20 PRACTICE PAPER

Time allowed: 45 minutes **Maximum Marks: 200**

General Instructions: *Same as Practice Paper-1.*

Choose the correct option in the following questions.

1. What is the SI unit of electric flux?

(*a*) $\frac{\text{N}}{\text{C}} \times \text{m}^2$ (*b*) $\text{N} \times \text{m}^2$

(*c*) $\frac{\text{N}}{\text{m}^2} \times \text{C}$ (*d*) $\frac{\text{N}^2}{\text{m}^2} \times \text{C}^2$

2. Force *F* between charges Q_1 and Q_2 separated by *r* is 25 N. It can be reduced to 5 N if the separation between them is made

(*a*) $\frac{r}{\sqrt{5}}$ (*b*) $\frac{r}{2}$

(*c*) 2r (*d*) $\sqrt{5}r$

3. The vector form of Coulomb's force ($\vec{F}_{12}$) is

(*a*) $\frac{1}{4\pi\varepsilon_0} \times \frac{q_1 q_2}{r_{12}^2} \hat{r}_{12}$ (*b*) $\frac{1}{4\pi\varepsilon_0} \times \frac{q_1 q_2}{r_{12}} \hat{r}_{12}$

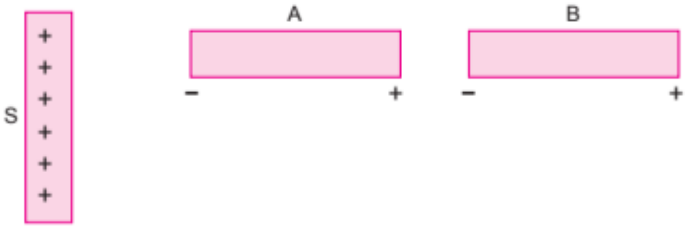
(*c*) $\frac{1}{4\pi\varepsilon_0} \times \frac{q_1 q_2}{r_{12}^3} \hat{r}_{12}$ (*d*) none of these

4. Charge on a conducting metal sphere is present

(*a*) on the surface of sphere (*b*) inside the sphere

(*c*) outside the sphere (*d*) both inside and outside of sphere

5. A large non-conducting sheet *S* is given a uniform charge density. Two uncharged small metal rods *A* and *B* are kept near the sheet as shown in figure. Which of the following is true?



(*a*) *S* attract *A* (*b*) *S* attracts *B*

(*c*) *A* attracts *B* (*d*) All of the above

6. A point charge $+q$, is placed at a distance d from an isolated conducting plane. The field at a point P on the other side of the plane is

(a) directed radially towards the point charge

(b) directed radially away from the point charge

(c) directed perpendicular to the plane but towards the plane

(d) directed perpendicular to the plane and away from the plane

7. An infinite number of charges each equal to 4 μC are placed along the X-axis at $x = 1$ m, $x = 2$ m, $x = 4$ m, $x = 8$ m, and so on, the Coulomb field at origin for all these charges is

(a) 4.8×10^3 N/C (b) 4.8×10^4 N/C

(c) 4.8×10^5 N/C (d) 4.8×10^6 N/C

8. A hollow charged metal sphere has radius r. If the potential difference between its surface and a point at distance $3r$ from the centre is V, then the electric field intensity at a distance $3r$ from the centre is

(a) $\frac{V}{6r}$ (b) $\frac{V}{4r}$ (c) $\frac{V}{3r}$ (d) $\frac{V}{2r}$

9. A parallel plate capacitor is charged to V volt by a battery. The battery is disconnected and the separation between the plates is halved. The new potential difference across the capacitor will be

(a) $\frac{V}{2}$ (b) V (c) $2V$ (d) $\frac{V}{4}$

10. Relation between drift velocity (v_d) of electron and thermal velocity (v_T) of an electron at room temperature is

(a) $v_d = v_T = 0$ (b) $v_d > v_T$ (c) $v_d < v_T$ (d) $v_d = v_T$

11. The ratio of current density and electric field is called

(a) Resistivity (b) Conductivity (c) Drift velocity (d) Mobility

12. In a cyclotron, a charge particle

(a) undergoes acceleration all the time

(b) speeds up between the dees because of the magnetic field

(c) speeds up in a dee

(d) slows down within a dee and speeds up between dees

13. A moving electron enters normally into a uniform magnetic field; its

(a) direction of motion will change (b) speed will increase

(c) speed will decrease (d) velocity will remain the same

14. In a magnetic field acting along x-axis, a conductor carries a current along the y-axis. The force experienced by the conductor is along

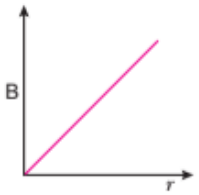
(a) the +ve z-axis (b) the –ve z-axis

(c) the –ve x-axis (d) the –ve y-axis

15. Which of the following correctly represents the variation of magnetic flux density B with distance r of a long straight wire carrying a steady current?

(a)

(b)



(c)

(d)

16. **There is a magnetic field acting in a plane downward perpendicular to sheet of paper (Fig.). Particles in vacuum move in the plane of paper from left to right. The path indicated by an arrow could be travelled by**

(*a*) proton (*b*) neutron
(*c*) electron (*d*) α-particle

17. **Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon**
(*a*) the materials of wires of the coils
(*b*) the currents in the two coils
(*c*) the rates at which currents are changing in the two coils
(*d*) relative position and orientation of the two coils

18. **Two coils have inductances $L_1 = 4$ mH and $L_2 = 1$ mH respectively. The currents in the two coils are increased at the same rate. At a certain instant of time, both coils are given the same power. If I_1 and I_2 are the currents in the two coils at that instant of time respectively, then the value of ratio $\frac{I_1}{I_2}$ is**

(*a*) $\frac{1}{8}$ (*b*) $\frac{1}{4}$ (*c*) $\frac{1}{2}$ (*d*) 1

19. **When 100 volt *dc* is applied across a solenoid, a current of 1.0 A flows in it. When 100 volt *ac* is applied across the same coil, the current drops to 0.5 A If the frequency of *ac* source is 50 Hz, the impedance and inductance of solenoid are:**
(*a*) 200 Ω and 0·55 henry (*b*) 100 Ω and 0·86 henry
(*c*) 200 Ω and 1·0 henry (*d*) 100 Ω and 0·93 henry

20. **A transformer is used to**
(*a*) convert *ac* into *dc* (*b*) convert *dc* into *ac*
(*c*) to step up or down *dc* voltage (*d*) to step up or down *ac* voltage

21. **A choke coil is a coil having**
(*a*) low inductance and high resistance (*b*) low inductance and low resistance
(*c*) high inductance and high resistance (*d*) high inductance and negligible or small resistance

22. **The voltage measured across the *ac* mains terminals is 210 V. Then the peak to peak variation of voltage between the terminals will be:**
(*a*) 420 V (*b*) $420/\sqrt{2}$ V (*c*) $420\sqrt{2}$ V (*d*) $210\sqrt{2}$ V

23. **An *ac* voltage source $E = 200\sqrt{2}$ sin 100 t is connected across a circuit containing an *ac* ammeter and a capacitor of capacitance 1μF. The reading of ammeter is**
(*a*) 10 mA (*b*) 20 mA (*c*) 40 mA (*d*) 80 mA

24. **Consider the following laws belongs electromagnetic induction in Column A and match with appropriate characteristics in Column B.**

Column A		Column B	
(*i*)	Faraday's Law	(*p*)	Motion of charge is moving perpendicular to a magnetic field.
(*ii*)	Lenz's Law	(*q*)	The magnitude of the rate of change of magnetic flux.
(*iii*)	Fleming's right hand rule	(*r*)	Current induced in a conductor moving perpendicular to a magnetic field.
(*iv*)	Fleming's left hand rule	(*s*)	Direction of induced current which opposes its change of magnetic flux.

(*a*) (*i*)–(*s*), (*ii*)–(*r*), (*iii*)–(*p*), (*iv*)–(*q*) (*b*) (*i*)–(*q*), (*ii*)–(*s*), (*iii*)–(*r*), (*iv*)–(*p*)
(*c*) (*i*)–(*p*), (*ii*)–(*q*), (*iii*)–(*r*), (*iv*)–(*s*) (*d*) (*i*)–(*r*), (*ii*)–(*s*), (*iii*)–(*q*), (*iv*)–(*p*)

25. **If we want to produce electromagnetic waves of wavelength 500 km by an oscillating charge; then frequency of oscillating charge must be**
(*a*) 600 Hz (*b*) 500 Hz (*c*) 167 Hz (*d*) 15 Hz

26. Infrared radiations are detected by

(*a*) spectrometer (*b*) nanometer

(*c*) pyrometer (*d*) photometer

27. A basic communication system consists of

(A) transmitter **(B) information source**

(C) user of information **(D) channel**

(E) receiver

Choose the correct sequence in which these are arranged in a basic communication system:

(*a*) ABCDE (*b*) BADEC (*c*) BDACE (*d*) BEADC

28. A convex mirror has a focal length *f*. An object is placed at a distance *f*/2 in front of it from the pole. The mirror produces an image at

(*a*) infinity (*b*) *f* (*c*) 2*f* (*d*) *f*/3

29. A ray of light enters from a denser medium into rarer medium. The speed of light in the rarer medium is twice than that in denser medium. What is the critical angle for total internal reflection to take place?

(*a*) 60° (*b*) 45° (*c*) 30° (*d*) 150°

30. A glass lens is immersed in water. What will be the effect on the power of lens?

(*a*) increases (*b*) constant (*c*) decreases (*d*) not depends

31. A lens forms a virtual image 4 cm away from it when an object is placed 10 cm away from it. The lens is of focal length

(*a*) concave, 6.67 cm (*b*) concave, 2.86 cm

(*c*) convex, 2.86 cm (*d*) may be concave or convex, 6.67 cm

32. Given below are two statements labelled as Statement P and Statement Q:

Statement P : A total reflecting prism is used to erect the inverted image without deviation.

Statement Q : Rays of light incident parallel to base of prism emerge out as parallel rays.

Select the most appropriate option:

(*a*) P is true, but Q is false (*b*) P is false, but Q is true

(*c*) Both P and Q are true (*d*) Both P and Q are false

33. An unpolarized light is incident onto a medium of refractive index $\sqrt{3}$ at the polarising angle of the medium then the angle of refraction is

(*a*) 30^0 (*b*) 45^0 (*c*) 60^0 (*d*) 90^0

34. Diffraction aspect is easier to notice in case of the sound waves then in case of the light waves because sound waves

(*a*) have longer wavelength (*b*) shorter wavelength

(*c*) longitudinal wave (*d*) transverse waves

35. The ratio of resolving powers of an optical microscope for two wavelengths λ_1 = 4000 Å and λ_2 = 6000 Å is

(*a*) 9 : 4 (*b*) 3 : 2 (*c*) 16 : 81 (*d*) 8 : 27

36. In young's double slit experiment, The distance between two consecutive bright and dark fringes are given by

(*a*) $\beta = \frac{\lambda D}{d}$ (*b*) $\beta = \frac{Dd}{\lambda}$ (*c*) $\beta = \frac{\lambda}{Dd}$ (*d*) $\beta = \frac{\lambda d}{D}$

37. The wave theory of light was given by

(*a*) Huygens (*b*) Newton (*c*) Thomas Young (*d*) Planck.

38. In interferene with two coherent sources the fringe width varies

(*a*) directly as wavelength (*b*) inversely as wavelength

(*c*) directly as the separation between slits (*d*) inversely as the distance between slits and screen.

39. An interference pattern is observed by Young's double-slit experiment. If now the separation between coherent sources is halved and the distance of screen from coherent sources is doubled; the new fringe width

(*a*) becomes double (*b*) becomes one-fourth (*c*) remains same (*d*) becomes four times

40. **If E is energy and p is momentum, then equation $E = pc$ is valid:**

(*a*) for an electron as well as for a photon (*b*) for an electron but not for a photon

(*c*) for a photon but not for an electron (*d*) neither for an electron nor for a photon

41. **Photoelectrons emitted from a metallic surface are those which are**

(*a*) present inside the nucleus

(*b*) are orbiting very near to nucleus

(*c*) are generated by the decay of neutrons within the nucleus

(*d*) free to move within interatomic spacing

42. **According to Bohr's model of hydrogen atom, an electron can revolve round a proton indefinitely, if its path is**

(*a*) a perfect circle of any radius (*b*) a circle of constantly decreasing radius

(*c*) a circle of an allowed radius (*d*) an ellipse

43. **Which state of triply ionised beryllium (Be^{+++}) has the same orbital radius as that of the ground state of hydrogen?**

(*a*) $n = 1$ (*b*) $n = 2$ (*c*) $n = 3$ (*d*) $n = 4$

44. **For an electron in the second orbit of hydrogen, what is the moment of momentum as per the Bohr's model?**

(*a*) $2\pi h$ (*b*) πh (*c*) h/π (*d*) $2h/\pi$

45. **An atom of mass number 15 and atomic number 7 captures an α-particle and then emits a proton. The mass number and atomic number of the resulting atom will be respectively.**

(*a*) 14 and 2 (*b*) 15 and 3 (*c*) 16 and 4 (*d*) 18 and 8

46. **In a nuclear fusion reaction, two nuclei, A and B fuse to produce a nucleus C, releasing an amount of energy ΔE in the process. If the mass defects of the three nuclei are ΔM_A, ΔM_B and ΔM_C respectively, then which of the following relations holds? Here, c is the speed of light.**

(*a*) $\Delta M_A + \Delta M_B = \Delta M_C - \Delta E/c^2$ (*b*) $\Delta M_A + \Delta M_B = \Delta M_C + \Delta E/c^2$

(*c*) $\Delta M_A - \Delta M_B = \Delta M_C - \Delta E/c^2$ (*d*) $\Delta M_A - \Delta M_B = \Delta M_C - \Delta E/c^2$

47. **Energy released in nuclear fission is due to**

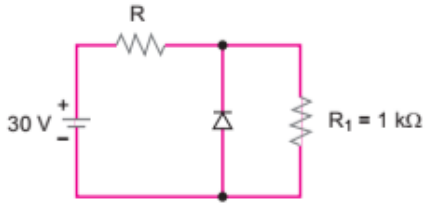
(*a*) total binding energy of fragments is more than the binding energy of parental element

(*b*) total binding energy of fragments is less than the binding energy of parental element

(*c*) total binding energy of fragments is equal to the binding energy of parental element

(*d*) some mass is converted into energy

48. **If current in diode is five times that in R_1 and breakdown voltage of diode is 6 volt, find the value of R.**



(*a*) 2000 Ω (*b*) $\frac{2000}{3}$ Ω (*c*) 1000 Ω (*d*) $\frac{2000}{3}$ Ω

49. **In a photodiode, when there is no incident light, the reverse current is almost negligible and is called**

(*a*) dark current (*b*) zener current (*c*) photocurrent (*d*) PIN current

50. **Application of a forward bias to p-n junction is**

(*a*) it decreases the electric field in the depletion zone

(*b*) it increases the number of donors on the n side

(*c*) it increases the potential difference across depletion zone

(*d*) it widens the depletion zone

ANSWERS

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

SOLUTIONS

PRACTICE PAPER–20

1. (*a*) $\phi = \vec{E} \cdot d\vec{S}$

$= \frac{N}{C} \times m^2$

2. (*d*) $F = \frac{kQ_1Q_2}{r^2}$

$25 = \frac{KQ_1Q_2}{r^2}$ ...(*i*)

$5 = \frac{KQ_1Q_2}{(r')^2}$ ...(*ii*)

Divide equation (*i*) and (*ii*)

$5 = \left(\frac{r'}{r}\right)^2 \Rightarrow r' = \sqrt{5}r$

3. (*a*) The Coulomb's force is directly proportional to the product of charges and inversely proportional to the square of distance between them. In vector form, it is represented as

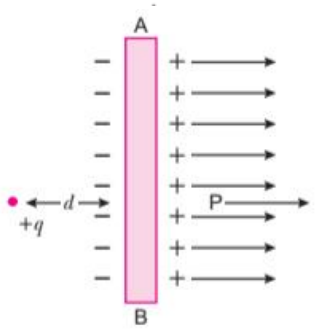
$$\vec{F}_{12} = \frac{1}{4\pi\varepsilon_0}\frac{q_1q_2}{r_{12}^2}\hat{r}_{12}$$

4. (*a*) Charge on conducting metal sphere reside on the surface of metal. Hence, electric field inside a conductor is zero.

5. (*d*) If the sheet S is given some positive charge density, then by induction, negative charge develop on ends of A and B, closer to S and an equal positive charge develops on farther ends of A and B as shown in figure. So, S attracts both A and B. Also, A attracts B.

6. (*d*) Let charge $+q$ is placed to the left of isolated conducting plane AB vertical to plane of paper.

Due to induction by $+q$, R.H.S. of plane acquire positive charge. So, lines of force will emerge perpendicularly outward and parallel to each other.



7. (*b*); Electric field (Coulomb field) due to point charge,

$$E = \frac{KQ}{r^2}$$

Now, Coulomb field due to system of charges, $Q = 4\ \mu C$

i.e., $E = KQ\left[\frac{1}{r_1^2} + \frac{1}{r_2^2} + \frac{1}{r_3^2} + \ldots\ldots\ldots + \infty\right]$

$E = 9\times10^9 \times 4\times10^{-6}\left[1 + \frac{1}{4} + \frac{1}{16} + \frac{1}{64} + \ldots.\infty\right]$

$E = \frac{36\times10^3}{1-1/4} = 4.8\times10^4\ N/C$

8. (*a*) $V = \frac{1}{4\pi\varepsilon_0}\left(\frac{q}{r} - \frac{q}{3r}\right) = \frac{1}{4\pi\varepsilon_0}\frac{2}{3}\frac{q}{r}$

$\Rightarrow \quad \frac{1}{4\pi\varepsilon_0}\frac{q}{r} = \frac{3}{2}V$

$E = \frac{1}{4\pi\varepsilon_0}\frac{q}{(3r)^2} = \frac{1}{4\pi\varepsilon_0}\frac{q}{9r^2} = \frac{V}{6r}$

9. (*a*) When the battery is disconnected the charge on the capacitor, $Q = CV$

Capacitance of parallel plate capacitor, $C = \frac{\varepsilon_0 A}{d}$

When the separation between the plates is halved, $C' = \frac{\varepsilon_0 A}{d/2} = 2C$

New potential difference $V = \frac{Q}{C'} = \frac{CV}{2C} = \frac{V}{2}$

10. (*c*) Electrons with the fermi energy carry considerable kinetic energy. Their mean thermal velocity at temperature T should be $v_T = \sqrt{3KT/m}$, which generally turns out to be quite large. The average velocity with which electrons must pass along a conductor to carry a current is called drift velocity and is given by $v_d = \frac{I}{neA}$ which is much less than the thermal velocity, or $v_d < v_T$.

13. (*a*) When a moving charged particle enters in a magnetic field. It experiences force and its direction of motion is determine.

14. (*b*) Accoding to FLHR, force experienced along the –ve z-axis.

15. (*d*) $B \propto \frac{1}{r}$

16. (*c*) As we know, $\vec{F} = q(\vec{v} \times \vec{B})$

$\therefore \quad \hat{F} = q(\hat{i} \times -\hat{k}) = q(+\hat{j})$

But direction of path is anticlock wise (downward). So, charge particle must be –ve type i.e., electron.

i.e., $\hat{F} = -\hat{j}$ (along –ve y-axis)

18. (*b*) $\frac{I_1}{I_2} = \frac{L_2}{L_1} = \frac{1}{4}$

19. (*a*) $R = \frac{V_{dc}}{I_{dc}} = \frac{100}{1} = 100\,\Omega,$

$Z = \frac{V_{rms}}{I_{rms}} = \frac{100}{0.5} = 200\,\Omega$

$X_L = \sqrt{Z^2 - R^2} = \sqrt{200^2 - 100^2} = 100\sqrt{3}\,\Omega,$

$L = \frac{X_L}{\omega} = \frac{100\sqrt{3}}{2\pi \times 50} = \frac{100\sqrt{3}}{314} = 0.55\,\text{H}$

22. (*d*) $V_0 = V_{rms}\sqrt{2} = 210\sqrt{2}\,\text{V}$

23. (*b*) $X_C = \frac{1}{\omega C} = \frac{1}{100 \times 10^{-6}} = 10^4\,\Omega$

$I_{rms} = \frac{V_{rms}}{X_C} = \frac{200}{10^4}\text{A} = 20\,\text{mA}$

25. (*a*) $\nu = \frac{c}{\lambda} = \frac{3 \times 10^8}{500 \times 10^3} = 600\,\text{Hz}$

26. (*c*) The heating effect produced by infrared radiations can be detected by a pyrometer.

28. (*d*) Using, $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$

$\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

Put $u = f/2$, we get

$v = f/3$

29. (*c*) We know, $n = \frac{2v}{v} = 2$

From critical angle condition, $n = \frac{1}{\sin i_c}$

$\sin i_c = \frac{1}{2} \Rightarrow i_c = 30°$

30. (*c*) As we know, $f_l = \left(\frac{n_g - 1}{\frac{n_g}{n_l} - 1}\right) f_a$

Also, $n_g > n_l$

When a glass lens is immersed in water, its focal length increases and hence the power decreases.

31. (*a*) As $v = -4$ cm $u = -10$ cm (given)

Using lens formula,

$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{f} = \frac{-1}{4} + \frac{1}{10}$

$= \frac{-5+2}{20} = \frac{-3}{20}$

$f = \frac{-20}{3} = -6.67\,\text{cm}$

$\therefore$ The lens is concave with focal length 6.67 cm.

32. (*c*) The emergent beam is parallel to the incident beam. The rays do not suffer any deviation, only their order is reversed. So a total reflecting prism can be used as an erecting prism.

33. (*a*) According to Brewster's law,

$n = \tan i_p$

$n = \tan (90° - r_p)$

$\Rightarrow \sqrt{3} = \tan (90° - r_p)$

$\tan 60° = \tan (90° - r_p)$

$90° - r_p = 60°$

$\Rightarrow r_p = 30°$

34. (*a*) Diffraction is easier to notice in sound waves than in light waves because of its longer wavelength.

35. (*b*) The resolving power of an optical microscope,

$R_P = \frac{2n \sin\theta}{\lambda}$

For $\lambda_1 = 4000$ Å, $(R_P)_1 = \frac{2n \sin\theta}{4000}$ ...(*i*)

For $\lambda_2 = 6000$ Å, $(R_P)_2 = \frac{2n \sin\theta}{6000}$ ...(*ii*)

Dividing equation (*i*) by (*ii*), we have

$\frac{(R_P)_1}{(R_P)_2} = \frac{6000}{4000} = \frac{3}{2} = 3:2$

38. (*a*) Fringe width, $\beta \propto \lambda$

39. (*d*) As we know, $\beta = \frac{D\lambda}{d}$

$\beta' = \frac{2D\lambda}{d/2} = 4\frac{D\lambda}{d} = 4\beta$

40. (*c*) $E = pc$ is valid for photon or massless particles while for electrons equation is

$E = \sqrt{p^2c^2 + m_0^2c^4}$

42. (*c*) In Bohr's model of hydrogen atom, an electron can revolve around nucleus only in a circle of allowed radius.

43. (*b*) $r_n = \frac{0.53\,n^2}{Z}$

For ground state in hydrogen atom, $r_1 = 0.53$ [$\because Z = 1$] ...(*i*)

For Be^{3+}, $r_n = \frac{0.53\,n^2}{4}$ ($\because Z = 4$) ...(*ii*)

For radius to be equal, $r_1 = r_n$

$0.53 = \frac{0.53\,n^2}{4} \Rightarrow n^2 = 4$

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$\Rightarrow \quad n = 2$

44. (*c*) In second orbit of hydrogen, $n = 2$

$$L = 2\left(\frac{h}{2\pi}\right) = \frac{h}{\pi}$$

45. (*d*) In nuclear reaction,

${}^{15}_{7}\text{X} + {}^{H}_{2}\text{He} \rightarrow {}^{1}_{1}\text{H} + {}^{A}_{Z}\text{Y}$

By conservation of mass,

$A + 1 = 15 + 4 \quad \Rightarrow \quad A = 18$

By conservation of charge,

$Z + 1 = 7 + 2 \quad \Rightarrow \quad Z = 8$

46. (*a*) As given nuclear reaction, $A + B \rightarrow C$

Energy released,

ΔE = B.E. of C – [B.E. of A + B.E. of B]

$= [\Delta M_C - (\Delta M_A + \Delta M_B)]c^2$

$$\Rightarrow \quad \frac{\Delta E}{c^2} = \Delta M_C - (\Delta M_A + \Delta M_B)$$

$$\therefore \quad \Delta M_A + \Delta M_B = \Delta M_C - \frac{\Delta E}{c^2}$$

47. (*a*) Energy released in nuclear fission is due to the fact that total binding energy of fragments is more than the binding energy of the parent nucleus.

48. (*b*) Current through R_1,

$$I_1 = \frac{\text{Breakdown voltage of diode}}{R_1}$$

$$= \frac{6\text{ V}}{1\text{ k}\Omega} = \frac{6}{1\times10^3}\text{ A} = 6\text{ mA}$$

The current in diode in 5 times that in R_1.

$\therefore$ Total current drawn from the battery, $I = I_1 + I_2 = 6\text{ mA} + 30\text{ mA} = 36\text{ mA}$

P.D. across R, $V_R = 30 - 6 = 24\text{ V}$

$$RI = V_R$$

$$R \times 36 \times 10^{-3} = 24$$

$$\therefore \quad R = \frac{24}{36\times10^{-3}} = \frac{2000}{3}\Omega$$

49. (*a*) The current generated through photodiode in absence of light is called dark current. It is a reverse current that is almost negligible.

50. (*a*) When a forward bias is applied to a *p*–*n* junction, the direction of applied potential is opposite to the built- in potential. As a result, the depletion layer width decreases.