Answer Key

+2 PHYSICS – ELECTROSTATICS – UNIT TEST 1

Part I

1	2	3	4	5	6	7	8	9	10
b	c	d	b	b	b	d	d	b	d
11	12	13	14						
d	a	c	c						

Part II

Q. No.	Content	Mark	Total
15	One coulomb is defined as the quantity of charge, which when placed at a distance of 1 metre in air or vacuum from an equal and similar charge, experiences a repulsive force of 9×10^9 N.	3	3
16	Electrostatic shielding it is the process of isolating a certain region of space from external field. It is based on the fact that electric field inside a conductor is zero.	2 1	3
17	The metal body of the bus provides electrostatic shielding, where the electric field is zero. During lightning the electric discharge passes through the body of the bus.	1 1 1	3
18	Polar Molecules explanation Eg. N_2O, H_2O, HCl, NH_3. Non polar molecule explanation. Example: O_2, N_2, H_2.	1 ½ 1 ½	3
19	The alignment of the dipole moments of the permanent or induced dipoles in the direction of applied electric field is called polarisation or electric polarisation.	3	3
20	Three Uses	3 x1	3
21	If all the points of a surface are at the same electric potential, then the surface is called an equipotential surface. If the charge is to be moved between any two points on an equipotential surface through any path, the work done is zero. Hemce electric lines of force must be normal to an equipotential surface	3	3
22	$E = \frac{\lambda}{2\pi\varepsilon_0 r}$ (or) $\lambda = E \times 2\pi\varepsilon_0 r$ Substitution $\lambda = 10^{-7}$ C m^{-1} (Answer + Unit)	1 1 ½+½	3
23	$\phi = \frac{q}{\varepsilon_0}$ $\phi = 10^6$ Nm^2C^{-1} Flux through each face $= \frac{10^6}{6}$ $=1.67 \times 10^5$ Nm^2C^{-1}	1 1 1	3

Part III

Q. No.	Content	Mark	Total
24	Five Properties	5 x 1	5
25	Diagram Explanation $dV = -E\,dx$ *and* $E = \frac{1}{4\pi\varepsilon_0}\frac{q}{x^2}$ The electric potential at the point P due to the charge $+q$ is the total work done in moving a unit positive charge from infinity to that point. $V = -\int_{\infty}^{r} \frac{q}{4\pi\varepsilon_0 x^2}.dx = \frac{q}{4\pi\varepsilon_0 r}$	1 1 1 1 1	5
26	Diagram Explanation $V = V_1+V_2+V_3$ $v_1 = \frac{q}{c_1}; v_2 = \frac{q}{c_2}; v_3 = \frac{q}{c_3}$ $v = \frac{q}{c_5}$ $\frac{1}{c_5} = \frac{1}{c_1} + \frac{1}{c_2} + \frac{1}{c_3}$	1 1 ½ 1 ½ 1	5
27	$E = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$ *Substitution & solving* q_1 *and* q_2 $q_1 = 8 \times 10^{-6}$ C , $q2 = -2 \times 10^{-6}$ C	1 3 1	5

	(OR) $C = \frac{\varepsilon_0 A}{D}$ Substitution $C = 3.186 \times 10^{-11}$ F Energy = $\frac{1}{2} CV^2$ Substitution Energy = 2.55×10^{-6} J	1 ½ 1 1 ½ 1	
28	Diagram Explanation τ = One of the forces x perpendicular distance between the forces $\tau = qE \times 2d \sin\theta = pE \sin\theta$ $\vec{\tau} = \vec{p} \times \vec{E}$	1 1 1 1 1	5

Part IV

29	Diagrams Explanation $E_1 = \frac{1}{4\pi\varepsilon_o} \frac{q}{(r^2+d^2)}$ along BP $E_2 = \frac{1}{4\pi\varepsilon_o} \frac{q}{(r^2+d^2)}$ along PA Resolving horizontal & vertical component explanation $E = E_1 \cos\theta + E_2 \cos\theta$ (along $\cos\theta = \frac{d}{\sqrt{r^2+d^2}}$ Upto $E = \frac{1}{4\pi\varepsilon_o} \frac{p}{r^3}$ The direction of E is along PR, directed opposite to the direction of dipole moment.	2 x 1 1 1 1 1 1 ½ 2 ½	10
30	Diagram Principle Construction Working Reducing leakage of charge used to accelerate positive ions (protons, deuterons) for the purpose of nuclear disintegration.	2 1 2 3 1 1	10
31	Gauss's law statement (i) Infinite long straight conductor Diagram Explanation The electric flux (φ) through curved surface = $\oint E\, ds \cos\theta$ (or) Total flux through the Gaussian	2 1 1 ½	10

	surface, φ = E. (2πrl) The net charge enclosed by Gaussian surface is, q = λl $E\,(2\pi rl) = \frac{\lambda l}{\varepsilon_o}$ or $E = \frac{\lambda}{2\pi\varepsilon_o r}$ (ii) Infinite charged plane sheet Diagram Explanation $\phi = \left[\oint E.ds\right]_p + \left[\oint E.ds\right]_{p^1}$ $= EA + EA = 2EA$ $\therefore E = \frac{\sigma}{2\varepsilon_o}$	½ 1 1 1 1 1	