P510/2

PHYSICS

Paper 2

June 2017

2 ½ hours

RESOURCE MOCK EXAMINATION, 2017

Uganda Advanced Certificate of Education

S.6

PHYSICS

Paper 2

2 hours 30 minutes

INSTRUCTIONS:

Answer **five** *questions in* **all**, *attempting at least* **one** *from each section and not more than* **two** *in each section:* **A**, **B**, **C** *and* **D**.

Write in **blue** *or* **black** *ink only. You may use pencil for diagrams or graphs only.*

Silent non-programmable scientific calculators may be used.

Assume where necessary,

Acceleration due to gravity, ***g***	=	$10ms^{-2}$
Electron charge, ***e***	=	$1.6 \times 10^{-19}C$
Avogadro's number, N_A	=	$9.11 \times 10^{31}kg$
Planks constant, ***h***	=	$6.6 \times 10^{-34}Js$
Speed of light in vacuum, **c**	=	$3.0x10^{8}ms^{-1}$
Permeability of free space, μ_0	=	1.0π x $10^{-7}Hm^{-1}$
Permittivity of free space, ε_0	=	8.85 x $10^{-12}Fm^{-1}$

The constant, $\frac{1}{4\pi\varepsilon}$ = $9.0 \times 10^{9} Fm^{-1}$

Electron mass = $9.11 \times 10^{-31} kg$

SECTION A

1. a) i) State the **laws of reflection** of light. (02 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. (05 marks)

   b) An object is placed 20cm in front of a diverging lens placed coaxially with a concave mirror of focal length 15cm. When the concave mirror is 20cm from the lens the final image coincides with the object.

   i) Draw the ray diagram to show how the final image is formed. (03 marks)

   ii) Determine the focal length of the diverging lens. (04 marks)

   c) i) Define angular magnification of an optical instrument. (01 mark)

   ii) What is meant by exit pupil of a compound microscope? (01 mark)

   iii) Describe with the aid of a diagram, the structure and action of a compound microscope in normal adjustment. (04 marks)

2. a) i) What is meant by **refractive index** of a material. (01 mark)

   ii) A monochromatic light incident on a block of material placed in a vacuum is refracted through angleθ. If the block has refractive index $\cap$ and is of thickness, t, show that the light takes a time $\frac{ntsec\theta}{c}$to emerge from the block where c is the speed of light in a vacuum. (03 marks)

   b) i) A ray of monochromatic light is incident at a small angle of incidence on a small angle prism in air. Obtain the expression $d = (n-1)A$ for the deviation of light by the prism. (05 marks)

   ii) Light of two wave lengths is incident at a mall angle on a thin prism of refracting angle 50^0 and refractive index 1.52 and 1.50 for the two wave lengths after refraction by the prism. Find the angular separation of the two waves after refraction by the prism. (03 marks)

   c) Explain how a mirage is formed. (03 marks)

   d) With the aid of a ray diagram, describe the structure and action of reflecting telescope in normal adjustment. (05 marks)

SECTION B

3. a) State the **Huygens's principle**. (01 mark)

   b) Monochromatic light propagating in air is incident obliquely onto a plane boundary with a medium of refractive index n.

   i) Use Huygens's principle to show that the speed, V of the light in the medium is given by

   $V = \frac{c}{n}$, where C is the speed of light in air. (06 marks)

   ii) If the wave length of light is 600nm in air, what will it be in the medium of refractive index 1.50?

   c) i) What is meant by **interference of waves**? (01 mark)

   ii) State the conditions necessary for interference fringes to be observed. (02 marks)

   iii) Explain the term path difference with reference to interference of two wave motions. (03 marks)

   d) When monochromatic light of wave length 5.8×10^{-7}m incident normally on a transmission grating, the second order diffraction line is observed at an angle of 27^0. How many lines per cm does the grating have? (04 marks)

4. a) i) Distinguish between an **Oscillation** and **a wave**. (02 marks)

   ii) State the necessary conditions for beats to be heard and **deduce**an expression for the Beat frequency. (04 marks)

   iii) A whistle of frequency 512Hz is mounted on a rim of a wheel of radius 0.5m which is rotating at a uniform rate of 100 revolutions per minute. An observer stands 20m away from the wheel. Give a quantitative description of what he hears. (Take velocity of sound in air as $344ms^{-1}$) (05 marks)

   b) i) With the aid of diagrams, explain **free oscillations** and **damped oscillations**. (04 marks)

ii) The displacement of a progressive wave is given by $y = 2\cos(t - \frac{x}{20})\pi$where x is the horizontaldistance and$t$ is the time. Find the;

i) Velocity (01 mark)

ii) Period (01 mark)

iii) Maximum particle speed (03 marks)

SECTION C

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

b) A circular coil of 100 turns and cross sectional area of 0.2m^2 is placed with its plane perpendicular to a horizontal magnetic field of flux density 1.0x10^{2}T. The coil is rotated about a vertical axis so that it turns through 60^0 in 2seconds. Calculate;

i) the initial flux linkage through the coil (02 marks)

ii) the energy induced in the coil (03 marks)

c) A rectangular coil of N-turns each of dimensions $l \times b$ is inclined at an angle θ to a uniform magnetic field of flux density, B. Derive an expression for the torque on the coil if a current, I is passed through it. (05 marks)

d) Write down an expression for the magnetic flux density at;

i) a perpendicular distance, d from a long straight wire carrying current I in a vacuum. (01 mark)

ii) the Centre of a circular cool of, N-turns each of radius, R and carrying current I. (01 mark)

ii)the centre of an air curved solenoid of n-turns per metre each carrying current I. (01 mark)

e) Two long parallel wire X and Y are separated by 8cm in a vacuum. The wires carry currents of 10A and 5A respectively in the same direction.

i) Sketch the magnetic flux pattern for the two waves. (02 marks)

ii) At what points between the waves is the magnetic flux density zero. (03 marks)

SECTION D

6. a) Distinguish between **e.m.f** and **terminal p.d** of a battery. (02 marks)

   b) i) Define **electrical resistivity**. (01 mark)

   ii) Explain any two factors on which resistance of a conductor depends. (05 marks)

   c) Two waves A and B have lengths which the resistance is in the ratio 4:5, diameters which are in a ratio 2:1 and resistances in the ratio of 3:2. If the wires are arranged in parallel and current of 1.0A flows through the combination, find the;

   i) ratio of resistance of wire A to that of wire B. (04 marks)

   ii) current through wire A (03 marks)

   d) Explain why a wire becomes hot when current flows through it. (05 marks)

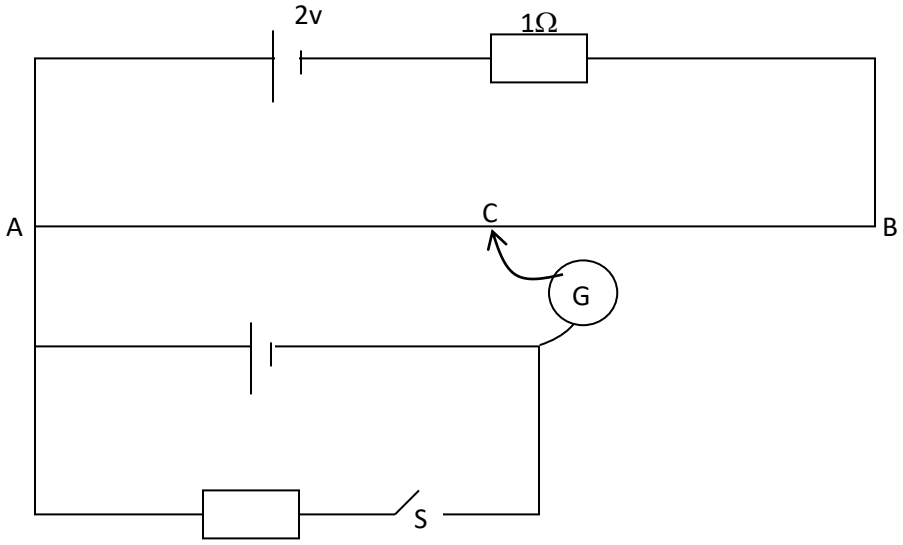
7. a) i) State **Ohm's law**. (01 mark)

   ii) State the factors which affect the resistance of a conductor. (02 marks)

   iii) A conductor of length; l and cross sectional area, A has n free electrons per unit volume each of charge, e. Find the drift velocity, V, of these electrons if a current, I flows through the conductor. (04 marks)

   b) Outline the principles of operation of a slide wire potential meter. (04 marks)

   c)



   AB is a slide wire 1m long and has resistance of 4Ω . When switch s is;

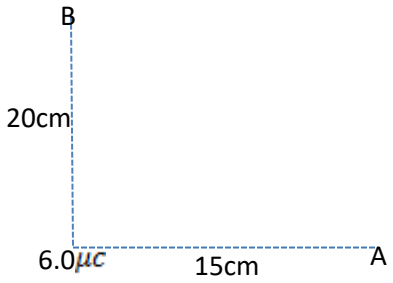
i) Open, the balance length AC is 88.8cm. Find the value of the e.m.f of the cell. (03 marks)

ii) Closed, the balance length is found to be 82.5cm. Calculate the internal resistance of this cell. (04 marks)

d) State two advantages of using a potential meter for measuring voltage. (02 marks)

8. a) Define **electric potential** and **electric field intensity**.

b) Consider two points A and B at distances of 15 cm and 20cm respectively, froma point charge of 6.0μcas shown below;



i) Find the electric potential difference between A and B. (06 marks)

ii) Calculate the energy required to bring a +1.0 $\mu c$from infinity to point A. (03 marks)

c) Alpha particle (charge = +2e), each having kinetic energy 1.0x10^{-12}J are incident head-on, on a gold nucleus (charge = +79e) in a gold foil. Calculate the distance of closest approach of an x-particle to a gold nucleus. ($e = 1.6x10^{-19}$c)

d) Describe an experiment to show that charge resides only on the outside surface of a hollow conductor. (05 marks)

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