UACE PHYSICS SEMINAR HELD AT UGANDA MARTYRS S.S.S, NAMUGONGO ON 24TH SEPTEMBER 2022

P510/1 & P510 /2

PHYSICS PAPER 1 & 2

Assume where necessary;

Acceleration due to gravity	=	$9.81ms^{-2}$
Electron charge, e	=	$1.6 \times 10^{-19}C$
Electron mass	=	9.11×10^{-31} kg
Gas constant R	=	$8.31Jmol^{-1}K^{-1}$
Radius of the earth	=	$6.4\times10^{6}m$
Radius of the sun	=	$7.0\times10^{8}m$
Radius of earth's orbit about the sun	=	$1.5\times10^{11}m$
Mass of the earth	=	5.97×10^{24} kg
Universal gravitational constant, G	=	$6.67\times10^{-11}Nm^{2}kg^{-2}$
Specific heat capacity of water	=	$4,200\ Jkg^{-1}K^{-1}$
Specific latent heat of vaporization of water	=	$2.26\times10^{6}Jkg^{-1}$
Speed of light in vacuum	=	$3.0\times10^{8}ms^{-1}$
Plank's constant, h	=	6.6×10^{-34} Js
Stefan's- Boltzmann's constant, σ	=	$5.7 \times 10^{-8}\ Wm^{-2}K^{-4}$
Avogadro's number N_A	=	$6.02\times10^{23}mol^{-1}$
Permeability of free space, μ_0 ,	=	4.0π x $10^{-7}\ Hm^{-1}$.
Permittivity of free space, ε_0 ,	=	8.85 x $10^{-12}\ Fm^{-1}$.
The constant $\frac{1}{4\pi\varepsilon_0}$	=	9.0 x $10^{9}\ F^{-1}m$.
One electron volt (eV)	=	1.6 x 10^{-19} J.

PAPER ONE (P510/1)

SECTION A

1. (a) (i) Define the following ***angular velocity*** and ***centripetal acceleration***. [2]

(ii) Derive the expression for the acceleration of a body moving with angular velocity **ω** through a circular path of radius **r**. [4]

(b) (i) What is meant by banking of a road in circular motion? [1]

(ii) Draw a sketch diagram to show forces acting on a car moving round a banked track. [2]

(iii) A car moves along a circular track of radius 100 m, banked at an angle of 10°. If the coefficient of friction between the tires of the car and the ground is 0.3, find the maximum speed at which the car can move without overturning. [4]

(c) A conical pendulum has a string of length 1.2 m and describes a horizontal circular path of radius 0.6 m. If the tension in the string is 22.66 N, find the;

(i) Mass of the body attached to the string [3]

(ii) Angular speed of the mass. [2]

(d) Explain why a motor cyclist leans towards the centre of a circular path. [2]

[Mt. St. Mary's College Namagunga]

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2. (a) (i) State Newton`s law of gravitation. [1]

(ii) Explain why acceleration due to gravity at different points on the earth`s surface differs. [4]

(b) Describe an experiment to determine the universal gravitational constant G. [6]

(c) A communication satellite of mass 200 kg is launched at a height of 4.6×10^6 m above the surface of the earth. Calculate the;

(i) Speed of the satellite in its orbit [3]

(ii) Mechanical energy of the satellite [2]

(d) Explain what happens to the satellite if its forward motion is resisted. [4]

[Namilyango College]

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3. (a) (i) Define **simple harmonic motion**. [1]

(ii) Show that a simple pendulum executes simple harmonic motion. [3]

(b) Outline the steps taken to determine acceleration due to gravity using a simple pendulum. [4]

(c) Draw a sketch graphs of velocity against displacement and acceleration against displacement during simple harmonic motion. [4]

(d) A body executing simple harmonic motion has a velocities of $0.13 ms^{-1}$ and $0.19 ms^{-1}$ while at displacements of 0.03 m and 0.01 m respectively from the equilibrium position. If the body has mass of 0.2 kg, find the;

(i) Amplitude of its motion. [2]

(ii) Angular velocity of the body. [2]

(iii) The potential energy of the body while at a displacement of 0.03 m from the equilibrium position. [2]

(e) State any two practical uses of simple harmonic motion. [2]

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4. (a) (i) Define **Young's modulus**. [1]

(ii) State Hooke`s law. [1]

(b) (i) Show that when a wire is stretched, the energy E stored per unit volume is given by $\boldsymbol{E = \frac{1}{2} Stress \times Strain}$. [3]

(ii) A copper wire of length 1.000 m is joined at one end to a steel wire of same length and diameter to form a composite wire of length 2.000 m. The composite wire is subjected to a tensile stress until its length becomes 2.002 m. Calculate the tensile stress applied to the wire. [5]

[Young`s moduli for copper and steel are 1.2×10^{11} Pa and 2.0×10^{11} Pa respectively]

(c) (i) Describe an experiment to determine Young`s modulus for a wire. [5]

(ii) State any two precautions taken in c (i) above to ensure accurate results. [2]

(d) (i) Distinguish between ***ductile*** and ***brittle*** materials. [2]

(ii) State the circumstance under which a brittle material can be used during construction. [1]

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5. (a) (i) What is projectile motion? [1]

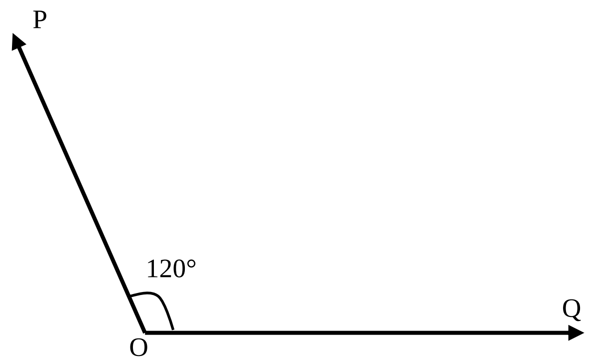
(ii) Define the terms, **Range** and **Time** of flight as used in projectile motion. [2]

(iii) A bomb is dropped from an aero plane when it is directly above a target at a height of 1402.5 m. the aero plane is moving horizontally with a speed of 500kmh^{-1}. Determine whether the bomb will hit the target [5]

(b) (i) Define relative velocity. [1]

(ii) A car X starts to move from city P which is 70km from city Q. Car Y starts to move from city Q. If the cars move towards each other they take one hour to meet. And if they move in the same direction they take seven hours to meet. Find the magnitudes of the velocities of the cars. [4]

(c) Two forces P and Q act on a particle at O. The angle between the lines of action of P and Q is 120° as shown in the figure below.



The force P has a magnitude 20N and Q has a magnitude of X newtons. The resultant of P and Q is 3X newtons. Find;

(i) The resultant of P and Q. [4]

(ii) The displacement of O after 15 seconds of actions of the forces given that O has a mass of 3kg and is initially at rest. [3]

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6. (a) (i) Distinguish between **elastic** and **inelastic** collisions. [2]

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

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

(b) (i) State the law of conservation of linear momentum. [1]

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

(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 3.0 m.

(i) What is the speed of the ball just after the first collision with the floor? [4]

(ii) If the collision lasts 0.01 seconds, find the average force which the floor exerts on the ball. [5]

[St. Mary's College Kisubi]

SECTION B

7. (a) (i) Define a **thermometric property**. [1]

(ii) Explain why different thermometers give different values for temperature of a body. [2]

(b) With use of a labeled diagram, describe how a constant-volume thermometer is used to determine absolute temperature of a body. [6]

(c) (i) Define specific latent heat of vaporization and state its units. [2]

(ii) Explain why specific latent heat of a substance is bigger than its specific latent heat of fusion. [3]

(d) (i) State Newton`s law of cooling. [1]

(ii) A metal sphere when suspended in a constant temperature enclosure cools from 80° C to 70° C in 5 minutes and to 62° in the next 5 minutes. Calculate the temperature of the enclosure. [5]

[Uganda Martyrs S.S.S. Namugongo]

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8. (a) (i) Define thermal conductivity of a material. [1]

(ii) Draw sketch graphs of temperature distribution along lagged and un-lagged conducting rods at steady state. [3]

(iii) Explain the graphs in a (ii) above. [4]

(b) (i) State Wien`s displacement law. [1]

(ii) With use of a diagram, describe how a thermopile is used to detect thermal radiation. [5]

(c) Pluto is a planet whose distance from the sun is forty times that of the earth from the sun. If the equilibrium temperature of Pluto is 41K, find;

(i) The frequency of the most intense radiation from Pluto. [3]

(ii) The temperature of the sun. [3]

[Wien`s displacement constant = 2.9×10^{-3}mk]

[Namilyango College]

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9. (a) (i) State Boyle`s law. [1]

(ii) Given that $P = \frac{1}{3}\rho c^{\frac{1}{2}}$ deduce Boyle`s law from $\frac{1}{2}mc^{\frac{1}{2}} = \frac{3}{2}KT$. [4]

(b) (i) Distinguish between real and ideal gases. [4]

(ii) Draw a labeled diagram showing P-V isothermal for a real gas above and below the critical temperature. [3]

(iii) Define a reversible process of a gas. [1]

(c) An ideal gas is trapped in a cylinder by a movable piston. Initially it exerts a pressure of 108 KPa. The gas undergoes a reversible isothermal expansion until its volume is three times bigger. It is then compressed adiabatically to half its original volume.

(i) Draw and label a P-V diagram for the above processes. [2]

(ii) Calculate the final pressure of the gas. [5]

[Ratio of molar heat capacities of the gas = 7:5]

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10. (a) Define the following terms; **thermometric property, fixed point** and **a kelvin** as used in thermometry. [3]

(b) (i) Explain why two different thermometers may read different values when used to measure temperature of a substance. [2]

(ii) The resistance R_θ of platinum varies with temperature θ° C as measured by a constant volume gas thermometer according to the equation $R_\theta = R_0(1+8000\beta\theta-\beta\theta^2)$ where β is a constant. Determine the platinum temperature corresponding to 400°C on the gas scale. [4]

(c) (i) With a labelled diagram describe the continuous flow method to determine the specific heat capacity of a liquid. [6]

(ii) State two advantages of the continuous flow method over the method of mixtures in the determination of specific heat capacity. [2]

(iii) In a continuous flow calorimeter experiment, water flows at a rate of $5.0gs^{-1}$ and a liquid Y must flow at $8.0gs^{-1}$ to maintain the same temperature difference and power supply as in the case of water. Find the specific heat capacity of liquid Y. [3]

[NAALYA SS]

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11. (a) (i) Define **molar heat capacity of a gas at constant pressure** C_p and state its units. [2]

(ii) Derive an expression for the difference between molar heat capacity at constant pressure C_p and molar heat capacity at constant volume C_v for a gas of n moles. [3]

(b) A vessel of volume $1.0\times10^{-2}m^3$ contains an idea gas at a temperature of 300 K and pressure 1.5×10^5Pa.

(i) Calculate the mass of the gas if its density at temperature 285 K and pressure 1.0×10^5 Pa is$1.2kgm^{-3}$ [3]

(ii) 750 J of heat is suddenly released into the gas and its pressure rises to 1.8×10^5 Pa. Assuming no heat is taken up by the vessel, calculate the temperature rise and the specific heat capacity of the gas at constant volume. [4]

(c) Explain why the pressure of a gas increases when the gas is heated at constant volume. [2]

(d) One mole of an ideal gas is initially at a pressure of 1.0×10^5Pa and temperature 25^oC. It undergoes a reversible adiabatic expansion to twice its volume followed by a reversible isothermal compression to its original volume.

(i) Draw a P-V sketch graph to show the two processes. [2]

(ii) Calculate the final temperature and pressure of the gas. [4]

(Ratio of molar Heat Capacities of the gas is1.4)

[St. Henry's college Kitovu]

SECTION C

12. (a) (i) State any three differences between **cathode rays** and **positive rays**. [3]

(ii) Explain two main failures of Rutherford`s model of the atom. [3]

(b) Explain how Millikan`s experiment for measuring the charge of an electron proves that charge is quantized. [3]

(c) In a Millikan's oil drop experiment, a charged oil drop of radius 9.2×10^{-7}m and density 800kgm^{-3} is held stationary in an electric field of intensity 4.0×10^{4} Vm^{-1}.

(i) What is the charge on the drop? [4]

(ii) Find the electric field intensity that can be applied vertically to move the drop with velocity 0.005ms^{-1} upwards. [3]
[Density of air = 1.29 kgm^{-3}; coefficient of viscosity of air = 1.8×10^{-5} Nsm^{-1}]

(d) A particle of charge 3.2×10^{-19}C is accelerated from rest through a potential difference of 10^{4} V. It enters a region of uniform magnetic field of flux density 0.5T. The particle describes a circular path of radius 8.94cm. Find the mass of the particle. [4]

[Mt. St. Mary's College Namagunga]

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13. (a) State the characteristics of photoelectric emission. [4]

(b) Define the following terms as used in photoelectric emission.

(i) Work function [1]

(ii) Stopping potential. [1]

(c) With use of a labeled diagram describe an experiment to determine Plank`s constant. [5]

(d) (i) A metal has a threshold wavelength of 9.09×10^{-7} m. Calculate the stopping potential for the photoelectrons when light of frequency 8.2×10^{14} Hz is incident on the metal. [3]

(ii) What will be the maximum velocity of photoelectrons when the metal in d (i) above is illuminated with light of frequency 9.0×10^{14} Hz? [3]

(e) Explain any one use of photoelectric effect. [3]

[NAALYA SS]

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14. (a) Define the following terms as used in the study of radioactivity.

(i) Activity (ii) Decay constant (iii) Atomic Mass Unit. [3]

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

(ii) Describe the main features of the graph in b (i) above. [3]

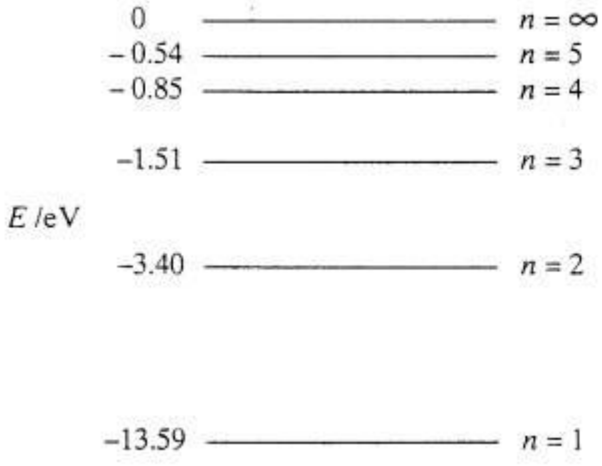
(c) A fresh sample of radioactive $^{54}_{26}Fe$, weighs 15g, and its activity is 8.5×10^{14} disintegrations per second. Find the:

(i) Half-life of $^{54}_{26}Fe$. [4]

(ii) The activity of 15g sample after two years [3]

(d) State the observations and conclusions made from Rutherford's Alpha particle scattering experiment. [3]

(e) The diagram below shows some of the energy levels of hydrogen atom.



(i) Calculate the ionisation energy for the hydrogen atom. [1]

(ii) Calculate the wave length of the radiation emitted by the electron transition from the 4th to 2nd energy level. [2]

[Uganda Martyrs S.S.S. Namugongo]

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15. (a) (i) With the aid of a diagram describe how cathode rays are produced. [4]

(ii) Explain how the sign of the charge of cathode rays may be determined. [2]

(b) An electron is projected with a speed of 3.0 x $10^7 ms^{-1}$ in the direction of a uniform electric field. After traveling a distance of 40cm the electron reverses its direction.

(i) Why does the electron reverse its direction [1]

(ii) Calculate the magnitude of the electric field. [4]

(c) With the aid of a labeled diagram, describe the operation of the Bainbridge mass spectrometer in the measurement of specific charge of positive ions. [6]

(d) A beam of positive ions is accelerated through a potential difference of 1 x 10^3 V into a region of uniform magnetic field of flux density 0.2T. While in the magnetic field it moves in a circle of radius 2.3cm. Calculate charge to mass ratio of these ions. [3]

[St. Mary's College Kisubi]

PAPER TWO (P510/2)

1. (a) Define the following with reference to a convex mirror.

(i) Principal focus [1]

(ii) Aperture [1]

(b) A concave mirror forms an image of magnification 2 when the object is placed in front of it. When the object is moved 6cm towards the mirror, the magnification becomes 2.5. Find focal length of the mirror. [4]

(c) An object coincides with its image when it is placed 30cm from a concave mirror. When a concave lens is placed 20cm from the object the concave mirror has to be moved 5cm farther away to make the image coincide with the object.

(i) Sketch a ray diagram to represent the final situation. [2]

(ii) Calculate focal length of the concave lens. [4]

(d) (i) A pin held above a concave mirror containing a small quantity of liquid coincides with its image when it is at height h above the mirror. Show that refractive index of the liquid, $n = \frac{R}{h}$, where R is radius of curvature of the mirror. [5]

(ii) A concave mirror is placed at the base of a stand and a pin clamped above the mirror coincides with its image when it is 15cm above the mirror. When a liquid is put in the mirror to a depth of 3cm the pin coincides with its image when it is 12.6 cm above the mirror. Calculate refractive index of the liquid. [3]

[Uganda Martyrs S.S.S. Namugongo]

2. (a) (i) With aid of ray diagrams distinguish between chromatic and spherical aberration. [3]

(ii) Distinguish between a microscope and a telescope. [2]

(b) (i) Draw a ray diagram to show how the final image is formed by a compound microscope in normal adjustment. [3]

(ii) Derive the expression for magnification produced by a microscope in normal adjustment. [4]

(iii) State **one** limitation of the microscope in normal adjustment. [1]

(c) A microscope consists of an objective lens of focal length 6cm and an eyepiece of focal length 10cm. The final virtual image of an object placed 8cm from the objective is formed 30cm from the eyepiece. Calculate the;

(i) separation of the lenses [4]

(ii) linear magnification produced [3]

[Namilyango College]

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3. (a) State the laws of refraction of light. [2]

(b) (i) A monochromatic light is incident on one of the refracting surfaces of an equilateral glass prism of refractive index 1.5, submerged in a liquid of refractive index 1.25. Find the angle of incidence for which the deviation of light through the prism is a maximum. [4]

(ii) Describe an experiment to determine the angle of minimum deviation of light through a prism. [6]

(c) An astronomical telescope consists of two thin lenses of focal lengths 10cm and 100cm. The telescope forms the image of a distant object on a screen placed 20cm from the eye-piece lens. Find the magnification produced by the telescope. [4]

[Mt. St. Mary's College Namagunga]

SECTION B

4. (a) (i) Define a wave front. [1]

(ii) State Huygens's construction principle. [1]

(iii) Use Huygens's principle to show that for light travelling from one medium to another, $\frac{\sin i_1}{\sin i_2} = \frac{c_1}{c_2}$, where c_1 and c_2 are the respective speeds in the media. [5]

(b) (i) What is meant by Doppler's effect? [1]

(ii) Explain how Doppler's effect is applied in the traffic radar speed gun. [5]

(c) (i) An observer standing by the road hears sound of frequency 600HZ coming from the horn of an approaching car. When the car passes, the frequency appears to change to 560HZ. Given that the speed of sound in air is $320ms^{-1}$, calculate the speed of the car. [4]

(ii) A radar speed gun emitting radio waves of frequency 10GHz is directed toward an approaching vehicle. The gun registers beats at the rate of 0.6Hz. Find speed of the vehicle. [3]

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5. (a) (i) State the principle of superposition of waves. [1]

(ii) Define beats [1]

(b) (i) Use the general equation of waves to explain how beats are formed. [5]

(ii) The displacement y of a wave, $y = 4sin2\pi\left(\frac{t}{0.1} - \frac{x}{2}\right) meters$. Find the velocity of the wave. [3]

(c) (i) Distinguish between division of wave front and division of amplitude. [2]

(ii) Describe how spectra are produced by a plane transmission grating. [5]

(iii) In Young's double slit experiment, the slits were placed 0.18mm apart and the fringes were observed on a screen 50cm from the slits. It was found that for a certain monochromatic light, the third fringe was situated 8.1mm from the central bright fringe. Calculate the wave length of the light. [3]

(d) Explain why the setting sun appears red. [4]

[St. Henry's College Kitovu]

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6. (a) Define the terms;

(i) Frequency, [1]

(ii) Phase of vibration as applied to waves. [1]

(b) A progressive wave of wavelength, $\boldsymbol{\lambda}$**,** and amplitude, $\boldsymbol{a}$, travels in a medium with a speed, $\boldsymbol{v}$**,** in the positive *x*-direction.

(i) Show that the displacement, $\boldsymbol{y}$ of the wave particle at a distance $\boldsymbol{l}$ from the source of wave is $\boldsymbol{y} = \boldsymbol{a}sin\frac{2\pi}{\lambda}(\boldsymbol{v}t + \boldsymbol{l})$ [5]

(ii) The wave in b(i) is directed normally on a plane reflector. State three characteristics of the resultant wave formed due to overlap of the incident wave and the reflected wave. [3]

(c) Describe an experiment to determine the velocity of sound in free air by interference method. [5]

(d) A loud sound is heard when a vibrating tuning fork of frequency 1564Hz is held near the mouth of a cylindrical tube of length 29cm closed at one end. Determine the;

(i) mode of vibration of the air column in the tube. [3]

(ii) end error. [2]

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SECTION C:

7. (a) Define electromagnetic induction. [1]

(b) With the aid of a diagram describe how a simple d.c motor works.[6]

(c) A motor with 600 turns coil of area $0.4m^2$ and resistance of 50Ω rotates in a radial magnetic field of flux density 2×10^{-4}T. The motor draws a current of 0.8A when connected to 240V upply. Find the;

(i) angular speed of the coil. [4]

(ii) efficiency of the motor. [3]

(d) Derive an expression for the charge Qwhich flows through a coil of resistance **R** when the magnetic flux linking the coil changes from $\boldsymbol{\phi_0}$ to $\boldsymbol{\phi_f}$. [6]

[Namilyango College]

8. (a) (i) Distinguish between mutual and self-induction. [2]

(ii) Define self inductance. [1]

(b) (i) Describe the construction and operation of the a.c. transformer. [6]

(ii) Explain why increase in the secondary current leads to an increase in the primary current. [4]

(c) A transformer designed to step down voltage to 12V is 90% efficient. It has 3000 turns in the primary and 150 turns in the secondary. Find amplitude of primary current when the load connected to the secondary takes power of 30W. [4]

(d) Give **three** advantages of a.c. over d.c. in power production and transmission. [3]

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9. (a) Define the terms;

(i) Impedance. [1]

(ii) Reactance. [1]

(b) A coil of wire of inductance $0.04VA^{-1}s$ is connected to sinusoidal current, $I = 5\sin 120\pi t$.

(i) Find the instantaneous back e.m.f. in the coil. [3]

(ii) Find the r.m.s. value of the voltage. [2]

(c) (i) Derive the expression for resonant frequency when an inductor of inductance L , a capacitor of capacitance C and the resistor of resistance R are connected in series to an ac source of variable frequency. [4]

(ii) Varying current I flows in a solenoid of length x, N turns and cross section area A. Show that back emf induced in the solenoid is $E = -L\frac{dI}{dt}$, where $L = \frac{\mu N^2 A}{x}$. [3]

(d) A coil of zero resistance and self inductance 5.0H is connected to a 1000Ω resistor and an oscillator whose output voltage is 400V (r.m.s) at a frequency of 63. 7Hz. Find,

(i) r.m.s value of the current flowing through the circuit. [3]

(ii) p.d across the coil [3]

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10. (a) (i) Define the root mean square value of an alternating current. [1]

(ii) Derive the relationship between the root mean square value and the peak value of an alternating current. [5]

(b) A 600Ω resistor, a 5μF capacitor and a 0.8H inductor are connected in series to an alternating voltage supply of $V = 340sin50\pi t$.

(i) Determine the root mean square value of the alternating current flowing through the circuit. [5]

(ii) Sketch on the same axes the variation of impedance, capacitive reactance and inductive reactance with frequency of the alternating voltage. [2]

(c) (i) Describe the action of a hot wire meter. [5]

(ii) Mention **two** advantages of a hot wire meter over the moving coil meter in measurement of current. [2]

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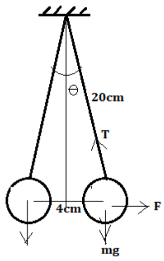
SECTION D

11. (a) Define the terms:

(i) Electric field intensity at a point in an electric field. [1]

(ii) Electric field potential at a point in an electric field. [1]

(b) Two small identical charged spheres of mass 8g each carrying similar charges each are hanged from the same point on insulating threads of length 20cm each. When the spheres settle they are 4cm from each other.



Find magnitude of charge on each sphere. [4]

(c) (i) Derive the relationship between electric field intensity and potential gradient. [3]

(ii) Explain the properties of an equipotential surface. [3]

(iii) Sketch graphs to show the variation of electric field potential and electric field intensity with distance from the centre of near a positively charged metal sphere. [4]

(d) Describe how static electricity can be applied in reducing smoke coming out of a chimney. [4]

[St. Henry's College Kitovu]

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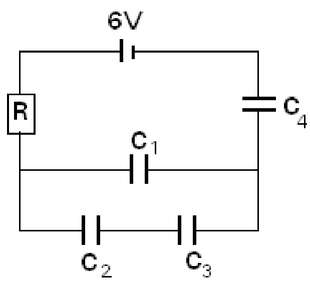
12. (a) (i) Define the capacitance of a capacitor. [1]

(ii) Distinguish between dielectric and dielectric constant. [2]

(b) Show that the capacitance of a parallel plate capacitor is given by, $C = \frac{\varepsilon A}{d}$. [4]

(c) Describe how a ballistic galvanometer is used to compare capacitances of two capacitors. [4]

(d) In the circuit shown below, each capacitor has capacitance 800μF and resistance of resistor R is 5Ω.



(i) Explain why p.d across R is zero. [2]

(ii) Find Pd across C_3. [4]

(iii) Find energy stored in C_4 [3]

[St. Mary's College Kisubi]

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13. (a) Define the terms

(i) Define the Farad. [1]

(ii) Dielectric strength. [1]

(b) With aid of an appropriate circuit diagram, describe how the ballistic galvanometer is used to determine dielectric constant of a dielectric. [5]

(c) Derive the expression for effective capacitance of two capacitors in series. [5]

(d) Two parallel plate air capacitors of equal dimensions and capacitance 600μF are connected in parallel. They are charged to 25 volts and then disconnected from the battery. A dielectric of constant 1.2 is inserted between the plates of one of the capacitors. Calculate the:

(i) the p.d. across the capacitors. [4]

(ii) final energy in the system of capacitors. [4]

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14. (a) (i) State Ohm's law. [1]

(ii) Distinguish between Ohmic and non-Ohmic conductors. [2]

(iii) State **one** example of each type of conductor in a(ii) and sketch their I-V curves. [2]

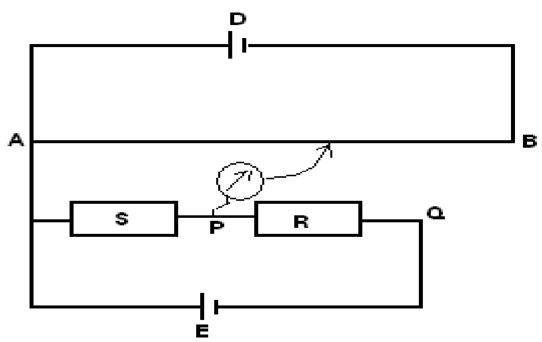
(b) Explain the following observations.

(i) Temperature of a wire increases when current flows in the wire. [2]

(ii) The resistance of a wire increases when temperature increases. [2]

(c) Describe how you would use a meter bridge to measure the temperature coefficient of resistance of wire. [5]

(d)



In the circuit shown above D is a driver cell of negligible internal resistance and e.m.f. 3V. AB is a uniform slide wire of resistance 20Ω. S is a standard resistor of 5Ω. E is a cell of e.m.f. 2.5V. R is an unknown resistor. When the galvanometer is connected at P the balance length is 20 cm. When the galvanometer is connected at Q length is 80cm.

(i) Find resistance of R. [3]

(ii) Find internal resistance of cell E. [3]

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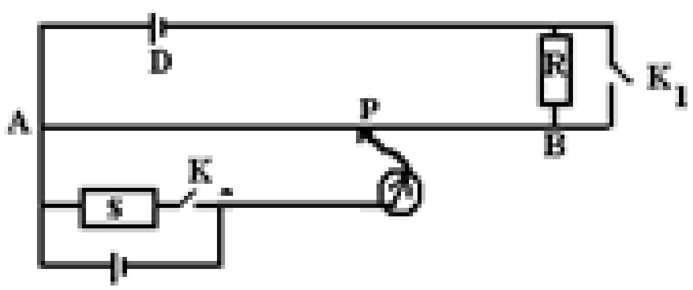
15. (a) (i) Distinguish between potential difference and e.m.f. [2]

(ii) Explain why terminal p.d across a cell is not always equal to the e.m.f? [3]

(b) Show that maximum power is produced in a circuit when its load resistance is equal to internal resistance of the battery to which it is connected. [4]

(c) Describe how you would use a potentiometer to calibrate a voltmeter. [5]

(d) In the circuit shown, D is a driver cell of negligible internal resistance. AB is a uniform slide wire of resistance 20Ω. S is a standard resistor of 5Ω. E is a cell of e.m.f. 1.5V. R is a resistor of 10Ω.



When both switches are open balance length is 20 cm. When only K_2 is closed the balance length is 15 cm.

(i) Calculate the internal resistance of E. [3]

(ii) Calculate the balance length when both K_1 and K_2 are closed. [3]

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END