INDIAN SCHOOL MUSCAT

HALF YEARLY EXAMINATION

SEPTEMBER 2019

SET C

CLASS XII

Marking Scheme – SUBJECT [THEORY]

Q.NO.	Answers	Marks (with split up)
1.	a	
2.	c	
3.	d	
4.	d	
5.	d	
6.	a	
7.	a	
8.	b	
9.	b	
10.	c	
11.	d	
12.	d	
13.	b	
14.	d	
15.	b	
16.	c	
17.	a	

18.	a	
19.	Inversely	
20.	Lorentz force	
21.	Derivation of expression for drift velocity of free electrons in a metallic conductor.	2
22.	For stable equilibrium $\theta_1 = 0^0$ For unstable equilibrium $\theta_2 = 180^0$ $W = pE (\cos \theta_1 – \cos \theta_2)$ $= pE (\cos 0^0 – \cos 180^0)$ $= 2pE$	 2
23.	$E_{net} = 10-4 =6$ V $I = 6/6 = 1A$ For charging $V = E + Ir$ $= 4 + 1x1 =5V$ OR $E=(E_1 r_2 + E_2 r_1)/ r_1 + r_2$ $= (1.5 \times 0.3 + 2 \times 0.2)/ 0.2 + 0.3$ $= 1.7$ V $r = r_1 r_2 /(r_1 + r_2)$ $=(0.2 \times 0.3)/(0.2 + 0.3)$ $= 0.12\ \Omega$	 1 1 1 1
24.	Using Gauss's Theorem $\oint \vec{E}.\vec{ds} = \frac{q(T)}{\varepsilon_0}$ Electric flux through sphere S_1, $\phi_1 = \frac{2(q)}{\varepsilon_0}$ Electric flux through sphere S_2, $\phi = \frac{(2Q + 4Q)}{\varepsilon_0} = \frac{6Q}{\varepsilon_0}$ Ratio $\frac{\phi_1}{\phi} = \frac{\frac{2Q}{\varepsilon_0}}{\frac{6Q}{\varepsilon_0}} = \frac{1}{3}$ If a medium of dielectric constant $K(= \varepsilon_r)$ is filled in the sphere S_1, electric flux through sphere, $\phi_1' = \frac{2Q}{\varepsilon_r \varepsilon_0} = \frac{2Q}{K\varepsilon_0}$	 1 1
25.	$V = \sqrt{3}\ H$ $\tan\theta = V/H$ $\theta = 60^0$	 1 1

26.	Derivation- current leads the voltage in phase by **π/2** in an a.c. circuit containing an ideal capacitor.	2
27.	Diagram Derivation of magnetic field in the interior of the solenoid. OR Diagram Derivation of magnetic field in the interior of the toroid.	½ 1½ ½ 1½
28.	(a) Capacitor (b) Curve A – Power Curve B - Voltage Curve C – Current (c) $X_C = 1/\omega C = 1/2\pi fC$ Graph between X_C and f	1 1 1
29.	(i) Derivation of torque experience by dipole in uniform electric field Diagram Derivation (ii) Resulting motion is combination of translational and rotational motion. OR (i) Definition of torque experience by dipole in uniform electric field Torque in vector form. (ii) Stable equilibrium $\theta = 0^0$ and diagram , $\tau = 0$ Unstable equilibrium $\theta = 180^0$ and diagram , $\tau = 0$	 ½ 1½ 1 ½ ½ ½ ½ ½ ½
30.	Charge on shell *A*, $q_A = 4\pi a^2\sigma$ Charge on shell *B*, $q_B = -4\pi b^2\sigma$ Charge of shell *C*, $q_C = 4\pi c^2\sigma$ Potential of shell *A*: Any point on the shell *A* lies inside the shells *B* and *C*. $V_A = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_A}{a} + \frac{q_B}{b} + \frac{q_C}{C}\right]$ $= \frac{1}{4\pi\varepsilon_0}\left[\frac{4\pi a^2\sigma}{a} - \frac{4\pi b^2\sigma}{b} + \frac{4\pi c^2\sigma}{c}\right]$ $= \frac{\sigma}{\varepsilon_0}(a - b + c)$ Any point on *B* lies outside the shell *A* and inside the shell *C*. Potential of shell *B*, $V_B = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_A}{b} + \frac{q_B}{b} + \frac{q_C}{c}\right]$ $= \frac{1}{4\pi\varepsilon_0}\left[\frac{4\pi a^2\sigma}{b} - \frac{4\pi b^2\sigma}{b} + \frac{4\pi c^2\sigma}{c}\right] = \frac{\sigma}{\varepsilon_0}\left[\frac{a^2}{b} - b + c\right]$ Any point on shell *C* lies outside the shells *A* and *B*. Therefore, potential of shell *C*. $V_C = \frac{1}{4\pi\varepsilon_0}\left[\frac{q_A}{c} + \frac{q_B}{b} + \frac{q_C}{c}\right]$ $= \frac{1}{4\pi\varepsilon_0}\left[\frac{4\pi a^2\sigma}{c} - \frac{4\pi b^2\sigma}{c} + \frac{4\pi c^2\sigma}{c}\right]$ $= \frac{\sigma}{\varepsilon_0}\left[\frac{a^2}{c} - \frac{b^2}{c} + c\right]$ Now, we have $V_A = V_C$ $\frac{\sigma}{\varepsilon_0}(a - b + c) = \frac{\sigma}{\varepsilon_0}\left(\frac{a^2}{c} - \frac{b^2}{c} + c\right)$ $a - b = \frac{(a-b)(a+b)}{c}$ or $a + b = c$	 1 1 1

31.	Potentiometer: Circuit diagram Principle Method for to compare the emfs of the two cells. OR Meter bridge: Circuit diagram Principle Determination the unknown resistance of a given wire	 ½ ½ 2 ½ ½ 2
32.	Difference between diamagnetic and ferromagnetic materials in respect of their (i) intensity of magnetization (ii) behavior in non uniform magnetic field and (iii) susceptibility	1,1,1
33.	(i) Given $V = V_0 \sin(1000t + \phi)$ $\omega = 1000\ s^{-1}$ Given, $L = 100$ mH $C = 2\ \mu F$ $R = 400\ \Omega$ Phase difference $\phi = \tan^{-1}(\frac{X_L - X_C}{R})$ $X_L = \omega L = 1000 \times 100 \times 10^{-3} = 100\ \Omega$ $X_C = \frac{1}{\omega C} = \frac{1}{1000 \times 2 \times 10^{-6}} = 500\ \Omega$ $\phi = \tan^{-1}(\frac{100-500}{400}) = \tan^{-1}(-1)$ $\phi = -45^0$ and the current is leading the voltage. (ii) For power factor to be unity, $R = Z$ or $X_L = X_C$ $\omega^2 = \frac{1}{LC}$ (C = resultant capacitance) $10^6 = \frac{1}{100 \times 10^{-3} \times C'}$ $\Rightarrow C' = 10^{-5}$ F For two capacitance in parallel, resultant capacitance $C' = C + C_1$ $10^{-5} = 0.2 \times 10^{-5} + C_1$ $\Rightarrow C_1 = 8\ \mu F$	 ½ ½ ½ ½ ½ ½

34.	Vertical component of earth magnetic field $V = B_e \sin\theta$ v = 1800km/h = 500 m/s Induced emf $\varepsilon = Vvl = (B_e \sin\theta)\, vl$ $= (\mathbf{5 \times 10^{-4}} \times 0.5) \times 500 \times 25 = 3.1$ V	 1 2
35.	(i) Definition mutual inductance and its SI unit. (ii) Derivation of mutual induction between of two long co-axial solenoids of same length wound one over the other. $M = (\mu_0 N_1 N_2 \pi r^2)/L$ Any two factors on which mutual inductance depend. OR (i) Definition self inductance and its SI unit. (ii) Derivation of expression self induction of long solenoid. Any two factors on which self inductance depend.	1,½ 2½ ½ ½ 1,½ 2½ ½ ½
36.	(i) Derivatyion of PE stored per unit volume $u_e = ½\, \varepsilon_0 E^2$ (ii) $C_s = 2/3\ C$ $C_P = 3C$ $½\, C_s V_s^2 = ½\, C_p V_p$ $V_p / V_s = \sqrt{2/3}$ OR (i) Definition of capacitance & derivation of $C_0 = \varepsilon_0 A/d$ (ii) Capacitance of a capacitor without dielectric is given by: $C_o = \frac{\varepsilon_o A}{d}$ ..... (i) Capacitance of capacitor when its plates are partly filled with dielectric of thickness t and of same area as the plates is $C = \frac{\varepsilon_o A}{d - t\left(1 - \frac{1}{K}\right)}$ Here, $t = \frac{3d}{4}$ $C = \frac{\varepsilon_o A}{d - \frac{3d}{4}\left(1 - \frac{1}{K}\right)} = \frac{\varepsilon_o A}{\frac{dK + 3d}{4K}} = \frac{\varepsilon_o A(4K)}{dK + 3d}$ $= \frac{\varepsilon_o A(4K)}{d(K+3)} = \frac{4K}{(K+3)} \times \frac{\varepsilon_o A}{d}$ Therefore, the ratio of the capacitance with dielectric inside it to its capacitance without the dielectric is $\frac{C_o}{C} = \frac{\frac{4K}{(K+3)} \times \frac{\varepsilon_o A}{d}}{\frac{\varepsilon_o A}{d}} = \frac{4K}{(K+3)}$	3 2 ½ .21/2

		2
37.	Moving coil galvanometer: Diagram Principle working Function of uniform radial magnetic field Function of soft iron core Definition of (i) current sensitivity and (ii) voltage sensitivity of a galvanometer. OR Cyclotron: Diagram Principle working Show that the period of a revolution of an ion is independent of its speed or radius of the orbit Any two uses of Cyclotron	 ½ ½ 1½ ½ ½ ½ ½ ½ 1 2 ½ ½