P510/2

**PHYSICS**

**Paper 2**

July/August 2022

2½ hours



WESTERN 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** question from section **A** and **B**, but not more than **two** from each of the sections **C** and **D**.

Any additional question(s) answered will not be marked.

Assume where necessary

Acceleration due to gravity,

Electron charge,

Speed of light in vacuum,

Permeability of free space,

Permittivity of free space,

The constant

**SECTION A**

1. (a) Define **reflection** as applied to light. (*01 mark*)

(b) (i) Derive the relation for a concave mirror. (*05 marks*)

(ii) An object is placed 4 cm from a concave mirror of radius of curvature 24 cm. Calculate the position of the image and the magnification produced. Draw a diagram to illustrate the position of the image. (*04 marks*)

(c) Describe an experiment to determine the focal length of a convex mirror using a plane mirror. (*05 marks*)

(d) (i) Distinguish between **spherical** and a **chromatic** aberration. (*02 marks*)

(ii) Explain how a chromatic aberration is minimised in lenses. (*03 marks*)

1. (a) Sate the laws of refraction of light. (*02 marks*)

(b) Light which passes symmetrically through a glass prism of refractive index, , and large refracting angle, , is deviated at an angle, . Derive an expression for in terms of and . (*04 marks*)

(c) (i) Describe an accurate method of determining the refractive index

of a transparent liquid for sodium light. (*05 marks*)

(ii) While determining the refractive index of the liquid by using a pulfrich refractometer, the ray of light **OPQR** is observed by the observer as shown in the figure below.

**O**

**P**

**Q**

46.6°

Find the refractive index of the liquid if the refractive index of the glass prism used is 1.51. (*03 marks*)

(d) What is meant by an **eye ring**? (*01 mark*)

(e) The objective of an astronomical telescope in normal adjustment has a diameter of 150 mm and focal length 4 m. The eye piece has a focal length of 25 mm.

Calculate the;

1. magnifying power of the telescope. (*02 marks*)
2. position of the eye ring. (*01 mark*)
3. the diameter of the eye ring, and give one advantage of placing the eye at the eye ring. (*02 marks*)

**SECTION B**

1. (a) Distinguish between;
2. **pitch** and **loudness** of a sound note. (*02 marks*)
3. **fundamental frequency** and **overtones** of a musical instrument. (*02 marks*)

(b) A tube100 cm long closed at one end has its lowest frequency at 86.2 Hz. With a tube of identical dimensions but open at both ends the first harmonic occurs at 171 Hz.

Calculate the;

1. speed of sound. (*03 marks*)
2. end correction. (*02 marks*)

(c) (i) What are **beats**?

(ii) Describe how beats can be used to measure frequency of a given note. (*05 marks*)

(d) (i) Define the term **Doppler effect**. (*02 marks*)

(ii) An observer moving between two stationary sources of sound along a straight line joining them hears beats at a rate of 4 s-1. What velocity is the observer moving at if the frequency of the source is 50 Hz and speed of sound in air is 340 ms-1? (*04 marks*)

1. (a) What is meant by the following?
2. **Constructive interference**. (*01 mark*)
3. **Interference of waves**. (*01 mark*)

(b) (i) Explain how interference fringes are formed in an air wedge.  *(04 marks*)

(ii) Two glass slides are separated by a razorblade to form air wedge. When the wedge is illuminated normally by light of wavelength 5.410-7 m, a total of 20 fringes occupying a distance of 15 mm are obtained. Calculate the angle of the wedge. (*03 marks*)

(c) Two slits **A** and **B** are separated by a distance, , and illuminated with light of wavelength, . Derive the expression for the separation between the successive fringes on a screen placed a distance, , from the slits. (*04 marks*)

(d) (i) Distinguish between **transmission grating** and **reflection**

**grating**. (*02 marks*)

(ii) Sodium light of wavelength 589 nm falls normally on a diffraction grating which has 600 lines per mm. Calculate the angle between the direction in which the first order maxima on the same side of the straight through position are observed. (*03 marks*)

(e) State any **two** necessary conditions for observing interference patterns. (*02 marks*)

**SECTION C**

1. (a) Define the term **magnetic flax** and state its S.I units. (*02 marks*)

(b) A coil of 100 turns is wound round the middle of a long solenoid of 500 turns per metre and radius 7 cm.

A sinusoidal current amperes is passed through the solenoid winding. Find the amplitude of the e.m.f induced across the terminals of the coil. (*04 marks*)

(c) (i) Describe with the aid of labelled diagram the structure and action

of an a.c generator. (*05 marks*)

(ii) Explain the term **back e.m.f** in a motor and derive the relation to the efficiency of the motor. (*04 marks*)

(d) A motor has an a marture resistance of 5 . When a 240 V supply and a light load motor speed is 200 revmin-1 and a marture current, I is 4 A, calculate

1. the induced back e.m.f. (*02 marks*)
2. the motor speed at full load when a marture current is 20 A.

(*03 marks*)

1. (a) Define the **self-inductance** of a coil. (*01 mark*)

(b)

**S**

9 V

**C**

**A**

**D**

**B**

In the figure above, **A** is a coil having a low resistance and high inductance. **B** is a resistor having the same resistance as **A**, but negligible inductance. **C** and **D** are identical filament lamps and battery can be assumed to have negligible resistance.

Briefly describe and explain how the appearance of each lamp changes in the period after switch S is closed. *03 marks*)

(c) (i) Define **magnetic moment** of a coil carrying current.

(ii) Describe with the aid of a labelled diagram the structure and mode of operation of a moving coil galvanometer. (*06 marks*)

(d) A circular coil of 50 turns and area 1.2510-3 m2 is pivoted about a vertical diameter in a uniform horizontal magnetic field and carries a current of 2.0 A. When the coil is held in the North-South direction, it experiences a couple of 0.04 Nm. When the plane is turned to East-West direction, it experiences a couple of 0.03 Nm. Calculate the magnetic flax density. (*Ignore earth’s magnetic field*.) (*04 marks*)

(e) (i) Define **magnetic median** and **angle of dip**. (*02 marks*)

(ii) A metal air craft with a wingspan of 40 m flies with a ground speed of 1000 kmhr-1 in a direction due East at a constant altitude in a region of the northern hemisphere where the horizontal component of the earth’s magnetic field is 1.610-5 T and angle of dip is 71.6°. Find the potential difference in Volts that exists between the wing tips and state with a reason, which tip is at the higher potential. (*04 marks*)

1. (a) (i) Define **root mean square value** and **peak value** of a sinusoidal

alternating current. (*02 marks*)

(ii) Derive the relation between the two. (*04 marks*)

(b) A 3.0 resistor is connected in series with a 10 mHz inductor of negligible resistance and a potential difference, V = 5.0 V (Rms) alternating at Hz is applied across the combination.

Calculate the p.ds and across the resistor and inductor respectively. (*05 marks*)

(c) A sinusoidal alternating potential difference of constant amplitude is applied across the resistor, R, and an inductor, L, as shown below.

R

Explain why the amplitude of current through the circuit decreases as the frequency of the alternating potential difference is increased.

(*03 marks*)

(d) (i) Describe with the aid of a diagram the structure and mode of

operation of a hot wire ammeter. (*05 marks*)

(ii) Give any **one** advantage of a.c over d.c. (*01 mark*)

**SECTION D**

1. (a) (i) Define the terms **electric intensity** and **electric potential** as

used in electrostatics. (*02 marks*)

(ii) A charged oil drop of radius 0.00013 m is prevented from falling under gravity by the vertical field between two horizontal plates charged to a difference of potential of 8340 V. The distance between the plates is 1.6 cm and the density of oil is 920 kgm-3. Calculate the magnitude of the charge on the drop. (*03 marks*)

(b) (i) What is meant by **Corona discharge**? (*03 marks*)

(ii) Describe the structure and action of a Van-de-Graf generator.

(*06 marks*)

(c) Explain why two insulating bodies rubbed together acquire equal and opposite charges. (*03 marks*)

(d) Explain what happens when a positively charged conductor is placed near a neutral metal pin pointing towards it. (*03 marks*)

1. (a) Define the following terms;
2. **Dielectric constant**. (*01 mark*)
3. **Dielectric strength**. (*01 mark*)

(b) State the factors that affect the capacitance of a parallel plate capacitor. (*03 marks*)

(c) Describe an experiment to show the effect of inserting a sheet of glass between the plates of a capacitor and a capacitance of the same capacitor. (*05 marks*)

(d)

The figure shows arrangement of electrodes , and diaphragm D to form capacitors and as shown above.

Assume equilibrium, distances to D and to D to equal to d and the effective area of and to be A. Show that when D has been moved down a distance, , from the central equilibrium position, . (*05 marks*)

(e) A 47 F 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 direction of the flash which is 2.8 minutes.

Calculate the;

1. potential difference between the terminals of the capacitor immediately before the flash. (*03 marks*)
2. maximum charge stored by the capacitor. (*02 marks*)
3. (a) What is meant by the terms **e.m.f** and **internal resistance** of a cell?

(*02 marks*)

(b) Explain the principle of a simple potentiometer circuit. (*03 marks*)

(c) A standard cell of e.m.f 1.02 V is balanced by a length of 5 cm along a potentiometer wire and a battery. A is balanced length of 75 cm.

(i) What is the e.m.f of A? (*03 marks*)

(ii) Calculate the new balance length if A has an internal resistance of 2 and a resistor of 8 is joined to the terminals. (*03 marks*)

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

(*01 mark*)

(ii) Find the length of a wire of diameter 1.5 mm and resistivity 0f 210-6 at 30°C needed to make a coil of resistance 4 at 125°C if the temperature coefficient of resistance is 2.510-3 K-1. (*04 marks*)

(e) Derive the balance condition for a metre bridge. *03 marks*)

**END**