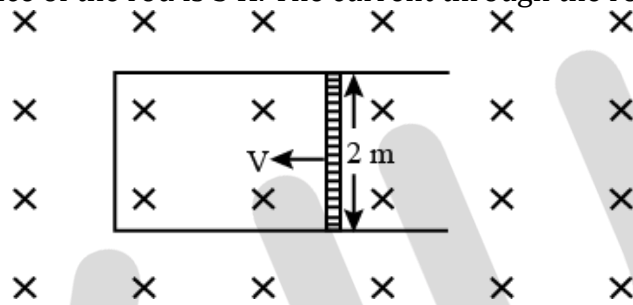
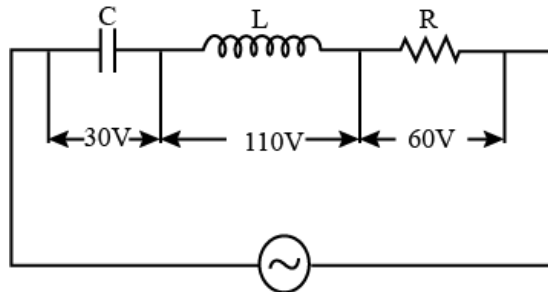


1. In a permanent magnet at room temperature
  - a. Domains are all perfectly aligned.
  - b. Magnetic moment of each molecule is zero.
  - c. The individual molecules have non-zero magnetic moment which are all perfectly aligned.
  - d. Domains are partially aligned.
  
2. A rod of length 2 m slides with a speed of  $5 \text{ ms}^{-1}$  on a rectangular conducting frame as shown in figure. There exists a uniform magnetic field of 0.04 T perpendicular to the plane of the figure. If the resistance of the rod is  $3 \Omega$ . The current through the rod is



- a. 1.33 A
  - b. 75 mA
  - c. 133 mA
  - d. 0.75 A
3. The ratio of magnetic field at the centre of a current carrying circular coil to its magnetic moment is 'x'. If the current and the radius both are doubled. The new ratio will become
    - a.  $\frac{x}{8}$
    - b.  $2x$
    - c.  $4x$
    - d.  $\frac{x}{4}$
  
  4. In the given circuit the peak voltages across C, L and R are 30 V, 110 V and 60 V respectively. The rms value of the applied voltage is



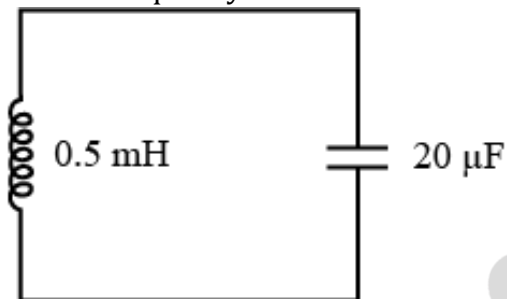
- a. 141 V
- b. 100 V
- c. 200 V
- d. 70.7 V

# KCET-2020 (Physics)

B

5. The power factor of R-L circuit is  $\frac{1}{\sqrt{3}}$ . If the inductive reactance is  $2 \Omega$ . The value of resistance is
- $\frac{1}{\sqrt{2}} \Omega$
  - $2 \Omega$
  - $\sqrt{2} \Omega$
  - $0.5 \Omega$

6. In the given circuit, the resonant frequency is



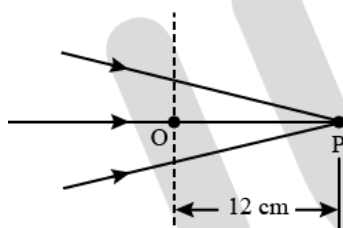
- $15910 \text{ Hz}$
  - $15.92 \text{ Hz}$
  - $159.2 \text{ Hz}$
  - $1592 \text{ Hz}$
7. The current in a coil of inductance  $0.2 \text{ H}$  changes from  $5 \text{ A}$  to  $2 \text{ A}$  in  $0.5 \text{ sec}$ . The magnitude of the average induced emf in the coil is
- $0.3 \text{ V}$
  - $0.6 \text{ V}$
  - $1.2 \text{ V}$
  - $30 \text{ V}$
8. An object approaches a convergent lens from the left of the lens with a uniform speed  $5 \frac{\text{m}}{\text{s}}$  and stops at the focus, the image
- Moves towards the lens with a non-uniform acceleration.
  - Moves away from the lens with uniform speed  $5 \frac{\text{m}}{\text{s}}$ .
  - Moves away from the lens with uniform acceleration.
  - Moves away from the lens with a non-uniform acceleration.
9. The refracting angle of a prism is  $A$  and refractive index of material of prism is  $\cot \frac{A}{2}$ . The angle of minimum deviation is
- $180^\circ - 2A$
  - $180^\circ - 3A$
  - $180^\circ + 2A$
  - $90^\circ - A$
10. A light beam of intensity  $20 \frac{\text{W}}{\text{cm}^2}$  is incident normally on a perfectly reflecting surface of sides  $25 \text{ cm} \times 15 \text{ cm}$ . The momentum imparted to the surface by the light per second is
- $1.2 \times 10^{-5} \text{ kg ms}^{-1}$
  - $2 \times 10^{-5} \text{ kg ms}^{-1}$
  - $1 \times 10^{-5} \text{ kg ms}^{-1}$
  - $5 \times 10^{-5} \text{ kg ms}^{-1}$

# KCET-2020 (Physics)

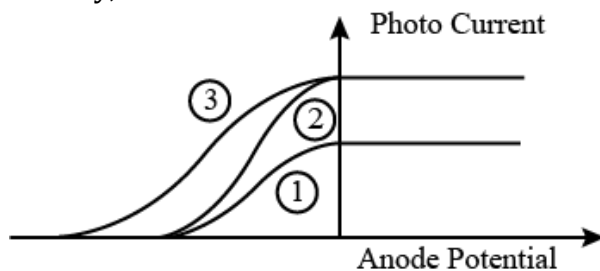


11. Three polaroid sheets  $P_1, P_2$  and  $P_3$  are kept parallel to each other such that the angle between pass axes of  $P_1$  and  $P_2$  is  $45^\circ$  and that between  $P_2$  and  $P_3$  is  $45^\circ$ . If unpolarised beam of light of intensity  $128 \text{ W m}^{-2}$  is incident on  $P_1$ . What is the intensity of light coming out of  $P_3$ ?
- a.  $64 \text{ W m}^{-2}$                       b.  $128 \text{ W m}^{-2}$   
 c. 0                                      d.  $16 \text{ W m}^{-2}$
12. Two poles are by a distance of 3.14 m. The resolving power of human eye is 1 minute of an arc. The maximum distance from which he can identify the two poles distinctly is
- a. 376 m                                  b. 10.8 km  
 c. 5.4 km                                  d. 188 m

13. The following figure shows a beam of light converging at point P. When a concave lens of focal length 16 cm is introduced in the path of the beam at a place shown by dotted line such that OP becomes the axis of the lens, the beam converges at a distance  $x$  from the lens. The value of  $x$  will be equal to



- a. 48 cm                                  b. 12 cm  
 c. 24 cm                                  d. 36 cm
14. The de-Broglie wavelength associated with electron of hydrogen atom in this ground state is
- a.  $10 \text{ \AA}$                                   b.  $0.3 \text{ \AA}$   
 c.  $3.3 \text{ \AA}$                                   d.  $6.26 \text{ \AA}$
15. The following graph represents the variation of photo current with anode potential for a metal surface. Here  $I_1, I_2$  and  $I_3$  represents intensities and  $\gamma_1, \gamma_2, \gamma_3$  represent frequency for curves 1, 2 and 3 respectively, then



- a.  $\gamma_2 = \gamma_3$  and  $I_1 = I_3$                       b.  $\gamma_1 = \gamma_2$  and  $I_1 \neq I_2$   
 c.  $\gamma_1 = \gamma_3$  and  $I_1 = I_3$                       d.  $\gamma_1 = \gamma_2$ , and  $I_1 = I_2$
16. In Young's Double Slit Experiment, the distance between the slits and the screen is 1.2 m and the distance between the two slits is 2.4 mm. If a thin transparent mica sheet of thickness

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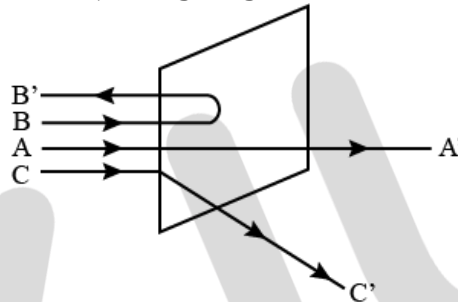
$1 \mu\text{m}$  and  $R.I.$  1.5 is introduced between one of the interfering beams, the shift in the position of central bright fringe is

- a. 0.25 mm
- b. 2 mm
- c. 0.5 mm
- d. 0.125 mm

17. Angular momentum of an electron in hydrogen atom is  $\frac{3h}{2\pi}$  ( $h$  is the Planck's constant). The K.E. of the electron is

- a. 6.8 eV
- b. 4.35 eV
- c. 1.51 eV
- d. 3.4 eV

18. A beam of fast-moving alpha particles were directed towards a thin film of gold. The parts A, B and C of the transmitted and reflected beams corresponding to the incident parts A, B and C of the beam are shown in the adjoining diagram. The number of alpha particles in



- a. C' will be minimum and in B' maximum
- b. B' will be minimum and in C' maximum
- c. A' will be maximum and in B' minimum
- d. A' will be minimum and in B' maximum

19. The period of revolution of an electron revolving in  $n^{\text{th}}$  orbit of H-atom is proportional to

- a. Independent of  $n$
- b.  $n^2$
- c.  $\frac{1}{n}$
- d.  $n^3$

20. During a  $\beta^-$  decay

- a. A proton in the nucleus decays emitting an electron.
- b. An atomic electron is ejected.
- c. An electron which is already present within the nucleus is ejected.
- d. A neutron in the nucleus decays emitting an electron.

21. A radio-active element has half-life of 15 years. What is the fraction that will decay in 30 years?

- a. 0.85
- b. 0.25
- c. 0.5
- d. 0.75

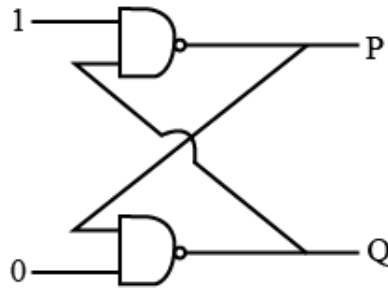
# KCET-2020 (Physics)



22. Two protons are kept at a separation of 10 nm. Let  $F_n$  and  $F_e$  be the nuclear force and the electromagnetic force between them

- a.  $F_e$  and  $F_n$  differ only slightly
- b.  $F_e = F_n$
- c.  $F_e \gg F_n$
- d.  $F_e \ll F_n$

23. In the following circuit what are P and Q:

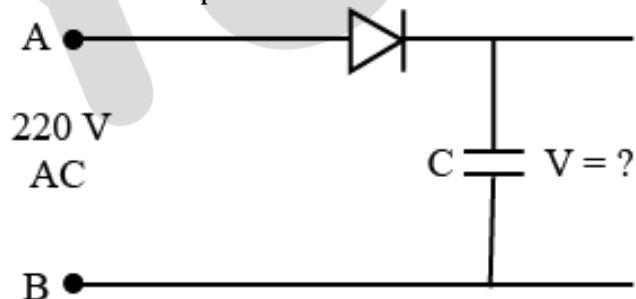


- a.  $P = 1, Q = 1$
- b.  $P = 1, Q = 0$
- c.  $P = 0, Q = 1$
- d.  $P = 0, Q = 0$

24. A positive hole in a semiconductor is

- a. an artificially created particle.
- b. an anti-particle of electron.
- c. a vacancy created when an electron leaves a covalent bond.
- d. absence of free electrons.

25. A 220 V A.C. supply is connected between points A and B as shown in figure what will be the potential difference  $V$  across the capacitor?

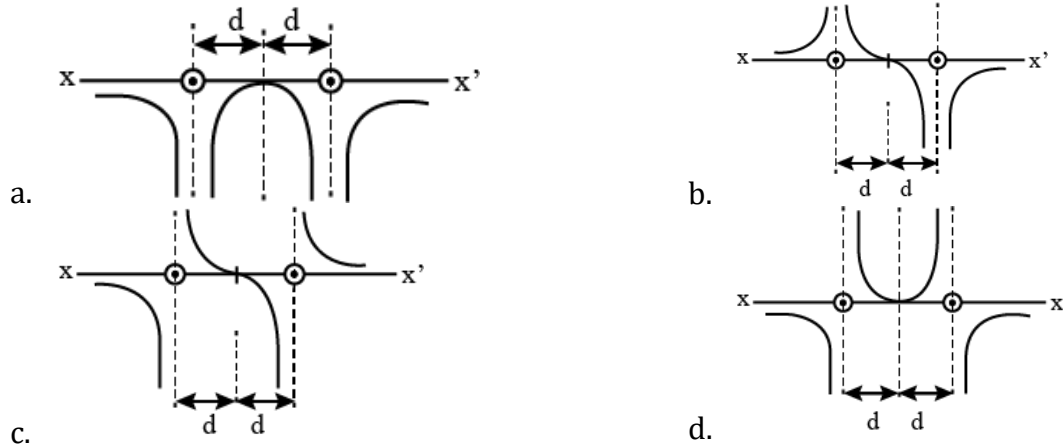


- a.  $220\sqrt{2}$  V
- b. 220 V
- c. 110 V
- d. 0

26. Two long straight parallel wires are a distance  $2d$  apart. They carry steady equal currents flowing out of the plane of the paper. The variation of magnetic field  $B$  along the line  $xx'$  is given by

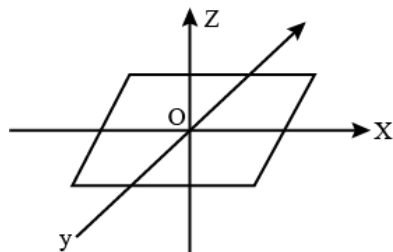
# KCET-2020 (Physics)

B



27. At a metro station, a girl walks up a stationary escalator in 20 sec. If she remains stationary on the escalator, then the escalator take her up in 30 sec. The time taken by her to walk up on the moving escalator will be
- a. 10 sec
  - b. 25 sec
  - c. 60 sec
  - d. 12 sec
28. Rain is falling vertically with a speed of  $12 \text{ ms}^{-1}$ . A woman rides a bicycles with a speed of  $12 \text{ ms}^{-1}$  in east to west direction. What is the direction in which she should hold her umbrella?
- a.  $45^\circ$  towards West
  - b.  $30^\circ$  towards East
  - c.  $45^\circ$  towards East
  - d.  $30^\circ$  towards West
29. A cylindrical wire has a mass  $(0.3 \pm 0.003) \text{ g}$ , radius  $(0.5 \pm 0.005) \text{ mm}$  and length  $(6 \pm 0.06) \text{ cm}$ . The maximum percentage error in the measurement of its density is
- a. 4
  - b. 1
  - c. 2
  - d. 3
30. A body is initially at rest. It undergoes one-dimensional motion with constant acceleration. The power delivered to it at time 't' is proportional to
- a.  $t^2$
  - b.  $t^{\frac{1}{2}}$
  - c.  $t$
  - d.  $t^{3/2}$
31. A thin uniform rectangular plate of mass 2 kg is placed in  $x - y$  plane as shown in figure. The moment of inertia about x-axis is  $I_x = 0.2 \text{ kgm}^2$  and the moment of inertia about y-axis is  $I_y = 0.3 \text{ kgm}^2$ . The radius of gyration of the plate about the axis passing through O and perpendicular to the plane of the plate is

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- a. 31.6 cm  
b. 50 cm  
c. 5 cm  
d. 38.7 cm
32. One end of a string of length ' $l$ ' is connected to a particle of mass ' $m$ ' and the other to a small peg on a smooth horizontal table. If the particle moves in a circle with speed ' $v$ ', the net force on the particle (directed towards the centre) is: ( $T$  is the tension in the string)
- a. 0  
b.  $T$   
c.  $T - \frac{mv^2}{l}$   
d.  $T + \frac{mv^2}{l}$
33. Young's modulus of a perfect rigid body is
- a. Between zero and unity  
b. Zero  
c. Unity  
d. Infinity
34. A wheel starting from rest gains an angular velocity of 10 rad/s after uniformly accelerated for 5 sec. The total angle through which it has turned is
- a.  $50\pi$  rad about a vertical axis  
b. 25 rad  
c. 100 rad  
d.  $25\pi$  rad
35. Iceberg floats in water with part of it submerged. What is the fraction of the volume of iceberg submerged if the density of ice is  $\rho_i = 0.917 \text{ g cm}^{-3}$ ?
- a. 0  
b. 0.917  
c. 1  
d. 0.458
36. The value of acceleration due to gravity at a height of 10 km from the surface of earth is  $x$ . At what depth inside the earth is the value of the acceleration due to gravity has the same value  $x$ ?
- a. 15 km  
b. 5 km  
c. 20 km  
d. 10 km
37. In an adiabatic expansion of an ideal gas the product of pressure and volume.
- a. At first increases and then decreases  
b. Decreases  
c. Increases  
d. Remains constant

# KCET-2020 (Physics)



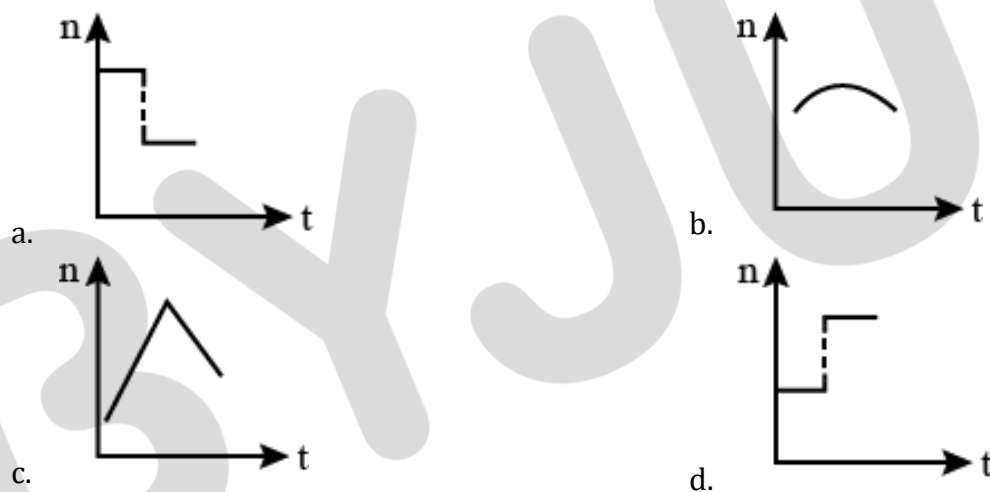
38. A certain amount of heat energy is supplied to a monoatomic ideal gas which expands at constant pressure. What fraction of the heat energy is converted into work?

- a.  $\frac{5}{7}$
- b. 1
- c.  $\frac{2}{3}$
- d.  $\frac{2}{5}$

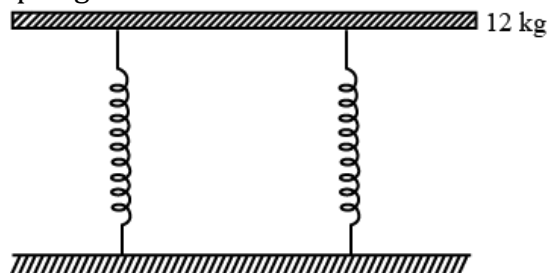
39. A sphere, a cube and a thin circular plate all of same material and same mass initially heated to same high temperature are allowed to cool down under similar conditions. Then the

- a. Cube will cool the fastest and plate the slowest.
- b. Plate will cool the fastest and cube the slowest.
- c. Sphere will cool the fastest and cube the slowest.
- d. Plate will cool the fastest and sphere the slowest.

40. A train whistling at constant frequency 'n' is moving towards a station at a constant speed V. The train goes past a stationary observer on the station. The frequency 'n' of the sound as heard by the observer is plotted as a function of time 't'. Identify the correct curve



41. A tray of mass 12 kg is supported by two identical springs as shown in figure. When the tray is pressed down slightly and then released, it executes SHM with a time period of 1.5 s. The spring constant of each spring is



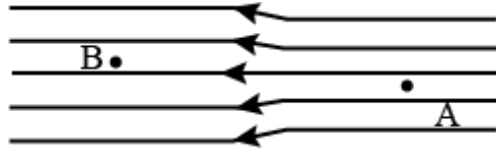
- a.  $\infty$
- b.  $50 \text{ Nm}^{-1}$
- c. 0
- d.  $105 \text{ Nm}^{-1}$



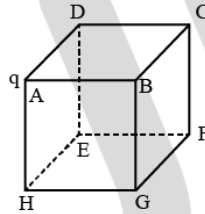
# KCET-2020 (Physics)



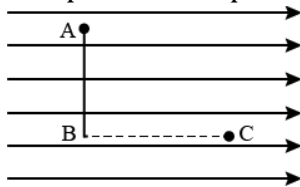
42. The electric field lines on the left have twice the separation on those on the right as shown in figure. If the magnitude of the field at A is  $40 \text{ Vm}^{-1}$ , what is the force on  $20 \mu\text{C}$  charge kept at B?



- a.  $1 \times 10^{-4} \text{ Vm}^{-1}$   
b.  $4 \times 10^{-4} \text{ Vm}^{-1}$   
c.  $8 \times 10^{-4} \text{ Vm}^{-1}$   
d.  $16 \times 10^{-4} \text{ Vm}^{-1}$
43. An infinitely long thin straight wire has uniform charge density of  $\frac{1}{4} \times 10^{-2} \text{ cm}^{-1}$ . What is the magnitude of electric field at a distance 20 cm from the axis of the wire?
- a.  $9 \times 10^8 \text{ NC}^{-1}$   
b.  $1.12 \times 10^8 \text{ NC}^{-1}$   
c.  $4.5 \times 10^8 \text{ NC}^{-1}$   
d.  $2.25 \times 10^8 \text{ NC}^{-1}$
44. A point charge 'q' is placed at the corner of a cube side 'a' as shown in the figure. What is the electric flux through the face ABCD?



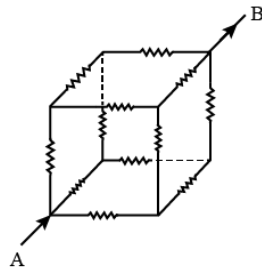
- a.  $\frac{q}{72 \epsilon_0}$   
b. 0  
c.  $\frac{q}{24 \epsilon_0}$   
d.  $\frac{q}{6 \epsilon_0}$
45. The difference between equivalent capacitances of two identical capacitors connected in parallel to that in series is  $6 \mu\text{F}$ . The value of capacitance of each capacitor is
- a.  $6 \mu\text{F}$   
b.  $2 \mu\text{F}$   
c.  $3 \mu\text{F}$   
d.  $4 \mu\text{F}$
46. Figure shows three points A, B and C in a region of uniform electric field  $\vec{E}$ . The line AB is perpendicular and BC is parallel to the field lines. Then which of the following holds good? ( $V_A, V_B$  and  $V_C$ ) represent the electric potential at points A, B and C respectively)



- a.  $V_A > V_B = V_C$   
b.  $V_A = V_B = V_C$   
c.  $V_A = V_B > V_C$   
d.  $V_A = V_B < V_C$

47. A dipole of dipole moment 'p' and moment of inertia  $I$  is placed in a uniform electric field  $\vec{E}$ . If it is displaced slightly from its stable equilibrium position, the period of oscillation of dipole is
- a.  $\pi \sqrt{\frac{I}{PE}}$                       b.  $\sqrt{\frac{PE}{I}}$   
c.  $2\pi \sqrt{\frac{I}{PE}}$                       d.  $\frac{1}{2\pi} \sqrt{\frac{PE}{I}}$
48. A hot filament liberates an electron with zero initial velocity. The anode potential is 1200 V. The speed of the electron when it strikes the anode is
- a.  $2.5 \times 10^8 \text{ ms}^{-1}$                       b.  $1.5 \times 10^5 \text{ ms}^{-1}$   
c.  $2.5 \times 10^6 \text{ ms}^{-1}$                       d.  $2.1 \times 10^7 \text{ ms}^{-1}$
49. A metal rod of length 10 cm and a rectangular cross – section of  $1 \text{ cm} \times \frac{1}{2} \text{ cm}$  is connected to a battery across opposite faces. The resistance will be
- a. Same irrespective of the three faces.  
b. Maximum when the battery is connected across  $1 \text{ cm} \times \frac{1}{2} \text{ cm}$  faces.  
c. Maximum when the battery is connected across  $10 \text{ cm} \times \frac{1}{2} \text{ cm}$  faces.  
d. Maximum when the battery is connected across  $10 \text{ cm} \times 1 \text{ cm}$  faces.
50. A car has a fresh storage battery of e.m.f. 12 V and internal resistance  $2 \times 10^{-2} \Omega$ . If the starter motor draws a current of 80 A. Then the terminal voltage when the starter is on is
- a. 9.3 V                      b. 12 V  
c. 8.4 V                      d. 10.4 V
51. When a soap bubble is charged?
- a. Its radius may increase or decrease.                      b. Its radius increases.  
c. Its radius decreases.                      d. The radius remains the same.
52. The colour code for a carbon resistor of resistance  $0.25 \text{ k}\Omega \pm 10\%$  is
- a. Red, Green, Silver                      b. Red, Grey, Brown, Silver  
c. Red, Green, Brown, Silver                      d. Red, Grey, Silver, Silver
53. Each resistance in the given cubical network has resistance of  $1\Omega$  and equivalent resistance between  $A$  and  $B$  is

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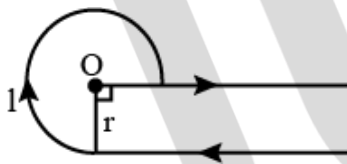


- a.  $\frac{12}{5} \Omega$                       b.  $\frac{5}{6} \Omega$   
 c.  $\frac{6}{5} \Omega$                         d.  $\frac{5}{12} \Omega$

54. A potentiometer has a uniform wire of length  $5\text{ m}$ . A battery of emf  $10\text{ V}$  and negligible internal resistance is connected between its ends. A secondary cell connected to the circuit gives balancing length at  $200\text{ cm}$ . The emf of the secondary cell is

- a.  $8\text{ V}$                                 b.  $4\text{ V}$   
 c.  $6\text{ V}$                                 d.  $2\text{ V}$

55. In the given figure, the magnetic field at 'O'

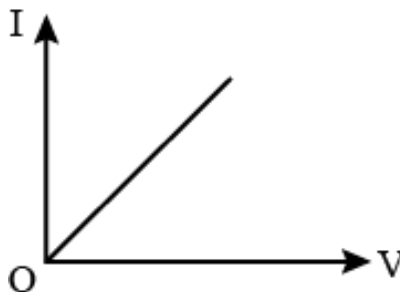


- a.  $\frac{3\mu_0 i}{8r} - \frac{\mu_0 i}{4\pi r}$                       b.  $\frac{3\mu_0 i}{4r} + \frac{\mu_0 i}{4\pi r}$   
 c.  $\frac{3\mu_0 i}{10r} - \frac{\mu_0 i}{4\pi r}$                         d.  $\frac{3\mu_0 i}{8r} + \frac{\mu_0 i}{4\pi r}$

56. The magnetic field at the origin due to a current element  $i\vec{dl}$  placed at a point with vector position  $\vec{r}$  is

- a.  $\frac{\mu_0 i}{4\pi} \frac{\vec{r} \times \vec{dl}}{r^2}$                                 b.  $\frac{\mu_0 i}{4\pi} \frac{\vec{dl} \times \vec{r}}{r^3}$   
 c.  $\frac{\mu_0 i}{4\pi} \frac{\vec{r} \times \vec{dl}}{r^3}$                                 d.  $\frac{\mu_0 i}{4\pi} \frac{\vec{dl} \times \vec{r}}{r^2}$

57.  $I - V$  characteristic of a copper wire of length  $L$  and area of cross-section  $A$  is shown in figure. The slope of the curve becomes



- a. Less if the length of the wire is increased.

# KCET-2020 (Physics)



- b. More if experiment is performed at higher temperature.
- c. More if a wire of steel of same dimension is used.
- d. Less if the area of the wire is increased.

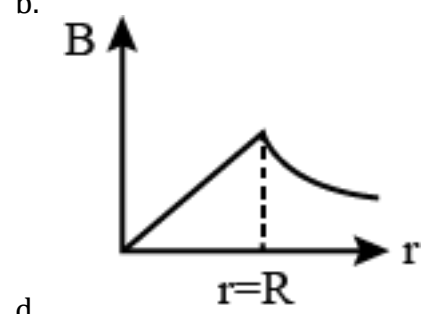
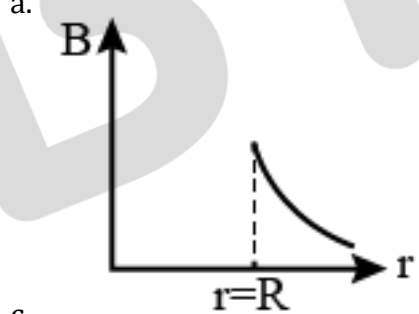
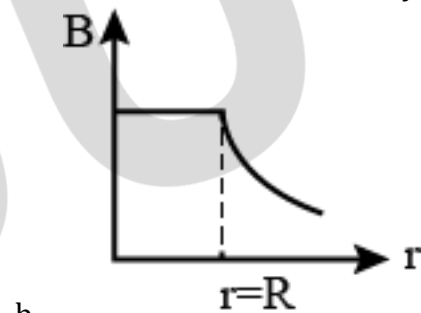
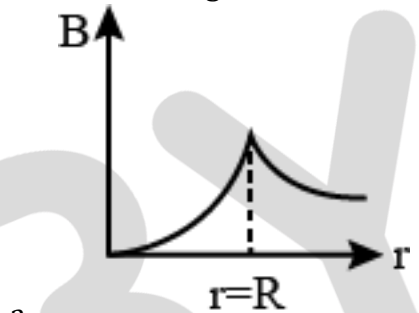
58. A cyclotron is used to accelerate protons ( ${}^1_1H$ ), Deuterons ( ${}^2_1H$ ) and  $\alpha$  - particles ( ${}^4_2He$ ). While exiting under similar conditions, the minimum K.E. is gained by

- a. Same for all
- b.  $\alpha$  - particle
- c. Proton
- d. Deuteron

59. A paramagnetic sample shows a net magnetization of  $8 Am^{-1}$  when placed in an external magnetic field of  $0.6 T$  at a temperature of  $4 K$ . When the same sample is placed in an external magnetic field of  $0.2 T$  at a temperature of  $16 K$ . The magnetization will be

- a.  $2.4 Am^{-1}$
- b.  $\frac{32}{3} Am^{-1}$
- c.  $\frac{2}{3} Am^{-1}$
- d.  $6 Am^{-1}$

60. A long cylindrical wire of radius  $R$  carries a uniform current  $I$  flowing through it. The variation of magnetic field with distance ' $r$ ' from the axis of the wire is shown by



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## ANSWER KEYS

|         |         |         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. (a)  | 2. (c)  | 3. (a)  | 4. (d)  | 5. (c)  | 6. (d)  | 7. (c)  | 8. (d)  | 9. (a)  | 10. (d) |
| 11. (d) | 12. (b) | 13. (a) | 14. (c) | 15. (b) | 16. (a) | 17. (c) | 18. (c) | 19. (d) | 20. (d) |
| 21. (d) | 22. (c) | 23. (c) | 24. (c) | 25. (a) | 26. (c) | 27. (d) | 28. (a) | 29. (a) | 30. (c) |
| 31. (b) | 32. (b) | 33. (b) | 34. (b) | 35. (b) | 36. (c) | 37. (b) | 38. (d) | 39. (d) | 40. (a) |
| 41. (d) | 42. (b) | 43. (d) | 44. (b) | 45. (d) | 46. (c) | 47. (c) | 48. (d) | 49. (b) | 50. (d) |
| 51. (b) | 52. (b) | 53. (b) | 54. (b) | 55. (d) | 56. (b) | 57. (a) | 58. (d) | 59. (c) | 60. (a) |

BYJU'S

## Solution

1. (a)

Due to thermal agitation, with increase in temperature randomness of the molecules increases and magnetic field moments get partially aligned. Hence the Domains are partially aligned.

2. (c)

We know that the current  $i = \frac{Blv}{R} = \frac{0.04 \times 2 \times 5}{3} = 133 \text{ mA}$

3. (a)

Magnetic field at the center of the current carrying loop is given by  $B = \frac{\mu_0}{4\pi} \times \frac{2\pi i}{a} = \frac{\mu_0 i}{2a}$ .

Magnetic moment at the center of the current carrying loop is given by  $M = i\pi a^2$

thus  $\frac{B}{M} = \frac{\mu_0}{2\pi a^3} = x$  (given) when both current and radius are doubled ratio become  $\frac{x}{8}$  times.

4. (d)

$$V_0 = \sqrt{V_R^2 + (V_L - V_C)^2} = \sqrt{60^2 + (110^2 - 30^2)} = 100,$$

$$V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{100}{\sqrt{2}} = \frac{100}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = 100 \times \frac{\sqrt{2}}{2} = 50 \times 1.414 = 70.7 \text{ V}$$

5. (c)

$$\cos \phi = \frac{1}{\sqrt{3}}, \tan \phi = \frac{\sqrt{2}}{1} \quad \tan \phi = \frac{X_L}{R} \quad \sqrt{2} = \frac{2}{R} \Rightarrow R = \sqrt{2} \Omega$$

6. (d)

Resonant frequency of an LC circuit is given by

$$\begin{aligned} f &= \frac{1}{2\pi\sqrt{LC}} \\ &= \frac{1}{2\pi\sqrt{0.5 \times 10^{-3} \text{ H} \times 20 \times 10^{-6} \text{ F}}} \\ &= 1592 \text{ Hz} \end{aligned}$$

7. (c)

$$\text{Average induced emf } \epsilon = L \frac{di}{dt}$$

$$= 0.2 \left( \frac{5-2}{0.5} \right) = \frac{2}{5} \times 3 = 1.2 \text{ V}$$

8. (d)

Velocity of image in convex lens  $V_i = \left( \frac{f}{f+u} \right)^2 V_o$  and image will move from focus to infinity (i.e. away from the lens).

From the formula, velocity of image

$$\frac{dv_i}{dt} = \frac{dv_i}{du} \times \frac{du}{dt} = 2 \left( \frac{f}{f+u} \right) f \ln(f+u) \times 5 \text{ (because } \frac{du}{dt} = 5 \text{ m/s)}$$

$$\Rightarrow \frac{dv_i}{dt} = 10f^2 \frac{\ln(f+u)}{f+u}$$

We can see that acceleration of image  $\propto \ln(f+u)$ , i.e varies with distance of object

So the image moves away from the lens with a non-uniform acceleration.

9. (a)

Refractive index of a prism is given by

$$n = \frac{\sin\left(\frac{A+d_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\Rightarrow \cot\left(\frac{A}{2}\right) = \frac{\sin\left(\frac{A+d_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\Rightarrow \frac{\cos\left(\frac{A}{2}\right)}{\sin\left(\frac{A}{2}\right)} = \frac{\sin\left(\frac{A+d_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$$

$$\Rightarrow \sin\left(90 - \frac{A}{2}\right) = \sin\left(\frac{A+d_m}{2}\right)$$

$$\Rightarrow 90 - \frac{A}{2} = \frac{A+d_m}{2}$$

$$\Rightarrow 180 - 2A = d_m$$

10. (d)

Intensity  $I = \frac{E}{A}$  where  $E$  is energy of radiation and  $A$  is incident area

$$\Rightarrow E = IA$$

Momentum of radiation is given by  $P = \frac{2E}{c} = \frac{2IA}{c}$

Where  $c$  is speed of light.

$$\therefore P = \frac{2 \times 20 \times 10^4 \frac{W}{m^2} \times 375 \times 10^{-4} m^2}{3 \times 10^8 \text{ m/s}} = 5 \times 10^{-5} \text{ kgms}^{-1}$$

11. (d)

We have unpolarised beam's intensity  $I_0 = 128 \text{ w/m}^2$

Using Malu's law we have  $I = I_0 \cos^2 \theta$

When beam passed from the first polaroid,  $I = \frac{I_0}{2}$

Again, as the angle between  $p_1$  and  $p_2$  is  $45^\circ$ , beam intensity when it will pass  $p_2$  would be

$$I_1 = \frac{I_0}{2} \cos^2 45^\circ = \frac{I_0}{4}$$

And, also the angle between  $p_2$  and  $p_3$  is  $45^\circ$ , beam intensity when it will come out of  $p_3$  will

$$\text{be } I_2 = \frac{I_0}{4} \cos^2 45^\circ = \frac{I_0}{8} = \frac{128}{8} = 16 \text{ w/m}^2$$

12. (b)

Given the lateral separation of the poles  $d = 3.14 \text{ m}$

The resolving power of the eye is  $\theta = 1 \text{ min} = \frac{\pi}{60 \times 180} \text{ rad}$

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The maximum distance from which poles are distinctly visible is  $D = \frac{d}{\theta}$

$$\Rightarrow D = \frac{3.14 \times 60 \times 180}{\pi} = 10800m = 10.8 km$$

13. (a)

So, here when we put the concave lens, let the beam will converge at a distance  $x = v$

Using lens formulae, we have,  $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

Where  $u = 12 cm$  and  $f = -16 cm$  is given

$$\therefore \frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{-1}{16} + \frac{1}{12} = \frac{1}{48} cm \Rightarrow v = 48 cm$$

Hence,  $x = 48 cm$

14. (c)

De-Broglie wavelength is given by  $\lambda = \frac{12.27}{\sqrt{E_0}}$ , where  $E_0$  is the ground state energy of the hydrogen atom whose value is 13.6 V

$$\therefore \lambda = \frac{12.27}{\sqrt{13.6}} = 3.33 \text{ \AA}$$

15. (b)

Here in the graph we can see that, the Stopping potential is same for 1 and 2. So, frequencies will be same i.e.  $\gamma_1 = \gamma_2$ . And, currents are different So, intensity are different i.e.  $I_1 \neq I_2$ .

16. (a)

Path difference due to insertion of mica sheet  $\Delta x = (\mu - 1)t$

Let the shift in the fringe pattern be 'y'

Also, path difference  $\Delta x = y \times \frac{d}{D}$ , so comparing both  $(\mu - 1)t = y \times \frac{d}{D}$

$y = (\mu - 1)t \times \frac{D}{d}$ , where  $\mu = 1.5, D = 2.4$  and  $d = 1.2$  putting the values, we get  $y = 0.25 mm$ .

17. (c)

Angular momentum,

$$L = \frac{nh}{2\pi} = \frac{3h}{2\pi}, \text{ which is given in the problem, also } n = 3$$

$$\therefore E = \frac{13.6}{n^2} eV \Rightarrow \frac{13.6}{3^2} = 1.51 eV.$$

18. (c)

$A'$  will be maximum and  $B'$  will be minimum, because atom is hollow and whole mass of the atom is concentrated in a small centre called nucleus.



19. (d)

As we know that time period of revolution of an electron is  $T = \frac{2\pi r}{v}$ ,

And  $r \propto \frac{n^2}{Z^2}$  and  $v \propto \frac{Z}{n} \quad \therefore T \propto \frac{n^3}{Z^2}$  and for  $H$  –atom  $Z = 1$ ,  $T \propto n^3$

20. (d)

During  $\beta^-$  decay, a neutron in the nucleus decays emitting an electron.

21. (d)

Fraction un decayed is given as,

$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^{t/T}$$

Here,  $t = 30 \text{ years}$  and  $T = 15 \text{ years}$

So,

$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^{\frac{30 \text{ years}}{15 \text{ years}}}$$

$$\text{or, } \frac{N}{N_0} = \left(\frac{1}{2}\right)^2$$

$$\text{or, } \frac{N}{N_0} = \frac{1}{4}$$

Therefore,

$$\text{Fraction un decayed} = 1 - \frac{N}{N_0}$$

$$\text{or, Fraction un decayed} = 1 - \frac{1}{4}$$

$$\text{or, Fraction un decayed} = \frac{3}{4} = \mathbf{0.75}$$

22. (c)

Nuclear forces are short range force existing in the range of a  $10^{-15} \text{ m}$ . If the separation between the particles is greater than  $10^{-15} \text{ m}$ , nuclear force is negligible.

Therefore, at a separation of  $10 \text{ nm}$ , the electromagnetic force is greater than the nuclear force.

Hence,  $F_e \gg F_n$

23. (c)

A NAND gate gives an output 1 if at least one of the inputs is zero.

Hence Q is 1.

Therefore, the inputs for the upper NAND gate are 1, 1.

Hence P=0.

24. (c)

A positive hole in a semiconductor is a vacancy which is created at the site of a covalent bond when an electron leaves a covalent bond.

25. (a)

During the positive half cycles of input ac, a  $p - n$  junction diode is forward biased and hence it conducts.}

While during the negative half cycles, the diode will be reverse biased and hence does not conduct.

The capacitor is charged to maximum potential difference. Therefore, the potential difference across capacitor  $C$  is equal to the peak value of the applied ac voltage, i.e.,

$$V = V_{max}$$

$$\text{or, } V = \sqrt{2}V_{rms}$$

$$\text{or, } V = \sqrt{2} \times 220 V = 200\sqrt{2} V$$

26. (c)

The magnetic field due to a long straight current carrying wire is given by,

$$B = \frac{\mu_0 I}{2\pi r}$$

$$\text{or, } B \propto \frac{1}{r}$$

At the point exactly mid-way between the conductors, the net magnetic field is zero. Using right hand thumb rule, we find that the magnetic field due to left wire will be in  $\hat{j}$  direction while due to the right wire is in  $(-\hat{j})$  direction.

Magnetic field at a distance  $x$  from the left wire, lying between the wires.

$$B = \frac{\mu_0 I}{2\pi x} \hat{j} + \frac{\mu_0 I}{2\pi(2d - x)} (-\hat{j})$$

$$\text{or, } B = \frac{\mu_0 I}{2\pi} \left( \frac{1}{x} - \frac{1}{2d-x} \right)$$

$$\text{At } x = d, B = 0$$

$$\text{For } x < d, B \text{ is along } \hat{j}$$

$$\text{For } x > d, B \text{ is along } (-\hat{j})$$

On the left side of the left conductor, magnetic fields due to the currents will add up and the net magnetic field will be along  $(-\hat{j})$  direction.

To the right side of second conductor, the total magnetic field will be along  $\hat{j}$  direction.

27. (d)

Let, the length of the escalator be  $L$ .

$$\text{Velocity of the girl, } v_g = \frac{L}{t_1} = \frac{L}{20}$$

$$\text{Velocity of the escalator, } v_e = \frac{L}{t_2} = \frac{L}{30}$$

On moving escalator,

$$v_{net} = v_g + v_e$$

$$\text{or, } v_{net} = \frac{L}{20} + \frac{L}{30}$$

$$\text{or, } v_{net} = \frac{L}{12}$$

$$\text{Since, } v_{net} = \frac{L}{t}$$

Therefore,

$$\frac{L}{t} = \frac{L}{12}$$

$$t = 12 \text{ s}$$

28. (a)

To protect herself from the rain, the woman must hold her umbrella in the direction of the relative velocity of the rain with respect to the woman.

$$\tan \theta = \frac{v_w}{v_f} = \frac{12 \text{ m/s}}{12 \text{ m/s}}$$

$$\text{or, } \tan \theta = 1$$

$$\text{or, } \theta = 45^\circ$$

Therefore, the direction in which she should hold her umbrella is  $45^\circ$  toward west.

29. (a)

$$\rho = \frac{m}{V} = \frac{m}{\pi r^2 l}$$

$$\text{or, } \frac{\Delta \rho}{\rho} = \frac{\Delta m}{m} + 2 \frac{\Delta r}{r} + \frac{\Delta l}{l}$$

$$\text{or, } \frac{\Delta \rho}{\rho} \times 100 = \left( \frac{0.003}{0.3} + 2 \frac{0.005}{0.5} + \frac{0.06}{6} \right) \times 100$$

$$\text{or, } \frac{\Delta \rho}{\rho} \times 100 = (0.01 + 0.02 + 0.01) \times 100$$

$$\text{or, } \frac{\Delta \rho}{\rho} \times 100 = 0.04 \times 100$$

$$\frac{\Delta \rho}{\rho} \times 100 = 4\%$$

Therefore, the percentage error in the measurement of density is 4.

30. (c)

As we know,

$$P = Fv$$

where,  $P$  is the power,  $F$  is the force and  $v$  is the velocity.

$$\text{or, } P = mav$$

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$$\text{or, } P = ma^2t$$

$$\text{or, } P \propto t$$

31. (b)

By perpendicular axis theorem we know that,

$$I_z = I_x + I_y = 0.3 + 0.2 = 0.5 \text{ kgm}^2$$

as we know that MOI  $I = mK^2 \Rightarrow 0.5 = 2 \times K^2$

$$K = \frac{1}{2} = 0.5 \text{ m} = 50 \text{ cm.}$$

32. (b)

When a particle connected to a string revolves in a circular path around a centre, the centripetal force is provided by the tension produced in the string. Hence, in the given case, the net force on the particle is the tension  $T$ . ( $T = \frac{mv^2}{l}$ )

33. (b)

Young's modulus = stress/strain, and for a perfect rigid body we know that strain is equal to 0 and hence Young's modulus of a perfect rigid body becomes Infinity.

34. (b)

$$\omega_1 = 0$$

$$\omega_2 = 10 \frac{\text{rad}}{\text{sec}} \quad t = 5 \text{ sec}$$

$$\theta = \frac{\omega_1 + \omega_2}{2} \times t = \frac{10}{2} \times 5 = 25 \text{ rad}$$

35. (b)

Let  $V$  be the total volume of the iceberg and  $V'$  of its volume be submerged into water  
Floatation condition weight of iceberg = Weight of water displaced by submerged part by ice

$$V\rho_i g = V'\rho_w g \Rightarrow \frac{V'}{V} = \frac{\rho_i}{\rho_w} = \frac{0.917}{1} = 0.917$$

36. (c)

$$g_h = g \left(1 - \frac{2h}{R}\right)$$

$$g_d = g \left(1 - \frac{d}{R}\right) \Rightarrow g_h = g_d$$

$$g \left(1 - \frac{2h}{R}\right) = g \left(1 - \frac{d}{R}\right) \Rightarrow d = 2h = 2 \times 10 = 20 \text{ km}$$

37. (b)

In an adiabatic expansion as temperature decreases from an ideal gas equation  $PV = nRT$ .  
Product of pressure and volume also decreases.

38. (d)

The heat  $Q$  is converted into the internal energy and work. According to the first law of thermodynamics,  $Q = U + W \Rightarrow nC_p\Delta t = nC_v\Delta t + W$

$$\frac{W}{Q} = \frac{nC_p\Delta t - nC_v\Delta t}{nC_p\Delta t}$$

$$\frac{C_p - C_v}{C_p} = 1 - \frac{1}{\gamma} = 1 - \frac{1}{\frac{5}{3}} = \frac{2}{5}$$

39. (d)

Surface area is more for plate and less for sphere. Hence plate will cool the fastest and sphere the slowest.

40. (a)

As the train approaches the observer the apparent frequency is higher than the actual frequency. As the train moves away from the observer, the apparent frequency is lower than the actual frequency. Hence the correct option is (a).

41. (d)

We know that

$$T = 2\pi \sqrt{\frac{m}{k_{eff}}}$$

$$\frac{3}{2} = 2\pi \sqrt{\frac{12}{2k}} \Rightarrow \frac{9}{4} = 4\pi^2 \times \frac{12}{2k} \quad k \approx 105 \text{ Nm}^{-1}$$

42. (b)

We know that  $F = qE = 20 \times 20 \times 10^{-6} = 4 \times 10^{-4} \text{ V/m}$ .

43. (d)

We know that

$$E = \frac{\lambda}{2\pi\epsilon_0 r} = \frac{1}{4} \times \frac{10^{-2}}{10^{-2}} \times 18 \times 10^9 \times 5$$

$$2.25 \times 10^8 \text{ N/C}$$

44. (b)

Since the flux passing through face ABCD is parallel to that surface and area vector is perpendicular. Hence flux passing through ABCD is zero.

45. (d)

$$C_P - C_S = 6 \mu F$$

$$2C - \frac{C}{2} = 6$$

$$C = 4 \mu F$$

46. (c)

Electric lines of force in an electric field always flow from a higher potential to a lower potential. Hence,  $V_A = V_B > V_C$

47. (c)

$$T = 2\pi \sqrt{\frac{I}{P.E}}$$

48. (d)

$$\frac{1}{2}mv^2 = Vq$$

$$v = \sqrt{\frac{2Vq}{m}} = 2.1 \times 10^7 \text{ ms}^{-1}$$

49. (b)

Resistance is inversely proportional to area.

Hence resistance will be maximum when the battery is connected across  $1 \text{ cm} \times \frac{1}{2} \text{ cm}$  faces.

50. (d)

$$V = E - ir = 10.4 \text{ V}$$

51. (b)

When the radius of a soap bubble increases, the soap bubble gets charged.

52. (b)

Red, Grey, Brown, Silver

53. (b)

$$\frac{5}{6} \Omega$$

54. (b)

Emf of cell in the secondary circuit = potential gradient  $\times$  balancing length

$$\Rightarrow \frac{10}{5} \times 2 = 4 \text{ V}$$

55. (d)

$$B_{net} = B_1 + B_2 + B_3$$
$$= \frac{3\mu_0 I}{8r} + \frac{\mu_0 I}{4\pi r} + 0$$

56. (b)

$$\frac{\mu_0 i \vec{dl} \times \vec{r}}{4\pi r^3}$$

57. (a)

$$\text{Slope} = \frac{1}{R} = \frac{A}{\rho l}$$

Hence the slope becomes less if the length of the wire is increased.

58. (d)

$$\text{K.E.} = \frac{q^2}{m}$$

Hence, a deuteron gains the least kinetic energy.

59. (c)

$$I \propto \frac{B}{T}$$

$$\frac{I_2}{I_1} = \frac{B_2}{B_1} \times \frac{T_1}{T_2}$$

$$I_2 = \frac{2}{3} A/m$$

60. (a)

The magnetic field increases as the point moves closer to the boundary of the wire and decreases as it moves away from the boundary of the wire.

Hence the correct option is (a).