NAME………………………………………………………..…………SIGNATURE…………

P510/2

PHYSICS

PAPER2

2 ½ HOURS

TRINITY COLLEGE NABBINGO

END OF TERM I EXAMINATIONS

S.6 PHYSICS PAPER 2

TIME: 2 ½HOURS

INSTRUCTIONS

- *Attempt **five** questions with at least one from each section but not more than **one** in sections **A** and **B** not more than **two** questions from section **C** and **D**.*
- *The constant* $\frac{1}{4\pi\varepsilon_0} = 9.0\times10^9\ f^{-1}m$
- *The permeability of free space* $\mu_0 = 4\pi\times10^{-7}\ H/M$.

Turn Over

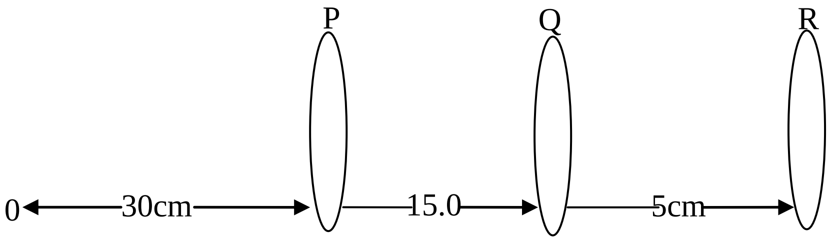
SECTION A

1. (a) Define the following terms as applied to a lens;

   (i) focal length *(1 mark)*
   (ii) principal focus *(1 mark)*
   (iii) conjugate points *(1 mark)*

   (b) Derive the lens formula for a thin diverging lens using a finite object. *(4 marks)*

   (c) Three lenses P, Q and R are arranged coaxially along a straight line. The focal length of the lenses are 20.0cm, 15.0cm and 5.0cm respectively. if the object is placed 30.0cm in front of P as shown.



   Determine the nature and position of the final image. *(7 marks)*

   (d) (i) Briefly describe how you would determine the focal length of a converging mirror using a convex lens. *(5 marks)*

   (ii) State two application of converging lens. *(1 mark)*

2. (a) Define the following terms;

   (i) Visual angle *(1 mark)*

   (ii) Angular magnification. *(1 mark)*

   (iii) Explain why poles of same size arranged in a straight line when viewed are seen having different sizes from the viewer? *(2 marks)*

   (b) (i) With aid of a ray diagram describe the structure and mode of action of a compound microscope in normal use. *(5 marks)*

   (ii) Use you diagram to the derive expression for the angular magnification. *(4 marks)*

   (c) A compound microscope consists of two thin converging lenses of focal length 3.0cm and 1.20cm respectively. An object is placed 5.0cm from the objective. If the final image is formed at the least distance of distinct vision. Calculate;

(i) the angular magnification *(3 marks)*
(ii) the separation of the lenses. *(3 marks)*

(d) What is an exit pupil? *(1 mark)*

SECTION B

3. (a) State ***three*** differences between sound and light waves. *(3 marks)*

(b) In Young's double slit experiment state what happens to the fringes.
(i) When the source is moved near the slit. *(1 mark)*
(ii) When the separation of the slits is changed. *(2 marks)*

(c) In Young's experiment, an interference pattern in which the tenth bright fringe was 3.4cm from the centre of the pattern was obtained. The distance between the slits and screen was 2.0m while the slit separation was 0.34mm. Find the wavelength of the source of light. *(3 marks)*

(d) Explain with aid of suitable diagrams the terms fundamental and overtone as applied to a vibrating wire fixed as both end. *(4 marks)*

(e) A stretched wire of length 0.75m is clamped at both ends and plucked in the middle. The fundamental note produced by the wire has the same frequency as the first overtone in a pipe of length 0.15m closed at one end.

(i) Sketch the standing wave pattern in the wire. *(1 mark)*

(ii) Calculate the tension in the wire. *(6 marks)*

(Speed of sound along the stretched wire is $\sqrt{(T/\delta)}$ where T – tension in were and δ - mass per unit length, speed of sound in air is 330m/s.

4. (a) (i) Derive the term amplitude, frequency and wavelength as applied to

wave motion. *(3 marks)*

(ii) Derive the relationship between velocity, wavelength and frequency of a wave. *(3 marks)*

(b) A plane progressive wave is given by $8Sin\left(100\pi t - \frac{10\pi}{9}x\right)$, where x and y are in cm and t in seconds.

(i) Write the equation of the progressive wave which would give rise to a stationary wave if super imposed on the above. *(1 mark)*

(ii) Find the equation of the stationary wave hence determine its amplitude of vibration. *(3 marks)*

(iii) Determine the frequency and velocity of the stationary wave. *(4 marks)*

(d) In an experiment to measure the speed of sound in air, a sounding tuning fork of given frequency is held over the air column.

The table results were recorded as shown below;

Resonance	512.0	480.0	426.0	384.0	320
Length of air Column (cm)	16.0	17.5	20.3	22.0	26.5

Plot a graph of l against $\frac{1}{f}$ and use it to determine the speed of sound in air.

SECTION C

5. (a) (i) What is meant by peak value and root mean square (cms) value of a sinusoidal current? *(2 marks)*

(ii) Show that the r.m.s value of an alternating current flowing through a resistance R is given by $I_{rms} = \frac{I_0}{\sqrt{2}}$ where I_0 = Peak value of current. *(3 marks)*

(b) (i) What is meant by the term capacitive reactance as applied to the flow of a.c? *(1 mark)*

(ii) Explain why an inductor heats up as the frequency of the a.c increases but a capacitor remains cool. *(3 marks)*

(c) An ideal capacitor of capacitance, C is connected to an a.c. source of current $I = I_0 Sinwt$ and frequency, *f*.

(i) Using the same axes, show how the applied voltage and the current in the circuit vary with time. Comment on the phase difference. *(3 marks)*

(ii) Sketch a phasor diagram to show the respective orientations of the voltage and current vectors in (c) (i) above. *(1 mark)*

(d) A 240V, 60Hz alternating voltage is applied across a capacitor of capacitance $10\mu F$. Calculate the;

(i) root mean square value of the current that flows. *(4 marks)*

(ii) power expended. *(1 mark)*

(iii) peak value of current. *(2 marks)*

6. (a) 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. *(1 mark)*

(ii) the centre of a circular cool of, N turns each of radius, R and carrying a current, *I*. *(1 mark)*

(iii) the center of an air- cored solenoid of *n* turns per metre each carrying a current, *I*. *(1 mark)*

(b) Sketch the magnetic field pattern around a vertical current carrying straight wire in the earth's magnetic field and use it to explain a neutral point in a magnetic field. *(4 marks)*

(c) What is meant by the terms;

(i) magnetic merdian? *(1 mark)*

(ii) angle of dip? *(1 mark)*

(d) Describe the construction and working of a moving coil galvanometer. *(6 marks)*

(e) A capacitor of capacitance 200 μF is fully charged to 10V. When the capacitor is discharged through a ballistic galvanometer, the galvanometer gives a maximum throw of 20 divisions. A coil of 25 turns, each of radius 10cm is placed with its plane perpendicular to a uniform magnetic field. The coil is connected in series with the ballistic galvanometer. When the coil is rotated through 180^0 the galvanometer gives a maximum throw of 15 divisions. Calculate the magnetic flux density, if the total resistance in the circuit is 3Ω. *(5 marks)*

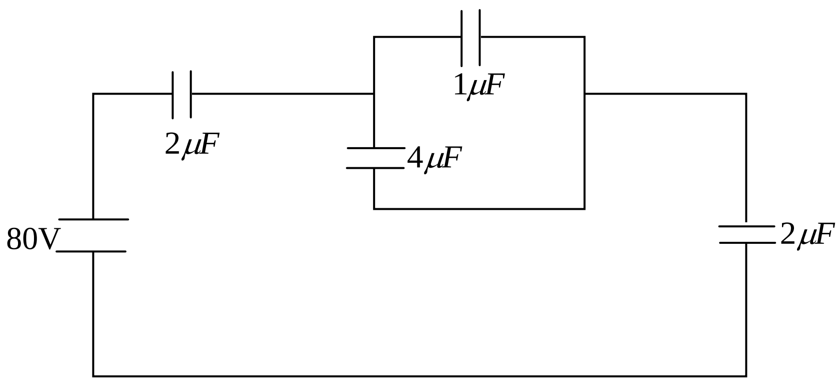
SECTION D

7. (a) What is a dielectric material? *(1 mark)*

(b) A capacitor filled with a dielectric is charged and then discharged through a galvanometer. The dielectric is then withdrawn half way and the capacitor charged to the same potential and discharged through the galvanometer again. Show that the relative permittivity $\varepsilon_r = \dfrac{I}{2I^1 - I}$. Where I and I^1 are the readings of the galvanometer respectively. *(6 marks)*

(c) Describe with the aid of a diagram how you would determine the capacitance of a capacitor using a ballistic galvanometer and another standard capacitor. *(5 marks)*

(d) The figure below shows a network of capacitor.



Calculate the;

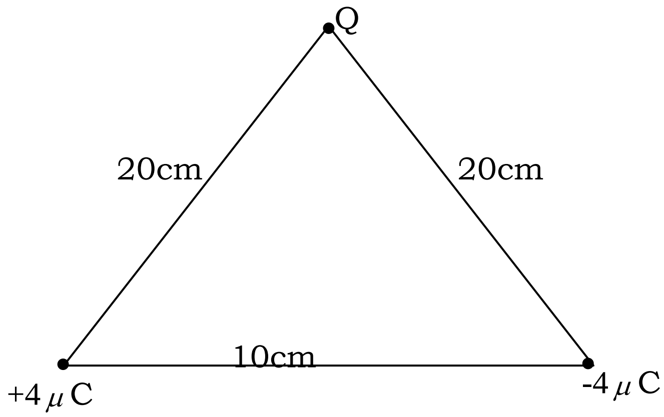
(i) Charge on the $4\mu F$ capacitor. *(5 marks)*

(ii) Energy stored in the $1\mu F$ capacitor. *(3 marks)*

8. (a) State Coulombs law of electrostatics. *(1 mark)*

(b) The electric field intensity of the surface of the earth is about $1.2\times10^{2} V/m$ and points towards the centre of the earth. Assuming that the earth is a spheres of radius $6.4\times10^{6} m$. Find the charge held by earth's surface. *(3 marks)*

(c) Two points charges +4.0 μC and -4.0 μC are separated by 10.0cm in air as shown below.



Find the electric field intensity at point Q. *(8 marks)*

(d) (i) What is meant by Corona discharge? *(4 marks)*

(ii) Explain how the lighting conductor works. *(4 marks)*

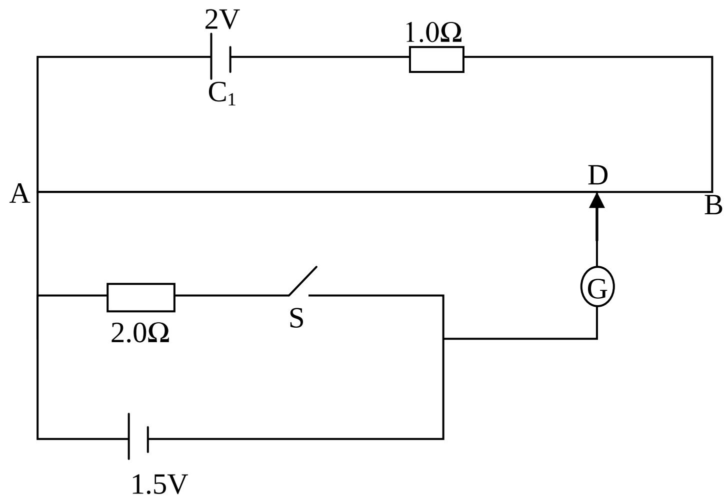
9. (a) Define electrical resistivity. *(1 mark)*

(b) (i) Draw a circuit diagram of a metre bridge. *(2 marks)*

(ii) Describe how the metre bridge may be used to measure the electrical resistivity of a material in the form of a wire. *(6 marks)*

(iii) A resistance coil is connected across the left hand gap of a metre bridge. When a 5.0Ω standard resistor is connected across the right hand gap of the metre bridge and the coil is immersed in an ice –water mixture, the balance point is at appoint 45.0cm from the left hand end of the bridge. When the coil is immersed in a steam bath at 100^{0}C, the balance point shifts to a point 52.8cm from the left hand end of the bridge. Find the temperature coefficient of the material at the coil. *(5 marks)*

(c) In the circuit shown below, AB is a uniform wire of length 1m and resistance 4.0Ω. C_1 is an accumulator of e.m.f. 2V and neglible internal resistance C_2 is a cell of e.m.f 1.5V.



(i) Find the balance length AD when the switch is open. *(2 marks)*

(ii) If the balance length is 75.0cm when the switch is closed. Find the internal resistance of C_2. *(4 marks)*

END