Prachand NEET 2025

Physical Chemistry

Structure of atom

DPP 01

Q1 A species having only one electron has ionization energy of 11808 kJ mol^{-1}. The number of protons in its nucleus will be:
(A) 1 (B) 2
(C) 3 (D) 4

Q2 In an atom having 2 K, 8 L, 8 M and 2 N electrons, the number of electrons with $m = 0; s = +\frac{1}{2}$ are;
(A) 6 (B) 2
(C) 8 (D) 16

Q3 If the kinetic energy of an electron is increased 4 times, the wavelength of the de-Broglie wave associated with it would become:
(A) 4 times
(B) 2 times
(C) $\frac{1}{2}$ times
(D) $\frac{1}{4}$ times

Q4 The nuclear radius is of the order of 10^{-13} cm while atomic radius is of the order 10^{-8} cm. Assuming the nucleus and the atom to be spherical, the fraction of the atomic volume occupied by the nucleus is
(A) 10^{-15} (B) 10^{-10}
(C) 10^{-14} (D) 10^{-13}

Q5 The ionization energy of H atom is 13.6 eV. The ionization energy of Li^{2+} ion will be
(A) 54.4 eV
(B) 40.8 eV
(C) 27.2 eV
(D) 122.4 eV

Q6 The MRI (magnetic resonance imaging) body scanners used in hospitals operate with 400 MHz radio frequency. The wavelength corresponding to this radio frequency is;
(A) 0.75 m
(B) 1.5 m
(C) 0.75 cm
(D) 2 cm

Q7 In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inner-orbit jumps of the electron for Bohr orbits in an atom of hydrogen?
(A) $3 \rightarrow 2$
(B) $5 \rightarrow 2$
(C) $4 \rightarrow 1$
(D) $2 \rightarrow 5$

Q8 $3p_y$ orbital has nodal plane
(A) XY
(B) YZ
(C) ZX
(D) All of these

Q9 The ratio of the difference in energy between the first and the second Bohr orbit to that between the second and the third Bohr orbit is
(A) $\frac{1}{2}$ (B) $\frac{34}{19}$
(C) $\frac{102}{121}$ (D) $\frac{27}{5}$

Q10 The first emission line in the H-atom spectrum in the Balmer series will have wave number:-
(A) $\frac{5R}{36}$ cm^{-1}
(B) $\frac{3R}{4}$ cm^{-1}
(C) $\frac{7R}{144}$ cm^{-1}
(D) $\frac{9R}{400}$ cm^{-1}

Q11

The maximum number of electrons in a subshell for which $l = 3$ is;

(A) 14 (B) 10

(C) 8 (D) 4

Q12 The electrons, identified by quantum numbers n and l, (i) $n = 4, l = 1$ (ii) $n = 4, l = 0$ (iii) $n = 3, l = 2$ (iv) $n = 3, l = 1$ can be placed in order of increasing energy, from the lowest to highest, as;

(A) $(iv) < (ii) < (iii) < (i)$

(B) $(ii) < (iv) < (i) < (iii)$

(C) $(i) < (iii) < (ii) < (iv)$

(D) $(iii) < (i) < (iv) < (ii)$

Q13 The Bohr orbit radius for the hydrogen atom $(n = 1)$ is approximately $0.530\ \text{A}^\circ$ The radius for the first excited state $(n = 2)$ orbit is (in A°);

(A) 0.13

(B) 1.06

(C) 4.77

(D) 2.12

Q14 The uncertainty in the position of an electron and proton is equal, the ratio of the uncertainties in the velocity of an electron and proton is:

(A) $10^3 : 1$ (B) $1 : 1838$

(C) $3672 : 1$ (D) $1836:1$

Q15 The atomic numbers of elements X, Y and Z are 19, 21 and 25 respectively. The number of electrons present in the M-shell of these elements follow the order;

(A) $Z > X > Y$

(B) $X > Y > Z$

(C) $Z > Y > X$

(D) $Y > Z > X$

Q16 Which of the following configuration is correct for iron?

(A) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^4$

(B) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6 4s^2$

(C) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2$

(D) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2 4s^2$

Q17 A 100 watt bulb emits monochromatic light of wavelength $400\ \text{nm}$. Calculate the number of photons emitted per second by the bulb.

(A) $20.12 \times 10^{20}\ \text{s}^{-1}$

(B) $2.012 \times 10^{20}\ \text{s}^{-1}$

(C) $4.969 \times 10^{-19}\ \text{s}^{-1}$

(D) $49.69 \times 10^{-19}\ \text{s}^{-1}$

Q18 The values of four quantum numbers of valence electron of an element X is n=4, l=0, m=0, $\text{s} = \pm\frac{1}{2}$. The element is;

(A) K

(B) Ti

(C) Na

(D) Se

Q19 Select the correct statements from the following

A. Atoms of all elements are composed of two fundamental particles.

B. The mass of the electron is $9.10939 \times 10^{-31}\ \text{kg}$.

C. All the isotopes of a given elements show same chemical properties.

D. Protons and electrons are collectively known as nucleons.

E. Dalton's atomic theory, regarded the atom as an ultimate particle of matter.

Choose the correct answer from the options given below

(A) C,D and E only (B) A and E only

(C) B,C and E only (D) A,B and C only

Q20 Match the following

	List I		List II
(a)	Energy of ground state of He^+	(i)	+6.04 eV
(b)	Potential energy of I-orbit of H-atom	(ii)	-27.2 eV
(c)	Kinetic energy of II-excited state of He^+	(iii)	54.4 eV
(d)	Ionisation potential of He^+	(iv)	-54.4 eV

(A) (A-i), (B-ii), (C-iii), (D-iv)

(B) (A-iv), (B-iii), (C-ii), (D-i)

(C) (A-iv), (B-ii), (C-i), (D-iii)
(D) (A-ii), (B-iii), (C-i), (D-iv)

Q21 **Assertion** : Angular momentum of an electron in an atom is quantized.
Reason : In an atom, only those orbits are permitted in which angular momentum of the electron is a natural number multiple of $\frac{h}{2\pi}$.
(A) Both Assertion & Reason are true and the reason is the correct explanation of the assertion.
(B) Both Assertion & Reason are true but the reason is **not** the correct explanation of the assertion.
(C) Assertion is true but Reason is false.
(D) Assertion is false but Reason is true.

Q22 Assertion: $2p_x$, $2p_y$ and $2p_z$ each have one nodal plane.
Reason: These orbital are degenrate orbitals.
(A) Both assertion and reason are correct, and the reason is the correct explanation for the assertion
(B) Both assertion and reason are correct, but the reason is not the correct explanation for the assertion
(C) The assertion is true, but the reason is false
(D) The assertion is false, but the reason is true

Q23 Match the columns and choose the correct option:

	List I		**List II**
(a)	Principal quantum number	(p)	orientation of the orbital
(b)	Azimuthal quantum number	(q)	energy and size of orbital
(c)	Magnetic quantum number	(r)	spin of electron
(d)	Spin quantum number	(s)	shape of the orbital

(A) a-(q), b-(s), c-(p), d-(r)
(B) a-(s), b-(q), c-(p), d-(r)
(C) a-(q), b-(p), c-(s), d-(r)
(D) a-(q), b-(s), c-(r), d-(p)

Q24 Assertion: Photon has both momentum and wavelength.
Reason: It is because a photon shows the dual nature of a particle as well as a wave.
(A) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(B) Assertion is correct, reason is correct; reason is not a correct explanation for assertion.
(C) Assertion is correct, reason is incorrect.
(D) Assertion is incorrect, reason is correct.

Q25 Statement-I: Energy of the orbitals increases as $1\ \mathrm{s} < 2\ \mathrm{s} = 2\mathrm{p} > 3\mathrm{p} = 3\ \mathrm{d} = 3\ \mathrm{d} < 4\ \mathrm{s} = 4\mathrm{p} = 4\ \mathrm{d} = 4\mathrm{f} < \ldots$
Statement-II: Energy of the electron depends completely on the principal quantum numbers.
(A) Both Statement-I and Statement-II are correct.
(B) Both Statement-I and Statement-II are incorrect.
(C) Statement-I is correct and Statement-II is incorrect.
(D) Statement-I is incorrect and Statement-II is correct.

Q26 The orbital angular momentum of an electron in $2\mathrm{s}$ orbital is :
(A) $+\frac{1}{2}\frac{h}{2\pi}$
(B) zero
(C) $\frac{\mathrm{h}}{2\pi}$
(D) $\sqrt{2}\frac{\mathrm{h}}{2\pi}$

Q27 Which one of the following is not the characteristic of Planck's quantum theory of radiation?
(A) The energy is not absorbed or emitted in whole number or multiple of quantum
(B) Radiation is associated with energy
(C) Radiation energy is not emitted or absorbed continuously but in the form of small packets called quanta
(D) This magnitude of energy associated with a quantum is proportional to the frequency.

Q28

For the total number of electron in Argon, where the value of $l + \mathrm{m} = 0$

(A) 12 (B) 10

(C) 8 (D) 6

Q29 Consider the following sets of quantum numbers

(a) n= 3, *l* = 0, m = 0, s = +1/2

(b) n= 2, *l* = 2, m = 1, s = +1/2

(c) n= 4, *l* = 3, m = –2, s = –1/2

(d) n= 1, *l* = 0, m = –1, s = –1/2

(e) n= 3, *l* = 2, m = 3, s = +1/2

Which of the following sets of quantum number is not possible?

(A) (a) and (c)

(B) (b), (c) and (d)

(C) (a). (b), (c) and (d)

(D) (b), (d) and (e)

Q30 Which of the following orbital is non-directional in nature?

(A) s

(B) p

(C) d

(D) f

Answer Key

Q1	(C)	Q16	(B)
Q2	(A)	Q17	(B)
Q3	(C)	Q18	(A)
Q4	(A)	Q19	(C)
Q5	(D)	Q20	(C)
Q6	(A)	Q21	(A)
Q7	(B)	Q22	(B)
Q8	(C)	Q23	(A)
Q9	(D)	Q24	(A)
Q10	(A)	Q25	(D)
Q11	(A)	Q26	(B)
Q12	(A)	Q27	(A)
Q13	(D)	Q28	(D)
Q14	(D)	Q29	(D)
Q15	(C)	Q30	(A)

Hints & Solutions

Note: scan the QR code to watch video solution

Q1 Text Solution:

(C)

Let the ionization energy of an atom of the given species is $\frac{11808\times10^3}{6.022\times10^{23}}\ \mathrm{J/atom}$

The ionization energy of any species is

$2.18\times10^{-18}\times Z^2\ \mathrm{J/atom}$

$\therefore\ Z^2=\frac{11808\times10^3}{6.022\times10^{23}\times2.18\times10^{-18}}=8.99\approx9$

$\therefore\ Z=3$ (Z is the atomic number of the given species)

Video Solution:

Q2 Text Solution:

(A)

K	L	M	N
2	8	8	2

Total electron count is 20. It is a Calcium.

$_{20}Ca=1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$

For s orbital and pz orbital, m = 0 and one of each orbital has an electron having s = +1/2.

Therefore, such number of electrons are six.

Video Solution:

Q3 Text Solution:

(C)

$\lambda=\frac{h}{p}=\frac{h}{mV}=\frac{h}{\sqrt{2mK}}$

All the symbols have their usuals meaning

$\because\ \lambda\propto\frac{1}{\sqrt{K}}$ therefore, if K increase four times λ decrease 2 times or λ is 1/2 times

Video Solution:

Q4 Text Solution:

(A)

An atom consists of electrons, protons, and neutrons. Protons and neutrons are present in small-sized nuclei at the center of an atom. And electrons are revolving around the nucleus in particular orbits. The size of the nucleus is too small in comparison to the size of an atom.

Given; that atomic radius = $10^{-8}\ \mathrm{cm}$ and the nuclear radius = $10^{-13}\ \mathrm{cm}$.

We know that the volume of the sphere is $\frac{4}{3}\pi r^3$, where r is the radius of the sphere.

Then the volume atom is given by

$V_{\text{atom}}=\frac{4}{3}\pi\left(10^{-8}\right)^3=\frac{4}{3}\pi\times10^{-24}$

And the volume of the nucleus is given by

$V_{\text{nucleus}}=\frac{4}{3}\pi\left(10^{-13}\right)^3=\frac{4}{3}\pi\times10^{-39}$

The fraction of an atom occupied by a nucleus is equal to the ratio of the volume of the nucleus to the volume of an atom. Then fraction of atoms occupied by the nucleus is given by

$f=\frac{V_{\text{nucleus}}}{V_{\text{atom}}}=\frac{\frac{4}{3}\pi\times10^{-39}}{\frac{4}{3}\pi\times10^{-24}}$

$f=\frac{10^{-39}}{10^{-24}}=10^{-15}$

Hence, option A is correct.

Q5 Text Solution:

(D)

$IE=13.6\times Z^2\ \mathrm{eV/atom}$

$\therefore\ IE\left(Li^{2+}\right)=13.6\times3^2$

$=122.4\ \mathrm{eV/atom}$

Video Solution:

Q6 Text Solution:

(A)

According to the relation,

$\nu = \frac{c}{\lambda}$

ν =frequency

λ =wave length = $400\,\mathrm{MHz} = 400 \times 10^6\,\mathrm{Hz}$

c =speed of light $\left(3 \times 10^8\ \mathrm{m/s}\right)$

$v = \frac{c}{\lambda} = \frac{3.0 \times 10^8}{\lambda}$

$\lambda = \frac{c}{v}$

$= \frac{3.0 \times 10^8}{400 \times 10^6} = 0.75\ \mathrm{m}$

Hence , option A $(0.75\ \mathrm{m})$ is correct .

Q7 Text Solution:

(B)

A line belonging to red and means it is a Balmer line:

First Balmer line : $3 \rightarrow 2$

Second Balmer line : $4 \rightarrow 2$

Third Balmer line : $5 \rightarrow 2$

Video Solution:

Q8 Text Solution:

(C)

A $3p_y$ orbitals has nodal plane in ZX plane.

Video Solution:

Q9 Text Solution:

(D)

$E_1 = -2.18 \times 10^{-18}\ \frac{Z^2}{1^2}\ J/atom$

$E_2 = -2.18 \times 10^{-18}\ \frac{Z^2}{2^2}\ J/atom$

$E_3 = -2.18 \times 10^{-18}\ \frac{Z^2}{3^2}\ J/atom$

$\Delta E_1 \& E_2 = E_2 - E_1 = +2.18 \times 10^{-18} \times Z^2 \left(\frac{1}{1^2} - \frac{1}{2^2}\right)$

$\Delta E_2 \& E_3 = E_3 - E_2 = +2.18 \times 10^{-18} \times Z^2 \left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

$\frac{\Delta E_{1\&2}}{\Delta E_{2\&3}} = \frac{3/4}{5/36} = \frac{3}{4} \times \frac{36}{5} = \frac{27}{5}$

Video Solution:

Q10 Text Solution:

(A)

The first emission line in the H-atom spectrum in the Balmer series is form $n_f = 3\ to\ n_i = 2$

$\overrightarrow{v} = \frac{R_H}{hc}\left(\frac{1}{{n_i}^2} - \frac{1}{{n_f}^2}\right) = \frac{R_H}{hc}\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

$= \frac{R_H}{hc} \times \frac{5}{36} = \frac{5R}{36} cm^{-1}$

$\left\{R = \frac{R_H}{hc}\right\}$

Video Solution:

Q11 Text Solution:

(A)

The maximum number of electron in a subshell

$= (4l + 2)$

$= 4(3) + 2$

$= 14$

Video Solution:

Q12 Text Solution:

(A)

$(i) \quad n = 4, l = 1 \; ; \; 4p$

$(ii) \quad n = 4, l = 0 \; ; \; 4s$

$(iii) \quad n = 3, l = 2 \; ; \; 3d$

$(iv) \quad n = 3, l = 1 \; ; \; 3p$

Incerasing order of energy is

3p < 4s < 3d < 4p

(iv) < (ii) < (iii) < (i)

Video Solution:

Q13 Text Solution:

(D)

$r_n = 0.530 \frac{n^2}{z} \overset{o}{A}$

$r_2 = 0.530 \times \frac{2^2}{1} = 2.12 \overset{o}{A}$

Video Solution:

Q14 Text Solution:

(D)

$\Delta x_e = \Delta x_p$

$Ratio = \frac{\Delta x_e \cdot m_e \Delta v_e}{\Delta x_p \cdot m_p \Delta v_p} = \frac{\mathrm{h}/4\pi}{\mathrm{h}/4\pi} = 1$

$\frac{\Delta v_e}{\Delta v_p} = \frac{m_p}{m_e} = \frac{1836}{1}$

The symbol have their usual meaning.

Video Solution:

Q15 Text Solution:

(C)

$_{19}X = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

$_{21}X = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^1$

$_{25}X = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^5$

M shell means n = 3

Number of electrons in n = 3

X 2 + 6 = 8

Y 2 + 6 + 1 = 9

Z 2 + 6 + 5 = 13

The correct order is Z > Y > X

Video Solution:

Q16 Text Solution:

(B)

$_{26}Fe = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$

$or \quad 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^6, 4s^2$

Video Solution:

Q17 Text Solution:

(B)

$P = 100\ W = 100\ Js^{-1}$

$\lambda = 400\ nm = 400 \times 10^{-9} m = 4 \times 10^{-7} m$

$P = \frac{E}{t} = \frac{nhv}{t} = \frac{nhc}{t \times \lambda}$

$\frac{n}{t} = \frac{P \times \lambda}{hc}$

$= \frac{100 Js^{-1} \times 4 \times 10^{-7} m}{6.626 \times 10^{-34} Js \times 3 \times 10^{8} ms^{-1}}$

$= \frac{4 \times 10^{-5}}{6.626 \times 3 \times 10^{-26}} = 2.012 \times 10^{20} s^{-1}$

The symbol have their usual meaning

Video Solution:

Q18 **Text Solution:**

(A)

$n = 4,\ l = 0,\ m = 0,\ s = +\frac{1}{2}$

The valence orbital is 4s.

Therefore, the elements is K

$\left(1s^2 2s^2 2p^6 3s^2 3p^6 4s^1\right)$

Video Solution:

Q19 **Text Solution:**

(C)

Atoms of all elements are composed of three fundamental particles, i.e, electron, proton, neutrons.

Protons and neutrons are collectively known as nucleons

Video Solution:

Q20 **Text Solution:**

(C)

(A) Energy of ground state of He^+ = -54.4eV

(B) Potential energy of Ist orbit of H-atom = $2 \times (-13.6)$ = -27.2 eV

(C) Kinetic energy of IInd excited state of He^+ = $13.6 \times \frac{2^2}{3^2}$ = 6.04 eV

(D) Ionization potential of He^+ = $13.6 \times 2^2 = 54.4\ \text{eV}$

Video Solution:

Q21 **Text Solution:**

(A)

The angular momentum of an electron in a given stationary state is

$m_e vr = \frac{nh}{2\pi}$

Video Solution:

Q22 **Text Solution:**

(B)

$2p_x, 2p_y, 2p_z$ are degenrate orbitals and have one nodal plane.

Video Solution:

Q23 **Text Solution:**

(A)

(A)	Principle quantum number ⇒ energy and size of orbital
(B)	Azimuthal quantum number ⇒ shape of orbital
(C)	Magnetic quamtum number ⇒ Orientation of orbital
(D)	Spin quantum number ⇒spin of electron

Video Solution:

Q24 **Text Solution:**

(A)

Photon has both momentum and wavelength because it shows the properties of both wave and particles.

Video Solution:

Q25 **Text Solution:**

(D)

Energy of the orbitals:

$1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s < 4d < 5p < 6s < 4p < 5d < 6p < 7s.....$

This is based on the $(n + l)$ rule.

Video Solution:

Q26 **Text Solution:**

(B)

Orbital angular momentum $= \sqrt{l(l+1)}\,\frac{h}{2\pi}$

For 2s orbital $l = 0$

Orbital angular momentum = 0

Video Solution:

Q27 **Text Solution:**

(A)

The energy is absorbed or emitted in whole number or multiple of quantum.

Video Solution:

Q28 **Text Solution:**

(D)

${}_{18}Ar : 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$

For s orbital $l = 0, m = 0, l + m = 0$

$\therefore 1s^2,\ 2s^2\ \&\ 3s^2$ electrons will contribute.

Hence, such electrons are six

Video Solution:

Q29 **Text Solution:**

(D)

(b)
$$n = 2$$
$$l = 0, 1$$
$$m = 0, +1, 0, -1$$
$$s = \pm 1/2$$

(d)
$$n = 1$$
$$l = 0$$
$$m = 0$$
$$s = \pm 1/2$$

(e)
$$n = 3$$
$$l = 0,\ 1,\ 2$$
$$m = 0, +1, 0, -1, +2, +1, 0, -1, -2$$
$$s = \pm 1/2$$

Video Solution:

Q30 **Text Solution:**

(A)

s orbital is spherical in nature and hence non-directional.

Video Solution: