ARJUNA-NEET(Chemistry)

PRACTICE TEST-03

46. Number of degenerate orbitals present in 2p subshell of hydrogen-like species is
(A) 7 (B) 5
(C) 3 (D) 1

47. Heisenberg's uncertainty principle can be expressed as
(A) $\Delta x \times \Delta v \geq h/4\pi$ (B) $\Delta x \times \Delta p \geq h/4\pi$
(C) $\Delta x \times \Delta p \geq h/2\pi$ (D) $\Delta x \times \Delta v \geq h/2\pi$

48. Number of angular node(s) present in a *p*-orbital is
(A) 3 (B) 2
(C) 4 (D) 1

49. The maximum number of electrons that can have principal quantum number, n = 3 and spin quantum number $m_s = +\frac{1}{2}$, is
(A) 4 (B) 5
(C) 9 (D) 2

50. The species to which Bohr's theory can be applied is
(A) Be^{3+} (B) He^{2+}
(C) B^{5+} (D) Li^{3+}

51. The angular momentum of an electron of hydrogen like species in second Bohr's orbit is
(A) $h/2\pi$ (B) h/π
(C) $2h/\pi$ (D) h^2/π

52. The total number of possible values of m for the value of $l = 2$ is
(A) 0 (B) 2
(C) 4 (D) 5

53. The information that can be obtained from the azimuthal quantum number is
(A) Size of the orbital
(B) The orientation of electrons
(C) Shape of the orbital
(D) Both (1) & (2)

54. Ionization energy of hydrogen atom is
(A) – 13.6 eV (B) 13.6 eV
(C) – 9.6 eV (D) 9.6 eV

55. The energy associated with the second orbit of Li^{2+} is (Energy of electron in first Bohr's orbit of H atom is -2.18×10^{-18} J/atom)
(A) -4.905×10^{-18} J/atom
(B) -3.624×10^{-18} J/atom
(C) -5.509×10^{-18} J/atom
(D) -8.124×10^{-18} J/atom

56. Match the following and choose the correct option.

Value of I (Azimuthal quantum number)	**Shape of orbital**
a. 1	(i) Complex
b. 0	(ii) Dumb-bell
c. 2	(iii) Spherical
d. 3	(iv) Double dumb-bell

(A) a(ii), b(iii), c(i), d(iv)
(B) a(iii), b(ii), c(i), d(iv)
(C) a(ii), b(i), c(iii), d(iv)
(D) a(ii), b(iii), c(iv), d(i)

57. If the de-Broglie's wavelength of a particle of mass 1g is 6.626×10^{-29} m, then its speed is ($h = 6.626 \times 10^{-34}$ Js)
(A) 100 m s^{-1} (B) 0.20 m s^{-1}
(C) 0.01 m s^{-1} (D) 3.00 m s^{-1}

58. If the ratio of the radius of 4^{th} orbit and n^{th} orbit of H-atom is 16/25, then n is
(A) 3 (B) 5
(C) 9 (D) 1

59. The set of quantum numbers which is not possible is
(A) $n = 3, l = 2, m = -1, s = +1/2$
(B) $n = 1, l = 0, m = 0, s = -1/2$
(C) $n = 2, l = 1, m = 0, s = +1/2$
(D) $n = 1, l = 1, m = 0, s = -1/2$

60. The total number of atomic orbitals in fourth energy level of hydrogen atom is
(A) 12 (B) 14
(C) 15 (D) 16

61. The wavelength of radiation emitted when the electron in an hydrogen atom undergoes transition from 8^{th} energy level to 2^{nd} energy level (R = Rydberg constant)
(A) 15R/64 (B) 15/64R
(C) 64R/15 (D) 64/15R

62. For H-atom, the energy of electron in an orbital depends on the value of
(A) ℓ only
(B) n only
(C) m only
(D) Both on n and ℓ

63. The orbital angular momentum for s-electron is
(A) $\frac{h}{2\pi}$ (B) $+\frac{1}{2}\frac{h}{\sqrt{2\pi}}$
(C) $\sqrt{2}\frac{h}{\pi}$ (D) Zero

64. The explanation for the presence of three unpaired electrons in the nitrogen atom can be explained by
(A) Hund's rule of maximum spin multiplicity
(B) Pauli's exclusion principle
(C) Heisenberg's uncertainty principle
(D) Aufbau's principle

65. Consider the given table.

Metals	Threshold frequency ($\times 10^{14}\ s^{-1}$)
A	5.2
B	3.8
C	4.6
D	5.8

Photoelectrons ejected from which metal surface will have highest kinetic energy on irradiating with light of frequency $8.6 \times 10^{15}\ s^{-1}$?
(A) C (B) B
(C) A (D) D

66. How many photons of light of frequency $5 \times 10^{15}\ s^{-1}$ can provide 5 J of energy? ($h = 6.626 \times 10^{-34}$ Js).
(A) 4.0×10^{17} (B) 1.65×10^{18}
(C) 1.5×10^{18} (D) 7.5×10^{33}

67. Consider the given box.

Black body radiation, photoelectric effect, diffraction, interference

The total number of phenomenon which cannot be explained by particle nature of light is
(A) one (B) Two
(C) Three (D) Four

68. Light of energy 4.7×10^{-19} J is irradiated on a metal surface having work function equal to 2.02 eV. The kinetic energy of the emitted photoelectron is (charge of electron = 1.6×10^{-19} C)
(A) 0.92 eV (B) 2.68 eV
(C) 6.09 eV (D) 4.96 eV

69. If $^{9x-5}_{3(x+1)}A$ and $^{7x+5}_{4x-1}B$ are isobars, then the element that has the same number of neutrons as that of A is
(A) $^{40}_{23}C$ (B) $^{40}_{20}D$
(C) $^{36}_{15}E$ (D) $^{35}_{13}F$

70. Region of electromagnetic radiation of smallest wavelength in the following is
(A) X-rays (B) UV-rays
(C) γ-rays (D) Radiowaves

71. The number of photoelectrons ejected from a metal surface depends on
(A) Frequency of light
(B) Threshold frequency
(C) Intensity of light
(D) Time lag between striking of light & ejection of electrons

72. The isotope of hydrogen in which two neutrons are present is
(A) Protium
(B) Tritium
(C) Deuterium
(D) No such isotope exists

73. All of the following are the conclusions of Rutherford's α-particle scattering experiment, except
(A) Large empty space is present in an atom
(B) Positive charge is concentrated in a very small region inside an atom
(C) Volume of nucleus is negligible as compared to the total volume of the atom
(D) Electrons are embedded in nucleus

74. ${}^{40}_{20}Ca$ and ${}^{40}_{19}K$ are
(A) Isotopes
(B) Isobars
(C) Isotones
(D) Isoelectronic species

75. Which one is the wrong statement?
(A) The uncertainty principle is
$$\Delta E \times \Delta t \geq \frac{h}{4\pi}$$
(B) Half-filled and fully filled orbitals have greater stability due to greater exchange energy, greater symmetry and more balanced arrangement.
(C) The energy of 2s-orbital is less than energy of 2p-orbital in case of hydrogen like atoms.
(D) de-Broglie's wavelength is given by $\lambda = \frac{h}{mv}$, where m = mass of the particle, v = group velocity of the particle

76. How many electrons can fit in the orbital for which $n = 3$ and $l = 1$?
(A) 2 (B) 6
(C) 10 (D) 14

77. Which of the following pairs of d-orbitals will have electron density along the axes?
(A) d_{z^2}, d_{xz} (B) d_{xz}, d_{yz}
(C) d_{z^2}, $d_{x^2-y^2}$ (D) d_{xy}, $d_{x^2-y^2}$

78. Two electrons occupying the same orbital are distinguished by
(A) azimuthal quantum number
(B) spin quantum number
(C) principal quantum number
(D) magnetic quantum number.

79. Which is the correct order of increasing energy of the listed orbitals?
(A) 4s 3s 3p 3d (B) 3s 3p 3d 4s
(C) 3s 3p 4s 3d (D) 3s 4s 3p 3d

80. The angular momentum of electron in 'd' orbital is equal to
(A) $2\sqrt{3}\hbar$ (B) $0\ \hbar$
(C) $\sqrt{6}\hbar$ (D) $\sqrt{2}\hbar$

81. What is the maximum number of orbitals that can be identified with the following quantum numbers?
$n = 3, l = 1, m_l = 0$
(A) 1 (B) 2
(C) 3 (D) 4

82. Calculate the energy in joule corresponding to light of wavelength 45 nm (Planck's constant, $h = 6.63 \times 10^{-34}$ J s, speed of light $c = 3 \times 10^{8}$ m s^{-1}
(A) 6.67×10^{15} (B) 6.67×10^{11}
(C) 4.42×10^{-15} (D) 4.42×10^{-18}

83. Be^{2+} is isoelectronic with which of the following ions?
(A) H^{+} (B) Li^{+}
(C) Na^{+} (D) Mg^{2+}

84. What is the maximum numbers of electrons that can be associated with the following set of quantum numbers?
$n = 3, l = 1, m_l = -1$
(A) 4 (B) 2
(C) 10 (D) 6

85. The frequency of radiation emitted when the electron falls from n = 4 to n = 1 in a hydrogen atom will be (Given ionization energy of H = 2.18×10^{-18} J $atom^{-1}$ and $h = 6.625 \times 10^{-34}$ J s)
(A) 1.54×10^{15} s^{-1} (B) 1.03×10^{15} s^{-1}
(C) 3.08×10^{15} s^{-1} (D) 2.00×10^{15} s^{-1}

86. The value of Planck's constant is 6.63×10^{-34} J s. The velocity of light is 3.0×10^{8} m s^{-1}. Which value is closest to the wavelength in nanometers of a quantum of light with frequency of 8×10^{15} s^{-1}?
(A) 2×10^{-25} (B) 5×10^{-18}
(C) 37.5 (D) 3×10^{7}

87. In hydrogen atom, energy of first excited state is –3.4 eV. Then find out K.E. of same orbit of hydrogen atom
(A) + 3.4 eV (B) + 6.8 eV
(C) –13.6 eV (D) + 13.6 eV

88. The following quantum numbers are possible for how many orbitals: n = 3, 1 = 2, m = +2?
(A) 1 (B) 2
(C) 3 (D) 4

89. For given energy, $E = 3.03 \times 10^{-19}$ Joules corresponding wavelength is
($h = 6.625 \times 10^{-34}$ J sec, $c = 3 \times 10^{8}$ m/sec)
(A) 65.6 nm (B) 6.56 nm
(C) 3.4 nm (D) 656 nm

90. Isoelectronic species are
(A) $CO, CN^{-}, NO^{+}, C_2^{2-}$
(B) CO^{-}, CN, NO, C_2^{-}
(C) $CO^{+}, CN^{+}, NO^{-}, C_2$
(D) CO, CN, NO. C_2

ANSWERS KEY

46.	(C)	61.	(D)	76.	(A)
47.	(B)	62.	(B)	77.	(C)
48.	(D)	63.	(D)	78.	(B)
49.	(C)	64.	(A)	79.	(C)
50.	(A)	65.	(B)	80.	(C)
51.	(B)	66.	(C)	81.	(A)
52.	(D)	67.	(B)	82.	(D)
53.	(C)	68.	(A)	83.	(B)
54.	(B)	69.	(D)	84.	(B)
55.	(A)	70.	(C)	85.	(C)
56.	(D)	71.	(C)	86.	(C)
57.	(C)	72.	(B)	87.	(A)
58.	(B)	73.	(D)	88.	(A)
59.	(D)	74.	(B)	89.	(D)
60.	(D)	75.	(C)	90.	(A)

HINTS & SOLUTIONS

46. (C)
For hydrogen like species (single electron system) the energy of that electron is just dependent upon the value of principal quantum number 'n'. In 2p, all 3 orbitals have same energy as they have same 'n' value.

47. (B)
The Heisenberg's uncertainty principle states that the position and momentum of microscopic moving particles cannot be determined simultaneously with accuracy or certainty.

$$\Delta x \cdot \Delta p_x \geq \frac{h}{2\pi}$$

48. (D)
Angular nodes = ℓ (azimuthal quantum number). For p, $\ell = 1$

49. (C)
Maximum number of electrons in
'n' = $2n^2 = 2(3)^2 = 18$

Half of them contains $+\frac{1}{2}$ spin and other half $-\frac{1}{2}$ spin.

50. (A)
Bohr's theory is applicable to single electron system only. Here, Be^{3+} has 1 electron only.

51. (B)
Angular momentum of an electron in fixed orbit is expressed as $mvr = \frac{nh}{2\pi}$

Here, n = 2, $mvr = \frac{2h}{2\pi} = \frac{h}{\pi}$

52. (D)
m = $-l$ to $+l$ including zero or $2l+1$
Here, $l = 2$ then, m = 2(2) + 1 = 5
m = –2, –1, 0, +1, +2.
'm' have total five values.

53. (C)
Azimuthal quantum number designates the subshells to which electron belongs and tells about the shape of the orbitals.

54. (B)

$$E = -13.6\frac{Z^2}{n^2}$$

I.E. = $E_\infty - E_1$ =

$$0 - \left(-13.6 \times \frac{(1)^2}{(1)^2}\right) = +13.6\,eV$$

55. (A)

$$E = -2.18 \times 10^{-18}\frac{Z^2}{n^2}\ \text{J/atom.}$$

n = 2, Z = 3

$$E = -2.18 \times 10^{-18}\ \frac{9}{4}$$

$$= -4.905 \times 10^{-18}\ J$$

56. (D)
$l = 1$, p – subshell ⇒ Dumb-bell
$l = 0$, s – subshell ⇒ Spherical
$l = 2$, d – subshell ⇒ Double dumb-bell
$l = 3$, f – subshell ⇒ Complex

57. (C)

$$\lambda = \frac{h}{mv}$$

$$6.626 \times 10^{-29} = \frac{6.626 \times 10^{-34}}{10^{-3}\,V}$$

v = 10^{-2} m/sec

58. (B)

$$\frac{r_4^H}{r_n^H}=\frac{0.53\frac{4^2}{1}}{0.53\frac{n^2}{1}}=\frac{16}{25}$$

$$\frac{16}{n^2}=\frac{16}{25}$$

$$n^2=25$$

$$\boxed{n=5}$$

59. (D)
For given value of 'n', the values of 'l' can range from 0 to (n – 1). So, for n = 1 'l' should be 0.

60. (D)
Total number of orbitals in a shell/orbit (n) = n^2.

61. (D)
$n_2 = 8$, $n_1 = 2$

$$\frac{1}{\lambda}=RZ^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

$$\frac{1}{\lambda}=R\cdot 1^2\left[\frac{1}{2^2}-\frac{1}{8^2}\right]$$

$$\frac{1}{\lambda}=R\left[\frac{1}{4}-\frac{1}{64}\right]$$

$$\frac{1}{\lambda}=R\left[\frac{16-1}{64}\right]$$

$$\frac{1}{\lambda}=R\frac{15}{64}\qquad \lambda=\frac{64}{15R}$$

62. (B)
For single electron system, energy only depends on value of 'n' i.e., principal quantum number.

63. (D)
Orbital angular momentum

$$=\sqrt{l(l+1)}\frac{h}{2\pi}$$

For a s-subshell, $l = 0$.

So, orbital angular momentum = 0

64. (A)
In degenerate orbitals electrons are filled according to Hund's rule of maximum multiplicity.

65. (B)
K.E. = $h\nu - h\nu_0$
Metals with lower value of ν_0 have higher KE.

66. (C)
$E_{total} = n(h\nu)$

$$n=\frac{E_{total}}{h\nu}=\frac{5}{6.626\times10^{-34}\times5\times10^{15}}$$

$$=\frac{1}{6.626}\times10^{19}$$

$$=1.5\times10^{18}$$

67. (B)
Fact based

68. (A)

$$E_p=4.7\times10^{-19}\,J$$

$$E_p=\frac{4.7\times10^{-19}}{1.6\times10^{-19}}eV$$

$$=2.9375\ eV$$

$KE = E_p - \phi$
= 2.9375 – 2.02
= 0.9175 eV

69. (D)
$^{(9x-5)}_{3(x+1)}A$ and $^{(7x-5)}_{(4x-1)}B$
Since 'A' and 'B' are isobars.
So, mass number of A and B are equal.
9x – 5 = 7x + 5, x = 5
$^{40}_{18}A$. No. of neutron in A= 40 – 18 = 22
No. of neutron in $^{35}_{13}F = 35 - 13 = 22$

70. (C)
Order of wavelength:
γ rays < X rays < UV < Radiowave

71. (C)
No. of photoelectron ejected $\propto$ Intensity of light.

72. (B)
Tritium $\left({}_1H^3\right)$ neutrons = 3 – 1 = 2

73. (D)
Experimentally proven

74. (B)
Atoms of elements having same mass number but different atomic numbers are called isobars.

75. (C)
For hydrogen like species (single electron system) the energy of that electron is just dependent upon the value of principal quantum number 'n'.
$\therefore$ For hydrogen, energy of 2p and 2s are same as they have same value of 'n'.

76. (A)
An orbital can accommodate maximum of $2e^-$s.

77. (C)
d_{z^2} and $d_{x^2-y^2}$ have lobes along the axis in which electron density resides.

78. (B)
Spin quantum no.

79. (C)
It depends on 'n + *l*' value.

80. (C)
Orbital angular momentum $= \sqrt{\ell(\ell+1)}\hbar$

81. (A)
Each value of 'm' represents only one orbital.

82. (D)
$$E = \frac{hc}{\lambda}$$
$$= \frac{6.63\times10^{-34}\,Js \times 3\times10^{8}\,ms^{-1}}{45\times10^{-9}\,m}$$

83. (B)
Isoelectronic = same no. of electrons
Be^{2+} =2 electrons
Li^{+} = 2 electrons

84. (B)
Each value of 'm' represents an orbital which contains 2 electrons.

85. (C)

$$\Delta E = 2.18\times10^{-18}\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$$
$$= 2.18\times10^{-18}\left[\frac{1}{1^2}-\frac{1}{4^2}\right]$$
$$= 2.18\times10^{-18}\left[\frac{16-1}{16}\right]$$
$$= \frac{2.18\times15}{16}\times10^{-18}$$
$$= 2.043\times10^{-18}\,J$$
$$\Delta E = h\nu$$
$$\nu = \frac{\Delta E}{h}$$
$$= \frac{2.043\times10^{-18}}{6.626\times10^{-34}} = 0.308\times10^{16}\,sec^{-1}$$
$$\nu = 3.08\times10^{15}\,sec^{-1}$$

86. (C)

$$\lambda = \frac{c}{\nu} = \frac{3\times10^{8}}{8\times10^{15}}$$
$$= 37.5\times10^{-9}\,m$$
$$= 37.5\,nm$$

87. (A)
Total Energy = – Kinetic Energy

88. (A)
Each value of ‘m’ represents only one orbital.

89. (D)

$$E = \frac{hc}{\lambda}$$
$$\lambda = \frac{hc}{E} = \frac{6.626\times10^{-34}\,Js\times3\times10^{8}\,m/sec}{3.03\times10^{-19}\,J}$$
$$= 6.559\times10^{-7}$$
$$= 655.9\times10^{-9}\,m$$
$$= 655.9\,nm$$
$$\approx 656\ nm$$

90. (A)

Isoelectronic species have same number of electrons.

***Note* - If you have any query/issue**

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