P510/2
PHYSICS
PAPER 2
August 2016
$2^1/_2$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	$= 9.11 \times 10^{-31} kg$
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) Distinguish between **real** and **virtual** images. (2 marks)

(ii) Describe how the position of an image in a plane mirror can be located. (3 marks)

(b) Show that an incident ray of light reflected successively from two mirrors inclined at an angle θ to each other is deviated through an angle 2θ. (4 marks)

(c) (i) What is meant by radius of curvature of a convex mirror? (1 mark)

(ii) Describe an experiment to determine the focal length of a convex mirror using a plane mirror. (5 marks)

(d) (i) Define **refractive index** of a medium. (1 mark)

(ii) An equi – convex lens is placed on a horizontal plane mirror and a pin held vertically above the lens is found to coincide with its image when positioned 20.0cm above the lens. When a few drops of liquid is placed between the lens and the mirror, the pin has to be raised by 10.0cm to obtain coincidence with the image. If the refractive index of the converging lens is 1.5, find the refractive index of the liquid. (4 marks)

2. (a) (i) Define the term **angular magnification** of an optical instrument. (1 mark)

(ii) Draw a ray diagram showing a refracting telescope in normal adjustment and derive an expression for its magnifying power. (5 marks)

(b) State **three** advantages of a reflecting telescope over a refracting telescope. (3 marks)

(c) The objective and eye piece of an astronomical telescope have focal lengths of 75.0cm and 2.5cm respectively. Find the separation of the two lenses if the final image is 25cm from the eye piece. (4 marks)

(d) (i) With the aid of a labelled diagram, describe the essential parts of a photographic camera. (5 marks)

(ii) Explain how chromatic and spherical aberration are minimized in the photographic camera. (2 marks)

SECTION B

3. (a) What is meant by the terms free, forced and damped oscillations? (6 marks)

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

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

(ii) Describe how you can determine the frequency of a tuning fork using beats. (4 marks)

(d) Two open pipes of length 92cm and 93cm are found to give beat frequency of 3.0Hz when each is sounding in its fundamental note. If the end corrections are 1.5cm and 1.8cm respectively, calculate the

(i) Velocity of sound in air. (3 marks)

(ii) Frequency of each note. (2 marks)

4. (a) (i) Define the term **diffraction.** (1 mark)

(ii) Explain the formation of fringes by transmission gratings. (4 marks)

(b) When monochromatic light of wave length 6.0×10^{-7}m is incident normally on a transmission grating, the second order diffraction image is observed at an angle of 30^0.
Determine the number of lines per centimetre on the grating. (4 marks)

(c) (i) State **Huygens's** principle. (1 mark)

(ii) Monochromatic light propagating in air is incident obliquely on a plane boundary with a material of refractive index, **n**. Use Huygens's principle to show that the speed, V, of light in the material is given by $V=\frac{c}{n}$
Where c is the speed of light in air. (6 marks)

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

(ii) Explain the term path difference with reference to interference of two wave motions. (3 marks)

SECTION C

5. (a) (i) Define the tesla. (1 mark)

(ii) Write down an expression for the force experienced by an electron having charge e, moving at an average velocity v in a wire placed at right angles to a field of flux density B. (1 mark)

(b) (i) With the aid of diagram, describe the structure and mode of operation of a moving coil galvanometer. (6 marks)

(ii) A rectangular coil of 100 turns is suspended in a uniform magnetic field of flux density 0.02T with the plane of the coil parallel to the field. The coil is 3cm high and 2cm wide. If a current of 50A through the coil causes a deflection of 30^0. Calculate the torsional constant of the suspension. (3 marks)

(c) (i) Define the **ampere** (1 mark)

(ii) Explain how the definition c(i) above is used in the measurement of current. (5 marks)

(iii) Two parallel wires carrying currents of 5A and 3A respectively are 10cm apart. If the wire carrying the 5A is 50cm long, find the force exerted on it. (3 marks)

6. (a) What is meant by the following terms?

(i) **Self-induction** (1 mark)

(ii) **Mutual induction** (1 mark)

(b) With the aid of a suitable diagram, describe the structure and mode of operation of an a.c transformer. (6 marks)

(c) Outline the causes of inefficiency in an a.c transformer and suggest ways of minimizing them. (4 marks)

(d) A motor which is 80% efficient is required to do mechanical work at a rate of 640W.

(i) Find the current that the motor will take from a 200V d.c supply. (3 marks)

(ii) Calculate the back e.m.f in the armature of the motor in d (i) above. (3 marks)

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

7. (a) (i) Define inductive reactance. (1 mark)

(ii) A source of sinusoidal current of amplitude I_0 and frequency, f, is connected a cross a pure inductor of inductance, L. Derive an expression for the peak voltage across the inductor. (3 marks)

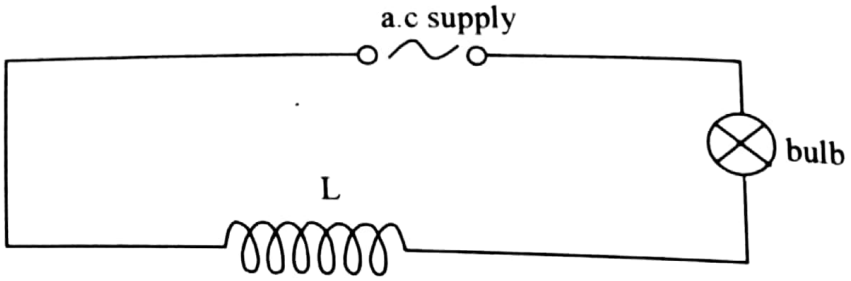
(iii) Sketch, using the same axes graphs to show the variation of voltage across the inductor and current through it with time. (2 marks)

(b) A sinusoidal voltage $V=340\sin 120\pi t$ volts is connected a cross a 40Ω resistor. Find the:-

(i) amplitude of the current through the resistor. (2 marks)

(ii) average power developed in the resistor. (3 marks)

(c)



The figure above shows a circuit consisting of an air-cored coil, L, a bulb and an alternating voltage source connected in series. An iron core is introduced into the coil.
Explain why the
(i) bulb becomes dimmer (3 marks)
(ii) iron core becomes warm. (2 marks)

(d) Describe the structure and action of a meter that makes use of a thermo couple in measuring the root mean-square value of an alternating current. (4 marks)

SECTION D

8. (a) (i) Define **capacitance** of a capacitor. (1 mark)
(ii) Derive an expression for the energy stored in a capacitor of capacitance, C charged to a p.d, V. (4 marks)

(b) A capacitor is charged by a 30V d.c supply. When the capacitor is fully charged, it is found to carry charge of 6.0μC.
Calculate the:
(i) capacitance of the capacitor. (2 marks)
(ii) energy stored in the capacitor. (3 marks)

(c) A parallel plate air-capacitor is charged to a potential difference of 20V. It is then connected in parallel with an uncharged capacitor of similar dimensions but having ebonite as its dielectric medium. The potential difference of the combination is found to fall to 15V.
(i) Explain why there is a decrease in p.d. (3 marks)
(ii) Calculate the dielectric constant of ebonite. (3 marks)

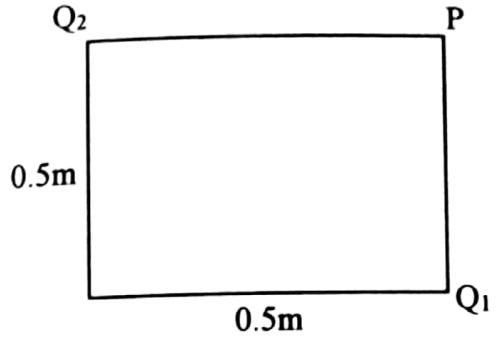
(d) Describe how an unknown capacitance of a capacitor can be determined using a ballistic galvanometer. (4 marks)

9. (a) Define the terms:
(i) **electric potential** (1 mark)
(ii) **electric field intensity.** (1 mark)

(b) (i) Explain briefly what happens to the potential energy as two point charges of the same sign are brought closer. (2 marks)
(ii) Explain how two insulating bodies rubbed together aquire charge. (3 marks)

Turn Over

(c) The figure below shows point charges Q_1 and Q_2 of $+ 44.4\mu C$ and $-22.2\mu C$ respectively placed at the corners of a square of side 0.5m.



Determine the:

(i) electric field intensity at point P. (4 marks)

(ii) electric potential energy of a charge Q_3 of magnitude $+10\mu C$ placed at P. (5 marks)

(d) Describe briefly how the **lightning** conductor works. (4 marks)

10. (a) Define the terms **electrical resistivity** and **temperature coefficient** of resistance. (2 marks)

(b) An electric heater consists of 5.0m of nichrome wire of diameter 0.58mm. When connected to a 240V supply, the heater dissipates 2.5kW and the temperature of the heater is found to be 1020^0C. If the resistivity of nichrome at 10^0C is $1.02 \times 10^{-6} \Omega m$,

Calculate:-

(i) the resistance of nichrome at 10^0C. (3 marks)

(ii) the mean temperature coefficient of resistance of nichrome between 10^0C and 1020^0C. (3 marks)

(c) (i) Derive the balance condition for wheatstone bridge. (4 marks)

(ii) Explain why the wheatstone bridge is not suitable for measuring very low or very high resistances. (4 marks)

(d) A dry cell gives a balance length of 85.0cm on a potentiometer wire. When a resistor of resistance 16Ω is connected a cross the terminals of the cell, a balance length of 76.0cm is obtained. Find the internal resistance of the cell. (4 marks)

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