UACE PHYSICS PAPER 2008 GUIDE

Instructions to the candidates:

Answer **five** questions taking at least one from each of the sections **A, B, C** and **D**, but not more than one question should be chosen from either section **A** or **B**

Any additional question (s) will not be marked.

Mathematical tables and squared paper will be provided

Non programmable calculators may be used.

Assume where necessary

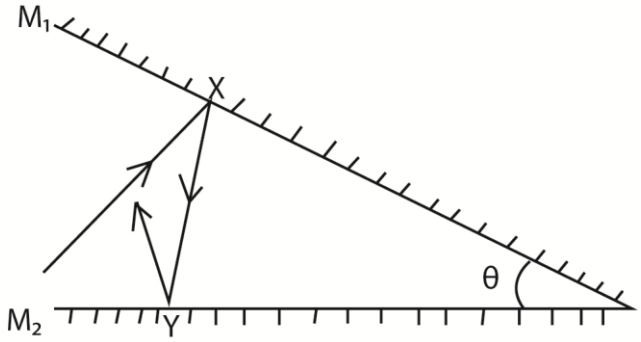
Acceleration due to gravity, g	$9.81ms^{-2}$
Electron charge, e	$1.6 \times 10^{-19}C$
Electron mass	$9.11 \times 10^{-31}kg$
Plank's constant, h	$6.6 \times 10^{-34}Js$
Speed of light in the vacuum, c	$3.0 \times 108ms^{-1}$
Specific heat capacity of water	$4.200Jkg^{-1}K^{-1}$
Avogadro's number, N_A	$6.02 \times 10^{23}mol^{-1}$
The constant, $\frac{1}{4\pi\varepsilon_0}$	$9.0 \times 10^{9}F^{-1}m$
Permittivity of free space, μ_0	$4.0\pi \times 10^{-7}Hm^{-1}$
Permittivity of free space, ε_0	$8.85 \times 10^{-12}Fm^{-1}$
One electron volt	$1.6 \times 10^{-19}J$
Resistivity of Nichrome wire at 25^0C	$1.2 \times 10^{-6}\Omega m$

SECTION A

1. (a) (i) Distinguish between real and virtual images. (02marks)

(ii) Describe how the position of an image in a plane mirror can be located (03marks)

(b) The diagram in the figure below shows a ray of light undergoing two successive reflections at points X and Y in two mirrors M_1 and M_2 inclined at an angle θ.



Show that the ray is deviated through an angle 2θ (03marks)

(c) (i) What is a radius of curvature of a convex mirror? (01mark)

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

(d) A small convex mirror is placed 0.60m from the pole and on the axis of a large concave mirror of radius of curvature 2.0m. The position of the convex mirror is such that a real image of a distant object is formed in the pane of a hole drilled through the concave mirror at its pole. Calculate the radius of curvature of the convex mirror. (04marks)

2. (a) (i) Define the terms linear magnification and angular magnification as applied to a lens. (02marks)

(ii) Derive the expression for magnifying power of a magnifying glass when the final image is formed at the near point. (04marks)

(b) An object is placed at a distance f + x from a converging lens of focal length, f. the lens produces an image at a distance, f + y from the lens. Show that $f^2 = xy$. (03marks)

(c) (i) Describe with the aid of a labelled diagram the structure and operation of a simple projection lantern. (04marks)

(ii) The slide of a projection lantern has dimension 36mm by 24mm. Find the focal length of the lens required to project an image 1.44m by 0.98m on a screen placed 4.0m from the lens. (04marks)

(d) Distinguish between a chromatic and spherical aberration. (03marks)

3. (a) (i) What is a wave? (01mark)
   (ii) Explain why an open tube is preferable as a musical instrument. (03marks)
   (b) (i) State two factors that affect the speed of sound in air (01mark)
   (ii) Explain the term reverberation. (02mark)
   (iii) What is the implication of reverberation in a hall? (02marks)
   (c) Describe an experiment to determine the velocity of sound in air using resonance method. (06mark)
   (d) (i) What is harmonic in sound? (01mark)
   (ii) A string of length 0.5m and mass 50g is stretched between two fixed points. If the tension in the string is 100N, find the frequency of second harmonic. (04marks)

4. (a) Distinguish between constructive and destructive interference. (03marks)
   (b) (i) Explain how interference fringes formed in air-wedged film between to glass slides when monochromatic light is used. (06marks)
   (ii) Describe the appearance of fringes when white light is used. (02marks)
   (c) Two glass slides in contact at one end are separated by a sheet of paper 15cm from the line of contact to form an air-wedge. When the air wedge is illuminated normally by light of wavelength 6.0×10^{-7}m, interference fringes of separation 1.8mm are found in reflection. Find the thickness of the paper. (04marks).
   (d) (i) Describe, with aid of a labelled diagram, one method of producing plane polarized light. (04marks)
   (ii) State two uses of polarized light. (01mark)

SECTION B

5. (a) Define:
   (i) The tesla (01mark)
   (ii) Magnetic flux (01mark)

   (b) Two infinitely long straight wire currying currents, I_1 and I_2 respectively are placed parallel to each other in a vacuum at a distance, d, meters apart. Derive an expression for the force per meter between the wires. (05marks)

   (c)(i) Sketch the magnetic field pattern due to a current flowing in a circular coil. (02mark)

   (ii) Write an expression for magnetic field flux density, B, at the center of circular coil of N turns of radius, r, and carrying a current I (01 mark)

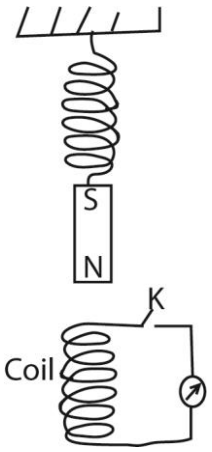
   (iii) A wire of length 7.85m is wound into a circular coil, find the magnetic flux density at the center of the coil of radius 0.05m. If the current of 2A passes through the coil, find the magnetic flux density at the center of the coil. (04marks)

   (d) (i) Explain the term back e.m.f in a d.c motor. (02mark)

   (ii) Show how the back e.m.f in a motor is related to efficiency of motor (04marks)

6. (a)(i) Define the terms amplitude and root mean square (r.m.s) value of an alternating current. (02amrks)

(b)



A small magnet is attached to a spring as shown above. Switch, K is closed and the magnet is displaced downwards slightly and released to oscillate vertically. Explain

(i) The observation made (03marks)

(ii) Why the magnet takes long to come to rest when K is opened (03marks)

(c) A sinusoidal voltage of r.m.s value 10V is supplied across a 50μF capacitor.

(i) Find the peak value of the charge on the capacitor. (02marks)

(ii) Draw a sketch graph of charge Q on the capacitor against time. (01mark)

(iii) Draw on the same sketch in (c)(i) a graph of voltage against time. (01mark)

(iv) If the a.c supply has a frequency of 50Hz, calculate the r.m.s value of the current through the capacitor. (04marks)

7. (a) (i) Distinguish between self-induction and mutual induction (02marks)

(ii) An aired cored inductor is connected in series with a switch and d.c. source. The switch is closed and left for some time. Explain why a spark is observed across the switch contacts when the switch is reopened. (03marks)

(b) Describe, with the aid of a diagram, how the magnetic flux density between the poles of a strong magnet can be measured. (06marks)

(c) (i) Explain how eddy currents can be produced. (02marks)

(iii) Explain the application of eddy currents. (03marks)

(d) A coil of 500 turns and mean area $4.0 \times 10^{-2} m^2$ is rotated at a uniform rate of 600 revolution per minute about an axis perpendicular to a uniform magnetic field of flux density 0.2T. Calculate the maximum value of the e.m.f induced in the coil. (04marks).

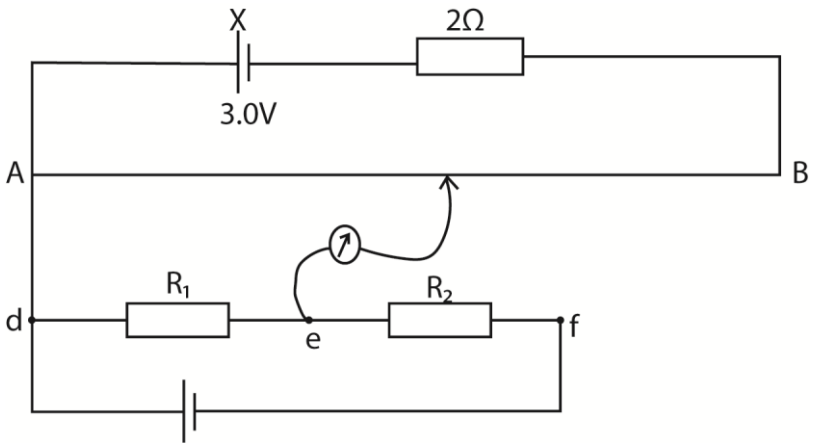
SECTION C

8. (a) (i) Derive the formula for combined resistance of three resistors in series. (04marks)

(ii) Explain why a metal wire becomes hot when an electric current flows through it. (04marks)

(iii) What advantage does the potentiometer have over Wheatstone bridge when used to compare two low resistances? (02marks)

(b)



In the figure above, AB is a slide wire of length 1.0m and resistance 10Ω. X is a driver cell of e.m.f 3.0V and negligible internal resistance. When the center –zero galvanometer is connected in turns to points e and f, the balance lengths obtained are 45.0cm and 80.0cm respectively.

Calculate the

(i) The current flowing through R_1. (04marks)
If the current through the driver circuit and R_1 is I_d and I_1 respectively, it follows that
(ii) Resistances of R_1 and R_2. (02marks)

(c) Describe with aid of a diagram, how a calibrated slide wire potentiometer may be used to measure thermoelectric e.m.f. (04marks)

9. (a) Explain why a redistribution of charge occurs on uncharged metal rod when a positively charged metal sphere is brought near one end (03marks)

(b) Sketch a graph showing the variation of potential
(i) Relative to the earth along the axis of metal rod in (a) from the center of the charged sphere to the furthest end of the rod. (02marks)

(ii) along the axis of the rod in (a) from the center of the sphere if the rod is earthed. (02marks)

(c) Explain why the electric field intensity close to the surface of a charged conductor is always at right angles to the surface of the conductor. (03marks)

(d) Describe with the aid of a diagram the mode of operation of Van de Graff generator. (006marks)

(e) Explain how two insulating bodies rubbed together acquire charge.

(f) A proton is fired from infinity with a speed of 3.7 x $10^6 ms^{-1}$ towards a stationary charge of +50e. Calculate the speed of the proton at a point 10^{12}m from stationary charge. (Assume mass of proton = 1.6 x 10^{-27}kg) (04marks)

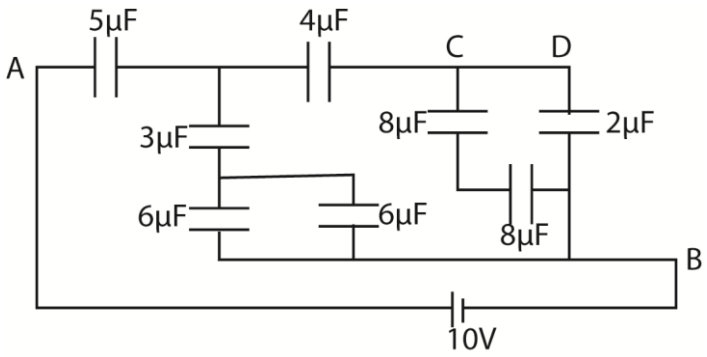
10. (a)(i) What is meant by a dielectric material? (01marks)

(ii) Explain the effect of a dielectric on the capacitance of a capacitor. (05marks)

(b) Two capacitors of capacitances, C_1 and C_2, are connected in series with a battery of e.m.f, V. Show that the p.d., V_1 across the capacitor of capacitance, C_1 is given by

$$V_1 = \left(\frac{C_2}{C_1 + C_2}\right) V$$ (04marks)

(c) The figure below shows a network of capacitors connected to a 10V battery. Calculate the total energy stored in the network. (06marks)



(d) Describe how the unknown capacitance of a capacitor can be determined using a ballistic galvanometer

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