Genesis Educates | "There is no element of genius Without some form of madness"

QUESTION BANK

PHYSICS MARATHON

8^{th} and 9^{th} Dec 2021

1. When is the angle of dip at a place equal to 45^o?
   a) When the vertical and horizontal components of earth's magnetic field are equal
   b) When the vertical component is twice the horizontal component of earth's magnetic field
   c) When the vertical component is half the horizontal component of earth's magnetic field
   d) When either the vertical component or the horizontal components of earth's magnetic field is equal to zero
2. An electron of charge e moves in a circular orbit of radius r around the nucleus at a frequency v. The magnetic moment associated with the orbital motion of the electron is
   (a) πver^2 (b) $\pi vr^2/e$
   (c) $\pi ve/r$ (d) $\pi vr^2/v$
3. There are two charges +1 microcoulombs and +5 micro coulombs. The ratio of the forces acting on them will be
   (a) 1 : 5 (b) 1 : 1
   (c) 5 : 1 (d) 1 : 25
4. A total charge Q is broken in two parts Q_1 and Q_2 and they are placed at a distance R from each other. The maximum force of repulsion between them will occur, when
   (a) $Q_2 = \frac{Q}{R}, Q_1 = Q - \frac{Q}{R}$ (b) $Q_2 = \frac{Q}{4}, Q_1 = Q - \frac{2Q}{3}$
   (c) $Q_2 = \frac{Q}{4}, Q_1 = \frac{3Q}{4}$ (d) $Q_1 = \frac{Q}{2}, Q_2 = \frac{Q}{2}$
5. Two small conducting spheres of equal radius have charges $+10\mu C$ and $-20\mu C$ respectively and placed at a distance R from each other experience force F_1. If they are brought in contact and separated to the same distance, they experience force F_2. The ratio of F_1 to F_2 is
   (a) 1 : 8 (b) – 8 : 1

(c) 1 : 2 (d) – 2 : 1

6. Two point charges placed at a certain distance r in air exert a force F on each other. Then the distance r' at which these charges will exert the same force in a medium of dielectric constant k is given by

(a) r (b) r/k

(c) $r/\sqrt{k}$ (d) $r\sqrt{k}$

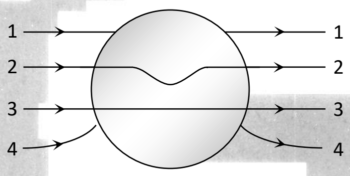
7. Two free point charges +q and +4q are placed a distance x apart. A third charge is so placed that all the three charges are in equilibrium. Then
 (a) unknown charge is -4q/9
 (b) unknown charge is -9q/4
 (c) It should be at (x/3) from smaller charge between them
 (d) both a and c

8. A particle of mass m and charge q is placed at rest in a uniform electric field E and then released. The kinetic energy attained by the particle after moving a distance y is

(a) qEy^2 (b) qE^2y

(c) qEy (d) q^2Ey

9. A metallic solid sphere is placed in a uniform electric field. The lines of force follow the path(s) shown in figure as



(a) 1 (b) 2

(c) 3 (d) 4

10. An electron of mass m_e initially at rest moves through a certain distance in a uniform electric field in time t_1. A proton of mass m_p also initially at rest takes time t_2 to move through an equal distance in this uniform electric field. Neglecting the effect of gravity, the ratio of t_2/t_1 is nearly equal to

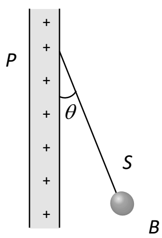
(a) 1 (b) $(m_p/m_e)^{1/2}$

(c) $(m_e/m_p)^{1/2}$ (d) 1836

11. A charged ball B hangs from a silk thread S, which makes an angle θ with a large charged conducting sheet P, as shown in the figure. The surface charge density σ of the sheet is proportional to

(a) $\sin\theta$ (b) $\tan\theta$

(c) $\cos\theta$ (d) $\cot\theta$

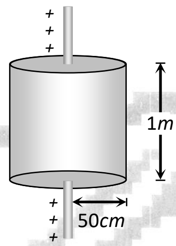


12. Electric charges $q, q, -2q$ are placed at the corners of an equilateral triangle ABC of side l. The magnitude of electric dipole moment of the system is

(a) ql (b) $2ql$

(c) $\sqrt{3}ql$ (d) $4ql$

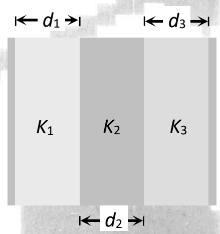
13. Electric charge is uniformly distributed along a long straight wire of radius 1*mm*. The charge per *cm* length of the wire is *Qcoulomb*. Another cylindrical surface of radius 50 *cm* and length 1*m* symmetrically encloses the wire as shown in the figure. The total electric flux passing through the cylindrical surface is



(a) $\frac{Q}{\varepsilon_0}$ (b) $\frac{100\,Q}{\varepsilon_0}$

(c) $\frac{10\,Q}{(\pi\varepsilon_0)}$ (d) $\frac{100\,Q}{(\pi\varepsilon_0)}$

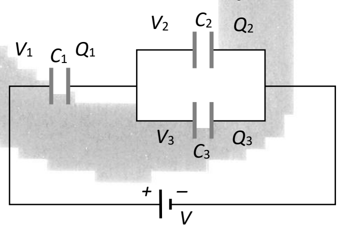
14. The expression for the capacity of the capacitor formed by compound dielectric placed between the plates of a parallel plate capacitor as shown in figure, will be (area of plate $= A$)



(a) $\frac{\varepsilon_0 A}{\left(\frac{d_1}{K_1}+\frac{d_2}{K_2}+\frac{d_3}{K_3}\right)}$ (b) $\frac{\varepsilon_0 A}{\left(\frac{d_1+d_2+d_3}{K_1+K_2+K_3}\right)}$

(c) $\frac{\varepsilon_0 A(K_1K_2K_3)}{d_1d_2d_3}$ (d) $\varepsilon_0\left(\frac{AK_1}{d_1}+\frac{AK_2}{d_2}+\frac{AK_3}{d_3}\right)$

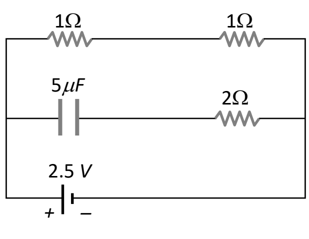
15. In an adjoining figure are shown three capacitors C_1, C_2 and C_3 joined to a battery. The correct condition will be (Symbols have their usual meanings)



(a) $Q_1 = Q_2 = Q_3$ and $V_1 = V_2 = V_3 = V$ (b) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2 + V_3$

(c) $Q_1 = Q_2 + Q_3$ and $V = V_1 + V_2$ (d) $Q_2 = Q_3$ and $V_2 = V_3$

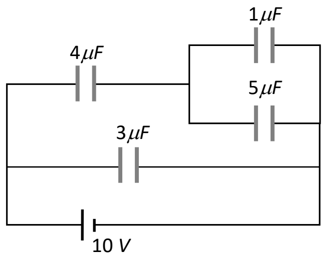
16. A capacitor of capacitance $5\,\mu F$ is connected as shown in the figure. The internal resistance of the cell is 0.5Ω. The amount of charge on the capacitor plate is



(a) $0\,\mu C$ (b) $5\,\mu C$

(c) $10\,\mu C$ (d) $25\,\mu C$

17. The charge on 4 μF capacitor in the given circuit is .... in μC



(a) 12 (b) 24

(c) 36 (d) 32

18. If n, e, τ and m respectively represent the density, charge relaxation time and mass of the electron, then the resistance of a wire of length l and area of cross-section A will be

(a) $\frac{ml}{ne^2\tau A}$ (b) $\frac{m\tau^2 A}{ne^2 l}$

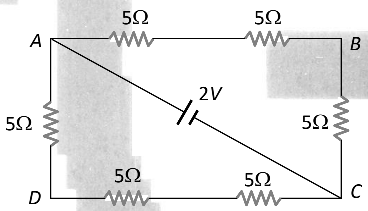
(c) $\frac{ne^2\tau A}{2ml}$ (d) $\frac{ne^2 A}{2m\tau l}$

19. The resistance of a conductor is 5 *ohm* at 50°*C* and 6 *ohm* at 100°*C*. Its resistance at 0°*C* is

(a) 1 *ohm* (b) 2 *ohm*

(c) 3 *ohm* (d) 4 *ohm*

20. The potential difference between points A and B of adjoining figure is



(a) $\frac{2}{3}V$ (b) $\frac{8}{9}V$

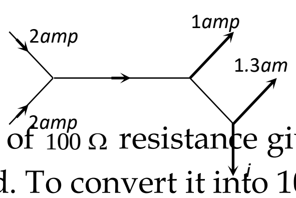
(c) $\frac{4}{3}V$ (d) $2\,V$

21. The electric field *E*, current density *J* and conductivity σ of a conductor are related as

(a) $\sigma = E/j$ (b) $\sigma = j/E$

(c) $\sigma = jE$ (d) $\sigma = 1/jE$

22. The figure below shows currents in a part of electric circuit. The current *i* is



(a) 1.7 *amp* (b) 3.7 *amp*

(c) 1.3 *amp* (d) 1 *amp*

23. A galvanometer of $100\,\Omega$ resistance gives full scale deflection when 10 *mA* of current is passed. To convert it into 10 *A* range ammeter, the resistance of the shunt required will be

(a) $-10\,\Omega$ (b) $1\,\Omega$

(c) $0.1\,\Omega$ (d) $0.01\,\Omega$

24. $100\ mA$ current gives a full scale deflection in a galvanometer of $2\,\Omega$ resistance. The resistance connected with the galvanometer to convert it into a voltmeter to measure $5\,V$ is

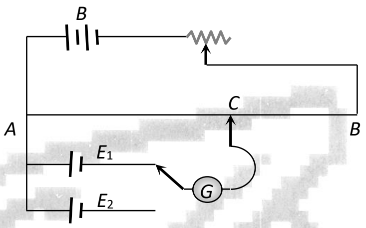
(a) $98\,\Omega$ (b) $52\,\Omega$

(c) $50\,\Omega$ (d) $48\,\Omega$

25. The circuit shown here is used to compare the e.m.f. of two cells E_1 and $E_2 (E_1 > E_2)$. The null point is at *C* when the galvanometer is connected to E_1. When the galvanometer is connected to E_2, the null point will be

(a) To the left of *C* (b) To the right of *C*

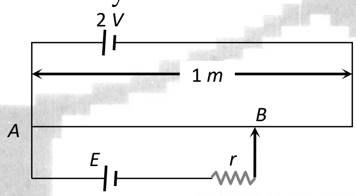
(c) At *C* itself (d) Nowhere on *AB*



26. In the given figure, battery *E* is balanced on 55 *cm* length of potentiometer wire but when a resistance of 10 Ω is connected in parallel with the battery then it balances on 50 *cm* length of the potentiometer wire then internal resistance *r* of the battery is

(a) 1 Ω (b) 3 Ω

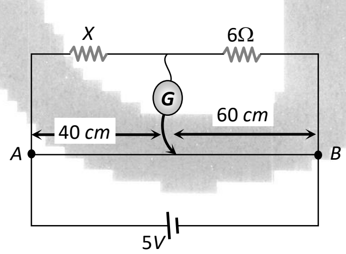
(c) 10 Ω (d) 5 Ω



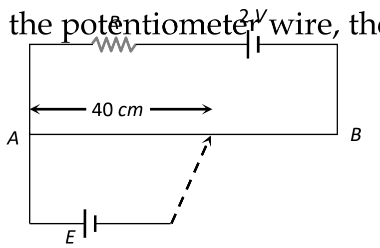
27. In the circuit shown, a *meter* bridge is in its balanced state. The *meter* bridge wire has a resistance 0.1 *ohm*/*cm*. The value of unknown resistance *X* and the current drawn from the battery of negligible resistance is

(a) 6 Ω, 5 *amp* (b) 10 Ω, 0.1 *amp*

(c) 4 Ω, 1.0 *amp* (d) 12 Ω, 0.5 *amp*



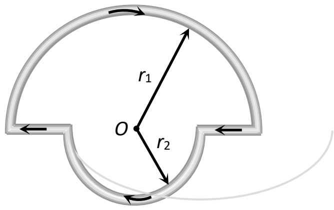
28. *AB* is a potentiometer wire of length 100 *cm* and its resistance is 10 *ohms*. It is connected in series with a resistance *R* = 40 *ohms* and a battery of e.m.f. 2 *V* and negligible internal resistance. If a source of unknown e.m.f. *E* is balanced by 40 *cm* length of the potentiometer wire, the value of *E* is



(a) 0.8 *V* (b) 1.6 *V*

(c) 0.08 *V* (d) 0.16 *V*

29. In the figure shown there are two semicircles of radii r_1 and r_2 in which a current i is flowing. The magnetic induction at the centre O will be



(a) $\frac{\mu_0 i}{r}(r_1+r_2)$ (b) $\frac{\mu_0 i}{4}(r_1-r_2)$

(c) $\frac{\mu_0 i}{4}\left(\frac{r_1+r_2}{r_1 r_2}\right)$ (d) $\frac{\mu_0 i}{4}\left(\frac{r_2-r_1}{r_1 r_2}\right)$

30. The magnetic field B with in the solenoid having n turns per metre length and carrying a current of i *ampere* is given by

(a) $\frac{\mu_0 ni}{e}$ (b) $\mu_0 ni$

(c) $4\pi\mu_0 ni$ (d) ni

31. The charge on a particle Y is double the charge on particle X. These two particles X and Y after being accelerated through the same potential difference enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of the mass of X to that of Y is

(a) $\left(\frac{2R_1}{R_2}\right)^2$ (b) $\left(\frac{R_1}{2R_2}\right)^2$

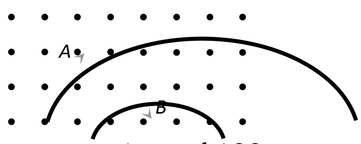
(c) $\frac{R_1^2}{2R_2^2}$ (d) $\frac{2R_1}{R_2}$

32. A proton, a deuteron and an α – particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If r_p, r_d and r_α denote respectively the radii of the trajectories of these particles, then

(a) $r_\alpha = r_p < r_d$ (b) $r_\alpha > r_d > r_p$

(c) $r_\alpha = r_d > r_p$ (d) $r_p = r_d = r_\alpha$

33. Two particles A and B of masses m_A and m_B respectively and having the same charge are moving in a plane. A uniform magnetic field exists perpendicular to this plane. The speeds of the particles are v_A and v_B respectively, and the trajectories are as shown in the figure. Then



(a) $m_A v_A < m_B v_B$ (b) $m_A v_A > m_B v_B$

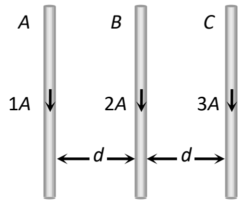
(c) $m_A < m_B$ and $v_A < v_B$ (d) $m_A = m_B$ and $v_A = v_B$

34. The coil of a galvanometer consists of 100 turns and effective area of 1 *square cm*. The restoring couple is $10^{-8}\ N-m/radian$. The magnetic field between the pole pieces is 5 T. The current sensitivity of this galvanometer will be

(a) $5\times10^4\ rad/\mu amp$ (b) 5×10^{-6} *per amp*

(c) 2×10^{-7} *per amp* (d) $5\ rad/\mu amp$

35. There long straight wires *A*, *B* and *C* are carrying current as shown figure. Then the resultant force on *B* is directed.....



(a) Towards *A* (b) Towards *C*

(c) Perpendicular to the plane of paper and outward

(d) Perpendicular to the plane of paper and inwards

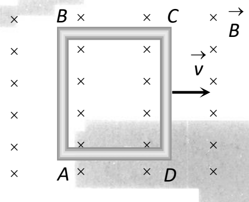
36. Magnetic flux ϕ (in *weber*) linked with a closed circuit of resistance 10 *ohm* varies with time *t* (in seconds) as $\phi = 5t^2 - 4t + 1$

The induced electromotive force in the circuit at t = 0.2 *sec.* is

(a) 0.4 *volts* (b) – 0.4 *volts*

(c) – 2.0 *volts* (d) 2.0 *volts*

37. A conducting square loop of side *L* and resistance *R* moves in its plane with a uniform velocity *v* perpendicular to one of its sides. A magnetic induction *B* constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere. The current induced in the loop is



(a) $\frac{Blv}{R}$ clockwise (b) $\frac{Blv}{R}$ anticlockwise

(c) $\frac{2Blv}{R}$ anticlockwise (d) Zero

38. If a current of 3.0 *amperes* flowing in the primary coil is reduced to zero in 0.001 *second*, then the induced e.m.f. in the secondary coil is 15000 *volts.* The mutual inductance between the two coils is

(a) 0.5 *henry* (b) 5 *henry*

(c) 1.5 *henry* (d) 10 *henry*

39. The self inductance of a solenoid of length *L*, area of cross-section *A* and having *N* turns is

(a) $\frac{\mu_0 N^2 A}{L}$ (b) $\frac{\mu_0 NA}{L}$

(c) $\mu_0 N^2 LA$ (d) $\mu_0 NAL$

40. The core of a transformer is laminated to reduce energy losses due to

(a) Eddy currents (b) Hysteresis

(c) Resistance in winding (d)None of these

41. In a transformer 220 ac voltage is increased to 2200 *volts*. If the number of turns in the secondary are 2000, then the number of turns in the primary will be

(a) 200 (b) 100

(c) 50 (d) 20

42. The ratio of secondary to the primary turns in a transformer is 3 : 2. If the power output be *P*, then the input power neglecting all loses must be equal to

(a) 5 *P* (b) 1.5 *P*

(c) *P* (d) $\frac{2}{5}P$

43. In an ac circuit, *V* and *I* are given by $V = 100 \sin (100\, t)$ *volts*, $I = 100 \sin\left(100\,t + \frac{\pi}{3}\right) mA$. The power dissipated in circuit is

(a) 10^4 *watt* (b) 10 *watt*

(c) 2.5 *watt* (d) 5 *watt*

44. In an ac circuit $I = 100 \sin 200\,\pi t$. The time required for the current to achieve its peak value will be

(a) $\frac{1}{100}\,sec$ (b) $\frac{1}{200}\,sec$

(c) $\frac{1}{300}\,sec$ (d) $\frac{1}{400}\,sec$

45. A resistance of 300 Ω and an inductance of $\frac{1}{\pi}$ henry are connected in series to a ac voltage of 20 *volts* and 200 *Hz* frequency. The phase angle between the voltage and current is

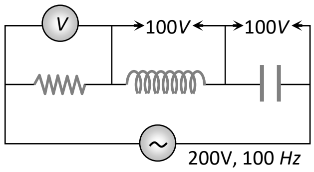
(a) $\tan^{-1}\frac{4}{3}$ (b) $\tan^{-1}\frac{3}{4}$

(c) $\tan^{-1}\frac{3}{2}$ (d) $\tan^{-1}\frac{2}{5}$

46. In the circuit given below, what will be the reading of the voltmeter

(a)300 *V* (b)900 *V*

(c)200 *V* (d)400 *V*



47. The figure shows variation of *R*, X_L and X_C with frequency *f* in a series *L*, *C*, *R* circuit. Then for what frequency point, the circuit is inductive

(a) *A* (b) *B*

(c) *C* (d) All points