P510/2
PHYSICS
Paper 2
June/July, 2018
2½ hours

Uganda Advanced Certificate of Education

INTERNAL MOCK EXAMINATIONS 2018

S.6 PHYSICS

(Principal Subject)
PAPER 2

2hours 30minutes

INSTRUCTIONS TO CANDIDATES

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

Where necessary assume the following constants:

Acceleration due to gravity,	g	=	$9.81 ms^{-2}$
Speed of light in vacuum,	c	=	$3.0 \times 10^{8} ms^{-1}$
Speed of sound in air	v	=	$340 ms^{-1}$
Electronic Charge,	e	=	$1.6 \times 10^{-19} C$
Electronic mass,	m_e	=	$9.1 \times 10^{-31} kg$
Permeability of free space,	μ_0	=	$4.0\pi \times 10^{-7} Hm^{-1}$
Permittivity of free space,	ε_0	=	$8.85 \times 10^{-12} Fm^{-1}$

The Constant, $\frac{1}{4\pi\varepsilon_0}$ = $9.0 \times 10^{9} F^{-1} m$

SECTION A

1 (a) (i) Define reflection of light? (1 mark)

(ii) Two mirrors are inclined to each other at an angle β. Show that if an incident light is reflected successively from each of the mirrors, the total deviation produced is 2β (4marks)

(iii) Describe how the result in a(ii) above is used to determine the angle of elevation of a star. (4 marks)

(b) Describe an experiment to determine the focal length of a convex mirror using a convex lens. (4 marks)

(c) A convex lens of focal length 18cm is arranged coaxially with a convex mirror of focal length 24cm; placed 8cm apart. An object is placed 40cm in front of the lens, on the side remote from the mirror. Find the;

(i) position of the final image. (5marks)

(ii) magnification of the image. (2 marks)

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

(ii) Describe an experiment to determine refractive index of a glass block using the real and apparent depth method. (5marks)

(b) When a small quantity of water is placed on a concave mirror and an object pin is moved above the mirror, it coincides with its image at distance 15cm. When the experiment is repeated with another liquid, the coincidence occurs at distance of14cm. Find the refractive index of the liquid. (refractive index of water = 1.33). (3marks)

(c) Explain how a plain mirror made of thick glass forms multiple images. (3 marks)

(d) (i) The objective and eye piece of an astronomical telescope have focal lengths of 85cm and 5cm respectively. Find the separation of the two lenses if the final image is 25cm from the eye piece. (4 marks)

(ii) State one advantage and one disadvantage of the telescope in (c) (i) above over a Galilean one. (2 marks)

(e) With the aid of a diagram explain chromatic aberration as applied to a concave (diverging) lens. (2 marks)

SECTION B

3 (a) (i) Define Doppler effect. (1 mark)

(ii) An observer is moving in one direction with velocity u_o. A source of sound is moving away from the observer with velocity u_s. Derive the expression for the apparent frequency of sound heard by the observer. (4marks)

(b) Describe how the Doppler effect is used to determine whether a star is moving away or towards the earth. (3marks)

(c) (i) What is a fundamental note with reference to a pipe ? (1mark)

(ii) With the aid of a diagram describe the variation of pressure and displacement of air in an open pipe when producing its fundamental note. (3 marks)

(iii) Explain why two open pipes of the same length may produce fundamental notes of different frequencies. (3 marks)

(d) A stretched wire of length 60cm and mass per metre 1.2×10^{-3}kg is under tension of 184.6N. If it is plucked at its midpoint, find the frequency and wave length of its lowest overtone. (5 marks)

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

(b) i. What are overtones? (1mars)

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

(c) A stretched string of length ***l***, is fixed at both ends and then set to vibrate in its allowed modes. Derive an expression for frequency of the second overtone in terms of the fundamental frequency. (4marks)

(d) A wire of length 0.60m and mass 9 x 10^{-4}kg is under tension of 135N. The wire is plucked such that it vibrates in its third harmonic. Calculate the frequency of the third harmonic. (5marks)

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

SECTION C

5. (a) (i) Distinguish between e.m.f and terminal p.d of a cell. (2 marks)

(ii) Derive an expression for power dissipated in a resistor of resistance R ohms when a current **I** amperes flows through it. (3 marks)

(b) (i) Define ***electrical conductivity*** of a wire and state its unit. (2 marks)

(ii) Figure 5 shows current- voltage graphs for two Nichrome wires P and Q maintained at the same temperature.

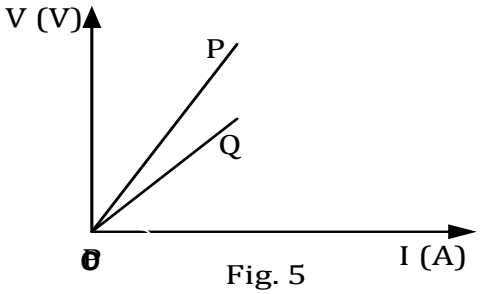


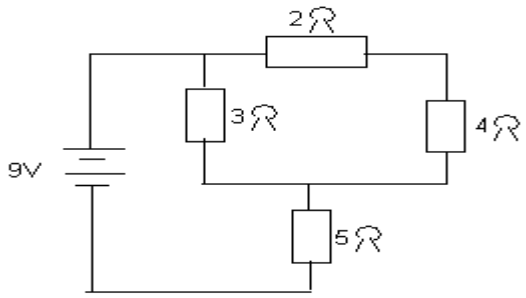
Fig. 5

State and explain the difference in shapes of the two graphs. (3 marks)

(c) (i) Distinguish between Ohmic and non-Ohmic conductors. (2 marks)

(ii) Sketch current- voltage graphs of a silver wire and a junction diode, and briefly account for the shape of each graph. (4 marks)

(d) The figure below shows a network of resistors connected across a battery of e.m.f 9V and negligible internal resistance.



Calculate the power dissipated in the 4Ω resistor. (4 marks)

6. (a) (i) Define reactance of a capacitor and impedance. (2 marks)

(ii) Derive the expression for the reactance of a capacitor of capacitance C, connected to a supply of sinusoidal current (4 marks)

(b) When a given capacitor and inductor are separately connected across a voltage source equal amounts of current is registered. Explain what is observed when a source of higher frequency is now used. (3marks)

(c) A coil of inductance 0.5H is connected in series with a resistor of resistance 70Ω, across an a.c voltage source of 240V mains and frequency 40Hz. Find the;

(i) current in the circuit (4 marks)

(ii) power dissipated in the circuit (2 marks)

(d) Describe how the attraction type of moving iron ammeter works. (5 marks)

SECTION D

7. (a) (i) State Ohm's law . (1 marks)

(ii) Derive an expression for effective resistance of three resistors connected in parallel. (4 marks)

(b) Describe an experiment to show how resistance varies with length of a wire. (5 marks)

(c) (i) Define temperature coefficient of resistance of a material. (1 mark)

(ii) A heating coil made of Nichrome wire, having a temperature coefficient of resistivity $8.0 \times 10^{-5} K^{-1}$ and resistivity of $1.08 \times 10^{-6} \Omega$ m at 273 K, has a power rating of 36 W when immersed in water at 373 K at a p.d of 12 V. If the wire of the coil has a diameter of 0.36 mm, determine the length of wire used for making the coil. (4 marks)

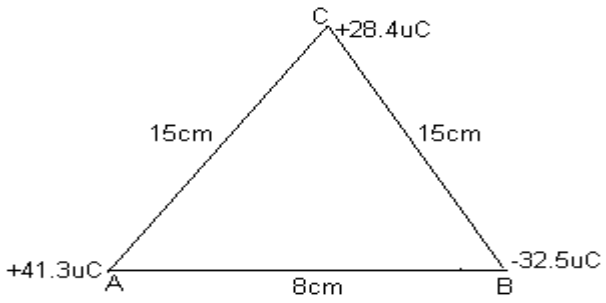
(d) (i) With the aid of a diagram describe how you would standardise a slide wire potentiometer. (3 marks)

(ii) State one advantage and one disadvantage of a potentiometer when measuring voltages. (2 marks)

8. (a) Define electric potential difference. (1 mark)

(b) Explain what happens to the potential energy when two like charges are brought closer. (2 marks)

(c)



Three charges of +41.3μC, -32.5μC and +28.4μC are placed as in the figure above in air. Find the:

(i) electric force experienced by the charge at C. (5 marks)

(ii) potential energy of the charge at B. (3 marks)

(d) With the aid of a diagram describe how a Van de Graaff generator works. (6 marks)

(e) Explain how a neutral material can be shielded from an external electric field. (3 marks)

9. (a) (i) Define dielectric strength and capacitance. (2 marks)

(ii) Sketch the electric field pattern between the plates of a charged capacitor. (1 mark)

(b) A capacitor of capacitance 70μF is charged to a p.d of 40V and then connected across another capacitor of capacitance 50μF.

(i) Find the energy stored in the 50μF capacitor. (4 marks)

(ii) With the capacitors still connected, a dielectric of relative permittivity 1.5 is inserted into the 50μF capacitor. Find the final p.d across the capacitors. (3 marks)

(c) Describe an experiment to show how capacitance varies with area of overlap of the plates. (5 marks)

(d) Three identical capacitors of capacitance, C, with air between their plates are connected in series across a voltage source. Show that when dielectrics of relative permittivity 1.5 and 2, are inserted respectively in two of the capacitors, the effective capacitance in the network increases by $\frac{5}{13}$ C. (4 marks)

(e) List two uses of a dielectric in a capacitor. (1 mark)

END