P510/2
PHYSICS
PAPER 2
July/August
$2^1/_2$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,	$= 9.81ms^{-2}$
Speed of sound in air	$= 330ms^{-1}$
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	$= 6.02x10^{23}mol^{-1}$
Specific heat capacity of water	$= 4200Jkg^{-1}k^{-1}$

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 turned through an angle θ while keeping the direction of the incident ray fixed. Show that the reflected ray is turned through angle 2θ. (3 marks)

(b) Define the following terms as applied to convex mirrors:

(i) **principal focus.** (1 mark)

(ii) **radius of curvature.** (1 mark)

(c) An object is placed at a distance **u** from a convex mirror of focal length **f**. The mirror forms an image of the object at a distance **v** from its pole. Using a geometrical ray diagram, derive an expression of the mirror formula for the convex mirror. (5 marks)

(d) The diagram in Fig. 1 below shows a small source of light S placed in between a large concave mirror C which is placed coaxially and in front of a small convex mirror B with their reflecting surfaces facing each other. A screen P, large enough to block light from S from falling directly on B but small enough to allow light from C to reach B, is placed at a distance of 10 cm in front of B.

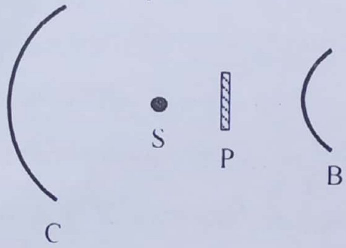

Fig. 1

If S is 20 cm from C and the radii of curvature of C and B respectively are 30 cm and 20 cm and the final image of S is formed on P on the side facing B, find the:

(i) distance between S and P. (5 marks)

(ii) magnification of the final image of S. (3 marks)

2. (a) What is meant by the following as applied to refraction?

(i) **absolute refractive index.** (1 mark)

(ii) **total internal refraction.** (1 mark)

(b) Describe an experiment to determine the refractive index of a liquid using an air cell. (5 marks)

(c) The figure 2 below shows two triangular glass prisms X and Y, each of refracting angle 30^0 and refractive index 1.51 and 1.65 respectively, cemented together to form a compound prism with a common interface along AB.

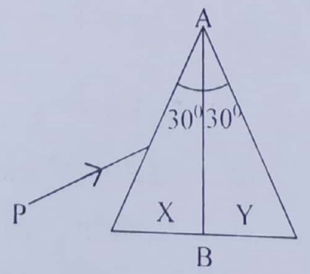

Fig. 2

If a ray of light from P, incident on one surface of X is refracted to pass normally across AB, calculate the angle of deviation of the light. (4 marks)

(d) What is meant by the following as applied to a telescope?

(i) **magnifying power**. (1 mark)

(ii) **eye-ring**. (1 mark)

(e) (i) With the aid of a diagram, derive an expression for the magnifying power of an astronomical telescope in normal adjustment. (5 marks)

(ii) State any **two** disadvantages refracting telescopes have as opposed to the reflecting type. (2 marks)

SECTION B

3. (a) (i) What is meant by **plane – polarised light**? (1 mark)

(ii) Describe how plane – polarised light can be produced by double refraction. (4 marks)

(b) A parallel beam of unpolarised light incident on a transparent glass of refractive index 1.50 is reflected as plane polarised light. Calculate the angle of refraction in glass. (3 marks)

(c) State the **principle of superposition** of waves. (1 mark)

(d) (i) Distinguish between **constructive** and **destructive** interference. (2 marks)

(ii) State the conditions for interference of two waves to occur. (2 marks)

(iii) Explain why an oil film on a water surface appears to be coloured. (3 marks)

(e) Figure 3 below shows two slits S_1 and S_2 and a screen S in Young's double – slit experiment. Light of wavelength 5.12×10^{-7} m is used.

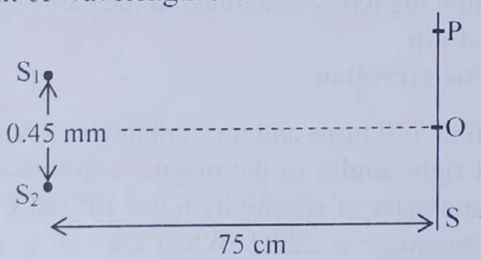

Fig. 3

If P is the position of the third bright fringe from the central fringe O, calculate the distance OP. (4 marks)

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

(b) (i) What is meant by **resonance** as applied to sound? (1 mark)

(ii) Describe the resonance tube method experiment to determine the speed of sound in air using tuning forks of different frequencies. (5 marks)

(c) A uniform glass tube 80 cm long is fully filled with water. When a tuning fork of frequency 60 Hz is sounded and placed above the tube as the water level is lowered, resonance is first obtained when the length of the water in the tube is 67 cm. If the third resonance is obtained when the liquid column is 10.2 cm, calculate the velocity of sound produced by the tuning fork. (4 marks)

Turn Over

(d) (i) Explain briefly how beats are formed. (2 marks)
(ii) Derive an expression for the beat frequency. (3 marks)

(e) State **two** applications of beats. (2 marks)

SECTION C

5. (a) Define the **unit of magnetic flux density**. (1 mark)

(b) (i) Write down an expression for the magnetic flux density at the centre of a flat circular coil, defining the symbols used. (2 marks)
(ii) Draw a sketch diagram to show the directions of the magnetic field, current and torque due to the current flowing in a flat circular coil. (2 marks)
(iii) A wire of length 9.81 m is wound into a flat circular coil of diameter 3.5 cm. If a current of 1.5 A passes through the coil, find the magnetic flux density at the centre of the coil. (3 marks)

(c) (i) Describe the structure and mode of operation of the moving coil galvanometer. (6 marks)
(ii) State any **two** limitations to increasing current sensitivity of a moving coil galvanometer. (2 marks)

(d) Explain with the aid of a diagram why a conductor carrying current experiences a mechanical force when placed in a magnetic force. (4 marks)

6. (a) (i) State the **laws of electromagnetic induction**. (2 marks)
(ii) Describe an experiment to verify Lenz's law. (6 marks)

(b) Define the following terms as applied to the earth's magnetic field:
(i) **angle of dip**. (1 mark)
(ii) **magnetic meridian**. (1 mark)

(c) A circular coil of 120 turns and mean diameter 80cm is placed in such a way that its plane is at right angles to the magnetic meridian. The coil is connected to a ballistic galvanometer of sensitivity 6.0×10^4 rad C^{-1}. The total resistance of the coil and galvanometer is 220Ω. When the coil is rotated through 180^0 about a vertical axis, the ballistic galvanometer deflects through 1.0 radians. Calculate the horizontal component of the earth's magnetic flux density. (4 marks)

(d) (i) Explain the term **back e.m.f.** as applied to a motor, and derive its relation to the efficiency of the motor. (4 marks)
(ii) State the significance of back e.m.f. in the d.c. motor. (2 marks)

7. (a) Define the following terms as applied to alternating current:
(i) **root – mean – value**. (1 mark)
(ii) **peak value**. (1 mark)

(b) (i) A source of sinusoidal voltage of amplitude V_o and frequency f is connected across a capacitor of capacitance C. Derive an expression for the instantaneous current which flows. (3 marks)
(ii) With reference to the circuit in (b) (i) above, sketch using the same axes, graphs to show variation of voltage V and current I with time. (2 marks)

© WAKISSHA Joint Mock Examinations_2
CamScanner

(iii) A capacitor of capacitance 1.0 μF is used in a radio circuit where the frequency is 1.1 kHz and the current flowing is 5 mA. Calculate the voltage across the capacitor. (3 marks)

(c) The figure 4 below shows a charged capacitor C, an inductor L and a switch K, all connected in series.

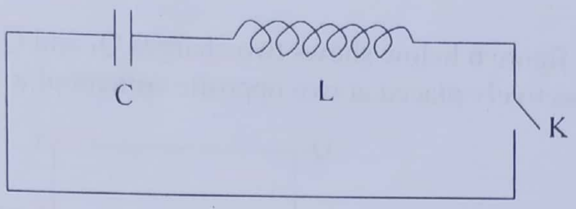

Fig. 4

Explain what happens when switch K is closed. (5 marks)

(d) (i) Explain the advantage of alternating current over direct current in power transmission. (2 marks)

(ii) Explain briefly how energy losses in an a.c. transformer can be minimised. (3 marks)

SECTION D

8\. (a) (i) What is meant by **e.m.f.** of a cell? (1 mark)

(ii) Derive the expression for the electrical energy dissipated in a resistor of resistance R ohms, carrying current I amperes for t seconds. (3 marks)

(b) The figure 5 below shows a network of five resistors, each of resistance 5 Ω connected to a battery of e.m.f. 25 V and internal resistance 0.2 Ω.

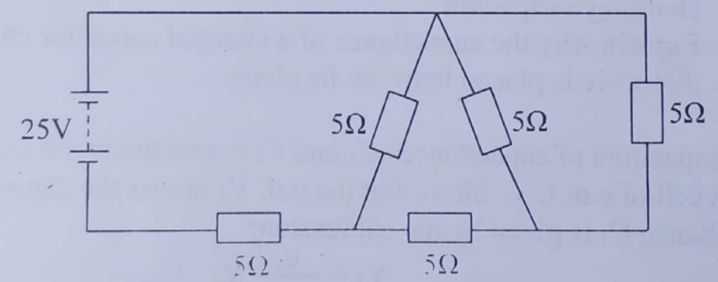

Fig. 5

Calculate the power dissipated in the battery. (5 marks)

(c) (i) Define **temperature coefficient of resistance** and state its S.I unit. (2 marks)

(ii) Explain why semiconductors have negative temperature coefficient of resistance. (2 marks)

(d) (i) Describe an experiment to determine temperature coefficient of resistance of a metal wire using a metre bridge. (5 marks)

(ii) State any **two** precautions that must be taken when carrying out the experiment in (d) (i) above. (2 marks)

Turn Over

CS CamScanner

9. (a) (i) Define the terms **electric field intensity** and **electric potential** at point. (2 marks)

(ii) Sketch graphs showing variation of electric potential and electric field intensity with distance from the centre of a charged conducting sphere. (2 marks)

(b) The figure 6 below shows two charges Q_1 and Q_2 of $+4.0\ \mu C$ and $-10\ \mu C$ respectively placed at two opposite corners of a rectangle of sides 10 cm and 5 cm.

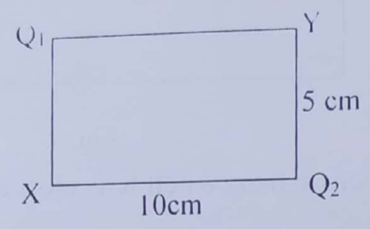

Fig. 6

Calculate the:

(i) electric potential at X. (4 marks)

(ii) electric field intensity at X. (4 marks)

(c) With the aid of a labelled diagram, describe the structure and mode of action of the Van de Graaf generator. (6 marks)

(d) Explain why the electric field intensity close to the surface of a charged conductor is always at right angles to the surface of the conductor. (2 marks)

10. (a) Define the **farad**. 1 mark)

(b) (i) Describe briefly the energy transformations that take place when charging a capacitor. (2 marks)

(ii) Explain why the capacitance of a charged capacitor changes when a dielectric is placed between its plates. (4 marks)

(c) Two capacitors of capacitances C_1 and C_2 respectively are connected in series with a cell of e.m.f. V. Show that the p.d. V_1 across the capacitance of capacitance C_1 is given by the expression:

$$V_1 = \frac{C_1}{C_1 + C_2} V$$ (4 marks)

(d) Two capacitors of capacitance $4\ \mu F$ and $2\ \mu F$ respectively are joined in series with a battery of e.m.f. 120 V. The connections are then broken and the like terminals of the capacitors are joined together. Find the final charge of each capacitor. (5 marks)

(e) Describe how the unknown capacitance of a capacitor can be determined by using a ballistic galvanometer. (4 marks)

END