) Describe an experiment to verify the law of flotation. (04 mks)

(d) The figure below shows apparatus used to observe the behaviour of smoke particles in air.



(i) Why is light shone into the container? (01 mk)

(ii) Why are smoke particles very suitable for use in this experiment? (01 mk)

(iii) Describe what you would see when looking through the microscope into the smoke cell. (02 mks)

10 (a) Define the terms:

(i) Work (01 mk)

(ii) Power (01 mk)

(b) A machine lifts a load of 2500N through a height of 3m in 1.5s
(i) What is the power developed by the machine? (02 mks)
(ii) Using the same power, how long would it take to lift a load of 6000N through a height of 5m? (02 mks)

(c) (i) What do you understand by the moment of a force about a point? (01 mk)
(ii) How would you use a metre rule, a 100g mass and some thread in order to find the mass of an apple? (03 mks)
(iii) State the conditions of equilibrium when a body is acted upon by a number of parallel forces. (02 mks)

(d) Describe how you would determine, by experiment, the centre of gravity of a piece of cardboard of irregular shape. (04 mks)

11 (a) (i) State Hooke's **law of elasticity.** (01 mk)

(ii) Describe how you would investigate experimentally, the relationship between extension of light spring and the load which it supports. (05 mks)

(b) A vertical spring of unstretched length 30cm is rigidly clamped at its upper end. When an object of mass 100g is placed in a pan attached to the lower end of the spring, its length becomes 36cm. For an object of mass 200g in the pan, the length becomes 40cm. Calculate the mass of the pan. (04 mks)

(c) (i) What is meant by **uniformly accelerated motion**? (01 mk)
(ii) Write down the equations of a uniformly accelerated motion. (03 mks)
(iii) If a train accelerates uniformly from rest at $0.2ms^{-2}$ over a distance of 1km, calculate the velocity it reaches. (02 mks)

ELECTRICITY

12(a) (i) What is meant by the **resistance of an electrical component?** (01 mk)

(ii) Describe an experiment to measure the resistance of a length of resistance Wire (05 mks)

(b) (i) Write down the equation relating V, I and R where V is the p.d across R carrying a current, I (01 mk)
(ii) State **three** factors that affect resistance of a conductor (03 mks)

(c) An electric Kettle has a heating element rated at 2KW when connected to a

250V electrical supply. Calculate

(i) Current that would flow when the element was connected to a 250 V. (02 mks)

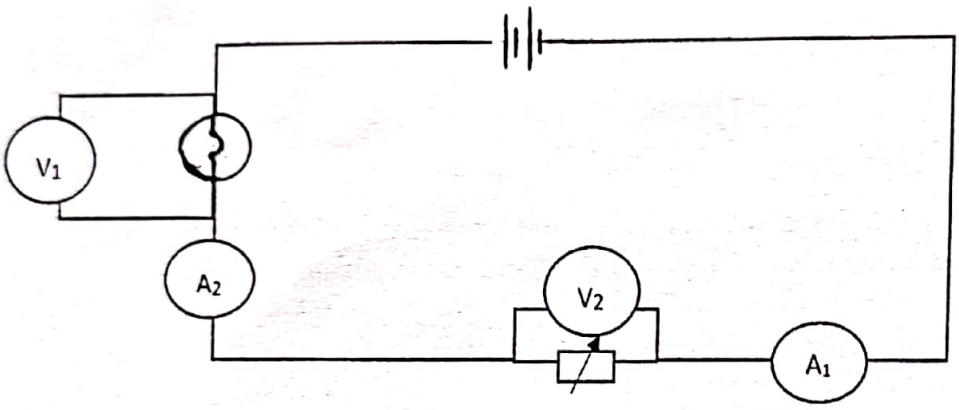
(ii) Resistance of the element (02 mks)

(iii) Heat produced by the element in 1 minute (02 mks)

13(a) (i) What is **electromotive force of a cell?** (01 mk)

(ii) Describe an experiment to determine internal resistance of a cell (04 mks)

(b) The figure below shows an electric circuit containing a lamp, a battery, a rheostat, two ammeters and two voltmeters.



(i) How will the readings of ammeters A_1 and A_2 compare? Give the explanation for your comparison (02 mks)

(ii) What difference will it make to the reading of V_1 if the resistance of rheostat is increased and why? (02 mks)

(c) A cell is joined in series with a resistance of a 2Ω and a current of 0.25A flows through it. When a second resistance of 2Ω is connected in parallel with the first, the current through the cell increases to 0.3A.
What is the:

(i) e.m.f

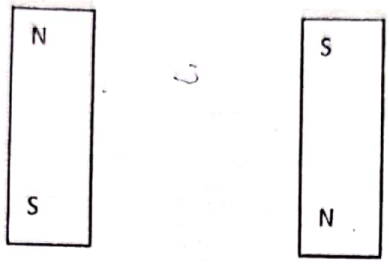
(ii) Internal resistance of the cell (05 mks)

(d) Explain why electricity is transmitted at high voltage like 400KV rather than low voltage like 240V. (02 mk)

14 (a) (i) Define the terms magnetic meridian and angle of dip (02 mks)

(ii) Describe how the magnetic meridian can be located on earth's surface (04 mks)

(b) Sketch the magnetic field pattern due to magnets shown below



(c) State **two** applications of a compass needle. (02 mks)

(d) Describe how a magnet can be kept for long without weakening its magnetism. (03 mks)

(e) Explain briefly how **consequent poles** are formed (02 mks)

15(a) (i) Distinguish between **conductors** and **insulators** as applied to electrostatics. (02 mks)

(ii) Explain how a pen rubbed on hair get charged (03 mks)

(b) Describe how a steel ball can be charged positively by induction (05 mks)

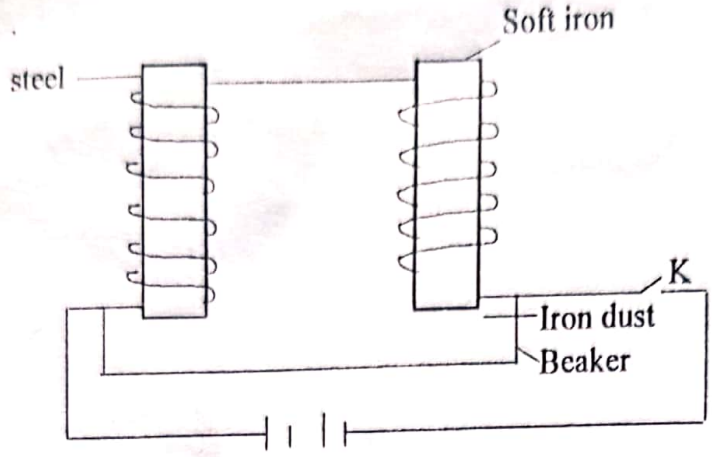
(c) State two conditions suitable for performing experiments in electrostatics (02 mks)

(d) Sketch the electric field pattern due to two equal point charges and use it to define a neutral point. (04 mks)

16(a) (i) Describe how a step up transformer works (04 mks)

(ii) State two energy losses in a transformer (02 mks0

(b) The set-up below is used to study magnetic properties of steel and soft iron.



State and explain what is observed when:

(i) Switch K is closed (03 mks)

(ii) Switch K is opened (03 mks)

(c) A milliammeter of resistance 20Ω is used to measure current of 2A. If its full scale deflection is 15mA. Calculate the resistance needed for the system to measure current of 2A.

WAVES

17. (a) what is ultra sound? (01 mk)

(b) Ultra sound is used in detecting other sea vessels and to measure the depth of the sea. Explain briefly how it is used for the purposes. (04 mks)

(c) An open tube was to produce harmonics. When air is blown into the tube, it was noted that the frequency of the fundamental tone is 256Hz.

(i) What is the frequency of the second harmonic? (02 mks)

(ii) If the speed of sound in air is 320 ms^{-1}, what length of the tube would produce this harmonics? (03 mks)

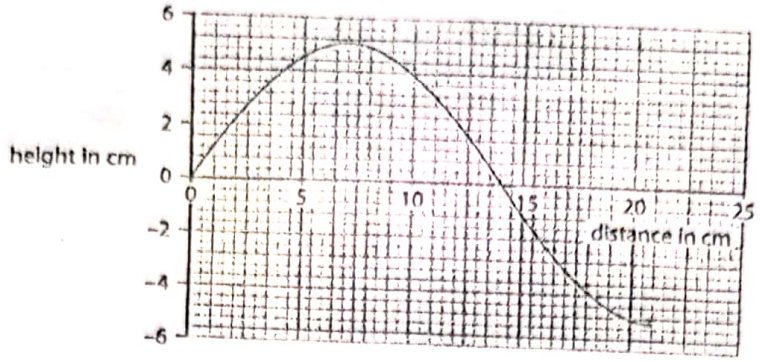
(d) Describe an experiment to show that sound is a mechanical wave. (06 mks)

18. (a) Define the following terms as applied to waves

(i) Amplitude (01 mk)

(ii) Frequency (01 mk

(iii) The figure below shows part of the wave travel



Use the data above to calculate the amplitude and the wavelength of the wave. (02 mks)

(b) Describe an experiment to demonstrate resonance of sound. (04 mks)

(c) A student standing 540m infront of a high wall in a clear space makes a loud sound and hears an echo after 3 seconds.

(i) Determine the speed of sound in air (01 mk)

(ii) State two factors which affect the speed of sound in air (02 mks)

(d) A radio wave transmits 5MHz, find its wavelength (02 mks)

(e) Draw a sketch diagram to show circular waves are reflected from a plane reflector (02 mks)

19. (a) Define the terms :

(i) Pulse (01 mk)

(ii) Wave front (01 mk)

(iii)

(b) With the aid of the diagram, show how a plane water wave is diffracted when it passes through:

(i) A small opening. (02 mks)

(ii) A slightly bigger opening. (02 mk)

(c)(i) Distinguish **between longitudinal** waves and **transverse waves** (02 mk)

(ii) Give one example of each of the wave in (c)(i) above. (01 mk)

(d) State four properties of electromagnetic waves. (02 mks)

(e) The distance between two successive antinodes on a standing wave is 6cm. if the distance between the source of the wave and the reflector is 48cm, find the

(i) Number of loops (02 mk)

(ii) Wavelength of the wave (02 mks)

20. (a) (i) State the laws of refraction of light. (03 mks)
(ii) Describe an experiment to determine refractive index of the glass block. (04 mks)

(b) Define the following as applied to lenses:
(i) Power (01 mk)
(ii) Principal focus (01 mk)

(c) An object 2cm high is placed 40cm away from a diverging lens of focal length 20cm. By means of graphical construction. Determine the position and size of the Image. (05 mks)

(d) State the conditions necessary for total internal reflection to occur. (02 mks)

21. (a) Define the following terms as applied to concave mirrors.
(i) Focal length (01 mk)
(ii) Radius of curvature (01 mk)

(b) With the aid of a ray diagram, describe how a concave mirror can be used as a magnifying mirror. (03 mks)

(c) A concave mirror of focal length 10.0cm form an image at distance of 30cm with a height of 8cm. Determine by accurate construction.
(i) The position of the object. (03 mks)
(ii) The size of the object (03 mks)
(iii) State the features of such an image. (02 mks)

(d) Explain why light and heat from the sun disappear during the total eclipse of the sun. (03 mks)

22. (a) Define **reflection of light.** (01 mk)

(b) Describe a simple experiment to show that light moves in a straight line. (04 mks)

(c) A man sits in an optician chair looking into a plane mirror which is 2m away from him and views the image of a chart which faces the mirror and is 50cm behind his head. How far away from his eye does the chart appear to be? (05 mks)

(d) (i) Define the term **critical angle.** (01 mk)
(ii) Explain how the critical angle of a material depends on its refractive index. (03 mks)