NEET Important Questions with Solutions from Structure of Atom

Q.1. According to Dalton's atomic theory, the smallest particle which is capable of independent existence is

A) element

B) atom

C) molecule

D) ion

Answer: atom

Solution: According to Dalton's atomic theory, matter is made up of a very small unit called atoms. Atoms are the smallest particle and atoms can neither be created nor be destroyed. Atoms combine in a simple whole-number ratio.

Q.2. Which of the following is the correct sequence in terms of increasing mass?

A) Proton, electron, alpha particle, hydrogen atom

B) Electron, proton, hydrogen atom, alpha particle

C) Hydrogen atom, proton, electron, alpha particle

D) Alpha particle, proton, hydrogen atom, electron

Answer: Electron, proton, hydrogen atom, alpha particle

Solution: Electrons and protons are the sub-atomic particles, mass of electrons is very less compared to the protons.

Hydrogen atom is H_1^1 , it contains one electron and one proton.

Alpha particle is Helium nucleus $\left(He^{2+}\right)$ which contain two neutrons and two protons.

So, the increasing order of mass is electron, proton, hydrogen atom, alpha particle.

Q.3. Neutrons are present in all atoms except

A) He

B) C

C) H

D) N

Answer: H

Solution: Number of neutrons $=$ Atomic mass $-$ Atomic number

For He, the number of neutrons $= 4 - 2 = 2$

For C, the number of neutrons $= 12 - 6 = 6$

For H, the number of neutrons $= 1 - 1 = 0$

For N, the number of neutrons $= 14 - 7 = 7$

Q.4. Which one among the following most correctly determines the atomic number of an element?

A) Number of protons

B) Number of protons and neutrons

C) Number of ions

D) Number of nucleons

Answer: Number of protons

Solution: Atomic number of the element

=Number of protons present in the nucleus of the atom of the element

=Charge on the nucleus of the atom of the element

=Serial number of the element in periodic table

=Number of extranuclear electrons present in the atom of the element.

Q.5. The pair of atoms having the same number of neutrons is

A) ${}^{12}_{6}\mathrm{C},\ {}^{24}_{12}\mathrm{Mg}$

B) ${}^{23}_{11}\mathrm{Na},\ {}^{19}_{9}\mathrm{F}$

C) ${}^{23}_{11}\mathrm{Na},\ {}^{24}_{12}\mathrm{Mg}$

D) ${}^{23}_{11}\mathrm{Na},\ {}^{39}_{19}\mathrm{K}$

Answer: ${}^{23}_{11}\mathrm{Na},\ {}^{24}_{12}\mathrm{Mg}$

Solution: In ${}^{A}_{Z}\mathrm{X}$, $\mathrm{A}-\mathrm{Z}$=number of neutrons.

${}^{23}_{11}\mathrm{Na}$=number of neutrons= $23-11=12$

${}^{24}_{12}\mathrm{Mg}$=number of neutrons=$24-12=12$

Q.6. The radii of the first Bohr orbit of $\mathrm{H}\left(\mathrm{r_H}\right),\ \mathrm{He}^{+}\left(\mathrm{r_{He}}^{+}\right)$ and $\mathrm{Li}^{2+}\left(\mathrm{r_{Li}}^{2+}\right)$ are in the order

A) $\mathrm{r_{He}}^{+}>\mathrm{r_H}>\mathrm{r_{Li}}^{2+}$

B) $\mathrm{r_H}<\mathrm{r_{He}}^{+}<\mathrm{r_{Li}}^{2+}$

C) $\mathrm{r_H}>\mathrm{r_{He}}^{+}>\mathrm{r_{Li}}^{2+}$

D) $\mathrm{r_{He}}^{+}<\mathrm{r_H}<\mathrm{r_{Li}}^{2+}$

Answer: $\mathrm{r_H}>\mathrm{r_{He}}^{+}>\mathrm{r_{Li}}^{2+}$

Solution: The radius of the bohr orbit is given by:

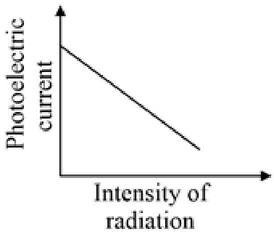
$\mathrm{r}=0.53\times\frac{\mathrm{n}^2}{\mathrm{Z}}\ \mathrm{A}^0$

So, according to the question, the orbit is the same so that the answer will be given by atomic number, and atomic number is inversely proportional to the radius, so order or radius:

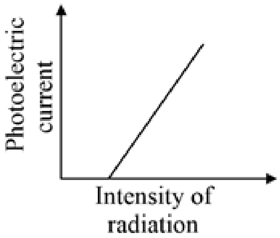
$\mathrm{r_H}>\mathrm{r_{He}}^{+}>\mathrm{r_{Li}}^{2+}$

Q.7. The graph that depicts Einstein's photoelectric effect for a monochromatic source of frequency above the threshold frequency is

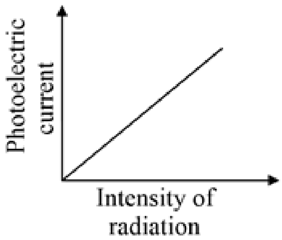
A)


Photoelectric current
Intensity of radiation

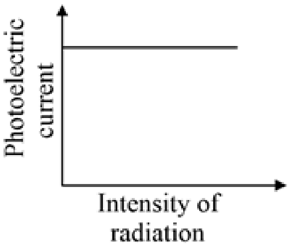
B)


Photoelectric current
Intensity of radiation

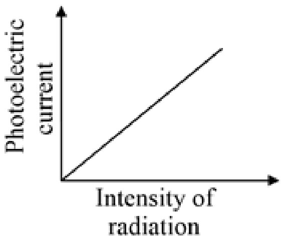
C)


Photoelectric current
Intensity of radiation

D)


Photoelectric current
Intensity of radiation

Answer:


Photoelectric current
Intensity of radiation

Solution: By the photoelectric effect:

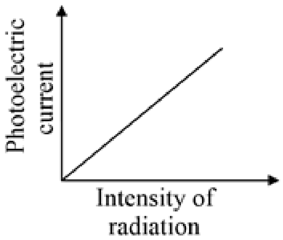
$\phi = \mathrm{h}\nu_0$

Where,

$\phi = \text{work function}$

$\nu_0 = \text{threshold frequency}$

And the current will pass till the work function of the metal is present; hence, the photocurrent is proportional to the intensity of radiation and, according to that graph, will be:



Q.8. The fraction of volume occupied by the nucleus with respect to the total volume of an atom is:

A) 10^{-15}

B) 10^{-5}

C) 10^{-30}

D) 10^{-10}

Answer: 10^{-15}

Solution:

Volume fraction $= \frac{\text{Volume of nucleus}}{\text{Total volume of atom}} = \frac{(4/3)\pi(10^{-13})^3}{(4/3)\pi(10^{-8})^3} = 10^{-15}$

Q.9. Photon of which light has maximum energy?

A) red

B) blue

C) violet

D) green

Answer: violet

Solution: Violet colour has the minimum wavelength, so, the maximum energy.

Violet has wavelength approximate $400\ \mathrm{nm}$. So, the frequency is high approximate $7.5 \times 10^{14}\ \mathrm{Hz}$.

Q.10. Electromagnetic radiations of wavelength $242\ \mathrm{nm}$ is just sufficient to ionise sodium atom. Then, the ionisation energy of Sodium in $\mathrm{kJ\ mole}^{-1}$ is:

A) 494.65

B) 400

C) 247

D) 600

Answer: 494.65

Solution: I.E. of one sodium atom $= \frac{hc}{\lambda}$

& I.E. of one mole Na atom $= \frac{hc}{\lambda}N_A = \frac{6.62\times10^{-34}\times3\times10^{8}\times6.02\times10^{23}}{242\times10^{-9}} = 494.65\ kJ.mol.$

Q.11. Which is the correct relationship?

A) E_1 of H = 1/2 E_2 of H = 1/2 E_2 of Li^{2+} = 1/4 E_4 of Be^{3+}

B) $E_1(H) = E_2(He^+) = E_3(Li^{2+}) = E_4(Be^{3+})$

C) $E_1(H) = 2E_2(He^+) = 3E_3(Li^{2+}) = 4E_4(Be^{3+})$

D) No relation

Answer: $E_1(H) = E_2(He^+) = E_3(Li^{2+}) = E_4(Be^{3+})$

Solution: Total energy of n^{th} orbit of single electron species is given by:

$E = \frac{-13.6\times Z^2}{n^2}\ eV/atom$

$E_1(H) = -13.6\times\frac{1^2}{1^2} = -13.6\,eV$; $E_2(He^+) = -13.6\times\frac{2^2}{2^2} = -13.6\,eV$

$E_3(Li^{2+}) = -13.6\times\frac{3^2}{3^2} = -13.6\,eV$; $E_4(Be^{3+}) = -13.6\times\frac{4^2}{4^2} = -13.6\,eV$

$\therefore E_1(H) = E_2(He^+) = E_3(Li^{2+}) = E_4(Be^{3+})$

Q.12. Maximum number of electrons that can be accommodated in the subshell with azimuthal quantum number $l = 4$, is:

A) 10

B) 8

C) 16

D) 18

Answer: 18

Solution: Value of $l \Rightarrow 0$ to $n-1$

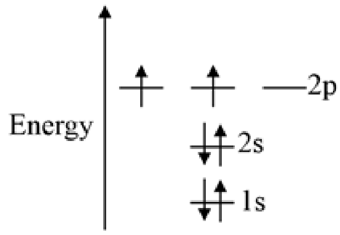
and

$l = 0 = s = 1$ orbital
$l = 1 = p = 3$ orbital
$l = 2 = d = 5$ orbital
$l = 3 = f = 7$ orbital
$l = 4 = g = 9$ orbital

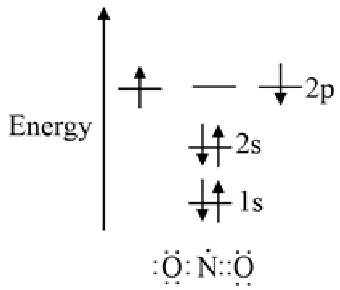
So, electrons in $l = 4$ are $18\ e^{-1}$.

Q.13. The electronic configuration which obeys Hund's rule for the ground state of carbon atom is:

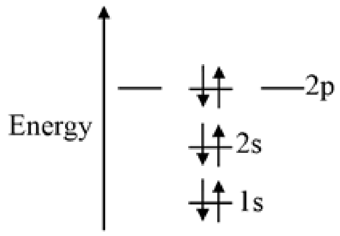
A)



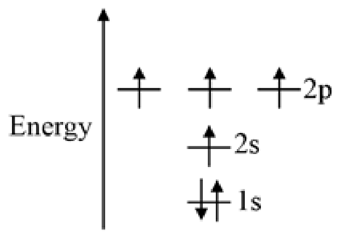
B)



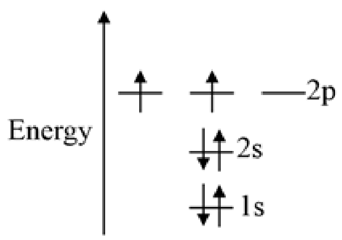
C)



D)



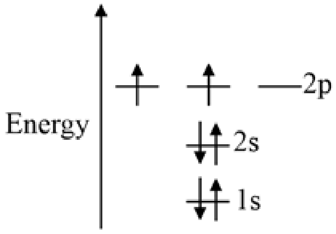
Answer:



Solution: According to Hund's rule:

One electron is filled first in orbitals, if there are more than one orbital and are present with the same energy. After filling orbital by one electron, pairing will take place.

So, the below structure is following Hund's rule:



Q.14. Among the following, the INCORRECT statement is

A) No two electrons in an atom can have the same set of four quantum numbers.

B) The maximum number of electrons in the shell with principal quantum number, n, is equal to n^2+2

C) Electrons in an orbital must have opposite spin.

D) In the ground state, atomic orbitals are filled in the order of their increasing energies.

Answer: The maximum number of electrons in the shell with principal quantum number, n, is equal to n^2+2

Solution: All statements are correct except, the maximum number of electrons in the shell with principal quantum number, n, is equal to n^2+2, because the maximum number of electron in the shell with principal quantum number, n, will be $2n^2$.

Q.15. The energy of hydrogen atom in its ground state is $-13.6\ eV$. The energy of the level corresponding to $n=5$ is:

A) $-0.54\ eV$

B) $-5.40\ eV$

C) $-0.85\ eV$

D) $-2.72\ eV$

Answer: $-0.54\ eV$

Solution: According to the Bohr theory,

$$E_n = E_1 \frac{Z^2}{n^2}\ E_5 = -13.6 \times \frac{(1)^2}{(5)^2} = -0.54\,eV$$

Q.16. The total number of lines in the Lyman series of H spectrum will be: (where $n =$ number of orbits)

A) n

B) $n-1$

C) $n-2$

D) $n\,(n+1)$

Answer: $n-1$

Solution: The spectrum of hydrogen has many spectral lines. These lines are formed due to electronic transitions. All the wavelengths in the Lyman series are in the ultraviolet region.

When an electron falls from n to 1, the total possible number of lines in the Lyman series $= n - 1$.

Q.17. The wavelength associated with a golf ball weighing $200\ g$ and moving at a speed of $5\ m/h$ is of the order (Planck constant, $h = 6.626 \times 10^{-34}\ J\ s$):

A) $10^{-10}\ m$

B) $10^{-20}\ m$

C) $10^{-30}\ m$

D) $10^{-4}\ m$

Answer: $10^{-30}\ m$

Solution: As we know, according to the De-Broglie equation:

$$\lambda = \frac{h}{mv}, \text{ where } \lambda = \text{wavelength}, h = \text{planck constant}, m = \text{mass of object}, v = \text{velocity}$$

$$\lambda = \frac{6.626 \times 10^{-34}}{\frac{0.2 \times 5}{60 \times 60}}$$

$$\lambda = \frac{6.626 \times 10^{-34} \times 3600}{1}$$

$$\lambda = 2.3853 \times 10^{-30}\text{m}$$

Q.18. The energy of the second Bohr orbit of the hydrogen atom is $-3.41\ eV$. The energy of the third Bohr orbit of the He^{+} ion will be

A) $-30.69\ eV$

B) $-13.64\ eV$

C) $-7.67\ eV$

D) $-6.06\ eV$

Answer: $-6.06\ eV$

Solution: Given,

The energy of the second Bohr orbit of the hydrogen atom $= -3.41\ eV$

Energy for n^{th} orbit of hydrogen and hydrogen-like species is given as,

$$E_n = -13.6 \times \frac{Z^2}{n^2}\ eV / atom$$

Now, for the third orbit of He^{+} ion.

Atomic number of He, is $Z = 2$ and the third Bohr's orbit is given as, $n = 3$.

Substituting the values, we get:

$$E_3 = -13.6 \times \frac{(2)^2}{(3)^2}$$

$$\Rightarrow E_3 = -13.6 \times \frac{4}{9} = -6.06\ eV$$

Q.19. What is the ratio of the radii of the first three Bohr's orbits in the $H-$atom?

A) $1 : 5 : 33$

B) $1:2:3$

C) $1:4:9$

D) $1:8:27$

Answer: $1:4:9$

Solution: According to the Bohr's model, the radius of an orbit of $H-$atom$\propto$ $(\text{orbit number})^2$.

Ratio of the radii of the first three Bohr's orbits:

$r_1:r_2:r_3=(1)^2:(2)^2:(3)^2$

$r_1:r_2:r_3=1:4:9$.

Q.20. The kinetic energy of an electron accelerated from rest through a potential difference of $5V$ will be:

A) $5\ J$

B) $5\ erg$

C) $5\ eV$

D) $8\times10^{-19}eV$

Answer: $5\ eV$

Solution: If a charged particle having charge, q, is accelerated by a potential difference of 'V' V from rest, the kinetic energy is given by:

$KE\ =\ qV$

For an electron, the magnitude of the charge is $e\ =1.6\times10^{-19}\ C$ and the potential difference is $5\ V$; its kinetic energy will be:

$KE\ =1.6\times10^{-19}\times5\ J\ =\ 5eV$
$(\because\ 1.6\times10^{-19}\ J\ =\ 1\ eV)$

Q.21. The maximum number of electrons in a subshell with $l=2$ and $n=3$ is

A) 2

B) 6

C) 12

D) 10

Answer: 10

Solution: The given quantum numbers, $n=3$ and $l=2$, represent $3d$ subshell.

The possible number of orbitals in a d subshell is equal to 5.

Each orbital can contain a maximum of 2 electrons.

Thus, the total possible number of electrons in the given subshell is 10.

Q.22. If an electron has spin quantum number $+1/2$ and the magnetic quantum number -1, it cannot be present in

A) $d-$orbital

B) $\mathrm{f-}$orbital

C) $\mathrm{p-}$orbital

D) $\mathrm{s-}$orbital

Answer: $\mathrm{s-}$orbital

Solution: The possible values of the magnetic quantum numbers for a given subshell are from $-l$ to $+l$.

Thus, for the 's' subshell, the only possible value of the magnetic quantum number is 0.

Q.23. Suppose that a hypothetical atom gives a red, green, blue and violet line spectrum, which jump according to the figure would give off the red spectral line?

A) $3 \rightarrow 1$

B) $2 \rightarrow 1$

C) $4 \rightarrow 1$

D) $3 \rightarrow 2$

Answer: $3 \rightarrow 2$

Solution: Higher the energy gap lower the wavelength. So that, lower the energy gap, higher the wavelength. Red spectral line is off between $3 \rightarrow 2$transition.

Q.24. The total number of electrons present in all the $\mathrm{p-}$orbitals in the ground state of $_{34}\mathrm{Se}$ are

A) $16.$

B) $14.$

C) $17.$

D) $18.$

Answer: $16.$

Solution: According to Aufbau's principle, electrons are filled in the lowest energy atomic orbital first before occupying higher energy level atomic orbitals.

If the value of $(n+l)$ is greater, then greater is the energy of electron in the orbital.

Electronic configuration of $_{34}\mathrm{Se} = 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$

The total number of electrons present in all the $\mathrm{p-}$orbitals $= 6 + 6 + 4 = 16$

Q.25. Which of the following pair of orbitals have the same number of nodal planes?

A) $p_x,\ d_{x^2-y^2}$

B) $s,\ d_{z^2}$

C) $d_{xz},\ d_{x^2-y^2}$

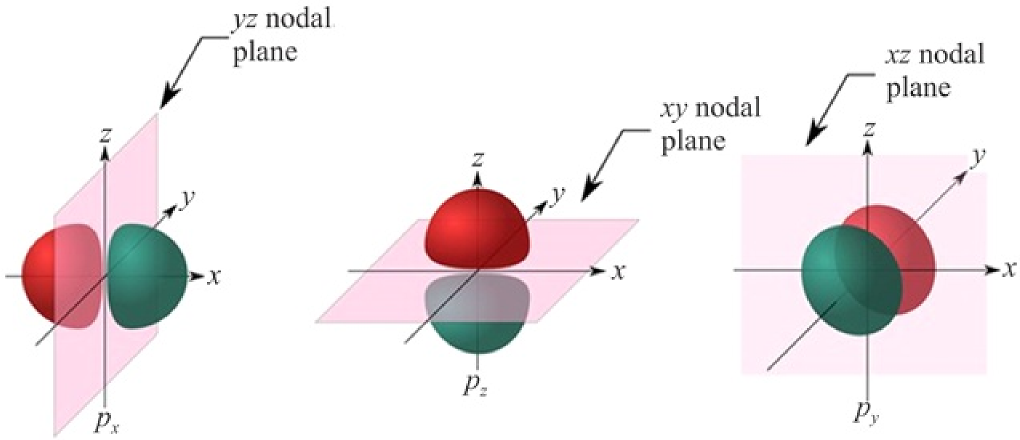
D) $p_y,\ d_{xy}$

Answer: $d_{xz},\ d_{x^2-y^2}$

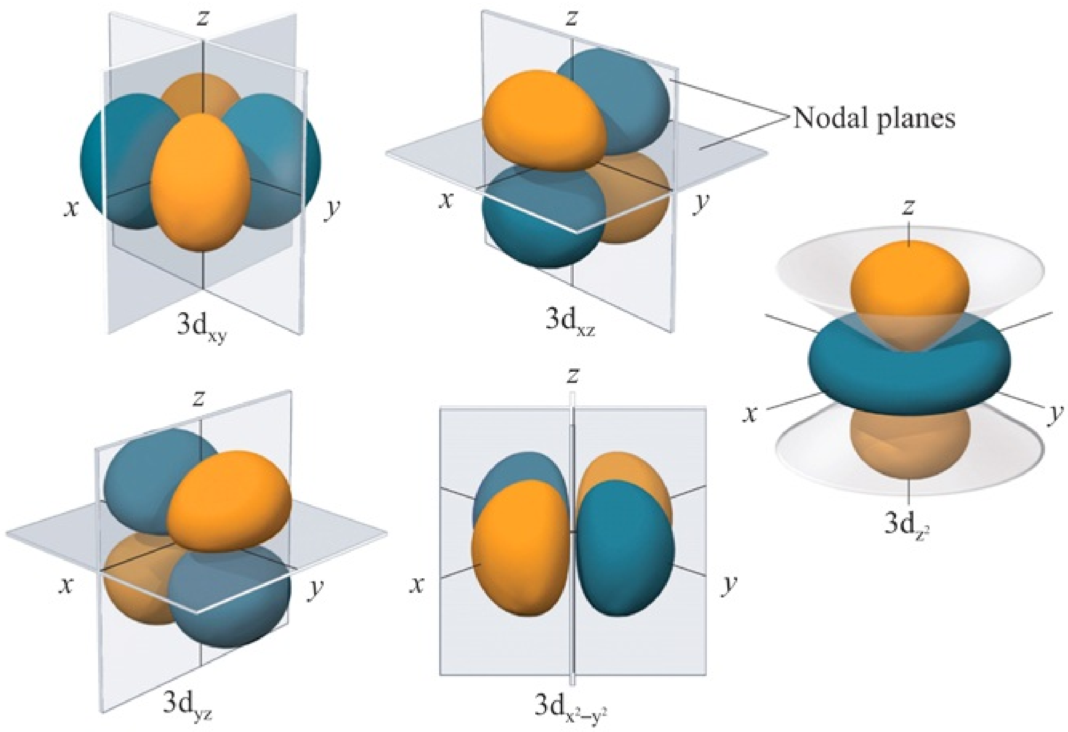
Solution: Nodal plane: These are the planes where the probability of finding an electron is zero.

In 's' sub-shell, nodal plane is zero as it has spherical structure.

'p' sub-shell has **3** dumbbell-shaped orbitals (p_x, p_y, p_z). Each p-orbital has one nodal plane:



'd' sub-shell has 5 orbitals $(d_{xy},\ d_{yz},\ d_{xz},\ d_{x^2-y^2},\ d_{z^2})$. Nodal plane in all orbitals is two**.**



Thus, d_{xy} and $d_{x^2-y^2}$, both have two nodal planes.

Practice more on Structure of Atom