UACE PHYSICS SEMINAR SLATED FOR 5th OCTOBER 2024 AT

UGANDA MARTYRS S.S. NAMUGONGO

Physics Paper One (P510/1)

Section A

1. (a) (i) Distinguish between ***elastic*** and ***inelastic*** collisions. ***(2 marks)***

(ii) Define the terms; ***momentum*** and ***impulse***. ***(2 marks)***

(iii) Derive the relation between impulse and linear momentum of the body on which it acts. ***(2 marks)***

(b) (i) State the law of conservation of linear momentum. ***(1 mark)***

(ii) Using Newton`s laws of motion, show that when two bodies collide, their total momentum is conserved. ***(4 marks)***

(c) A ball of mass *0.5kg* is allowed to drop from rest, from a point a distance of 5.0m above a horizontal concrete floor. When the ball first hits the floor, it rebounds to a height of *3.0m*.

(i) What is the speed of the ball just after the first collision with the floor?

(3 marks)

(ii) If the collision lasts *0.01 seconds*, find the average force which the floor exerts on the ball. ***(3marks)***

(d) Giving two examples of each, distinguish between conservative and non-conservative forces. ***(3 marks)***

[UGANDA MARTYRS S.S. NAMUGONGO]

2. (a) Define ***surface tension*** and derive its dimensions. ***(2 marks)***

(b) (i) Calculate the amount of energy liberated when *1000 droplets* of water, each of diameter 1.0×10^{-1} *cm* coalesce under isothermal conditions, to form a bigger drop. [*Surface tension of water* $= 7.2\times10^{-4} Nm^{-1}$] ***(4 marks)***

(ii) Derive an expression for the pressure difference between the inside and outside of a soap bubble in air given that the radius of the bubble is r and surface tension of soap solution is γ ***(3 marks)***

(iii) Two soap bubbles of diameters d_1 and d_2 respectively are attached to each other to form an interface of radius r, if $d_1 < d_2$, derive the expression for r in terms of d_1 and d_2. ***(4 marks)***

(c) (i) Distinguish between streamline flow and turbulent flow of a liquid. ***(2 marks)***

(ii) Describe an experiment to demonstrate streamline and turbulent flows. ***(5 marks)***

[Mt. St. MARY'S COLLEGE, NAMAGUNGA]

3. (a) (i) State ***Bernoulli's principle***. ***(1 mark)***

(ii) Derive Bernoulli`s equation. ***(5 marks)***

(b) (i) Define ***coefficient of viscosity*** and state its units. ***(2 marks)***

(ii) Explain the temperature dependence of viscosity of a liquid. ***(3 marks)***

(iii) Water of negligible viscosity flows steadily through a horizontal pipe of varying cross-sectional area. At a point A of cross-sectional area $10cm^2$, the velocity is $0.2ms^{-1}$. What is the pressure difference between A and B if the cross section area of point B is $2.5cm^2$?
(*Given that the density of water =* 10^3kgm^{-3}) ***(4 marks)***

(c) (i) Distinguish between ***laminar*** and ***turbulent flow*** of a fluid. ***(2 marks)***

(ii) Briefly explain any one application of Bernoulli`s principle. ***(3 marks)***

[St. HENRY'S COLLEGE, KITOVU]

4. (a) (i) Define ***limiting friction***. ***(1 marks)***

(ii) Draw a graph of friction against force for a body initially at rest, acted on by a gradually increasing force until it starts to move with constant velocity. ***(2 marks)***

(b) A car of mass *2,000kg* moves up a road inclined at *20°* to the horizontal with a constant velocity of $15\ ms^{-1}$. If the coefficient of friction between the road and the tiers of the car is *0.2*, find;

(i) The force exerted by the car's engine. ***(3 marks)***

(ii) The power developed in the engine. ***(3 marks)***

(c) State the conditions for a rigid body to attain mechanical equilibrium. ***(2 marks)***

(d) A *3m* long ladder rests at an angle of 60° to the horizontal against a smooth vertical wall on a rough ground. The ladder weighs *5kg* and its center of gravity is one-third from the bottom of the ladder.

(i) Draw a sketch diagram to show the forces acting on the ladder. ***(2 marks)***

(ii) Find the reaction of the ground on the ladder. ***(2 marks)***

(e) (i) Define ***a couple***. ***(1 mark)***

(ii) A wheel of radius *0.60m* is pivoted at its center. A tangential force of *4.0N* acts on the wheel so that the wheel rotates with uniform velocity. Find the work done by the force to turn the wheel through *10 revolutions*.***(4 marks)***

[SEETA HIGH SCHOOL, MUKONO]

5. (a) (i) Define ***moment of inertia*** and state its units. ***(2 marks)***

(ii) Derive an expression for rotational kinetic energy of a body about an axis in terms of its moment of inertia ***I***, mass ***m*** and distance ***r*** from the axis of rotation. ***(4 marks)***

(b) A weightless rod of length *1.0 m* has four masses each of *10.0g* attached to it at distances of *0.0 cm, 25.0 cm, 75.0 cm* and *100.0 cm* from one end respectively. The rod is made to rotate in a horizontal plane about a vertical axis at its center. If the rod makes *8.0 rev/s*, find;

(i) Rotational kinetic energy of the system. ***(3 marks)***

(ii) Moment of inertia for the system. ***(4 marks)***

(c) (i) Draw a sketch diagram of a car moving round a circular track on level ground and indicate the forces acting on the car. ***(3 marks)***

(ii) If the track is of radius r, derive an expression for the maximum speed with which the car can move round the track without overturning.

(4 marks)

[WAMPEEWO NTAKE]

6. (a) (i) State ***Kepler's laws of planetary motion***. ***(3 marks)***

(ii) State ***Newton`s law of Universal gravitation***. ***(1 mark)***

(b) (i) Sketch a graph showing the variation of acceleration due to gravity with distance from the center of the earth. ***(2 marks)***

(ii) Derive an expression for the acceleration due to gravity g, inside the earth at a distance r, from the earth's surface given that the earth has a uniform density ρ. ***(3 marks)***

(c) The orbital radius of Mars about the Sun is *1.53 times* that of the earth about the Sun. How many days does Mars take to move once round the Sun? ***(3 marks)***

(d) (i) Define ***a parking orbit.*** ***(1 mark)***

(ii) State any two uses of artificial satellites. ***(2 marks)***

(e) A satellite of mass *100kg* is in a circular orbit at a height of $3.59 \times 10^7 m$ above the earth's surface.

(i) Find the mechanical energy of the satellite. ***(3 marks)***

(ii) Explain what would happen if the satellite encountered resistance to its forward motion. ***(2 marks)***

[St. PETER'S S.S, NSAMBYA]

Section B

7. (a) Define ***specific heat capacity*** and state its units. ***(2 marks)***

(b) (i) With use of a well labelled diagram, describe the continuous flow method to determine the specific heat capacity of a liquid. ***(6 marks)***

(ii) State any **two** advantages of the continuous flow method over the method of mixtures. ***(2 marks)***

(c) In an experiment to determine the specific heat capacity of a liquid by the continuous flow method, the following two sets of readings were obtained.

	Set 1	***Set 2***
Voltage V(v)	35.0	26.0
Current I(A)	2.0	2.0
Mass m, of liquid (kg) collected in 10.0 seconds	4.07×10^{-2}	3.0×10^{-2}
In flow temperature (°C)	25	25
Out flow temperature (°C)	29	29

Use the information provided and find the;

(i) Specific heat capacity of the liquid. ***(2 marks)***

(ii) Rate of heat loss by the apparatus. ***(4 marks)***

(d) Steam at *100°C* is passed into a copper calorimeter of mass *150g* containing *340 g* of water at *15°C*. This is done until the temperature of the calorimeter and its contents is *71°C*. If the mass of the calorimeter and its contents is found to be *525g*, calculate the specific latent heat of vaporization of water. ***(4 marks)***

[St. CYPRIAN HIGH SCHOOL, KYABAKADDE]

8. (a) (i) Define ***isobaric*** and ***iso - volumetric*** processes of a gas. ***(2 marks)***

(ii) Write down the equations representing isobaric and an iso - volumetric processes. ***(2 marks)***

(b) An ideal gas of temperature *25°C* and pressure $1.01 \times 10^5\ Pa$, undergoes an isobaric expansion to twice its volume, followed by an iso-volumetric change to a temperature *-73°C*. The gas is then compressed adiabatically to its original volume.

(i) Draw a pressure-volume sketch graph to show the above processes.

(3 marks)

(ii) Calculate the final temperature and pressure of the gas. ***(6 marks)***

(d) (i) State ***Boyle`s law***. ***(1 mark)***

(ii) With a labelled diagram, describe an experiment to verify Boyle`s law.

(6 marks)

[GREEN LIGHT S.S, NANSANA]

9. (a) (i) State the assumptions made in the derivation of the gas equation $P = \frac{1}{3}\rho\overline{c^2}$. ***(2 marks)***

(ii) State ***Dalton's law*** of partial pressures. ***(1 mark)***

(iii) Use the expression $P = \frac{1}{3}\rho\overline{c^2}$ to deduce Dalton's law stated in (ii) above. ***(3 marks)***

(b) Explain:

(i) what happens to the pressure of a fixed mass of a gas in a sealed container when the temperature of that gas is raised. ***(4 marks)***

(ii) why water on top of a high mountain boils at a lower temperature than that at the bottom of the mountain. ***(4 marks)***

(c) Two hollow spheres A and B of volume $500cm^3$ and $250cm^3$ respectively are connected by a narrow tube fitted with a tap. Initially the tap is closed and A is filled with an ideal gas at 10^oC at a pressure *of* $3.0 \times 10^5 Pa$ and B is filled with an ideal gas at 100^oC at a pressure of $1.0 \times 10^5 Pa$. Calculate:

(i) the equilibrium pressure when the tap is opened. ***(3 marks)***

(ii) the resulting temperature when the tap is opened. ***(3 marks)***

[IGANGA S.S]

10. (a) (i) Define a cooling correction as used in calorimeter experiments. ***(1 mark)***

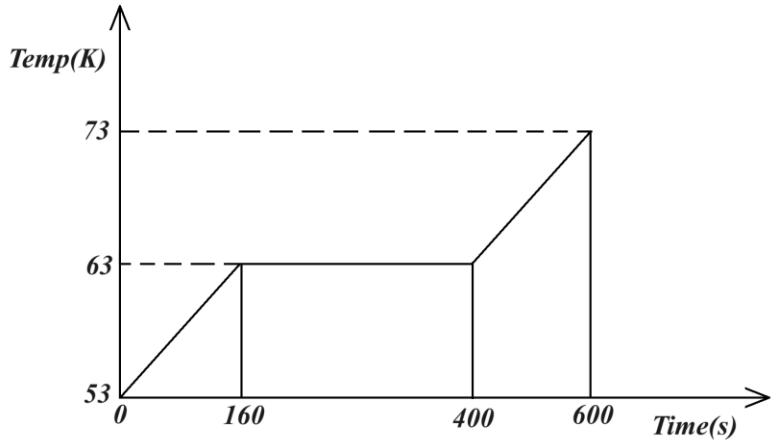
(ii) State Newton's law of cooling. ***(1 mark)***

(b) (i) Using a well labeled diagram, describe an experiment to determine the specific heat capacity of a solid by the method of mixtures. ***(6 marks)***

(ii) State any assumption made in the experiment described in b(i) above.

(1 mark)

(c) The graph in figure below refers to an experiment in which solid nitrogen absorbs heat at a constant rate and melts at 63 K



Given that the specific heat capacity of solid nitrogen is 1.6×10^{3} $Jkg^{-1}K^{-1}$, calculate the;

(i) specific latent heat of fusion of nitrogen. ***(4 marks)***

(ii) specific heat capacity of liquid nitrogen. ***(3 marks)***

(d) Explain why cloudless nights feel cooler than cloudy ones. ***(4 marks)***

[NAALYA S.S, BWEYOGERERE CAMPUS]

Section C

11. (a) (i) Draw a well labelled diagram of a Cathode Ray Oscilloscope (C.R.O) and state the operation of the major parts indicated. ***(6 marks)***

(ii) With the time base switched off, a sinusoidal voltage of root-mean-square value *7.072V* is connected across the Y-plates, and a vertical trace of *4.0cm* length is formed on the screen. Find the y-sensitivity setting of the C.R.O. ***(4 marks)***

(b) An alpha particle is accelerated through a potential difference of *3,000V* to enter a magnetic field of flux density *0.6T* at right angles. Given that the mass of the alpha particle is $6.64\times10^{-27}kg$, find;

(i) The speed of the alpha particle as it enters the magnetic field. ***(3 marks)***

(ii) The radius of the path taken by the particle within the magnetic field.

(2 marks)

(iii) The electric field intensity that would be crossed with the magnetic field to cause the particle to move in a straight line within the magnetic field.

(2 marks)

(c) State any three differences between Cathode rays and Gamma rays. ***(3 marks)***

[St. JOSEPH'S S.S, NAGGALAMA]

12. (a) Define the following: ***(3 marks)***
(i) A mole. (ii) Faraday's constant, (iii) Avogadro`s number.

(b) With use of a labelled diagram, describe Millikan`s oil drop experiment to determine the charge of an electron. ***(6 marks)***

(c) An oil drop of radius $1.0 \times 10^{-3} cm$ falls freely in air, mid-way between two vertical parallel metal plates, which are *0.50 cm* apart, and its terminal velocity is $1.066\ cms^{-1}$. When a potential difference of *3,000V* is applied between the plates, the path of the drop becomes a straight line inclined at an angle of *31° 36`* to the vertical. Find;
(i) The horizontal velocity of the drop when the potential difference is applied on the plates. ***(2 marks)***
(ii) The charge on the oil drop. ***(3 marks)***
(iii) The density of air. ***(2 marks)***
(Assume the viscosity of air to be $1.816 \times 10^{-5}\ kg\ m^{-1}s^{-1}$, density of oil $=880\ kgm^{-3}$)

(d) In Bohr`s model of the Hydrogen atom, the ground state energy level is *13.6eV*. Find the frequency of the photon emitted when the electron transits from the third energy level to the ground state. ***(4 marks)***

[CRANE HIGH SCHOOL, ENTEBBE]

13. (a) State the laws of photoelectric emission. ***(4 marks)***

(b) With use of a labeled diagram, describe a simple experiment to demonstrate photoelectric emission. ***(3 marks)***

(c) A metal surface has a work function of *4.0 eV*. Calculate,

(i) the longest wavelength of light that will cause emission of photoelectrons from the metal surface. ***(3 marks)***

(ii) the velocity of the most energetic photoelectrons emitted from the metal surface when radiation of wavelength $0.2\mu m$ is incident on it. ***(3 marks)***

(d) (i) Define mass defect of a nucleus. ***(1 mark)***

(ii) Explain the observations of Rutherford's scattering of alpha particles by a gold foil. ***(3 marks)***

(iii) Calculate the closest distance of approach when a *5.0MeV* proton approaches a gold nucleus. *(Atomic number of gold = 79)* ***(3 marks)***

[JINJA PROGRESSIVE ACADEMY]

14. (a) Define ***binding energy*** of a nuclide ***(1 mark)***

(b) (i) Sketch a graph showing how binding energy per nucleon varies with mass number. ***(1 mark)***

(ii) Describe the main features of the graph in b (i) above. ***(3 marks)***

(c) Distinguish between ***nuclear fission*** and ***nuclear fusion*** and account for energy released. ***(3 marks)***

(d) With the aid of a labelled diagram, describe the working of an ionization chamber. ***(6 marks)***

(e) (i) What is meant by ***half-life*** and ***decay constant*** as applied to radioactivity? ***(2 marks)***

(ii) A Geiger Muller (GM) tube placed ***20cm*** from a ***2.0g*** of Radon $^{222}_{86}Rn$ gives a count rate of ***85 counts per second***. If the entrance window of the GM tube has an area of ***$10cm^2$***, calculate the half-life of Radon. ***(4 marks)***

[St. MARY'S COLLEGE, KISUBI]

Physics Paper Two (P510/2)

Section A

1. (a) (i) With the aid of a diagram explain what is meant by ***chromatic aberration***. ***(2 marks)***

(ii) Explain how chromatic aberration is minimized. ***(3marks)***

(b) (i) What is meant by ***refractive index*** of a material? ***(1 mark)***

(ii) Derive an expression for the focal length of a convex lens in terms of the radii of curvature of its surfaces and its refractive index. ***(4 marks)***

(c) A thin biconvex lens is illuminated a narrow beam of light of two colours; red and blue. If the refractive indices of the lens for red and blue light are respectively 1.514 and 1.524 and if the radii of curvature of its faces are 30cm and 20cm, calculate the separation of the foci for red and blue lights? ***(4 marks)***

(d) Describe an experiment to determine refractive index of a small quantity of a liquid using a convex lens and plane mirror. ***(4 marks)***

(e) Explain why an observer sees a spectrum of colors through raindrops during a sunny rain shower**?** ***(2 marks)***

[SEETA HIGH SCHOOL, MAIN CAMPUS]

2. (a) (i) Define ***principal focus*** of a convex mirror. ***(1 mark)***

(ii) Show that the radius of curvature of a convex mirror is twice the focal length of the mirror. ***(3 marks)***

(b) Explain why parabolic mirrors instead of concave mirrors are used as reflectors in search lights. ***(2 marks)***

(c) Explain the terms ***magnifying power*** and resolving power in relation to a microscope? ***(2 marks)***

(d) A compound microscope consists of two thin lenses, an objective of focal length 20mm an eye piece of focal length 50mm, placed 220mm apart. If the final image is at infinity, Calculate the,

(i) distance of the object from the objective. ***(4 marks)***

(ii) magnifying power of the system if the near point distance is 250mm from the eye. ***(2 marks)***

(e) (i) Derive an expression for magnifying power of an astronomical telescope in normal adjustment. ***(3 marks)***

(ii) Describe how an astronomical telescope can be modified to produce erect images of a distant object on earth. ***(3 marks)***

[St. JOSEPH'S GIRLS S.S, NSAMBYA]

3. (a) (i) Define prism with reference to light propagation through a prism. ***(1 mark)***

(ii) Describe an experiment to determine the angle of minimum deviation of a prism using optical pins. ***(5 marks)***

(b) Define principal focus and radii of curvature of a convex lens. ***(2 marks)***

(c) (i) Show that the focal length, f, of a converging lens is given by $\frac{1}{f} = (n-1)(\frac{1}{r_1} + \frac{1}{r_2})$, where n, is the refractive index of the material of the lens and r_1 and r_2 are the radii of curvature of the lens surfaces. ***(4 marks)***

(ii) A biconvex lens of radii of curvature *23cm* is placed on a liquid film on a plane mirror. A pin clamped horizontally above the lens coincides with its image at a distance of *37.3cm* above the lens. If the refractive index of the liquid is *1.4,* what is the refractive index of the material of the lens? ***(4 marks)***

(d) (i) Explain what is meant by spherical aberration. ***(2 marks)***

(ii) Explain why a parabolic mirror is used in search lights instead of a concave mirror. ***(2 marks)***

[NAMILYANGO COLLEGE]

Section B

4. (a) (i) Distinguish between a ***progressive wave*** and a ***stationary wave***. ***(3 marks)***

(ii) What are the main characteristics of a progressive wave motion? Give your reasons for believing that sound is propagated through the atmosphere as a longitudinal wave motion. ***(2 marks)***

(b) Describe an experiment to determine the end correction of a resonance tube. ***(4 marks)***

(c) A narrow tube of length *0.400m* is closed at one end. A turning fork of frequency *960Hz* set into vibration just above the open end of the tube causes air in the tube to resonate with the tuning fork. If the speed of sound in air is $330ms^{-1}$, determine the mode of vibration of air in the tube. ***(3 marks)***

(d) (i) Define ***Doppler effect*** and ***beats***. ***(2 marks)***

(ii) Describe how the velocity of a star may be determined using the Doppler effect. ***(3 marks)***

(e) An observer, standing by a railway track, notices that the pitch of an engine's whistle changes in the ratio 5:4 on passing him. What is the speed of the engine? (*Velocity of sound in air = 340 m* s^{-1}) ***(4 marks)***

[NABISUNSA GIRLS SCHOOL]

5. (a) Define the following as applied to sound ***(3 marks)***

(i) A tone
(ii) A harmonic
(iii) An overtone

(b) (i) Describe an experiment to show that a stretched wire plucked in the middle vibrates in more than one mode simultaneously. ***(4 marks)***

(ii) A wire of length *0.3m* and mass *5g* is stretched to a tension of *170N*. When sounding its third harmonic, the wire resonates with an open pipe sounding its fundamental note. If the velocity of sound in air is $340ms^{-1}$, find the length of the pipe. ***(3 marks)***

(c) (i) Explain what is meant by beats. ***(2 marks)***

(ii) A pedestrian moving in a straight line between two stationary sources of sound , each of frequency 425Hz, hears beats at the rate of $5.0s^{-1}$. Calculate the speed of the pedestrian, if the velocity of sound in air is $340ms^{-1}$. ***(3 marks)***

(d) (i) Distinguish between sound and light waves**.** ***(2 marks)***

(ii) Describe an experiment to show that sound is a mechanical wave. ***(3 marks)***

[St. MARIA GORRETI S.S, KATENDE]

6. (a) (i) State ***Huygens's principle***? ***(1 mark)***

(ii) A beam of light is refracted at the boundary of two media. Using Huygen's principle show that the ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant. ***(3 marks)***

(b) What is meant by ***diffraction*** and ***polarization*** of light waves? ***(2 marks)***

(c) A transmission diffraction grating of spacing ***d*** is illuminated normally with light of wavelength λ. Derive the condition for occurrence of diffraction maxima. ***(3 marks)***

(d) Describe how polarized light can be produced by reflection. ***(4 marks)***

(e) Explain why it is possible to observe sound interference effects using two whistles, but not light interference using two lamps, even if the dimensions of the apparatus are suitably modified. ***(3 marks)***

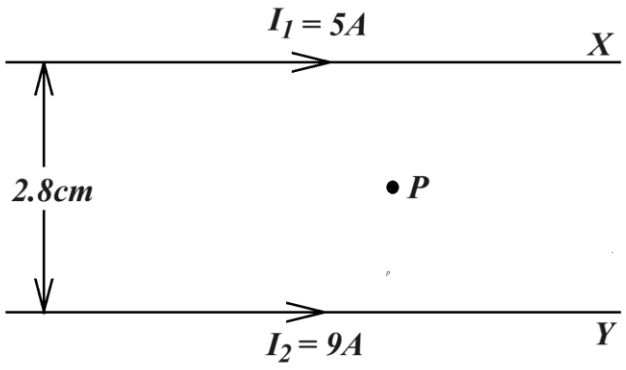
(f) In a Young's double-slit experiment a total of *23* bright fringes occupying a distance of *3.9mm* were visible in the travelling micro-scope. The microscope was focused on a plane which was 31 cm from the double slit and the wavelength of the light being used was 5.5×10^{-7} *m*. What was the separation of the double slit? ***(4 marks)***

[KIWAWU S.S, MITYANA]

Section C

7. (a) Define ***magnetic field strength*** and ***magnetic flux***. ***(2 marks)***

(b)



The figure above shows two parallel wires X and Y carrying currents of *5A* and *9A* respectively in the same direction, placed *2.8cm* apart in air.

(i) Sketch the magnetic field pattern around the wires. ***(2 marks)***

(ii) Find the magnetic field strength at position P distance 0.9cm from Y. ***(3 marks)***

(iii) Find the force on a wire *5m* long through P and parallel to Y carrying current of *3A*. ***(3 marks)***

(iv) Explain the origin of force on wire P in (iii) above. ***(3 marks)***

(c) Define the following as applied to the earth's magnetic field:

(i) Angle of dip ***(1 mark)***

(ii) Magnetic meridian ***(1 mark)***

(d) Describe how the angle of dip in the earth's magnetic field can be determined using a search coil and a ballistic galvanometer. ***(5 marks)***

[KABOWA HIGH SCHOOL]

8. (a) (i) State the ***laws of electromagnetic induction***. ***(2 marks)***

(ii) A metal block suspended by an insulating thread is set to oscillate across a field from electromagnetic source. Explain why the oscillation takes only a short time when the field is on and yet lasts longer when the field is off. ***(3 marks)***

(b) A coil of N turns and area A is connected to a ballistic galvanometer and then suspended with its plane perpendicular to a magnetic field of flux density B. If the total resistance of the coil's circuit is R, Show that when the coil is rotated

through 180^0, about its diameter, the charge, Q, caused to circulate in the circuit is given by $Q = \frac{2NBA}{R}$. ***(4 marks)***

(c) Describe how a d.c generator works. ***(5 marks)***

(d) (i) Define ***back emf***. ***(1 mark)***

(ii) A coil of a motor has *100 turns* each of area $12cm^2$ and total resistance 3Ω. The coil is mounted in a radial magnetic field of flux density *0.74T*. When the coil is connected to a d.c supply of *220V*, it draws a current of *1.5A*. Calculate the maximum angular velocity the motor attains. ***(3 marks)***

(e) An iron cored coil is connected in series with a switch and d.c source of large voltage. Explain why sparks are observed at the contacts when the switch is opened. ***(2 marks)***

[St. JOSEPH OF NAZARETH HIGH SCHOOL]

9. (a) (i) Distinguish between ***self induction*** and ***mutual induction***. ***(3 marks)***

(ii) An air- cored inductor is connected in series with a switch and a d.c source. The switch is closed and left for some time. Explain why a spark is observed across the switch contacts when the switch is reopened. ***(3 marks)***

(b) Describe with the aid of a diagram, how the magnetic flux density between the poles of a strong magnet can be measured. ***(5 marks)***

(c) (i) Explain how eddy currents are produced. ***(2 marks)***

(ii) Describe one application of eddy currents. ***(3 marks)***

(d) A coil of *500 turns* and mean area $3.0x10^{-2}m^2$ is rotated at a uniform rate of *400 revolutions per minute* about an axis perpendicular to a uniform magnetic field of flux density *0.7T*. If the terminals of the coil are connected across a resistor of 1.5Ω, calculate the maximum current that flows in the circuit. ***(4 marks)***

[BULO PARENTS S.S]

10. (a) Define ***impedance*** and ***root mean square value*** as applied to a.c ***(2 marks)***

(b) (i) Explain what is meant by ***resonance*** in an alternating current circuit containing an indicator, resistor and capacitor in series. ***(2marks)***

(ii) Give an application of effect in *b(i)* and explain it ***(3 marks)***

(c) An alternating current of $I = I_0 \sin \omega t$ is supplied in a circuit containing a capacitor of capacitance C.

(i) Derive the expression for the voltage across the capacitor. ***(2 marks)***

(ii) Sketch the variation of voltage across the capacitor and current in the circuit with time and explain the phase relationship. ***(3 marks)***

(d) A *100μF* capacitor is joined in series with a *2.5V, 0.30A* lamp and a *50 Hz* supply. Calculate the p.d *(r.ms)* of the supply to light the lamp to its normal brightness. ***(4 marks)***

(e) Describe how a full wave rectifier meter works. ***(4 marks)***

[TRINITY COLLEGE, NABBINGO]

Section D

11. (a) Define ***electrical resistivity*** and show that its ***S.I unit is*** Ωm**.** ***(2 marks)***

(b) A cell of *e.m.f, E,* and internal resistance, *r,* drives current through a resistor of resistance, *R,* connected in series with it. Derive the expression for the efficiency of the circuit. ***(3 marks)***

(c) (i) Explain the principle of operation of a slide wire potentiometer. ***(3marks)***

(ii) Explain the modifications necessary to use an ordinary slide wire potentiometer for measuring thermoelectric emf. ***(2 marks)***

(d) Describe how a potentiometer is used to measure unknown resistance. ***(4 marks)***

(e) In an experiment to investigate the variation of resistance with temperature, a nickel wire and a 10Ω standard resistor were connected in the gaps of a metre bridge. When the nickel wire was at $0°C$, a balance point was found *40cm* from the end of the bridge adjacent to the nickel wire. When it was at $100°C$, the balance point occurred at *50cm.* Calculate the;

(i) temperature of the nickel wire when the balance point was *42cm.*

(4 marks)

(ii) resistivity of nickel at this temperature if the wire was then *150cm* long and of cross – sectional area $2.5\times10^{-4}cm^2$. ***(3 marks)***

(f) State and explain one important property of a conductor used to make heating elements. ***(2 marks)***

[UGANDA MARTYRS S.S. NAMUGONGO]

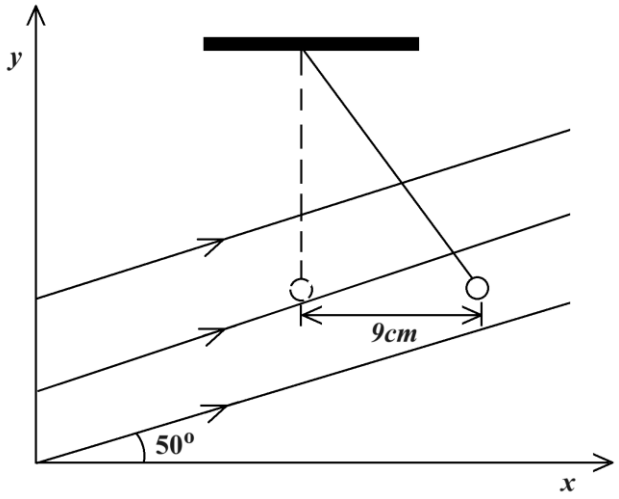
12. (a) (i) What is meant by ***action at a point***. ***(2 marks)***

(ii) A negatively charged rod is placed on the cap of a neutral gold leaf electroscope, and them after it is withdrawn. A sharp pin, while resting on its flat surface is placed on the cap of this gold leaf electroscope with its sharp end pointing away. Explain what is observed. ***(3 marks)***

(b) (i) State ***Gauss' law*** of electrostatics ***(1 mark)***

(ii) Use the law in b(i) above to show that the electric flux, ϕ, due to a charged metal plate is given by $\phi = \frac{\sigma}{\varepsilon_0}$, where σ, and ε_0 are surface charge density and permittivity of free space respectively. ***(2 marks)***

(c) The figure below shows a small sphere of mass $60g$ initially hanging vertically from an insulating thread $16cm$ long. A uniform electric field of magnitude $1.24x10^5 NC^{-1}$ applied at 50^0 to the horizontal displaces the sphere by $9cm$ horizontally.



Determine the;

(i) tension in the thread. ***(3 marks)***
(ii) magnitude of the charge on the sphere. ***(4 marks)***

(d) (i) What is meant by the term ***equipotential surface*** and give two examples of equipotential surfaces. ***(2 marks)***

(iii) Show that electric field lines are always perpendicular to the surface of charged conductors. ***(3 marks)***

[SEROMA CHRISTIAN HIGH SCHOOL]

13. (a) What is meant by ***capacitance of a capacitor*** and define the S.I unit in which it is measured. ***(2 marks)***

(b) (i) Show that when a battery is used to charge a capacitor through a resistor, the heat dissipated in the circuit is equal to the energy stored on the capacitor. ***(4 marks***

(ii) Explain how the strength of the electric field at any point is related to the electric potential at and near the point. ***(3 marks)***

(c) The circular plates A and B of a parallel plate air capacitor have each an effective diameter of *10.0cm* and are *2.0mm* apart. The plates C and D of a similar capacitor have each an effective diameter of *12.0cm* and are *3.0mm* apart. A is

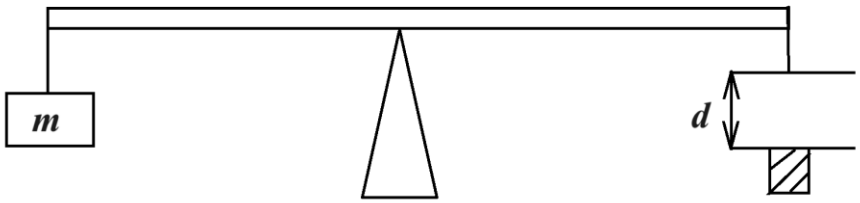
earthed, B and C are connected together and D is connected to the positive pole of a *120V* battery whose negative pole is earthed. Calculate the;

(i) The combined capacitance of the arrangement. ***(3 marks)***

(ii) The energy stored in the arrangement. ***(2 marks)***

(d) Describe an experiment to determine permittivity of a dielectric using a vibrating reed switch circuit. ***(5 marks)***

(e) One of the plates of a parallel plate capacitor is suspended at one end of a light uniform rod pivoted at its middle point carrying mass m at the other end.



The plates have $120cm^2$ each and are separated by $d = 40cm$. Calculate the;

(i) p.d across the plates required to balance the rod horizontally when

$m = 2.66 \times 10^{-6} kg$. ***(3 marks)***

(ii) surface charge density in the plates. ***(2 marks)***

[KIBULI S.S]

14. (a) Define ***dielectric strength***. ***(1 mark)***

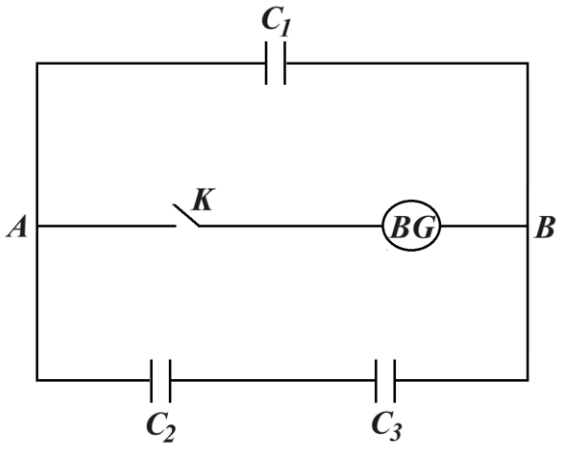
(b) Describe an experiment to investigate the effect of increasing the area of overlap of the plates of a capacitor on capacitance, using a ballistic galvanometer. ***(4 marks)***

(c) (i) Derive the expression for the energy stored in a capacitor of capacitance C carrying charge of Q. ***(4 marks)***

(ii) A parallel plate capacitor is charged by connecting it to a battery. Explain the effect on energy stored when the plate separation is now reduced, when the battery is still on. ***(3 marks)***

(iii) Explain how presence of a dielectric in a capacitor affects capacitance. ***(4 marks)***

(d) The figure below shows three identical capacitors, of capacitance $3\mu F$ each, with air between the plates, connected in parallel with a ballistic galvanometer of charge sensitivity *4 divisions per* μC. With switch K open, a dielectric of relative permittivity *2.3* is inserted in C_3 and the system is charged so that the p.d across *AB* is *60V*



Find the maximum deflection of the BG when K is closed. ***(4 marks)***

[BLESSED SACRAMENT S.S, KIMAANYA]

END

Important information to note

1. ***All presentations are to be done in power point.***
2. ***Font type of "Times New Roman" preferred and font size 44 at minimum for better visibility.***
3. ***All power point documents are to be received at a central desk on arrival***