P510/2

PHYSICS

Paper 2

June/July 2018

2 ½ hours

MWALIMU EXAMINATIONS BUREAU

UACE PRE-MOCK RESOURCE EXAMINATIONS 2018

PHYSICS

PAPER 2

2 Hours 30 Minutes

INSTRUCTION TO CANDIDATES

*Answer any **five** questions, including at least **one** from each section, but **not** more than **one** from either section A or 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	=	$330ms^{-1}$
Electronic charge,	e	=	$1.6 \times 10^{-19}C$
Electronic mass,	m_e	=	$9.1x10^{-31}kg$
Permeability of free space,	μ_0	=	$4.0\ \pi\ x10^{-7}Hm^{-1}$
Permittivity of free space,	ε_0	=	$8.85x10^{-12}Fm^{-1}$
The Constant	$1/4\pi\varepsilon_0$	=	$9.0x10^{9}F^{-1}m$

SECTION A

1. (a) (i) State the laws of reflection (2mks)

(ii) State four properties of images formed by plane mirrors (2mks)

(b) (i) When you look in a mirror, you are able to see the image of your face but when you look onto the wall, you can't see your image; explain why. (3mks)

(ii) Two mirrors are inclined at each other at an angle **θ**. Show that if an incident light is reflected once at each of the mirrors, the total deviation produced is **2θ.** (4mks)

(c) (i) Describe an experiment to determine the focal length of a convex mirror using a convex lens. (4mks)

(ii) A small convex mirror is placed 60cm from the pole and on the principal axis of a large concave mirror of radius of curvature 200cm. the position of the convex mirror is such that a real image of a distant object I formed in the plane of a hole drilled through the concave mirror at its pole. Calculate the radius of curvature of the convex mirror. (5mks)

2 (a) Describe an experiment to determine refractive index of a glass block using the real and apparent depth method. (4mks)

(b) A prism of refracting angle 60° has refractive indices 1.515 and 1.529 for red and violet light respectively. When white light is incident on one face of the prism, red light undergoes minimum deviation. Calculate the angle of;

(i) incidence for the white light. (2mks)
(ii) mergence for violet light (3mks)

(c) Derive the relationship between focal length, f, object distance, u, and image distance, v, for thin lens (5mks)

(d) A thin converging lens, A of focal length 12cm and a thin diverging lens, B, of focal length 18cm are placed coaxially, 40cm apart. If an object is placed 15cm from A on the side remote from A;

(i) Find the position of the final image. (4mks)

(ii) Find the magnification (2mks)

SECTION B

3 (a) What is meant by coherent sources of light? (2mks)

(b) Outline the principle of Young's double slit interference and derive the expression for fringe separation. (7mks)

(c) Two plane glass plates which are in contact at one edge are separated by a piece of metal foil 12.50cm from the edge. Interference fringes parallel to the line of contact are

observed in reflected light of wavelength 5.46 x 10^{-7}m and are found to be 1.50mm apart. Find the thickness of the foil (4mks)

(d) (i) State Huygen's principle (1mk)

(ii) Use Huygen's principle to show that the refractive index of medium 2 relative to medium 1 is given by

$_1n_2 = \frac{V_1}{V_2}$ where V_1 and V_2 are velocities of light in media 1 and 2 respectively (6mks)

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

(b) Describe an experiment to show that a stretched string vibrates in more than one mode. (5mks)

(c) A uniform wire of length 0.8m and mass $2.0x10^{-2}$kg is stretched between two fixed points so that the tension in the wire is 200N. If the wire is plucked in the middle, calculate the:

(i) speed of the transverse wave produced. (3mks)

(ii) frequency of the fundamental note. (2mks)

(d) (i) What is Doppler effect? (1mk)

(ii) Describe one application of Doppler effect. (3mks)

(iii) A driver of a car speeding at $18ms^{-1}$ receives a note of frequency 714Hz from the hooter of a factory behind the car. Find the true frequency of the note (3mks)

SECTION C

5 (a) (i) Write down the expression for the force exerted on a straight wire of length Lm carrying a current of I Amperes at right angles to a magnetic field of flux density B Teslas (1mk)

(ii) Define the unit of magnetic flux density. (1mk)

(b) A small rectangular coil of N terns with a cross sectional area A is suspended so that it can rotate about an axis through the centre of its shorter sides. The coil is arranged so that the verticle sides are perpendicular to a uniform magnetic field of flux density B. Derive an expression for the couple acting on the coil when a current of I Amperes flows and when the plane of the coil makes an angle θ with the direction of the magnetic field. (4mks)

(c) With the aid of a labelled diagram describe the structure of a moving coil galvanometer and explain how it works (6mks)

(d) A small circular coil of 10 turns and mean radius 2.5cm is mounted at the centre of a long solenoid of 750 turns per metre with its axis at right angles to the axis of the solenoid. If the current in the solenoid is 2.0A, calculate the

(i) Magnetic flux density inside the solenoid (3mks)

(ii) Initial torque on the circular coil when a current of 1.0A is passed through it. (3mks)

(e) Explain how a moving coil galvanometer can be used to measure alternating current (2mks)

6 (a) Describe with aid of a labelled diagram the structure and action of a hot wire ammeter. (5mks)

(b) Explain why on average, the power delivered to a capacitor and an inductor is zero. (6mks)

(c) A sinusoidally alternating voltage of 20V (r.m.s) and frequency 60Hz is applied across a coil of wire of inductance 0.2H and negligible resistance.

(i) Find the reactance of the coil at this frequency. (3mks)

(ii) Calculate the r.m.s value for the current which passes through the coil (2mks)

(iii) Using the same axes, sketch graphs to show the variation with time of the applied voltage, the current which flows and the power delivered to the inductor (3mks)

(d) Define the term reactance (1mk)

7 (a) Define

(i) root mean square value of an alternating voltage. (1mk)

(ii) reactance of a capacitor. (1mk)

(b) A sinusoidal alternating voltage of $V= 8\sin 120\pi t$ volts is connected across a resistor of 6Ω. Find the mean power dissipated in the resistor. Hence deduce the *r.m.s* value of the current. (4mks)

(c) Describe, with the aid of a diagram, a hot wire ammeter works. (5mks)

(d) A capacitor of capacitance C is connected across a source of alternating voltage, $V= V_o \sin \omega t$.

(i) Find the current which flows in the circuit. (3mks)

(ii) Sketch using the same axes, the voltage across the capacitor and current which flows in the circuit, with time. (2mks)

(iii) Explain the phase difference between the voltage and current in (ii) above. (4mks)

SECTION D

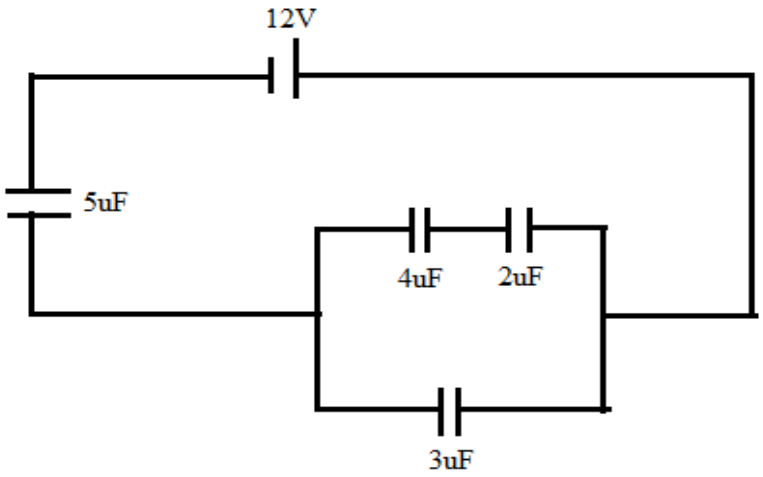
8 (a) Define the following

(i) Capacitance (1mk)

(ii) Dielectric (1mk)

(b) Derive the expression for effective capacitance of three capacitors in series (4mks)

(c)



A battery of e.m.f 12V is connected across a system of capacitors of capacitances 4μF, 5μF, 2μF and 3μF as shown above. Find the;

(i) Charge on the 5μF capacitor (3mks)

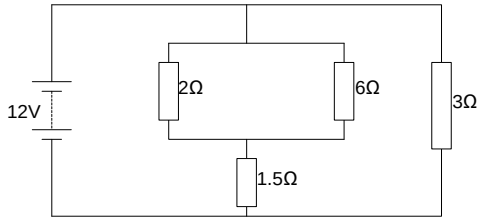
(ii) Energy stored in the 3μF capacitor (3mks)

(iii) Potential difference across the 4μF capacitor (4mks)

(d) Describe an experiment that can be used to show how capacitance of a capacitor depends on permittivity of a dielectric (4mks)

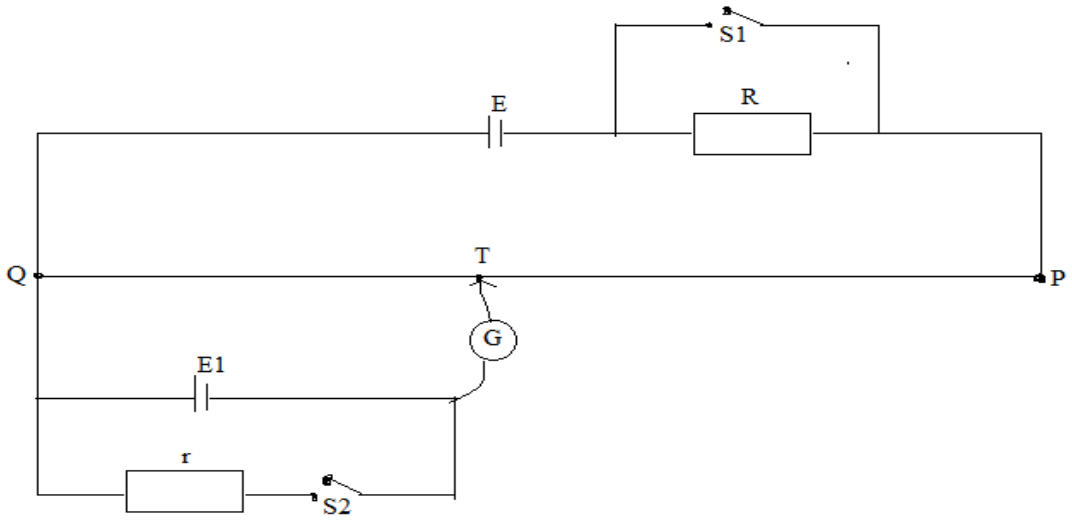
9 (a) Derive the expression for electrical energy dissipated in a resistor of resistance, R ohms, carrying current, I amperes for a time, t seconds. (3mks)

(b) The figure below shows a network of resistor connected to a total volts d.c supply of negligible internal resistance. Calculate the power dissipated in the 6Ω resistor. (5mks)



(c) Describe an experiment used to measure the electromotive force of a thermocouple junction (5mks)

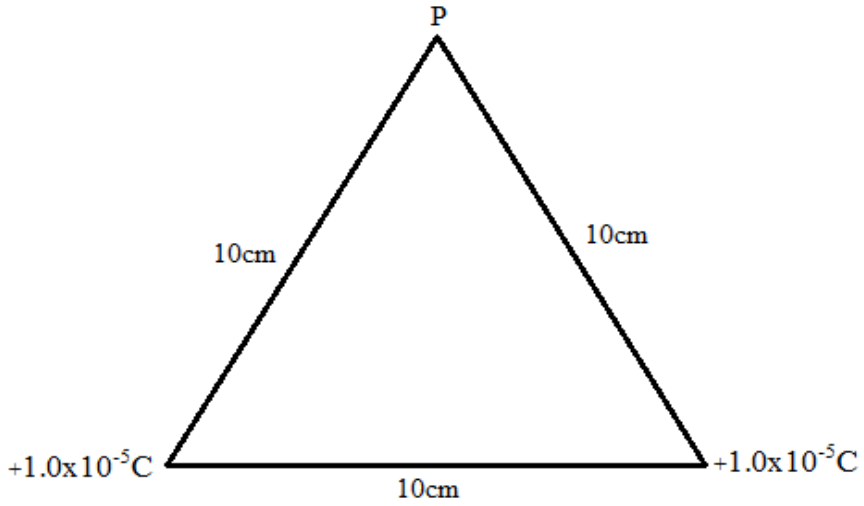
(d) In the following Figure



PQ is a uniform wire of length 1.0m and has a resistance of 10Ω. E is an accumulator of e.m.f 2.0V and negligible internal resistance. The resistor R has a resistance of 15Ω and r is a 5Ω resistor. With both switches S_1 and S_2 open, the balance length QT is 62.5cm. When S_1 and S_2 are closed, the balance length is 10cm. Calculate:

(i) The e.m.f of the cell E1 (2mks)
(ii) The internal resistance of cell E1 (2mks)
(iii) The balance length QT when S1 is open and S2 is closed (3mks)

10 (a) (i) State Coullumb's law of electrostatics (1mk)
(ii) Sketch the electric field patterns for a positively charged metallic sphere and for a negative point charge (2mks)
(b) (i) Define electric field intensity and electric potential at a point (2mks)
(ii) What is the relationship between them? (1mk)
(c) Two point charges of $1.0x10^{-5}C$ are placed apart as shown below.



Calculate the;

(i) Electric field intensity at P (5mks)
(ii) Electric potential at P (3mks)
(d) With the aid of a labelled diagram, describe the structure of and action of a Van de Graaff generator (6mks)

END