P510/2
PHYSICS
Paper 2
July/August 2019
2½ hours

MWALIMU EXAMINATIONS BUREAU

UACE RESOURCE MOCK EXAMINATIONS 2019

PHYSICS

PAPER 2

2 Hours 30 Minutes

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	=	$9.81ms^{-2}$
Speed of light in vacuum,	c	=	$3.0 \times 10^{8}ms^{-1}$
Speed of sound in air	v	=	$340ms^{-1}$
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) Define focal *plane focal* and *power of* a lens. (2)

(b) (i) Describe an experiment to determine the focal length of a concave lens using a concave mirror. (5)

(ii) Explain why monochromatic light is usually preferred in experiments when using lenses. (2)

(c) A concave lens of focal length 30cm is arranged coaxially with a convex lens of focal length 18cm, placed 4cm apart. An object 3cm high is placed 40cm in front of the concave lens, on the side remote from the convex lens. Find the:

(i) position of the final image (5)

(ii) height of the image. (2)

(d) With the aid of a diagram describe how prism binoculars work. (4)

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

(ii) Derive the expression for the refractive index of a material of a prism in terms of the refracting angle, A, and angle of minimum deviation, D. (4)

(iii) When light is incident on a prism of refractive index 1.52, at an angle of incidence 36^0, the emergent ray makes angle 54.3^0 with the normal on the opposite face. Find the angle of incidence for minimum deviation. (4)

(b) Describe how the refractive index of a liquid may be determined using an air cell. (5)

(c) (i) Explain why we are able to see the sun before sun rise. (3)

(ii) Explain why a vertical pole near the observer appears taller than one of equal height placed farther away. (3)

SECTION B

3. (a) (i) What is Doppler effect? (1)

(ii) A source of sound moving with velocity, u_s, approaches an observer moving with velocity, u_o, in the same direction. Derive the expression for the frequency of the sound heard by the observer. (4)

(iii) Explain what happens to the pitch of the sound heard by the observer in a(ii) above when the observer moves faster than the source. (2)

(b) (i) What is sound? (1)

(ii) Explain the main factors that determine the velocity of sound in air. (4)

(c) Explain how beats are formed. (3)

(d) When two stopped pipes of lengths 62cm, with end corrections of 1.2cm and 1.8cm respectively are sounding their fundamental notes, beats are formed. If the velocity of sound in air is $340ms^{-1}$, find the beat period. (5)

4. (a) What is meant by interference and diffraction with reference to light? (2)

(b)(i) With the aid of a diagram, explain how Newton's rings are formed. (5)

(ii) Explain the change in spacing of rings in b(i) above when the air film is replaced with water. (2)

(c) An air wedge is formed using two flat glass plates of length 150mm in contact at one end and separated by a thin wire at the other end. When the wedge is illuminated almost normally with monochromatic light of wavelength 570nm, 20 fringes are counted in a distance of 1.85mm. Find the diameter of the wire. (4)

(d) Describe how the wavelength of light may be determined using a transmission grating. (5)

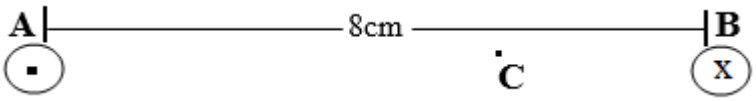
(e) Find the angular position for the second order image when light of wavelength 548nm, is made incident normally on a grating of 600 lines per mm (2)

SECTION C

5. (a) (i) Write an expression for the force a charge, q, moving with velocity, v, in the direction making an angle α with a uniform magnetic field of flux density, B. (1)

(ii) Hence, define **one tesla**. (1)

(b)



In the **figure** above, A and B are current carrying wires placed 8cm apart in air. Current through A is 7A and that through B is 4A.

(i) Find the magnetic flux density at C, 3cm from B. (3)

(ii) Sketch the magnetic field pattern between A and B. (2)

(c) (i) Describe how you can determine the horizontal component of the earth's magnetic field intensity using the earth inductor, campus needle and a resistance box. (5)

(ii) A vertical wire of length 15cm carries current of 5A in a place where the earth's total intensity is 56.4 Am^{-1}. If the angle of dip at the location is 47.8^0, find the force experienced by the wire. (4)

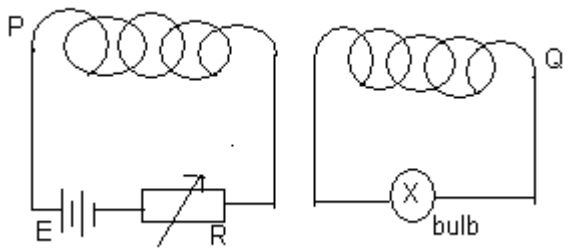
(d) Describe the design features in a moving coil galvanometer that ensure linear scale and high sensitivity. (4)

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

(i) self induction? (1)

(ii) mutual induction? (1)

(b) Two coils P and Q are placed co- axially near each other as shown in figure below. R is a rheostat of large value while E is a strong battery.



Explain the following observations:

(i) When the resistance is varied very fast, the bulb lights up. (2)

(ii) When coil Q is moved away from P, and the procedure repeated, the bulb lights dimly. (2)

(c) A transformer whose secondary coil has 72 turns and the primary 900 turns has its secondary connected to a 3Ω resistor. If the primary is connected to a 240V a.c supply and assuming the transformer is 90% efficient, calculate the current flowing in the primary. (4)

(d) State the laws of electromagnetic induction. (2)

(e) Describe an experiment to demonstrate Faraday's law of electromagnetic induction. (4)

(f) A coil of 80 turns is wound round the middle of a long solenoid of 750 turns per metre and radius 10.0cm. A sinusoidal current $I = 7\sqrt{2}\sin(150\pi t)$, is passed through the solenoid. Find the e.m.f induced across the terminals of the coil. (4)

7. (a) (i) Describe how a hot wire ammeter works. (5)

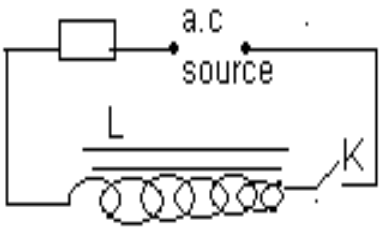
(ii) Explain why the instrument in a(i) above is suitable for measuring alternating current while a moving coil galvanometer is not. (3)

(b) Define reactance and state its unit. (2)

(c) Show that current leads voltage by phase angle 90^0 when a sinusoidal voltage is applied across a capacitor; hence find the expression for reactance of the capacitor. (4)

(d) A 240V, 60Hz alternating voltage is applied across an inductor of 0.2H and negligible resistance. Find the maximum value of current that flows through the inductor. (3)

(e)



An iron cored coil L is connected in series with a resistor and switch K, across a strong a.c. source as above. Switch K is closed and after some time it is opened. Explain why a spark occurs at the switch. (3)

SECTION D

8. (a) Define *terminal p.d* of a battery and *one volt*. (2)

(b) Derive the expression for electrical energy dissipated in a resister of resistance, *R*, when a p.d of, *V*, is maintained across it for a time, *t*. (3)

(c)

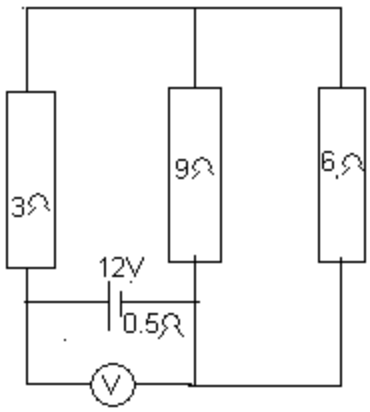


Figure above shows a network of resistors of 3Ω, 9Ω and 6Ω, connected to a battery of 12V and internal resistance 0.5Ω.

Find: (i) Voltmeter reading. (3)

(ii) power generated by the battery in 2minutes. (3)

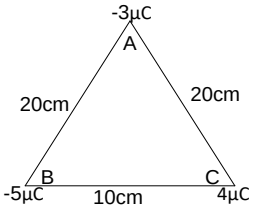
(d) (i) Describe how the e.m.f of a thermal couple can be determined using a potentiometer.(4)

(ii) Explain one advantage of a potentiometer over an ordinary voltmeter in measurement of voltages. (2)

(e) A wire has resistance of 52.3Ω at 40^0C and 54.4Ω at 100^0C. Calculate its temperature coefficient of resistance. (3)

9. (a) (i) State Coulomb's law of electrostatics. (1)

(ii)



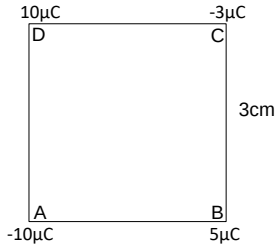
Charges -5μC, 4μC, and -3μC are placed at the corners A, B, and C of an isosceles as shown above. Find the resultant force on the charge at A. (6)

(b) (i) Explain how a conductor can be charged negatively by induction. (3)

(ii) Describe an experiment to show that two bodies acquire equal but opposite charges by rubbing. (3)

(c) (i) Define electric potential. (1)

(ii)



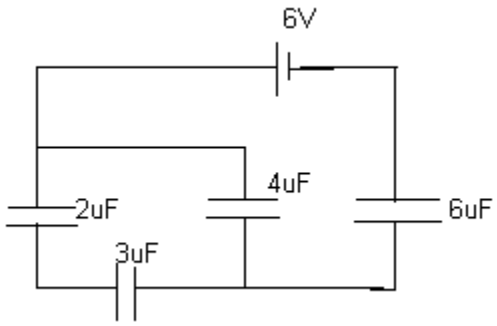
Charges -10μC, 5μC, -3μC, and 10μC are placed at the edges A, B, C, and D of a square of sides 3cm as shown above. Calculate the electric potential and electric field intensity at the point where the diagonals cross. (6)

10. (a) (i) Define *relative permittivity* and *dielectric strength*. (2)

(ii) Describe an experiment to determine how capacitance of a capacitor varies with area of overlap of the plates. (4)

(b) Two identical capacitors are connected in parallel and then charged to a p.d, V. The capacitors are then disconnected from the battery. Show that when a dielectric of constant, ε_r, is inserted between the plates, the pd across the capacitors reduces by $\frac{1-\varepsilon_r}{1+\varepsilon_r}$ V. (3)

(c)



Four capacitors of 2μF, 3μF, 4μF and 6μF are connected in a network as above across a battery of e.m.f 6V. Find the:

(i) Charge stored in the network. (4)

(ii) p.d across the 4μF capacitor. (3)

(d) A capacitor is connected in series with a micro ammeter to a d.c voltage source through a switch. When the switch is closed the micro ammeter pointer deflects in one direction then it comes to zero. When a dielectric is now inserted between the capacitor plates, the pointer again deflects then it comes to zero. Explain this observation. (4)

End