P510/2
PHYSICS
PAPER 2
July / August 2009
2 ½ Hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

Answer five questions, including at least one but not more than two from each of the sections A, B and C.

Mathematical tables and squared paper will be provided.

Non-programmable scientific Calculators may be used.

Assume where necessary;

Acceleration due to gravity g	$= 9.81 ms^{-2}$
Speed of light in a vacuum, c	$= 3.0 X 10^{8} ms^{-1}$
Election charge, e	$= 1.6 X 10^{-19} c$
Election mass	$= 9.11 X 10^{-31} kg$
Mass of the earth	$= 5.97 X 10^{24} kg$
Planck's Constant, h	$= 6.63 X 10^{-34} Js$
Permeability of free space, μ_o	$= 4.0\pi X 10^{-7} Hm^{-1}$
Stefan's – Boltzmann's Constant, σ	$= 5.67 X 10^{-8} Wm^{-2} K^{-4}$
Permittivity of free space, ε_0	$= 8.85 X 10^{-12} Fm^{-1}$
The constant $1/4_{\pi} \varepsilon_0$	$= 9.0 X 10^{9} mF^{-1}$
One election volt (eV)	$= 1.6 X 10^{-19} J$
Avogadro's number, N_A	$= 6.02 X 10^{23} mol^{-1}$

Turn Over

SECTION A

1. (a) (i) What is radius of curvature of a convex mirror? (01 mark)

(ii) Describe an experiment to determine the focal length of a convex mirror using a convex lens. (04 marks)

(iii) Give the disadvantage a convex mirror has over a plane mirror when used as a driving mirror. (01 mark)

(b) A glass block of thickness t and refractive index n is placed on a pencil mark made on a white piece of paper. Derive an expression for the vertical displacement d of the pencil mark when seen directly from above the glass block in terms of t and n. (05 marks)

(c) A small object is placed on the principal axis of a concave mirror of radius of curvature 20cm at a distance of 30cm. A parallel-sided glass slab of thickness 6cm and refractive index 1.5 is placed, with its parallel sides perpendicular to the principal axis of the mirror, between the centre of curvature of the mirror and the object.

Calculate:

(i) the distance through which the image position of the object changes when the slab is introduced. (05 marks)

(ii) the magnification of the final image. (02 marks)

(d) Give **four** advantages of reflecting telescopes over the refracting type. (02 marks)

2. (a) What is meant by the term centre of curvature as applied to a converging lens? (01 mark)

(b) (i) Show that the focal length 'f' of a converging lens is given by $\frac{1}{f} = (n-1)\left(\frac{1}{r^1} + \frac{1}{r^2}\right)$ 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. (05 marks)

(ii) Two equiconvex lenses of focal length 20cm each are placed in contact and the space between them is filled with water.
Find the focal length of the combination.
Take refractive index of the lens material and the water to be $^3/_2$ and $^4/_3$ respectively. (05 marks)

(c) What is meant by the following as applied to optical instruments;
(i) Visual angle (01 mark)
(ii) Magnifying power? (01 mark)

(d) The objective lens of an astronomical telescope in normal adjustment has a diameter of 15cm and a focal length of 400cm. The eye piece has a focal length of 2.5cm.
Find;
(i) the magnifying power of the telescope (02 marks)
(ii) the diameter of the eye ring (04 marks)

(e) Give one advantage a terrestrial telescope has over other types. (01 mark)

3. (a) Distinguish between longitudinal and transverse waves. (02 marks)

(b) The displacement y given of a wave traveling in the x-direction at a time t is

$$Y = a \sin 2\pi \left(\frac{t}{0.1} - \frac{x}{2.0} \right) metres.$$

Find

(i) the velocity of the wave

(ii) the time period of the wave (04 marks)

(c) (i) What is Doppler effect? (01 mark)

(ii) An ambulance van sounds a siren of 2570Hz as it approaches a stationery observer. What is the apparent frequency of the siren as heard by the observer if the speed of sound in air is 240m/s?(03 marks)

(iii) Give any one application of Doppler effect (01 mark)

(d) (i) State the condition necessary for the formation of standing waves. (02 marks)

(ii) A uniform tube 50cm long is filled with water and a vibrating turning fork of frequency 512Hz is sounded and held above it. When the level of water is gradually lowered the air column resonates with turning fork, when its length is 12cm and again when it is 43.3cm. Estimate the lowest frequency to which the air in the tube lowered resonate if the tube was empty. (07 marks)

4. (a) What is meant by the terms free, damped and forced oscillations. (06 marks)

(b) Explain how beats are produced. (03 marks)

(c) (i) An observer moving between two identical stationery sources of sound along a straight line joining them hears the beats at the rate of $4.0s^{-1}$. At what velocity is the observer moving if the frequency of the sources are 500Hz and the velocity of sound is 340m/s. (06 marks)

(d) (i) Describe the method of producing plane polarized light by reflection. (04 marks)

(ii) Mention one practical application of plane polarized light. (01 mark)

SECTION B

5. (a) State the laws of electromagnetic induction. (02 marks)

(b) (i) With aid of a labeled diagram, describe the structure and the mode of operation of an a.c transformer. (05 marks)

(i) What are the main energy losses in a transformer and how are they minimized? (04 marks)

(c) An a.c transformer operates on a 240V mains. The voltage across the secondary which has 960 turns is 20V.

(i) Find the number of turns in the primary coil. (02 marks)

(ii) If the efficiency of the transformer is 80%. Calculate the current in the primary coil when a resistor of 50Ω is connected across the secondary. (04 marks)

(d) Two long parallel wires P and Q are separated by 12cm in a vacuum. The wire carry currents of 15A and 10A respectively in the same direction. At what point between the wires is the magnetic flux density Zero? (05 marks)

6. (a) (i) Distinguish between root mean square value and peak value of a sinusoidal voltage, (1 mark)

(ii) Write down the relationship between them. (1 mark)

(b) (i) With the aid of a labelled diagram describe the mode of operation of an alternating current generator and state what factors determine the peak value of the induced *emf.* (8 marks)

(ii) Explain the structural modifications that are made to the generator described in (b) (i) above in order to obtain a d c generator. (I mark)

(c) A flat circular coil with 200 turns and each of radius 10 cm is rotated at a uniform rate of 400 revolutions per minute about its diameter at right angles to a uniform magnetic field of flux density 5×10^{-2}T

Calculate:

(i) the peak value of the emf induced in the coil. (2 marks)

(ii) the rms value of the induced emf. (2 marks)

(d) Sketch a well-labelled diagram to show the moving iron ammeter and explain its mode of action. (5 marks)

7. (a) Distinguish between reactance and impedance as applied to alternating current (02 marks)

(b) A 240V, 60Hz alternating voltage is applied across a capacitor of capacitance 10μf. Calculate the;

(i) r.m.s value of current which follows (03 marks)

(ii) power expanded (02 marks)

(c) Describe with aid of diagram how a thermocouple meter works (04 marks)

(d) A galvanometer gives a full scale deflection when a current of 10mA flows through it.
Describe how a moving coil galvanometer can be converted to an ammeter capable of measuring 3A if the resistance of the galvanometer is 5Ω. (04 marks)

(e) (i) What are eddy currents? (01 marks)

(ii) Explain why a metal plate freely swinging in a uniform magnetic field comes to stop faster than when there is no magnetic field. (03 marks)

(iii) Give two applications of eddy currents. (01 mark)

SECTION C

8. (a) Define the term dielectric constant and capacitance. (02 marks)

(b) Derive an expression for effective capacitance of three capacitors connected in series. (04 marks)

(c) An air capacitor of capacitance 400μF is charged to 180V and then connected across an uncharged capacitor of capacitance 500μF. Find the energy stored in the capacitor. (04 marks)

(d) (i) State coulumb's law. (01 mark)

(e) Charges Q_1 and Q_2 of +5μC and + 2μC respectively are placed at two opposite corners as shown in the figure below.

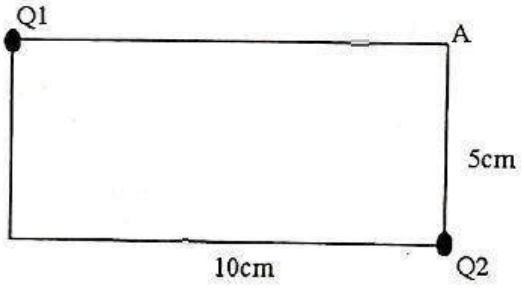


Fig 2

Calculate;

(i) Electric field intensity at A (05 marks)

(ii) Electric potential at A (04 marks)

9. (a) (i) Define electrical resistivity (01 marks)

(ii) State the law of conservation of current at a junction in an electric circuit. (01 mark)

(b) A battery of emf E and internal resistance r is connected across a resistor of variable resistance R. Derive an expression for maximum power expended in the resistor. (05 marks)

(c) Describe with aid of a circuit diagram an experiment to determine the relationship between the resistance and length of the wire. (05 marks)

(d)

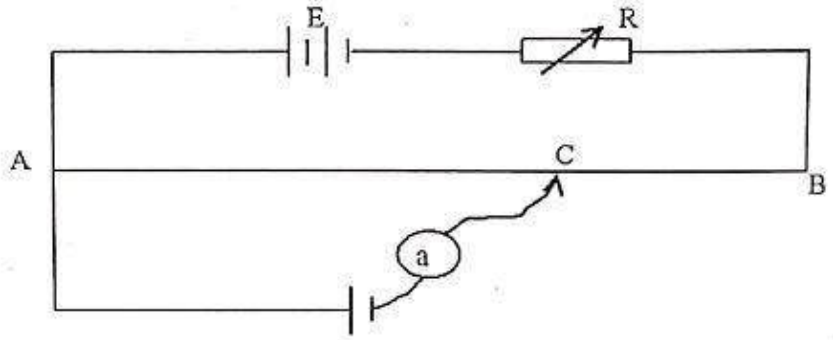


Fig 3

A simple potential meter circuit is set up as shown in fig 3 above. Using a uniform wire AB of length 100cm which has a resistance of 2.0Ω, the emf E of the driver cell is 4.0v and has negligible internal resistance.

(i) If the variable resistor R was given a value of 2.4Ω, what would be the length AC for zero galvanometer deflection? (04 marks)

(ii) If R was made 1.0Ω and the 1.5V cell and galvanometer were replaced by a voltmeter of resistance 20Ω.
What should be the reading of the voltmeter if the contact C was placed at the mid point of AB (04 marks)

10. (a) (i) Define temperature co-efficient of resistance. (01 mark)

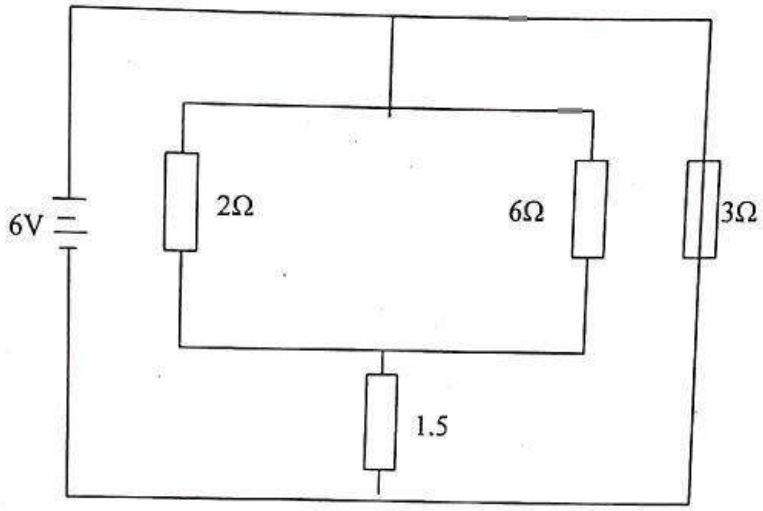
(ii) Describe an experiment for determining temperature co-efficient of resistance using a meter bridge. (05 marks)

(b) The resistance of a nicrome element of electric fire is 50.9Ω at 20°C when operating on 240V supply. The current flowing through it is 4.17A.
Calculate the steady temperature reached by electric fire if the temperature co-efficient of resistance of a nicrome is $1.7 \times 10^{-4} K^{-1}$ (04 marks)

(c) Explain how lightening can cause severe damage to buildings. Name one device that can be used to prevent such damage and explain how it works. (04 marks)

(d) Explain why two cells connected in series deliver more current than when in parallel. (02 marks)

(e) A battery of emf 6V and internal resistance 1Ω is connected across a network of resistors as shown in fig 4 below.



Calculate the current passing through the circuit. (04 marks)

END

P510/2
PHYSICS
PAPER 2
July/August 2018
$2^1/_2$hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

- *Answer* **five** *questions, taking at least one from each of the sections* A, B, C *and* D *but* ***not*** *more than* **one** *question should be chosen from either section* A *or* B.
- *Any additional question(s) answered will* **not** *be marked.*
- *Non-programmable scientific calculators may be used.*
- *Mathematical tables and squared papers will be provided.*

Assume where necessary;

Acceleration due to gravity, g,	$= 9.81 ms^{-2}$
Speed of sound in air	$= 330 ms^{-1}$
Speed of light in vacuum, c,	$= 3.0 \times 10^8 ms^{-1}$
Electronic charge, e,	$= 1.6 \times 10^{-19} C$
Electron mass	$= 9.11 \times 10^{-31} kg$
Planck's constant, h,	$= 6.63 \times 10^{-34} Js$
Permeability of free space, μ_o.	$= 4.0\pi \times 10^{-7} Hm^{-1}$
Permittivity of free space, ε_0,	$= 8.85 \times 10^{-12} Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	$= 9 \times 10^9 F^{-1} m$
One electron volt, (eV)	$= 1.6 \times 10^{-19} J$
Avogadro's number, N_A	$= 6.02 \times 10^{23} mol^{-1}$
Specific heat capacity of water	$= 4200 Jkg^{-1} k^{-1}$

SECTION A

1. a) (i) State the **laws of reflection of light.** (2 marks)

(ii) A ray of light is incident on a plane mirror. The mirror is then rotated through an angle keeping the direction of the incident ray constant. Show that the reflected ray is turned through an angle 2θ. (4 marks)

b) (i) Define the term **radius of curvature** of a convex mirror. (1 mark)

(ii) Describe an experiment to determine the radius of curvature of a convex mirror using a plane mirror. (4 marks)

c) A concave mirror is laid flat on a horizontal table and a pin is moved along its axis until it coincides with its own image at a distance of 20.0cm above the pole. A parallel – sided glass block of thickness 15cm and refractive index 1.5 is placed with its faces horizontal, just above the mirror. Find the position of the image of a pin now held 20.0cm above the pole. (4 marks)

d) Explain the term **chromatic aberration** as applied to lenses. (2 marks)

e) With the aid of a sketch ray diagram explain spherical aberration in concave lenses and state how it is minimized. (3 marks)

2. a) Define the terms;

i) **power of the lens** (1 mark)

ii) **exit pupil** (1 mark)

b) i) With the aid of a ray diagram, describe the action of a Galilean telescope in normal adjustment. (5 marks)

ii) Explain why a Galilean telescope cannot be used to make a precise determination of angular positions of objects being viewed; (2 marks)

c) A telescope has two lenses of focal lengths 1.0m and 0.10m and it is adjusted to produce an image of a distant object onto the screen. The object subtends an angle of 0.30^0 at the telescope objective.

Calculate the;

i) linear size of the image formed at the screen 0.5m from the eye piece. (4 marks)

ii) the distance between the objective and the screen. (1 mark)

iii) Describe an experiment in which minimum deviation of a prism can be measured. (6 marks)

SECTION B

3. a) State **three** differences between mechanical and electromagnetic waves. (3 marks)

b) i) What are **overtones**? (1 mark)

ii) Explain why a musical note played on one instrument sounds different from the same note played on another instrument. (3 marks)

c) Describe an experiment to determine the end-correction of a resonance-tube. (5 marks)

d) i) What is meant by **Doppler effect**? (1 mark)

ii) A motor cyclist and a police car are approaching each other. The motor cyclist is moving at $15ms^{-1}$ and the police car at $25ms^{-1}$. If the police siren is sounded at 500Hz, calculate the frequency of the note heard by the cyclist after the police car passes by.
(Speed of sound in air = $330ms^{-1}$) (3 marks)

e) Describe the variation of pressure with displacement of air in a closed pipe vibrating with fundamental frequency. (4 marks)

4. a) i) What is meant by the terms **interference** and **diffraction** of waves. (2 marks)

ii) State the conditions necessary for diffraction to occur. (4 marks)

b) Two coherrent sources of waves a distance, a, apart produce light of wavelength λ which interfere on a screen, a distance D from the source forming an interference pattern.
Show that the fringe width, w, is given by $w = \frac{\lambda D}{a}$ (4 marks)

c) Light from a monochromatic source of light with wave length of 5.0×10^{-7}m and is requested to produce fringes of separation 5.0mm. Given that the screen is placed a distance 2.0m from the double slits.
Determine the separation between the slits. (3 marks)

d) i) Explain how interference fringes are formed on the air wedge film between two glass slides when mono chromatic light is used. (3 marks)

ii) Two glass slides in contact at one end are separated by a sheet of paper 15cm from the line of contact to form an air wedge. When the air wedge is illuminated normally by light of wavelength 600nm, interference fringes of separation 1.8mm are formed. Find the thickness of paper. (4 marks)

Turn Over

SECTION C

5. a) Define **root mean square value** of an alternating current. (1 mark)

b) A resistor of resistance 200Ω is connected across an alternating voltage $V = 40\sin 160\pi t$.

i) Find the frequency of the alternating voltage. (1 mark)

ii) Calculate the mean power dissipated in the resistor. (3 marks)

c) i) Show that when a capacitor is connected to an a.c supply voltage $V = V_0 \sin 2\pi ft$, the resulting current leads the voltage by 90^0. (4 marks)

ii) Sketch on the same axes the variation with time of the voltage and current if an inductor is connected to the voltage supply in (c) (i). (2 marks)

d) A sinusoidal alternating voltage of 8.0 V r.m.s of frequency 1.5 kHz is applied to a coil of inductance 0.5H. Calculate the root mean square value of the current. (3 marks)

e) Describe with the aid of a labelled diagram the structure and action of a hot wire ammeter. (6 marks)

6. a) Define the **ampere**. (1 mark)

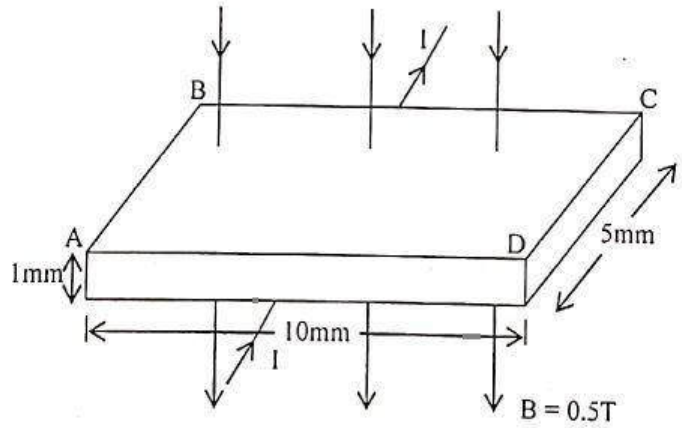
b) Two long straight conductors carrying currents I_1 and I_2 in opposite directions are placed at a distance, d, in vacuum.

(i) Explain why the conductor repel each other. (3 marks)

(ii) Derive an expression for the force per metre between the wires. (2 marks)

c) Draw a labelled diagram of a moving coil galvanometer and explain how it works. (6 marks)

d)



The specimen above shows a piece of semi-conductor material. A magnetic field B of flux density 0.5T is applied perpendicular to the face ABCD. When a current I = 150mA flows, a hall p.d is developed across the specimen.

i) Explain how this effect occurs. (3 marks)

ii) Explain why hall p.d is much larger in semi-conductors than in metals of the same dimensions. (2 marks)

iii) If the maximum hall p.d developed was 8.75mV, find the number of free charge carriers per unit volume. (3 marks)

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

b) i) With the aid of a labelled diagram, describe the structure and action of a simple a.c generator. (6 marks)

ii) State **one** structural adjustment necessary to convert an a.c generator into a d.c generator. (1 marks)

c) i) Define the terms **self-induction** and **mutual induction.** (2 marks)

ii) Describe an experiment which can be used to demonstrate self-induction. (3 marks)

d) i) Explain any **two** of the main precautions taken in the construction of an a.c transformer. (2 marks)

ii) A transformer whose secondary coil has 30 turns and primary coil 600 turns has its secondary connected to a resistor of 3Ω. If its primary is connected to a 240V a.c supply, calculate the current flowing in the primary assuming that the transformer is 80% efficient. (4 marks)

SECTION D

8. a) Define **dielectric strength** of a capacitor and state its units. (2 marks)

b) Describe an experiment to determine dielectric constant of a material. (5 marks)

c) A parallel air capacitor of area $25cm^2$ and with plates 1mm apart is charged to a potential of 100V. The power supply is then disconnected and the plates moved a further 1 mm apart.

i) Calculate the energy change due to the movement of the capacitor plates. (5 marks)

ii) Account for the energy change in (c) (i) above. (2 marks)

d) i) When capacitors are connected in series, the effective capacitance of the combination is less than the capacitance of either capacitor. Explain why. (3 marks)

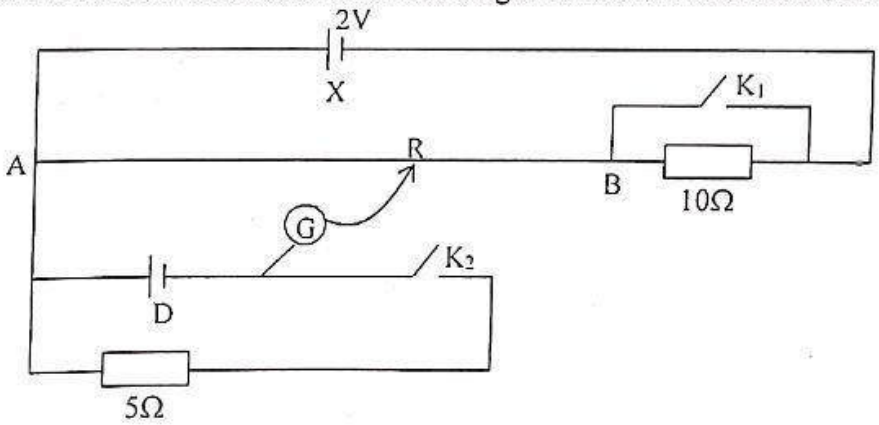
ii) Explain the effect of a dielectric on capacitance of a charged capacitor. (3 marks)

9. a) i) Define a **volt**. (1 mark)

ii) Derive the expression for the combined resistance of three resistors in parallel. (4 mark)

b) Explain the principle of operation of a slide wire potentiometer. (3 marks)

c) The figure below shows a cell X of negligible internal resistance with e.m.f of 2V. AB is a uniform slide wire of length 100cm and resistance 50Ω.



With both switches K_1 and K_2 open, the balance length is 90.0cm. When K_2 is closed and K_1 left open, the balance length changes to 75.0cm.
Determine the;-

i) e.m.f of cell D, (2 marks)

ii) Internal resistance of cell D, (3 marks)

iii) Balance length when both K_1 and K_2 are closed. (3 marks)

SECTION D

8. a) Define **dielectric strength** of a capacitor and state its units. (2 marks)

b) Describe an experiment to determine dielectric constant of a material. (5 marks)

c) A parallel air capacitor of area $25cm^2$ and with plates 1mm apart is charged to a potential of 100V. The power supply is then disconnected and the plates moved a further 1 mm apart.

i) Calculate the energy change due to the movement of the capacitor plates. (5 marks)

ii) Account for the energy change in (c) (i) above. (2 marks)

d) i) When capacitors are connected in series, the effective capacitance of the combination is less than the capacitance of either capacitor. Explain why. (3 marks)

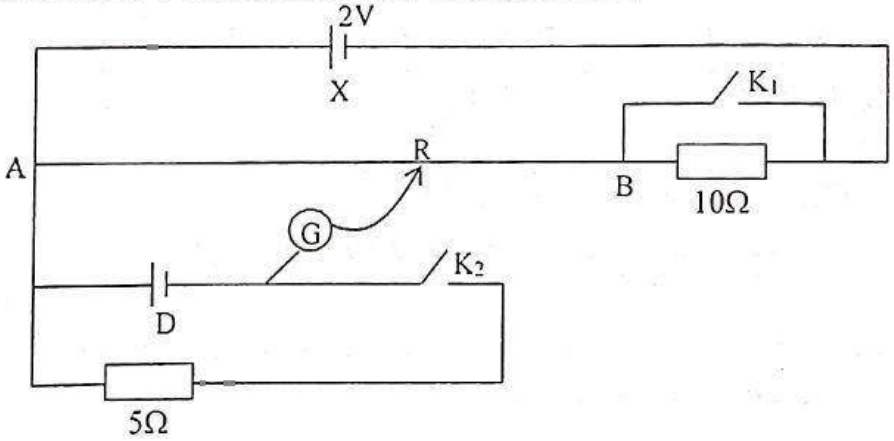
ii) Explain the effect of a dielectric on capacitance of a charged capacitor. (3 marks)

9. a) i) Define a **volt**. (1 mark)

ii) Derive the expression for the combined resistance of three resistors in parallel. (4 mark)

b) Explain the principle of operation of a slide wire potentiometer. (3 marks)

c) The figure below shows a cell X of negligible internal resistance with e.m.f of 2V. AB is a uniform slide wire of length 100cm and resistance 50Ω.



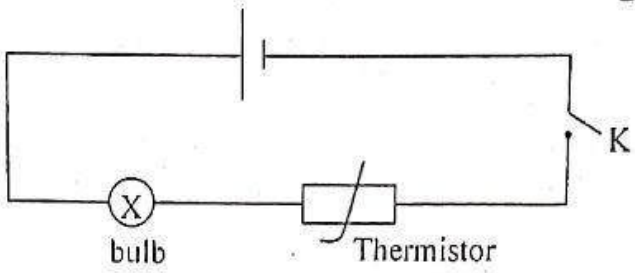
With both switches K_1 and K_2 open, the balance length is 90.0cm. When K_2 is closed and K_1 left open, the balance length changes to 75.0cm.
Determine the;-

i) e.m.f of cell D, (2 marks)

ii) Internal resistance of cell D, (3 marks)

iii) Balance length when both K_1 and K_2 are closed. (3 marks)

d) A dry cell, a bulb, a switch and a thermistor with negative temperature coefficient of resistance are connected as shown in the figure below:-



Explain what would happen when switch K is closed. (4 marks)

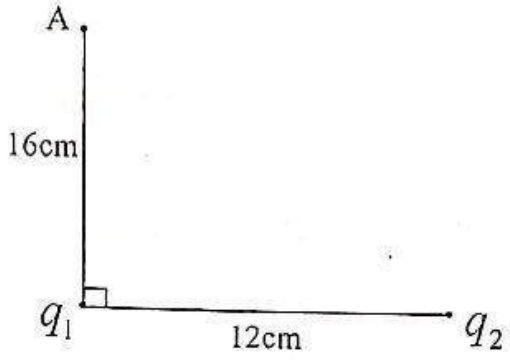
10. a) i) State **coulomb's law of electrostatics.** (1 mark)

ii) Define the terms **electric field intensity** and **electric potential.** (2 marks)

b) i) A pin is placed on the cap of a positively charged gold leaf electroscope with its blunt end on the cap. Explain what is observed. (3 marks)

ii) Describe an experiment to show that the surface of a pear shaped conductor is an equipotential. (4 marks)

c)



In the figure above, A is a point 16cm from a point charge q_1. Another point charge q_2 is 12cm from q_1 as shown. If $q_1 = 4\mu c$ and $q_2 = 6\mu c$,
Find the;-

i) Electric field intensity at A, (4 marks)

ii) Electric potential at a point mid-way between A and q_2. (4 marks)

d) Sketch an electric field pattern between two equal and opposite point charges and indicate equipotential surfaces in the field. (2 marks)

END

P510/2
PHYSICS
PAPER 2
July/August 2015
2 1/2 hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

- *Answer* **five** *questions, taking at least* **one** *from each of the sections* **A, B, C** *and* **D** *but* ***not*** *more than* **one** *question should be chosen from either section* **A** *or* **B.**
- *Any additional question(s) answered will* **not** *be marked.*
- *Non-programmable scientific calculators may be used.*
- *Mathematical tables and squared paper will be provided.*

Assume where necessary;

Acceleration due to gravity, g,	$= 9.81 ms^{-2}$
Speed of sound in air	$= 330 ms^{-1}$
Speed of light in vacuum, c,	$= 3.0 \times 10^{8} ms^{-1}$
Electronic charge, e,	$= 1.6 \times 10^{-19} C$
Electron mass	$= 9.11 \times 10^{-31} kg$
Plank's constant, h,	$= 6.63 \times 10^{-34} Js$
Permeability of free space, μ_o.	$= 4.0\pi \times 10^{-7} Hm^{-1}$
Permittivity of free space, ε_0,	$= 8.85 \times 10^{-12} Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	$= 9 \times 10^{9} F^{-1} m$
One electron volt, (eV)	$= 1.6 \times 10^{-19} J$
Avogadro's number, N_A	$= 6.02 \times 10^{23} mol^{-1}$
Specific heat capacity of water	$= 4200 Jkg^{-1} k^{-1}$

SECTION A

1. (a) (i) State the laws of reflection of light. (2 marks)

(ii) Show, with the aid of a ray diagram that the radius of curvature of a concave mirror is twice the focal length of the mirror. (4 marks)

(b) A concave mirror forms an image half the size of the object. The object is then moved towards the mirror until the image size is three quarters that of the object. If the image is moved by a distance of 0.8cm, calculate the:-

(i) focal length of the mirror, (3 marks)

(ii) new position of the object. (2 marks)

(c) Describe how you would determine experimentally the angle of minimum deviation produced by a prism. (4 marks)

(d) A ray of light propagating in a liquid is incident on a prism of refracting angle 60^0 and refractive index 1.50 at an angle of 40^0. If the ray passes symmetrically through the prism, find the refractive index of the liquid. (3 marks)

(e) State **two** applications of total internal reflection. (2 marks)

2. (a) With the aid of ray diagrams, explain the following as applied to lenses.

(i) **Conjugate points.** (2 marks)

(ii) **Spherical aberration.** (2 marks)

(b) An object, O, placed in front of a converging lens forms a real image I on the screen. The distance between the object and its real image is'd' while that of the image from the lens is x.
Derive the expression for the least possible distance between the object and its image. (5marks)

(c) Give the properties of the lenses in an achromatic combination. (3marks)

(d) A compound microscope consists of two converging lenses of focal length 1.0cm and 5.0cm respectively. An object is placed 1.1cm from the objective and the micro scope is adjusted so that the final image is formed 30cm from the eye piece.
Calculate:-

(i) the separation of the lenses. (3 marks)

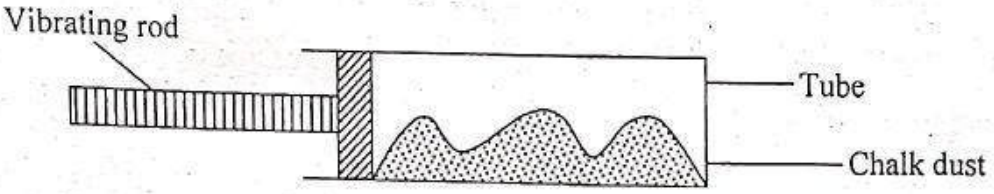
(ii) the magnifying power of the lenses. (3 marks)

(e) State two differences between a compound microscope and an astronomical telescope. (2 marks)

SECTION B

3. (a) What is meant by the following terms as applied to sound?
   (i) **Resonance.** (1 mark)
   (ii) **Fundamental frequency.** (1 mark)

   (b) In an experiment to determine the speed of sound in air in a tube, chalk dust settled in heaps as shown in the diagram below:-



   If the frequency of the vibrating rod is 220Hz and the distance between three consecutive heaps is 1.50m, calculate the speed of sound in air. (3 marks)

   (c) (i) State the **principle of superposition of waves.** (1 mark)
   (ii) Explain using the principle of superposition of waves the formation of beats. (3 marks)

   (d) (i) Describe an experiment to show how the fundamental frequency varies with tension in a given wire. (4marks)
   (ii) A string of length 50cm and mass 5.0g is stretched between two points. If the tension in the string is 100N, find the frequency of the second harmonic. (3 marks)

   (e) (i) What is meant by **Doppler effect?** (1 mark)
   (ii) A car sounds its horn as it travels at a steady speed of $20ms^{-1}$ along a straight road between two stationary observers X and Y. Observer X hears a frequency of $560H_z$ while Y hears a lower frequency. Calculate the frequency heard by Y assuming the speed of sound in air is $330ms^{-1}$ (3 marks)

4. (a) What is a **diffraction grating?** (1 mark)
   (b) Describe how the wavelength of monochromatic light can be measured using a diffraction grating. (7 marks)
   (c) Two glass slides in contact at one end are separated by a sheet of paper 16cm from the line of contact to form an air – wedge. When the air-wedge is illuminated normally by light of wavelength $5.8 \times 10^{-7}m$, interference fringes of separation 2.0 mm are found in reflection. Find the thickness of the paper. (4 marks)

(d) (i) What is meant by **interference of waves?** (1 mark)

(ii) State **three** differences between constructive and destructive interference. (3 marks)

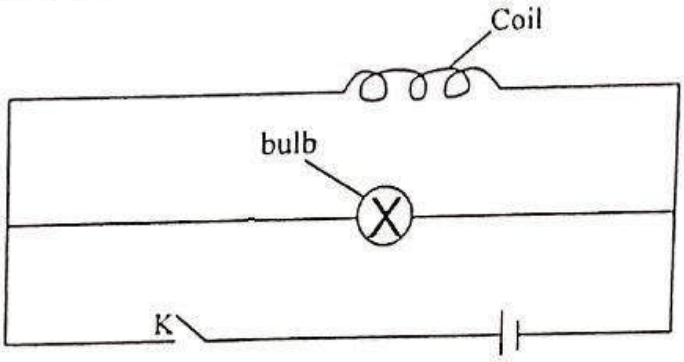
(e) In young's double – slit experiment, the 6th bright fringe is formed 4mm away from the centre of the fringe system when the wave length of light used is 6.0×10^{-7}m. Calculate the separation of the two slits if the distance from the slits to the screen is 60cm. (4 marks)

SECTION C

5. (a) (i) Define the term **root-mean-square** value and **peak value** of an alternating current. (2 marks)

(ii) A sinusoidal alternating current $I = 3 \sin (120\pi t)$ amperes flows through a resistor of resistance 2.5Ω. Find the power dissipated in the resistor and sketch a graph of voltage and current through the resistor on the same axes against time. (4 marks)

(b) A coil of wire is connected in parallel with an electric bulb to a d.c source as shown in the figure below.



At the instant switch K is closed, the bulb flashes briefly for a short time and then goes off. Explain the observation. (4 marks)

(c) (i) Define the term **reactance.** (1 mark)

(ii) In an experiment to measure the reactance of a capacitor, the r.m.s current is measured to be 10mA.
The peak to peak voltage is measured to be 16V.
If the frequency is 10Hz; find the capacitance of the capacitor. (3 marks)

(d) (i) With the aid of a diagram, describe the structure and action of a moving-iron meter of attraction type. (5 marks)

(ii) State **one** advantage of this type of meter over an ordinary ammeter. (1 mark)

6. (a) (i) Draw a well labelled diagram to show the structure of the moving coil galvanometer. (2 marks)

(ii) Explain how the galvanometer in (a) (i) above is able to measure alternating current. (5 marks)

(b) (i) Write an expression for the magnetic flux density at the centre of a flat circular coil of, N, turns each of radius, a, carrying current I. (1 mark)

(ii) Describe how you would determine the value of the Earth's magnetic flux density at a place using a search coil. (6 marks)

(c) A coil of 50 turns and radius 4cm is placed with its plane in the earth's magnetic meridian. A compass needle is placed at the centre of the coil. When a current of 0.1A passes though the coil, the campass needle deflects through 40^0. When the current is reversed, the needle deflects through 43^0 in the opposite direction. Calculate the;

(i) horizontal component of the earth's flux density. (4 marks)

(ii) magnetic flux density of the earth's field at that place given that the angle of dip at the place is 15^0. (2 marks)

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

(b) Describe the structure and action of an a.c transformer. (5 marks)

(c) A metal rod of length 50cm moves with a velocity of $5ms^{-1}$ in a plane perpendicular to a uniform magnetic field of flux density 5×10^{-2} T. Find the:

(i) Magnetic force on an electron in the rod, (3 marks)

(ii) Electric field intensity in the rod, (3 marks)

(iii) Potential difference between the ends of the rod. (3 marks)

(d) Show that the total charge which passes through the coil depends on the resistance of the coil and the total flux linked. (4 marks)

SECTION D

8. (a) (i) Define **electromotive force** of a battery. (1 mark)

(ii) 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 an expression for the efficiency of the circuit. (4 marks)

(b) Describe an experiment to determine the internal resistance of a cell. (4 marks)

(c) A battery of e.m.f, E and internal resistance, r is connected across a variable resistor, When the resistor is set at 21Ω, the current through it is 0.48A. When it is set at 36Ω, the current is 0.30A. Find E and r. (5 marks)

(d) (i) Define the terms electrical resistivity and temperature coefficient of resistance. (2 marks)

(ii) The resistivity of a certain wire is $1.6 \times 10^{-7}\Omega m$ at 30^0C and its temperature coefficient of resistance is $6.0 \times 10^{-3}K^{-1}$. Calculate the resistivity at 80^0C. (4 marks)

9. (a) State **Coulomb's law of electrostatics.** (1 mark)

(b) Derive the relation between electric field intensity, E, and electric potential, V, due to a charge at a point. (4 marks)

(c) Two pith balls P and Q each of mass 0.1g are separately suspended from the same point by threads 30 cm long. When the balls are given equal charges, they repel each other and come to rest 18cm apart. Calculate the magnitude of charge on each ball. (6 marks)

(d) Describe how you would investigate the distribution of charge on a spear shaped conductor. (4 marks)

(e) Explain how a charged body attracts uncharged conductor. (3 marks)

(f) Describe how an electroscope can be used to distinguish a conductor from an insulator. (2 marks)

10. (a) Define the following:

(i) **Capacitance,** (1 mark)

(ii) **Dielectric material.** (1 mark)

(b) Describe an experiment that can be used to show how capacitance of a capacitor depends on the permittivity of a dielectric. (4 marks)

(c) A 10.0μF capacitor charged to 300V is connected across an uncharged 60μF capacitor. Calculate the total energy stored in both capacitors before and after connection. (4 marks)

(d) Describe briefly how the sign of a charge on a given body can be determined using a gold leaf electroscope. (4 marks)

(e) Two point charges A and B of -17.6μC and -9.0μC respectively are placed in vacuum at a distance of 21cm apart. When a third charge, C is placed mid-way between A and B, the net force on B is zero.

(i) Determine the charge on C. (4 marks)

(ii) Sketch the electric field lines corresponding to the charge distribution. (2 marks.)

-END-

P510/2
PHYSICS
PAPER 2
July/August 2014
$2^1/_2$hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

2hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

- *Answer* **five** *questions, taking at least* **one** *from each of the sections* **A**, **B**, **C** *and* **D** *but* ***not*** *more than* **one** *question should be chosen from either section* **A** *or* **B**.
- *Any additional question(s) answered will* **not** *be marked.*
- *Non-programmable scientific calculators may be used.*

Assume where necessary;

Acceleration due to gravity, g,	$= 9.81 ms^{-2}$
Speed of sound in air	$= 330 ms^{-1}$
Speed of light in vacuum, c,	$= 3.0 \times 10^{8} ms^{-1}$
Electronic charge, e,	$= 1.6 \times 10^{-19} C$
Electron mass	$= 9.11 \times 10^{-31} kg$
Planck's constant, h,	$= 6.63 \times 10^{-34} Js$
Permeability of free space, μ_o.	$= 4.0\pi \times 10^{-7} Hm^{-1}$
Permittivity of free space, ε_0,	$= 8.85 \times 10^{-12} Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	$= 9 \times 10^{9} F^{-1} m$
One electron volt, (eV)	$= 1.6 \times 10^{-19} J$
Avogadro's number, N_A	$= 6.02 \times 10^{23} mol^{-1}$
Resistivity of Nichrome wire at 25^0C	$= 1.2 \times 10^{-6} \Omega m$
Specific heat capacity of water	$= 4200 JKg^{-1}k^{-1}$

Turn Over

SECTION A

1. (a) State the laws of refraction of light. (2marks)

(b) Light which passes symmetrically through a glass prism of refraction index η and a large refracting angle . is deviated through an angle D. Derive an expression for η in terms of A and D. (4marks)

(c) You are provided with a glass block and an optical pin.
Describe how you would determine the refractive index of the glass block.
(4marks)

(d) An equilateral prism of refractive index 1.50 is placed in water of refractive index 1.33.
Calculate;
(i) the angle of minimum deviation for light refracted through the prism.
(4marks)
(ii) angle of incidence of a ray in air when the angle of deviation is a maximum.
(3marks)

(e) Explain why the rays from the sun can still be seen by an observer on earth shortly after sun set.
(3marks)

2. (a) (i) Distinguish between lateral magnification and angular magnification. (2marks)

(ii) An object is placed at a distance x from a converging lens of focal length f.
Derive an expression for lateral magnification of the image in terms of x and f.
(3marks)

(b) Derive the expression for the focal length f of a thin diverging lens in terms of the object distance u and image distance V using an extended object. (4marks)

(c) A concave lens of focal length 30 cm is arranged coaxially with a convex lens of focal length 20 cm. An object 3cm tall is placed at a distance of 70cm from the concave lens, on the side remote from the concave lens. If the lenses are 10cm apart, find;
(i) the position of the final image.
(4marks)
(ii) the height of the final image.
(3marks)

(d) (i) What is meant by chromatic aberration?
(1mark)
(ii) Give the properties of the lenses in an achromatic doublet.
(3marks)

SECTION B

3. (a) Define the following terms as applied to sound.
   (i) a harmonic. (1mark)
   (ii) an overtone. (1mark)

   (b) (i) Describe the motion of air in a tube closed at one end and vibrating in its fundamental mode. (3marks)

   (ii) A cylindrical pipe of length 30cm is closed at one end. The air in the pipe resonates with a tuning fork of frequency 825Hz sounded near the open end of the pipe. Determine the mode of vibration of air assuming there is no end correction. (3marks)
   (Take the speed of sound in air as $330ms^{-1}$).

   (c) (i) What is meant by the term beats? (1mark)
   (ii) An observer moving between two identical stationary sources of sound along a straight line hears beats at a rate of $5.0s^{-1}$.
   If the frequencies of the sources are 600Hz and the velocity of sound in air is $330ms^{-1}$, calculate the velocity at which the observer is moving. (4marks)

   (d) (i) State the principle of superposition of waves. (1mark)
   (ii) Explain, using the principle of superposition of waves, the formation of stationary waves. (3marks)

   (e) State three differences between sound and light waves. (3marks)

4. (a) Explain why light is referred to as a transverse wave. (2marks)

   (b) (i) With the aid of a ray diagram, explain the formation of coherent sources by the Lloyd's mirror. (4marks)

   (ii) Two slits A and B are separated by a distance d and illuminated with light of wave length λ. Derive the expression for the separation between the successive fringes on a screen placed a distance d from the slits. (4marks)

   (iii) In young's double slit experiment, the 8^{th} bright fringe is formed 5mm away from the center of the fringe system when the wave-length of light used is $6.2 \times 10^{-7}m$. Calculate the separation of the two slits if the distance from the slits to the screen is 80cm. (3marks)

   (c) (i) Distinguish between transmission grating and reflection grating. (2marks)

   (ii) Sodium light of wave-length 589nm falls normally on a diffraction grating which has 600 lines per mm. Calculate the angle between the directions in which the first order maxima, on the same side of the straight through positions are observed. (3marks)

   (d) Distinguish between polarized and unpolarized light. (2marks)

SECTION C

5. (a) (i) What is meant by voltage sensitivity of a galvanometer? (1mark)

(ii) State briefly how the voltage sensitivity of a moving coil galvanometer can be increased. (2marks)

(b) Explain why the ballistic galvanometer has a heavy insulating former onto which a fine copper is wound and has a fine suspension. (3marks)

(c) A ballistic galvanometer is connected to a flat coil of 50 turns and mean area $4.0cm^2$ to form a circuit of total resistance 100Ω. The coil, held between the poles of an electromagnet with its plane perpendicular to the field, is suddenly rotated through 90° about a vertical axis, producing a throw of 60 scale divisions. Find the magnetic induction of the electromagnet assuming the sensitivity of the galvanometer is 0.2 divisions per micro coulomb. (4marks)

(d) (i) What is meant by back emf as applied to d.c motor? (1mark)

(ii) What is the significance of back emf in a motor? (2marks)

(iii) State one application of eddy currents. (1mark)

(e) Explain the following observations:

(i) When a d.c motor is switched on, the initial current decreases to a steady value when the motor is running at a constant speed. (3marks)

(ii) If the motion of the d.c motor is slowed down, the current rises and then falls again when the motor is allowed to run freely. (3marks)

6. (a) Define the following:

(i) Magnetic meridian. (1mark)

(ii) Angle of dip. (1mark)

(b) An air craft is flying horizontally at $1000kmh^{-1}$ at a point where the earth's magnetic flux density is $2.4 \times 10^{-5}T$ and the angle of dip 80°. If the distance between the wing tips is 60m, calculate the potential difference induced between its wing tips. (4marks)

(c) Describe with the aid of a diagram an absolute method of determining resistance. (5marks)

(d) (i) What is meant by the terms self induction and mutual induction? (2marks)

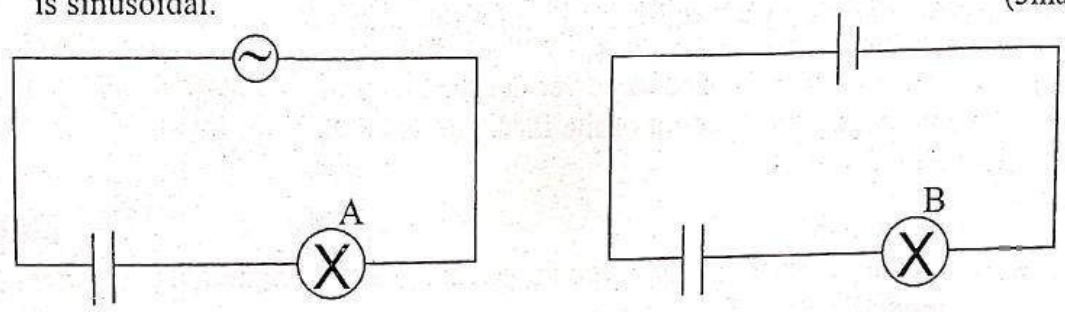
(ii) State with reasons, the main precautions taken in the construction of an a.c transformer. (3marks)

(e) A small rectangular coil of 12 turns and dimensions 5cm by 3cm is suspended inside a long solenoid of 1200turns per metre so that its plane lies along the axis of the solenoid. The coil is connected in series with the solenoid. The coil deflects through 40° when a current of 3.0A is passed through the solenoid. Find the torsion constant of the suspension. (4marks)

7. (a) (i) Define the terms peak value and root mean square value (r.m.s) of an alternating voltage. (2marks)

(ii) An electric kettle draws 3000W from a 240V mains supply.
Find the peak value of the current drawn by the kettle if the voltage is sinusoidal. (3marks)

(b)



Bulbs A and B have the same rating. A is connected in series with a capacitor a cross an a.c source while B is connected in series with an identical capacitor across a d.c source of e.m.f equal to the root mean square voltage of the a.c as shown in the figure above.
Explain why bulb A lights continuously while bulb B does not. (5marks)

(c) (i) What is meant by the term reactance? (1mark)

(ii) Derive an expression for the reactance of an inductor of inductance L when a sinusoidally varying a.c. of frequency f passes through it. (4marks)

(iii) Explain why on average the power delivered to an inductor in one cycle is zero. (3marks)

(d) Explain why a moving coil ammeter is unsuitable for measuring alternating current. (2marks)

SECTION D

8. (a) What is meant by the term dielectric constant? (1mark)

(b) Describe an experiment you would carry out to verify that the capacitance of a parallel plate is proportional to the area of overlap of the plate, A, plate separation d and the permittivity ε of the material of the medium between the plates. (6marks)

(c) A 47μF capacitor is used to power the flash gun of a camera.
The average power output of the flash gun is 4.0 KW for the duration of the flash which is 2.0ms.

Calculate the;

i) potential difference between the terminals of the capacitor immediately before a flash. (3marks)

ii) maximum charge stored by the capacitor. (2marks)

iii) average current provided by the capacitor during a flash and state any assumption(s) made. (3marks)

(d) Describe with the aid of a labeled diagram, the structure and mode of operation of a van de Graaff generator. (5marks)

9. (a) (i) What is an electric field line? (1mark)

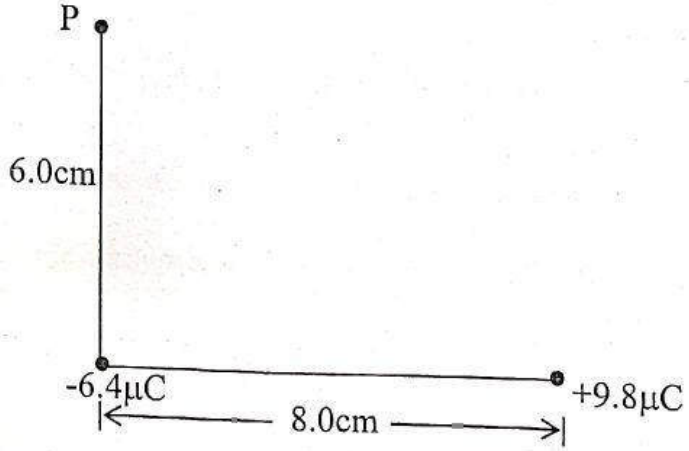
(ii) Derive the relation between electric field intensity, E, and electric potential V due to a charge at a point. (3marks)

(b) Two point charges q_1 and q_2 of +47.0μC and +24.0μC respectively are placed in a straight line in vacuum at a distance of 30cm apart. A third charge q of -35.0μC is placed between q_1 and q_2 at a distance of 20cm from q_1.
Find the resultant force on q_2. (5marks)

(c) Describe briefly how the sign of charge on a given body can be detected using a gold leaf electroscope. (4marks)

(d) Explain, with the aid of a diagram, how a charged body can be screened against external electric fields. (3marks)

(e)



Two point charges of +9.8μC and -6.4μC are placed as in the figure above in air. Find the potential energy of a charge of +2.5μC placed at a point P. (4marks)

10. (a) What is meant by the terms e.m.f and internal resistance of a cell? (2marks)

(b) Describe, using a diagram, how you would standardize a potentiometer. (3marks)

(c) A d.c source of e.m.f 20V and negligible internal resistance is connected in series with two resistors of 500 and R ohms respectively. When a voltmeter is connected across the 500Ω resistor it reads 5.0V, while it reads 6.0V when connected across a resistor of R ohms.
Find the;

i) resistance of the voltmeter. (6marks)

ii) value of R. (1mark)

(d) (i) Define temperature coefficient of resistance of a conductor. (1mark)

(ii) The resistance of an element of an electric fire is 50Ω at 20°C.
When operating at a 240V supply, the current flowing through it is 5A.
Calculate the steady temperature reached by the electric fire,
if the temperature coefficient of resistance of the element is $2.0 \times 10^{-4}K^{-1}$.
(4marks)

(e) Explain why semi-conductors have negative temperature coefficient of resistance.
(3marks)

END

P510/2
PHYSICS
PAPER 2
July/August 2013
$2^1/_2$hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

2hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

Answer **five** *questions, taking at least* ***one*** *from each of the sections* A,B,C *and D but* ***not*** *more than* **one** *question should be chosen from either section A or* **B**. *Any additional question(s) answered will* **not** *be marked.*

Assume where necessary;

Acceleration due to gravity, g,	$= 9.81 ms^{-2}$
Speed of light in vacuum, c,	$= 3.0x10^{8} ms^{-1}$
Electronic charge, e,	$= 1.6x10^{-19} C$
Electron mass	$= 9.11x10^{-31} kg$
Planck's constant, h,	$= 6.63x10^{-34} Js$
Permeability of free space, μ_o.	$= 4.0\pi x10^{-7} Hm^{-1}$
Permittivity of free space, ε_0,	$= 8.85x10^{-12} Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	$= 9x10^{9} F^{-1}m$
One electron volt, (eV)	$= 1.6x10^{-19} J$
Avogadro's number, N_A	$= 6.02x10^{23} mol^{-1}$
Resistivity of Nichrome wire at 25^0C	$= 1.2x10^{-6} \Omega m$

SECTION A

1. (a) (i) State the laws of reflection of light. (2 marks)

(ii) When a plane mirror is turned through an angle Ø the reflected ray turns through an angle ϒ. Derive the relation between Ø and ϒ. (4 marks)

(b) Describe an experiment to determine the focal length of a concave mirror using the following apparatus;- a screen with cross- wire, a lamp, a concave mirror and a meter rule. (5 marks)

(c) A plane mirror is placed 10cm in front of a convex mirror so that it covers about half of the mirror. A pin placed 25cm in front of the plane mirror gives an image in it which coincides with that of the pin in the convex mirror. Find the focal length of the convex mirror. (3 marks)

(d) (i) Give the properties of lenses in an achromatic combination. (3 marks)

(ii) A compound lens consists of two lenses in contact having powers of +12.5D and -2.5D. Find the position and nature of the image of an object placed 15.0cm from the compound lens. (3 marks)

2. (a) (i) Define refractive index of a material. (1 mark)

(ii) State the laws of refraction of light. (2 marks)

(b) In the figure 1 below, prism A causes minimum deviation for yellow light for the angle of incidence *i*.

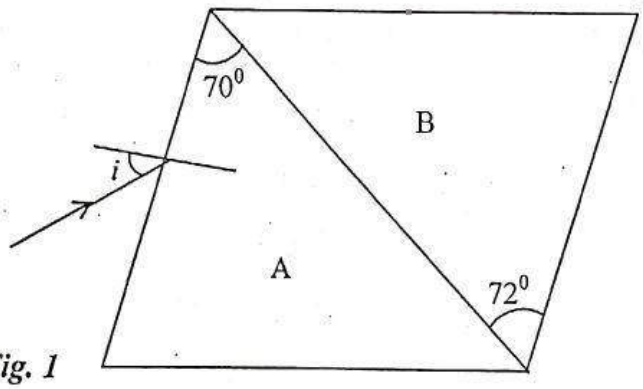


Fig. 1

If the refractive indices of A and B for yellow light are respectively 1. 56 and 1.60. Determine the total deviation produced. (5 marks)

(c) Obtain an expression relating the deviation of a beam of light by a thin prism in terms of the refracting angle A and the refractive index **n** of the prism. (5 marks)

(d) (i) Describe how the refractive index of a liquid can be determined using a concave mirror. (5 marks)

(ii) Explain the suitability of a convex mirror as a driving mirror. (2 marks)

SECTION B

3. (a) Define the following terms as applied to waves;
   (i) wavelength. (1 mark)
   (ii) wavefront. (1 mark)

   (b) Use Huygen's construction principle to deduce the laws of reflection of light at a plane surface. (5 marks)

   (c) (i) Explain the meaning of the terms constructive interference and destructive interference. (2 marks)

   (ii) A parallel beam of light of wavelength 700nm from a lamp is incident on a pair of narrow slits 0.1mm apart. The interference pattern is focused on a screen 2.5m from the slits. Calculate the separation of the third order bright fringes. (4 marks)

   (d) (i) What is meant by plane polarised light? (1 mark)
   (ii) Describe **one** application of polarisation. (3 marks)

   (e) A diffraction grating has 500 lines per mm. Find the maximum number of images it can form when light of wavelength 600nm is incident on it. (3 marks)

4. (a) What is meant by the following terms as applied to sound?
   (i) An overtone (1 mark)
   (ii) Resonance (1 mark)

   (b) Describe, with the aid of a diagram, an experiment to investigate the variation of frequency of a stretched string with its length. (4 marks)

   (c) A wire of length 76cm is maintained under tension of 40N and plucked at its mid point. Calculate the fundamental frequency of the note produced if the diameter and density of the wire are 1mm and 8800kgm^{-3} respectively. (4 marks)

   (d) (i) What is meant by Doppler effect? (1 mark)

   (ii) Calculate the frequency of beats heard by a stationary observer when a source of sound of frequency 120Hz is receding with a speed of 8.0m s^{-1} towards a vertical wall. (4 marks)
   (Speed of sound in air = 340ms^{-1})

   (e) The speed of sound in air is given by $V=\sqrt{\frac{\gamma p}{\rho}}$, where ρ is the density, P is the pressure and γ, the ratio of the principal heat capacities of air. Use this expression to explain the effect of temperature on speed of the air. (3 marks)

   (ii) Explain the term reverberation. (2 marks)

SECTION C

5. (a) (i) Define the terms magnetic field and magnetic flux density. (2 marks)

(ii) Sketch the magnetic field pattern due to two parallel straight wires carrying currents I_1 and I_2 in the same direction in air. (2 marks)

(b) (i) Write down the expression for the magnetic flux density at the centre of a plane circular coil of N turns, radius R, and carrying a current I in a vacuum. (1 mark)

(ii) Two identical wires R and S lie parallel in a horizontal plane, their axes being 0. 10m apart. A current of 10A flows in R in opposite direction to a current of 30A in S. Neglecting the effect of the earth's magnetic flux density, calculate the magnitude of the magnetic flux density at a point P midway between R and S and state its direction. (4 marks)

(c) (i) Describe with the aid of a labeled diagram the structure and mode of action of a moving coil galvanometer. (5 marks)

(ii) Two moving coil galvanometers which have the same constants, are fitted with different coils. One has a coil of 50 turns and resistance 10Ω while the other has 500 turns and resistance 600Ω. Determine the ratio of their deflections when each is connected in turn to a cell. (4 marks)

(d) Explain what is meant by hall voltage. (2 marks)

6. (a) (i) State the law of electromagnetic induction. (2 marks)

(ii) Describe an experiment to verify Faraday's law. (5 marks)

(b) A circular disc of copper and a horseshoe magnet are mounted as shown in the diagram below.
The disc is free to rotate and the magnet can be rotated on the axle as shown in fig. 2

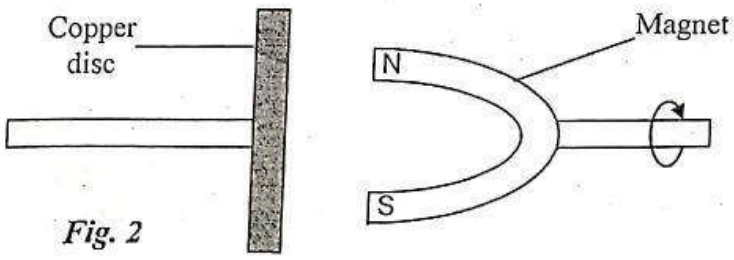


Fig. 2

(i) Describe and explain what happens when the magnet is set into rotation. (4 marks)

(ii) The disc above has a radius of 10cm and is situated in a uniform field of flux density 1.0×10^{-2}T, with its plane perpendicular to the field.

The disc is rotated about an axis through its centre parallel to the field at 3000 rev min^{-1}.
Calculate the emf between the rim and centre of the disc. (4 marks)

(c) Describe the construction of a simple form of an a.c transformer. (2 marks)

(d) Briefly explain why the primary current increases when the secondary coil of a transformer is loaded. (3 marks)

7. (a) (i) Define the term peak value and root mean square value of an alternating current. (2 marks)

(ii) A resistor of 300Ω is connected to 240V a.c supply.
Find the amplitude of the current through the resistor. (3 marks)

(b)

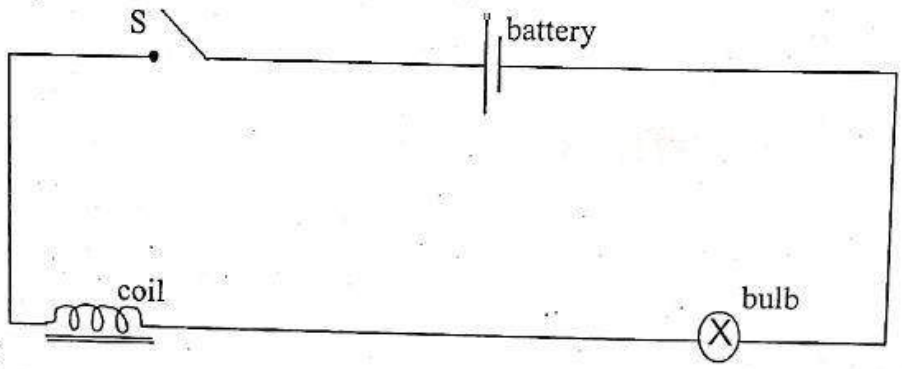


Fig. 3

A coil of many turns of wire, a bulb and a battery are connected in series as shown in the diagram in fig.3 above.

(i) What is observed when switch S is closed and when it is opened? (2 marks)

(ii) Explain your observations in b(i) (4 marks)

(c) A source of Sinusoidal voltage of amplitude, Vo, and frequency, f, is connected across a capacitor of capacitance C. Derive an expression for the instantaneous current which flows. (3 marks)

(d) Explain why the voltage at a generating power station must be stepped up to very high value for long distance transmission. (2 marks)

(e) (i) What is rectification as applied to alternating current? (1 mark)

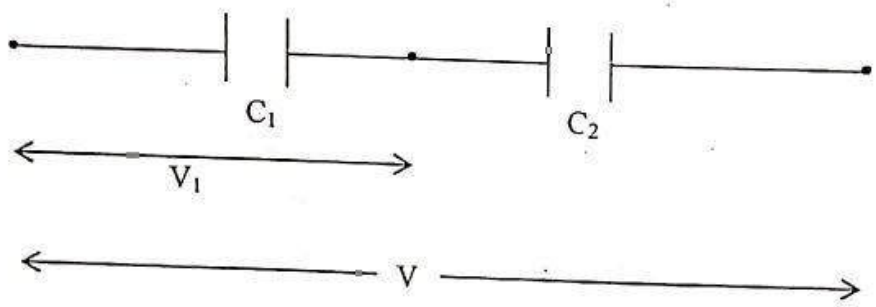
(ii) With the aid of a diagram, describe how a half wave rectifier type of meter works. (3 marks)

(c) (i) Distinguish between electric potential and electric field intensity and state the relationship between them. (3 marks)

(ii) Charges of magnitude +5μC,-3μC, + 6μC and + 2μC are placed at the corners A,B,C and D of a square ABCD of side 1.0m.
Calculate the electric field intensity at a point O at the center of the square.
(5 marks)

10. (a) Define the following terms;
(i) Dielectric strength. (1 mark)
(ii) Relative permittivity. (1 mark)

(b) If a potential difference V is applied across the two capacitors of capacitances C_1 and C_2 connected in series as shown below, show that V_1 is given by the expression $\frac{1}{V_1} = (\frac{1}{C_1} + \frac{1}{C_2})\frac{C_1}{V}$, where V_1 is the p.d. across C_1. (4 marks)



(c) (i) A 5.0μF capacitor charged to 100V is connected across an uncharged 25μF capacitor.
Calculate the total energy stored in both capacitors before and after connection. (4 marks)

(ii) Account for the difference in the energy(ies) calculated in b(i) above. (1 mark)

(d) Describe with the aid of a circuit diagram, an experiment to compare two unknown capacitances. (5 marks)

(e) (i) Explain briefly how a capacitor in which the potential difference across the plates is V can be fully discharged. (2 marks)

(ii) State briefly the energy transformations that take place when charging a capacitor using a dry cell. (2 marks)

END

P510/2
PHYSICS
PAPER 2
July/August 2012
$2^1/_2$ hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

Answer **five** *questions, including* **one** *question from each of sections* A & B *and atleast* **one,** *but not more than* **two** *questions from each of the sections* **C** *and* **D.**

Assume where necessary,

Acceleration due to gravity, g,	$= 9.81 ms^{-2}$
Speed of light in vacuum, c,	$= 3.0x10^8 ms^{-1}$
Electronic charge, e,	$= 1.6x10^{-19}C$
Electron mass	$= 9.11x10^{-31}kg$
Plank's constant, h,	$= 6.63x10^{-34}Js$
Permeability of free space, μ_o.	$= 4.0\pi x10^{-7}Hm^{-1}$
Permitivity of free space, ε_0,	$= 8.85x10^{-12}Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	$= 9x10^9F^{-1}m$
One electron volt, (eV)	$= 1.6x10^{-19}J$
Avogadro's number, N_A	$= 6.02x10^{23}mol^{-1}$
Resistivity of Nichrome wire at 25^0C	$= 1.2x10^{-6}\Omega m$
Specific heat capacity of water,	$= 4.2x10^3 J\ kg^{-1}K^{-1}$

SECTION A

1. a) Define the terms
   i) Lens power *(01mk)*
   ii) Exit pupil *(01mk)*

   b) i) With the aid of a ray diagram, describe the action of a Galilean telescope in normal adjustment. *(05mks)*

   ii) Explain why Galilean telescope cannot be used to make precise determination of angular positions of objects being viewed. *(02mks)*

   c) A telescope has two lenses of focal lengths 1.0m and 0.10m and it is adjusted to produce an image of a distant object on a screen. The object subtends an angle of 0.30^0 at the telescope objective. Calculate,
   i) The linear size of the image formed on the screen 0.5m from the eye piece. *(04mks)*
   ii) The distance between the objective and the screen. *(01mk)*

   d) Describe an experiment in which the minimum deviation of a prism can be measured. *(06mks)*

2. a) i) State the laws of reflection. *(02mks)*
   ii) When a plane mirror is turned through an angle α the reflected ray turns through an angles β. derive the relation between α and β. *(04mks)*

   b) A rod which is 10cm long is placed along the principal axis of a concave mirror such that the mid-point of the rod is 35cm from the pole of the mirror.
   Calculate the radius of curvature of the mirror if it forms a real image of the rod which is 20cm long. *(04mks)*

   c) Describe how a sextant can be used to determine the elevation of the sun. *(05mks)*

   d) i) Explain the appearance of the bottom of a swimming pool to an observer on the side. *(02mks)*

   ii) Light from luminous point on the lower face of a rectangular glass slab, 2.0cm thick, strikes the upper face and the totally internally reflected rays outline a circle of 3.2cm radius on the lower face.
   Determine the refractive index of glass. *(03mks)*

SECTION B

3. a) i) State the principle of **super position** of wave. *(01mk)*

ii) State **Huygens's principle.**

iii) Use Huygens' principle to show that for light traveling from one medium to another,

$\frac{sin_1}{sin_2} = \frac{C_1}{C_2}$ Where C_1 and C_2 are respective speeds

b) i). What is a **plane transmission grating**? *(01mk)*

ii) Explain how a spectrum is produced by a diffractive (plane transmission) grating. *(04mks)*

c) Light of wave length 2×10^{-7}m is incident on a plane transmission grating of 600 lines per cm. calculate,

i) the maximum order of the spectra formed *(02mks)*

ii) the diffraction angle for the 1st order spectrum *(03mks)*

iii) in what ways is the spectrum produced by a grating different from that produced by dispersion? *(03mks)*

4. a) What is meant by a **progressive wave** and wave front. *(02mks)*

b) A plane – progressive wave is represented by the equation.
$y = 0.1\sin(200\pi t - \frac{20\pi}{17}x)$ where y is the displacement in mm, t is time in seconds and x is the distance from a fixed origin O in metres;

Find;

i) The equation of the wave that can produce a stationery wave with the wave equation above. *(01mk)*

ii) The frequency of the wave *(02mks)*

iii) Its speed *(02mks)*

iv) The phase difference in radians between a point 0.25m from 0 and a point 1.10m from 0. *(02mks)*

c) Describe how speed of sound in air can be obtained by resonance method. *(05mks)*

d) Explain how to determine whether a star is receding or approaching to the earth. *(04mks)*

e) Explain how a mechanical wave transmits energy without motion of medium particles. *(02mks)*

SECTION C

5. a) i) Define **the ampere.** *(01mk)*

ii) Describe an experiment with the aid of a labeled diagram to show how the current balance can be used to determine the flux density at the centre of a current carrying coil. *(06mks)*

b) i) Write an expression for the magnitude of the flux density B at a distance d from a very long straight conductor carrying current I. *(01mk)*

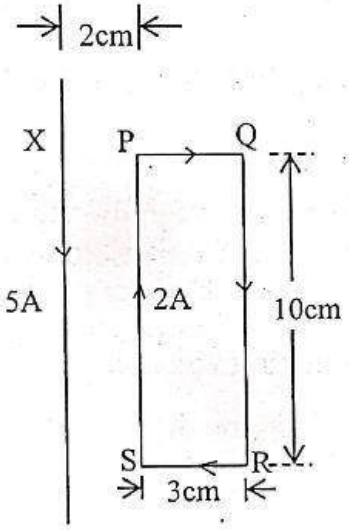


Fig 1

Figure 1 Shows a metal rectangle PQRS, of dimension 10cm by 3cm, suspended near a very long straight conductor X carrying current of 5.0A with PS 2cm from X. a current of 2.0A flows in the coil PQRS. Calculate the resultant force on PQRS. *(05mks)*

i) Explain the term **dead beat** as applied to a moving coil galvanometer. *(03mks)*

ii) Explain two features of a moving coil galvanometer that should be modified for it to be used as a ballistic galvanometer. *(04mks)*

6. a) i) State the laws of **electromagnetic induction.** *(02mks)*

ii) Describe an experiment in which Faraday's law of electromagnetic induction can be verified. *(05mks)*

b) i) What is meant by a **non-inductive coil?** *(02mks)*

ii) Explain two reasons why non-inductive coil is used in a resistance box *(03mks)*

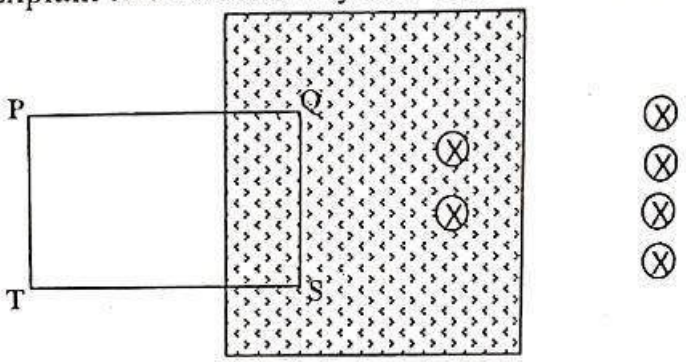


Fig 2

c) Figure 2 above shows a metal frame PQST moving with a uniform velocity V of $0.2ms^{-1}$ into a uniform field B of 10^{-2} T acts normally to the metal frame. PT = 0.1m and PQ = 0.2m and the resistance R of the frame is 5Ω.
Calculate;-

i) The current flowing in metal frame when QS just enters the field. *(03mks)*

ii) The current flowing in metal when QS just moves out of the field on the other side. *(02mks)*

d) Draw a sketch graph showing variation of current through the metal frame from when QS just enters and PT just leaves the magnetic field in (c) above. *(03mks)*

7. a) Define the following terms as applied to alternating voltage.

i) Root mean square value. *(01mk)*

ii) Reactance *(01mk)*

b) The instantaneous value of a sinusoidal alternate voltage V = 330 sin 120πt is applied across a 20μF capacitor. Calculate;

i) the root mean square value of the voltage. *(02mks)*

ii) the reactance of the circuit *(03mks)*

c) i). Describe how a repulsion type of a moving iron ammeter is used to measure alternating current. *(05mks)*

ii) Explain why a capacitor conducts alternating current not direct current. *(03mks)*

d) i). How can hysteresis loss be minimised in the A.C transformer? *(02mks)*

ii) Explain why the primary current in the A.C transformer increase when the secondary coil is connected to the load. *(04mks)*

SECTION D

8. a) i) Explain the principle of the side wire potentiometer *(03mks)*

ii) Give two cases when it may not be possible to obtain a balance point in a potentiometer and indicate in each case how the fault can be rectified. *(02mks)*

b) With the aid of a labeled diagram, describe how a slide wire potentiometer can be used to calibrate an ammeter. *(06mks)*

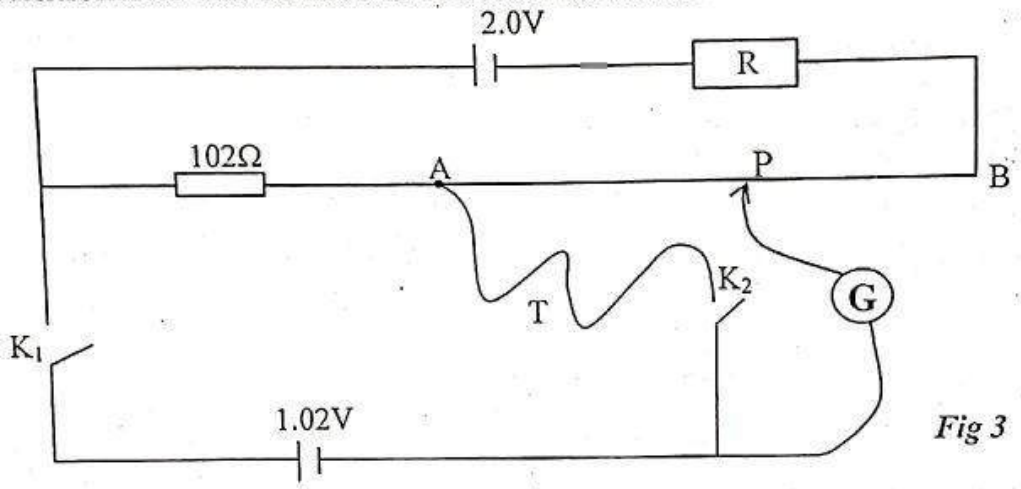


Fig 3

The circuit shown is figure 3 is being used to measure the e.m.f of a thermal couple T. AB is a uniform wire of length 1.00m and resistance 2.0Ω. With K_1 closed and K_2 open the balance length is 90.0cm. With K_2 closed and K_1 open balance length is 45.0cm.

Find;-

i) The e.m.f of the thermo couple. *(03mks)*

ii) The value of R. *(03mks)*

d) What advantages does a potentiometer have over an ordinary voltmeter in measuring voltage? *(03mks)*

9. a) i) Define **electric potential** and **electric field intensity.** *(02mks)*

ii) Explain why the electric field intensity close to the surface of conductor is always at right angles to the surface of the conductor.

b) Describe the action of a **Van der Graff generator.** *(05mks)*

c) Two point charges of magnitude +5μC and -3μC are placed at a point A and B as shown. Figure 4

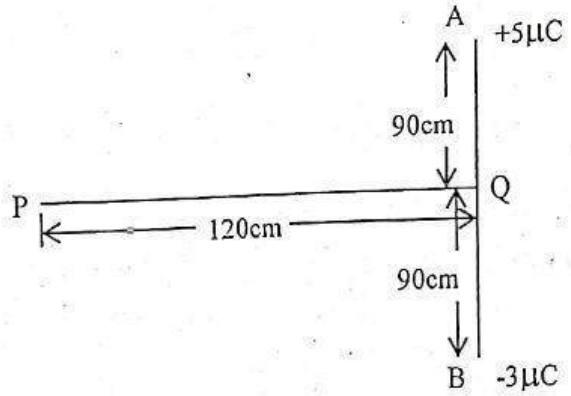


Fig 4

Calculate the work done in moving a charge -3μC from P to Q. *(05mks)*

d) i). Define a dielective constant. *(02mks)*

ii) A capacitor of capacitance C_1, is charged by a potential difference Vo. The charging battery is then removed and the capacitor is connected to an uncharged capacitor of capacitance C_2.

Show that the energy loss E after connection is given by $E = \frac{1}{2}\left(\frac{C_1\ C_2}{C_1+C_2}\right)V_0^2$ *(4mks)*

10.a) Define a **coulomb.** *(01mk)*

b) i). Derive the relation between electric field intensity E and electric potential V due to a charge or a point. *(04mks)*

ii) Explain how a charged body attracts uncharged conductor. *(03mks)*

c) Describe an experiment to show that when a charged body is enclosed by a hallow conductor, a charge is induced on the outside of the conductor and is equal to that on the charged body. *(05mks)*

d) Define the term **e.m.f** of a battery. *(01mk)*

e) In figure 5, B is a battery of four cells each of e.m.f 10V and internal resistance 1.5Ω. A is an ammeter of resistance 1Ω and V is a voltmeter of resistance 140Ω.

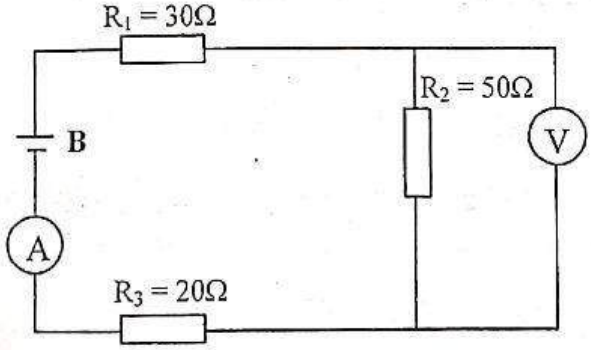


Fig 5

Calculate the;

i) Power dissipated in the battery *(04mks)*

ii) Reading of voltmeter *(04mks)*

END

P510/2
PHYSICS
PAPER 2
July/August 2011
$2^1/_2$ hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

PHYSICS

Paper 2

2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES:

*Answer **five** questions, including at least **one**, but not more than **two** questions from each of the sections **A, B** and **C**.*

Assume where necessary,

Acceleration due to gravity, g,	$= 9.81 ms^{-2}$
Speed of light in vacuum, c,	$= 3.0 \times 10^8 ms^{-1}$
Electronic charge, e,	$= 1.6 \times 10^{-19} C$
Electron mass	$= 9.11 \times 10^{-31} kg$
Plank's constant, h,	$= 6.63 \times 10^{-34} Js$
Permeability of free space, μ_o.	$= 4.0\pi \times 10^{-7} Hm^{-1}$
Permitivity of free space, ε_0,	$= 8.85 \times 10^{-12} Fm^{-1}$
The constant $\frac{1}{4\pi\varepsilon_0}$	$= 9 \times 10^9 F^{-1} m$
One electron volt, (eV)	$= 1.6 \times 10^{-19} J$
Avogadro's number, N_A	$= 6.02 \times 10^{23} mol^{-1}$
Resistivity of Nichrome wire at $25^0 C$	$= 1.2 \times 10^{-6} \Omega m$
Specific heat capacity of water,	$= 4.2 \times 10^3 J\ kg^{-1} K^{-1}$

SECTION A

1. a) Define the following terms as applied to a convex mirror;
   i) Principal focus (1 mark)
   ii) Radius of curvature (1 mark)

   b) When a plane mirror is turned through an angle 'α' the reflected ray turns through an angle β. Derive the relationship of α and β. (3 marks)

   c) Describe the action of a sextant. (5 marks)

   d) i) Explain why a virtual image seen in a magnifying glass is free from chromatic aberration. (3 marks)
   ii) Derive an expression for magnifying power of a simple microscope not in normal use. (3 marks)

   e) A man 2m tall, whose eye level is 1.84m above the ground, looks at his image in a vertical mirror. What is the minimum vertical length of the mirror if the man is to be able to see the whole of himself? (4 marks)

2. a) Explain what is meant by Huygen's principle. (1 mark)

   b) Use Huygen's principle to show that a plane wave incident obliquely on a plane mirror is reflected;
   i) as a plane wave (3 marks)
   ii) so that the angle of incidence is equal to the angle of reflection. (4 marks)

   c) The equation $y = A \sin (wt + kx)$ represents a progressive wave.
   i) What do the quantities A, w and k represent? (3 marks)
   ii) Explain the direction of the wave. (3 marks)
   iii) If $A = 1.0 \times 10^{-7}m$, $w = 6.6 \times 10^{3}S^{-1}$ and $k = 20m^{-1}$, Calculate the speed of the wave. (4 marks)

3. a) Explain, with the aid of a geometric diagram, what is meant by Virtual and real image as applied to plane mirrors. (4 marks)

   b) Describe how the position of a virtual image in a plane mirror can be located by no parallex method. (4 marks)

   c) What is meant by the terms spherical and chromatic aberration as applied to lenses?. (4 marks)

   d) A thin biconvex lens is placed with its principal axis first along a beam of parallel red light and then along a beam of parallel blue light. The refractive indicies of the lens for red and for blue light are respectively 1.514 and 1.524. if the radii of curvature of its faces are 30cm, Calculate the separation of the foci for red and blue light. (5 marks)

   e) Explain the occurrence of Light dispersion and dispersive power in a material. (3 marks)

4. a) What is meant by the terms forced vibration, resonance and resonant frequency as applied to oscillating systems? (3 marks)

b) i) Explain how audible beats arise when two turning forks of slightly different frequencies f_o and f are sounded together. (4 marks)

ii) Derive an expression for the number of beats heard per second. (3 marks)

c) A vertical wire of length 'ℓ' cross sectional area 'A' and made of material of density 'ρ' is fixed at its upper end and supports a mass 'm' of volume 'v' at the other. If the mass of the wire is negligible compared with m. use the following data to calculate;

i) the frequency of the fundamental mode of transverse vibration of the wire: (3 marks)

ii) the frequency of the fundamental mode when m is totally immersed in water.
(ℓ = 0.500m, A = 7.50 X 15^7m^2, ρ = 8.00 X 10^3kgm^{-3}, m = 5.00kg, V = 3.75 X 15^4m^3 and density of water = 1.00 X 10^3kgm^{-3}) (5 marks)

d) State the conditions for creation of a stationary wave. (2 marks)

SECTION B

5. a) i) State the laws of electro magnetic induction. (2 marks)

ii) Describe with aid of a labeled diagram, an experiment to illustrate Faraday's law of electromagnetic induction. (4 marks)

b) Explain the main precautions taken in the construction of an A.C transformer. (4 marks)

c) A transformer whose secondary coil has 63 turns and the primary 1340 turns, has its secondary connected to a 3Ω resistor. If the primary is connected to a 240V a.c supply and assuming that the transformer is 78% efficient; Calculate the current flowing in the primary. (2 marks)

d) Explain the effect of the following on the voltage obtained from an a.c generator.
i) an increase in the number of turns of coil (2 marks)
ii) a reduction in the area of the coil. (2 marks)
iii) replacing the slip rings with split rings. (2 marks)

Turn Over

6. a) Define the following terms as applied to alternating currents;
   i) Root mean square value (1 mark)
   ii) Reactance (1 mark)

   b) Describe the structure and action of a hot wire metre. (5 marks)

   c) i) Show that current leads voltage by 90^0 when a sinusoidal voltage is applied across a capacitor. (4 marks)

   ii) Sketch a phasor diagram to illustrate the orientation of the current vector with respect to the voltage vector in c(i) (1 mark)

   d) An inductor of inductance 0.2H and negligible resistance is connected in series with a 9Ω resistor and a cell and switch. The cell has an e.m.f of 1.5V and its resistance is 1Ω . Calculate;
   i) the final current when switched on. (2 marks)
   ii) the rate of growth of current when the current is 0.1A

   e) Explain how a capacitor conducts a.c. (3 marks)

7. a) Define the ampere. (1 mark)

   b) Two long parallel wires A and B in a vaccum are 5cm apart. The wires carry currents of 6A and 4A respectively; in opposite directions. Calculate;
   (i) the distance of the neutral point from A. (3 marks)
   (ii) the force between the wires. (3 marks)

   c) i) Describe the direct method of determination of resistance. (5 marks)
   ii) Explain why it is called absolute method (2 marks)

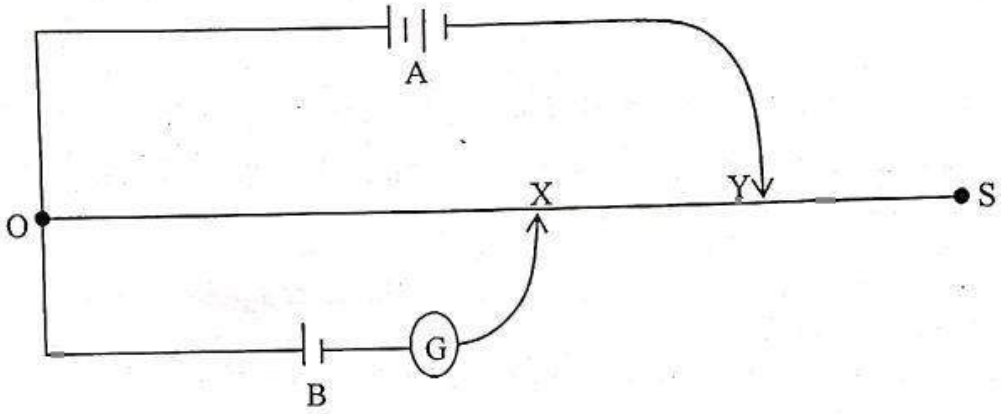
   d) A motor consists of a coil of 50 turns each of area $400cm^2$ and total resistance 25Ω placed in a radial magnetic field of density $5 \times 10^{-4}T$. Given that it draws a current of 6A when connected to a 240V supply. Find;
   (i) the angular velocity of the motor (3 marks)
   (ii) efficiency of the motor. (3 marks)

SECTION C

8. a) State ohm's law (1 mark)

b) Describe, with the aid of a circuit diagram, an experiment to determine the relationship between the resistance and the length of a wire. (6 marks)

c)



Two cells A and B and a centre zero galvanometer G are connected to a uniform slide wire OS by two sliding contacts X and Y as shown in the figure above. The length of the slide wire is 100cm and has a resistance of 12Ω. With OY of length 75cm, the galvanometer shows no deflection when OX is 50cm. When Y is moved to be in contact with the end of the wire at S, the balance length OX is 62.5cm. if the e.m.f of cell B is 1.0V,
Calculate;

(i) the internal resistance of cell A (5 marks)

(ii) the e.m.f of cell A (2 marks)

d) (i) What is meant by the term end errors as applied to potentiometers? (1 mark)

(ii) Explain why a potentiometer is preferred to a voltmeter in measuring voltage. (2 marks)

e) Derive an expression for the heat developed in a wire of resistance 'R' connected across a battery of e.m.f E and negilible internal resistance for a time t. (3 marks)

9. a) What is meant by action of a point? (1 mark)

b) Describe the mode of action of a Vander Graff generator. (6 marks)

c) i) What is an electrophorous? (1 mark)

ii) How is an electrophorous used to provide unlimited supply of charge? (4 marks)

iii) Explain the energy changes in charging an electrophorus. (2 marks)

d) Two point charges P and Q of magnitudes -15μC and -8.2μC are placed 20cm apart in a vaccum. Determine the;

i) Potential at a point mid-way between the charges (3 marks)

ii) The potential energy of a -5.6μC charge, placed at a point mid-way between P and Q. (2 marks)

iii) Sketch the electric field pattern corresponding to the charge distribution in (ii) above. (1 mark)

10 a) Define the terms;

i) Capacitance (1 mark)

ii) a Farad (1 mark)

iii) Dielecrtic constant (1 mark)

b) Explain how a body can be charged at zero potential (4 marks)

c) Describe an experiment to show how capacitance of a capacitor varies with the area of overlap of the plates. (4 marks)

d) Two capacitors of capacitance 6μF and 18μF respectively, are connected in series and the combination connected momentarily across a 200V battery. The charged capacitors are then isolated and connected in parallel, similar charged plates being connected together.
Find;

i) the resulting potential difference across the combination? (4 marks)

ii) the difference is the initial and final total energies stored into the combination. (4 marks)

END