THE OPEN UNIVERSITY OF SRI LANKA
ADVANCED CERTIFICATES IN SCIENCE
TAF2526-PHYSICS – 4
FINAL EXAMINATION
DURATION – THREE HOURS

Date : 20th December 2021 Time :1.30-4.30 pm

Part -A

- The Question paper(Part A) consists of 25 multiple choice questions
- Answer all the questions
- Answers for the Multiple Choice Questions, should be provided by placing X in the relevant cage indicating the most appropriate answer in the MCQ answer sheet provided
- At the end of the examination you should submit the question paper with answer sheet.
- Maximum marks for this part is 40%.

$1/4\pi\varepsilon_0 = 9 \times 10^9\ NmC^{-2}$

Charge of the electron, $e = 1.6 \times 10^{-19}\ C$

(1).Two point charges $4\mu C$ and $3\mu C$ are 3 cm apart. What would be the force between them?

(1) 120 N (2) 300 N (3) 900 N (4) 1.2×10^{-6}N

(2). The electric field intensity at a point, distance 'r' from a point charge q is

(1) $\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$ (2) $\frac{1}{4\pi\varepsilon_0}\frac{q}{r}$ (3) $\frac{1}{4\pi\varepsilon_0}\frac{q^2}{r}$ (4) $\frac{1}{4\pi\varepsilon_0}\frac{q^2}{r^2}$ (5) 0

(3). There is a charged spherical conductor of radius 'a' having charge 'q'. what would be the electric field intensity '**E**' at a point distance '**r**' from its centre. **(r>a)**

(1) 0 (2) $\frac{1}{4\pi\varepsilon_0}\frac{q}{r}$ (3) $\frac{1}{4\pi\varepsilon_0}\frac{q}{r^2}$ (4) $\frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)^2}$ (5) $\frac{1}{4\pi\varepsilon_0}\frac{q}{(r-a)}$

(4)How many electrons will have a charge of one coulomb?

(1)5.2x10^{18} (2) 5.2 x 10^{20} (3) 6.2 x 10^{18} (4) 6.2 x10^{20} (5) 1.6 x 10^{19}

(5)A spherical Gaussian surface surrounds a point charge the following changes were made.

(A) The magnitude of the charge is increased

(B) The radius of the sphere was decreased

(C)The charge is split into several charges

Of the changes mentioned above, the net electric flux through the surface is changes only in

(1) (A) and (B) (2) only in (A) and (C) (3) only A (4) only B (5) all (A), (B) & (C)

(6). Two charged conducting spheres of radii R_1 and R_2Separated by a large distance are connected a long wire. The ratio of the charge on first and second sphere is,

(1) $\frac{R_1}{R_2}$(2) $\frac{R_2}{R_1}$(3) $\frac{R_1^2}{R_2^2}$(4)$\frac{R_2^2}{R_1^2}$(5) 1

(7)Force between two charges placed in vacuum is F. If the charges are placed, at the same separation, in a medium of relative permittivity 2, the force between them will be,

(1) F (2) 2 F (3) F/2 (4) 4 F

(8). A positively charged particle of mass **'m' (kg)** and charge **'q'(C)** travels from rest through a potential difference **2V** (V)'. Its kinetic energy is,

(1) qV (2)2qV (3) $\frac{mq}{V}$(4)$\frac{m}{qV}$ (5)$\frac{1}{2}mV^2$

(9)An isolated parallel plate capacitor filled with air is charged to a potential difference of V.If the space between the plates is then filled with a medium of dielectric constant 4,the potential difference will be,

(1) v/2 (2) v/4 (3) 4v (4) 2 v

(10)A given parallel plate capacitor is connected to a battery .Energy stored is E. When the emf of the battery is doubled the energy of the capacitors is ,

(1) E (2) E/2 (3) 2E (4) 4E

(11)The magnitude of the electric field on the surface of a sphere of radius **r** having a uniform surface charge density σ is,

(1) σ/ε_0 (2) $\sigma/2\varepsilon_0$ (3) $\sigma/\varepsilon_0 r$ (4) $\sigma/2\varepsilon_0$

(12)A point charge q is placed at the Centre of a sphere of radius r. The electric flux emerging from the sphere is,

(1) q/ε_0 (2) $q/4\pi\varepsilon_0 r^2$ (3) $q\,4\pi\varepsilon_0 r^2$ (4) q/r^2 (5) 0

(13). A charged particle of mass '**m**' and charge '**q**' is released from rest in a uniform electric field 'E'. The kinetic energy of the particle after (1) $\frac{2E^2r^2}{mq}$ (2) $\frac{Eq^2m}{2r^3}$ (3) $\frac{E^2q^2t^2}{2m}$ (4) $\frac{Eqm}{2t}$ (5) $\frac{Eq}{m}$

time **t** is

(14)Three capacitors of capacitance 2μF,3 μF and 6μF are connected in series to a 10V battery. What would be the charge on the 3 μF capacitor?

(1) 5 μC (2) 10 μC (3) 11 μC (4) 15μC (5) 12 μC

(15). A wire of resistance **R** is stretched till its length is increased to **3** times its original length. What is its new resistance?

(1) R (2)3 R (3) 9 R (4) $\frac{R}{3^2}$ (5) 12 R

(16)A long uniform wire of resistance R is cut into **n** number of pieces of equal length.These pieces are bundled together into composite wire of length that is equal to piece. The resistance of the composite wire is,

(1) R (2) n R (3) n^2R (4) R/n (5) R/n^2

(17). When current I Flows through a wire, the drift velocity of the electron is v. When current 3I flows through another wire of the same material having triple the length and area of cross-section, the drift velocity of the electron will be,

(1) V (2) V/2 (3) V/3 (4) 3V (5) 9V

(18) A wire has resistance 24 Ohm. It is bent in the form of a circle. The effective resistance between two points across a diameter is,

(1) 3 Ohm (2) 6 Ohm (3) 12 Ohm (4) 24 Ohm (5) 30 Ohm

(19) Three resistances each of R Ohm, are connected to form a triangle. The resistance between any two terminals is ,

(1) 3R Ohm (2) 2R Ohm (3) 2R/3 Ohm (4) 6R Ohm (5) 8R Ohm

(20).Sensitivity of a potentiometer can be increased by,

(1) Connecting a resistance in series with the wire

(2) Increasing the emf of the cell connected across the wire

(3) Reducing the area of cross-section of the wire

(4)Decreasing the length of the wire

(5) Sensitivity cannot be changed

(21) .A voltmeter of range 1 V has a resistance 1000 Ohm. To extend the range to 10 V, The additional series resistance required is,

(1) 9000 Ohm (2) 10,000. Ohm (3) 5000 Ohm (4) 1000/9 Ohm (5) 2000 Ohm

(22)A battery of 6V (r=0) is connected to the terminals of a 3m long uniform wire of resistance 100 Ω.The potential difference between two points separated by 50 cm on the wire is?

(1) 1v (2) 1.5 V (3) 2V (4) 3V (5) 4V

(23)A battery of an emf 1.5 V is connected across 5Ω resistor, the current through it is 0.2 A.The internal resistance of the battery is,

(1) 0.5Ω (2) 1.25Ω (3) 2.0 Ω (4) 2.5 Ω (5) 3.0 Ω

(24)Four resistors P,Q,R, and S ,having resistances 2,2,2,and 3 Ohm respectively are arranged to form a Wheaton's Bridge .The value of the resistance with which S must be shunted across a one of the above resistors in order to balance the bridge is,

(a)2 Ohm (b) 4 Ohm (c) 3 Ohm (d) 5 Ohm (5) 6 Ohm

(25) A flow of 10^7 electrons per seconds in a conductor. The current is,

(1)1.6×10^{-26} A (2) 1.6×10^{12} A (3) 1.6×10^{-12} (4) 1.6×10^{26}A (5) 1A

Part - B

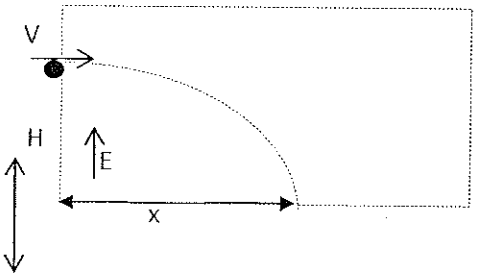
- **Answer any four (04) questions only.**
- **If more than (04) question are answered only the first four will be marked.**
- **Each question earns fifteen (15) marks, amounting to total of 60% marks.**
- **You have to show the steps involved in solving problems. No marks are awarded for the mere final answer without proper steps.**

(01)(a)State the Coulomb's Law in electric field. **(02 Marks)**

(b) Two charged particles of masses m and 2m have charges +2q and +q respectively. They are kept in uniform electric field of intensity E. They are kept away from each other and allowed to move for the same time. Find the ratio of their kinetic energies. **(06 Marks)**

(c) An electron of charge '-q' and mass 'm' is projected horizontally with the initial velocity V_0 into uniform electric field between two charged plates as shown in the figure.

Assume that the effect due to gravity is negligible and the electric field is directed vertically upward with intensity E.



(i) What would be the force acting on the electron by the electric field. **(01 Marks)**

(ii) What would be the acceleration of the electron. **(02 Marks)**

(iii) If the electron strikes the lower plate at point P, Find the distance x. **(04 Marks)**

(02) (a) Define (i) Electric field Intensity (ii) potential difference of two points in a field.

How they related. **(04 Marks)**

(b) Two plane parallel conducting plates 1.5 cm apart are held horizontal, one above the other in air.The upper plate is maintained at a positive potential of 1500 V.The lower plate is earthed.A small oil drop of mass 4.9×10^{-12} is remain stationary in the air.

(i) What are the forces acting on the oil drop. **(04 Marks)**

(neglect the up thrust inserted by air)

(ii) Calculate the number of electrons present in the oil drop. **(07 Marks)**

(3). Using Gauss' Law prove that the capacity two metal plates of area A placed at a distance d apart is $C = \epsilon_0 A/d$. **(04 Marks)**

This capacitor is then charged by connecting the plated to the terminals of a battery of e.m.f. E_0 and the space between the plated is filled with a material of dielectric constant ε_r. Calculate the charge on the plates. **(03 Marks)**

By moving one plate through a distance 'd' the space between the plates is doubled. There is no material between the moved plate and the upper surface of the dielectric. State whether the quantities given below will increase, decrease or remain constant.

(a). The potential difference between the plates.

(b). The charge on the plate

(c). Total capacity (d). Total energy

Explain the answer briefly in each cas **(08 Marks)**e.

(4)(a)Draw a labelled circuit diagram of a potentiometer arranged to measure a potential difference. Explain why no current flows through the galvanometer when the potentiometer is balanced. Why is a standard cell needed in order to measure the emf of another cell using potentiometer? (05 Marks)

(b)Describe, how potentiometer is used to compare the two resistances. (05 Marks)

(C)Potentiometer circuit consists of a cell of emf 2.0 V and potentiometer wire of length 100cm.Calculate the balance length of the potentiometer wire for a cell of emf 1.5V. (05 Marks)

(5)(a)A current I is passing through a moving coil galvanometer.Draw a graph to show how the galvanometer deflection θ varies with current I (02 Marks)

(b)A moving coil galvanometer has a resistance of 5 Ω and full scale deflection is produced by a current of 1.0 mA.

(i)How can this galvanometer be adopted for use as a ammeter reading up to 2A. (05 Marks)

(ii)How would you convert this galvanometer into voltmeter reading upto 10V? (05 Marks)

(c)Compare moving coil voltmeter with potentiometer. (03 Marks)

(6) (a)Define the "Visual angle" and "magnifying power" of a microscope. (03 Marks)

(b)A compound microscope is made up of two converging lenses of 3 and 9 cm focal lengths at separation of 24 cm.

(i)Where must be the object be placed so that the final image be at infinity? (05 Marks)

(ii)Determine the magnifying power of the microscope. (04 Marks)

(Assume that a person whose nearest distance of distinct vision 25 cm is using this)

(iii)Calculate the best position for the observers eye. (03 Marks)