Solution

NEET PHYSICS SAMPLE PAPER - 12 - 02

NEET-UG - Physics

Section A

1. **(a)** The third charge is in unstable equilibrium.
   Explanation: The third charge is in unstable equilibrium.

2. **(d)** $\frac{2e}{\varepsilon_0}$
   Explanation: According to Gauss law, electric flux, $\phi_E = \frac{q_{\text{inside}}}{\varepsilon_0}$
   Charge on α-particle = 2e
   $\therefore\ \phi_E = \frac{2e}{\varepsilon_0}$

3. **(c)** $V_A = V_B < V_C$
   Explanation: Electric lines of forces constitute the electric fields. In an electric field electric line of force always flow from higher potential to lower potential. Hence, A and B are at the same higher potential and B is at lower potential. Thus $V_A = V_B > V_C$

4. **(d)** 1
   Explanation: 1

5. **(d)** 625 V
   Explanation: After charging, total charge on the capacitor:
   Q = CV (where C = $10\mu F$)
   $\therefore \quad Q = 10 \times 10^{-6} \times 1000 = 10^{-2}\text{C}$
   When this charged capacitor is connected to uncharged capacitor, then total charge remains same.
   $\therefore$ Q = Q_1 + Q_2
   10^{-2} = (C_1 + C_2)V
   $\therefore \quad V = \frac{10^{-2}}{16\times10^{-6}}$ = 625 volt

6. **(a)** 10 W
   Explanation: Actual power of bulb (P_1) = 40 W Actual voltage of bulb (V_1) = 200 V and supply voltage (V_2) = 100 V.
   Power (P) = $\frac{V^2}{R} \propto V^2$
   Therefore $\frac{P_1}{P_2} = \frac{V_1^2}{V_2^2}$
   or, $\frac{40}{P_2} = \frac{(200)^2}{(100)^2}$ = 4
   or P_2 = $\frac{40}{4}$ = 10 W
   (where P_2 = power when voltage is 100 V)

7. **(d)** 1 amp
   Explanation: 1 amp

8. **(b)** 0.36 A
   Explanation: Wheatstone network is balanced as per resistances of P, 2, R and S given. No current flow through galvanometer.
   P and R are in series in upper branch.
   Resistance = (P + R) = 10 + 15 = 25 Ω
   Q and S are in series in lower branch
   $\therefore$ Resistance = Q + S = 20 + 30 = 50 Ω

The upper and the lower branches are in parallel.

∴ Resistance = $\frac{25 \times 50}{25+50} = \frac{25 \times 50}{75} = \frac{50}{3}\Omega$

∴ Current I = $\frac{V}{R} = \frac{6}{50/3}$ = 0.36 A

9.

(b) 17 Ω

Explanation: 17 Ω

Emf of the battery, E = 10 V

The internal resistance of the battery, r = 3 Ω

Current in the circuit, I = 0.5 A

The resistance of the resistor = R

The relation for current using Ohm's law is,

$I = \frac{E}{R+r}$

$R + r = \frac{E}{I}$

$= \frac{10}{0.5} = 20\Omega$

∴ R = 20 - 13 = 17Ω

10. **(a)** ($\frac{1}{3}$) A

Explanation: ($\frac{1}{3}$) A

11.

(b) 250 μT

Explanation: Using the formula,

B = $\frac{\mu_0 i R^2}{2\left(R^2+x^2\right)^{3/2}}$

we get; 54 = $\frac{\mu_0 i(3)^2}{2\left[3^2+4^2\right]^{3/2}}$

or $\mu_0 i = \frac{54 \times 2 \times 5 \times 25}{9}$

Now, at the centre of the coil, x = 0 and

B = $\frac{\mu_0 i}{2R} = \frac{\mu_0 i}{2 \times 3} = \frac{\mu_0 i}{6}$

= $\frac{54 \times 2 \times 5 \times 25}{9 \times 6}$ = 250

B = 250 μT

12.

(c) $6\pi^2 \times 10^{-7}$ N-m

Explanation: B for solenoid = $\mu_0 ni = \mu_0 \frac{500}{0.4} \times 3$

Magnetic moment of the coil, M = iAN

= $0.4 \times \pi \times (0.01)^2 \times 10$

= $4\ \pi \times 0.0001$

τ = MB sin 90°

= $4\ \pi \times 10^{-7} \times \frac{500}{04} \times 3 \times 4\ \pi \times 0.0001$

= $6\ \pi^2 \times 10^{-7}$ N-m

13.

(c) Only (B)

Explanation: According to Curie's law intensity of the magnetisation,

$I = C\left(\frac{B}{T}\right) \propto \frac{1}{T}$

i.e., Paramagnetism is temperature-dependent.

14.

(c) connecting a short length of copper wire across the ends of the coil

Explanation: connecting a short length of copper wire across the ends of the coil

15.

(c) 4×10^{-4} Wb

Explanation: We know that,

$e = -\frac{d\phi}{dt}$

or $d\phi$ = -edt

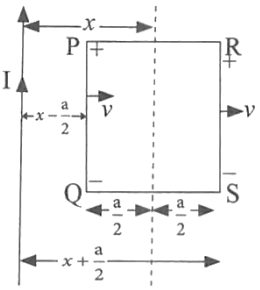
or $\phi = 4 \times 10^{-3} \times 0.1$

$= 4 \times 10^{-4}$ Wb

16.

(b) $\frac{1}{(2x-a)(2x+a)}$

Explanation:



Emf induced in the frame is given by,

e_{PQRS}

$= e_{PQ} + e_{RS}$

$= av(B_1 - B_2)$ ...($\because$ e = Blv sinθ)

$= av\left[\frac{\mu_0 I}{2\pi r_1} - \frac{\mu_0 I}{2\pi r_2}\right]$ ... $\left(\because B = \frac{\mu_0}{4\pi}\frac{2I}{r}\right)$

$= \frac{av\mu_0 I}{2\pi}\left[\frac{1}{\left(x-\frac{a}{2}\right)} - \frac{1}{\left(x+\frac{a}{2}\right)}\right]$ $\left(\begin{matrix}\because r_1 = x - \frac{a}{2} \\ r_2 = x + \frac{a}{2}\end{matrix}\right)$

$= \frac{av\mu_0 I}{2\pi}\left[\frac{2}{(2x-a)} - \frac{2}{(2x+a)}\right]$

$= 2\frac{a^2 v\mu_0 I}{\pi}\left[\frac{1}{(2x-a)(2x+a)}\right]$

$\Rightarrow e_{PQRS} = \frac{1}{(2x-a)(2x+a)}$

17.

(b) 20 Hz

Explanation: Resonant angular frequency,

$\omega_r = \frac{1}{\sqrt{LC}}$ ...(i)

Quality factor, Q = $\frac{\text{Resonant angular freq.}}{\text{Bandwidth}}$

Bandwidth = $v_2 - v_1 = \frac{v_r}{Q}$ ...(ii)

Where v_r = resonant frequency = $\frac{1}{2\pi\sqrt{LC}}$

Q = quality factor

Also, Q = $\frac{\omega_r L}{R}$

$\therefore \quad v_2 - v_1 = \frac{v_r R}{2\pi v_r L} = \frac{R}{2\pi L}$

$= \frac{5}{2\pi \times 40 \times 10^{-3}}$ = 20 Hz

18.

(c) $(\frac{1}{R})\sqrt{\frac{L}{C}}$

Explanation: $(\frac{1}{R})\sqrt{\frac{L}{C}}$

19. **(a)** 90%

Explanation: Given: Output power, P = 100 W

Voltage across primary, V_p = 220 V

Current in the primary, I_p = 0.5 A

Efficiency of a transformer, $\eta = \frac{\text{output power}}{\text{input power}} \times 100$

$= \frac{P}{V_p I_p} \times 100 = \frac{100}{220 \times 0.5} \times 100$ = 90%

20.

(b) 100

Explanation: Average intensity em wave is

= $\frac{P}{4\pi r^2} = \frac{1}{2} \in_0 E_0^2 \times c$

or $E_0 = \left[\frac{P}{2\pi v r^2 \in_0 c}\right]^{1/2}$

= $\left[\frac{500}{2\pi(3)^2 \times \left[1/\left(4\pi \times 9 \times 10^9\right)\right] \times 3 \times 10^8}\right]^{1/2}$

= 100 V/m

21.

(c) 0.25 $\overset{o}{A}$

Explanation: $\lambda_{\text{min.}} = \frac{hc}{\text{e}V} = \frac{12375}{V(\text{ volt})}\overset{o}{A}$

$= \frac{12375}{40000}\overset{o}{A}$ = 0.31 $\overset{o}{A}$

Hence, a wavelength of 0.25 $\overset{o}{A}$ must be absent in the X-rays given out by the tube.

22. **(a)** inversely proportional to the energy of the electrons hitting the target

Explanation: As we know,

$\lambda_{\text{min}} = \frac{\text{hc}}{\text{eV}}$

$\lambda_{\text{min}} \propto \frac{1}{\text{e}}$

Hence, inversely proportional to the energy of the electrons hitting the target.

23.

(b) t sin (i - r)/cos r

Explanation: t sin (i - r)/cos r

24.

(c) a convex lens

Explanation: a convex lens

25. **(a)** decreasing the distance between the two sources

Explanation: decreasing the distance between the two sources

26.

(d) conserved but redistributed

Explanation: conserved but redistributed

27. **(a)** both have equal momentum

Explanation: both have equal momentum

28. **(a)** $\lambda_p \propto \lambda_e^2$

Explanation: The wavelength of an electron of energy E is

$\lambda_e = \frac{h}{\sqrt{2m_e E}}$ ...(i)

Wavelength of a photon of same energy E is

$\lambda_p = \frac{hc}{E}$ or E = $\frac{hc}{\lambda_p}$ ...(ii)

Squaring on both sides of eq. (i), we get

$\lambda_e^2 = \frac{h^2}{2m_e E}$ or E = $\frac{h^2}{2m_e \lambda_e^2}$

Equating (ii) and (iii), we get:

$\frac{hc}{\lambda_p} = \frac{h^2}{2m_e \lambda_e^2}$

$\therefore \lambda_p = \left(\frac{2m_e c}{h}\right) \lambda_e^2$

$\therefore \lambda_p \propto \lambda_e^2$

Hence, this option is correct.

29. **(a)** 10^4 V

Explanation: The de-Broglie wavelength of an electron is given as:

$\lambda = \frac{1.227}{\sqrt{V}}\text{nm}$

Substitute the wavelength in the above expression:

V = $\left(\frac{1.227}{1.227 \times 10^{-2}}\right)^2$

V = 10^4 V

30. **(a)** $4\pi a_0$

Explanation: The radius of n^{th} orbit is $r_n = n^2a_0$, where a_0 is Bohr's radius. If λ is the de Broglie wavelength of an electron while revolving in n^{th} orbit of radius r_n, then $2\pi a_0 = n\lambda$ or $\lambda = \frac{2\pi r_n}{n}$

For 2nd orbit, n = 2

$\therefore \quad \lambda = \frac{2\pi/2}{2} = \frac{2\pi(2)^2 a_0}{2} = 4\pi a_0$

31. **(a)** $4v_0$ Hz

Explanation: $v = Z^2RC\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$v_0 = RC\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{5RC}{36}$

Further $v = (2)^2 RC\left[\frac{1}{2^2} - \frac{1}{3^2}\right] = \frac{20RC}{36}$

$\therefore \frac{v}{v_0} = 4$ or $v = 4v_0$ Hz

32.

(b) $(A_1 - A_2)T$

Explanation: $A_1 = N_1\lambda$, $A_2 = N_2\lambda$

Mean life, $T = \frac{1}{\lambda}$

$A_1 - A_2 = (N_1 - N_2)\lambda = (N_1 - N_2)\frac{1}{T}$

So, number of atoms disintegrated in $(t_2 - t_1)$ sec $= (N_1 - N_2) = (A_1 - A_2)T$

33.

(c) $_{90}Th^{234}$

Explanation: $_{92}U^{238} \rightarrow_{90} Th^{234} + {}_2He^4$

34.

(c) amplification

Explanation: amplification

35.

(c) 0.11 mA

Explanation: 0.11 mA

Section B

36.

(d) A is false and R is also false

Explanation: The rate of decrease in the electric field is different in the two cases. In the case of a point charge, it decreases as $(\frac{1}{r^2})$ but in the case of electric dipole, it decreases more rapidly, as $E \propto \frac{1}{r^3}$.

37.

(c) Assertion is correct statement but reason is wrong statement.

Explanation: Assertion is correct statement but reason is wrong statement.

38. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: It is clear that electrons move in all directions haphazardly in metals. When an electric field is applied, each free electron acquires a drift velocity. There is a net flow of charge, which constitutes a current. In the absence of an electric field, this is impossible and hence, there is no current.

39.

(c) Assertion is correct statement but reason is wrong statement.

Explanation: Assertion is correct statement but reason is wrong statement.

40. **(a)** Assertion and reason both are correct statements and reason is correct explanation for assertion.

Explanation: Assertion and reason both are correct statements and reason is correct explanation for assertion.

41.

(d) If both assertion and reason are false.

Explanation: Magnetic resonance imaging is based on resonance on the nuclear magnetic resonance of protons. Therefore, both assertion and reason are correct.

42. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

43.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation: The assertion is true. Heat loss can be reduced by using thick wire in the secondary.

The reason is also true. When the plane of the armature is parallel to the magnetic field, the rate of change of flux is maximum. Hence induced emf is maximum. But the reason is not the correct explanation of the assertion.

44.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation: Both A and R are true but R is not the correct explanation of A.

45. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: When light ray incident along normal to the mirror, angle of incidence, $\angle i = 0^o$. According to law of reflection, $\angle i = \angle r$. therefore angle of reflection, $\angle r = 0^o$, i.e. the incident ray retraces its path.

46.

(d) A is false but R is true.

Explanation: If one of the slit is covered by some transparent medium of thickness t and refractive index μ, then the path from the slit to the centre of the fringe pattern becomes optically longer than the other. Thus the zeroth fringe shifts to a new position where the two optical paths are equal. The entire fringe pattern being grouped symmetrically around the zeroth fringe shifts along the screen in the direction of covered slit. But the width of the screen fringes remains unchanged as the wavelength in air remains the same as before.

47. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Brightlines in the spectra of universe outside our own galaxy (the milky way) appear to be displaced towards red end of the spectrum, and that effect is known as the red shift. These observation have give rise to the belief that our universe is expanding.

48.

(d) A is false but R is true.

Explanation: One photon can eject one electron only. Hence, the assertion is false.

Einstein's equation related to photoelectric effect is, Energy of photon = Maximum kinetic energy of photo electron - work function. Hence, the reason is true.

49. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Both A and R are true and R is the correct explanation of A.

50. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation: Nuclear force acts between nucleons. It is a powerful attractive force and is charge independent. So, nuclear force between neutron & neutron, proton &proton and neutron & proton are equal.

So, assertion and reason both are true and the reason explains the assertion.