DPP - Daily Practice Problems

Name : Date :

Start Time : End Time :

CHEMISTRY 04

SYLLABUS : Atomic structure 2 (Heisenberg's uncertainty principle, Quantum Numbers, Orbitals, Electronic configuration Principles, Energy level diagram, Extra stability of half filled and completely filled orbitals)

Max. Marks : 120 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE choice is correct.

Q.1 If the Planck's constant $h = 6.6 \times 10^{-34}$ Js, the de-Broglie wavelength of a particle having momentum of 3.3×10^{-24} kg.m.s^{-1} will be-

(a) 0.002 Å (b) 0.02 Å (c) 0.2 Å (d) 2Å

Q.2 The uncertainty in the momentum of an electron is 1.0×10^{-5} kg ms^{-1}. The uncertainty in its position will be ($h = 6.62 \times 10^{-34}$ kg m^{2}s^{-1})

(a) 1.05×10^{-26} m (b) 1.05×10^{-28} m

(c) 5.27×10^{-30} m (d) 5.25×10^{-28} m

Q.3 The uncertainty in position and velocity of a particle are 10^{-10} m and 5.27×10^{-24} ms^{-1} respectively. Calculate the mass of the particle is ($h = 6.625 \times 10^{-34}$ Js) –

(a) 0.099kg (b) 0.99g (c) 0.92kg (d) None

Q.4 The wave-mechanical model of atom is based upon -

(a) De Broglie concept of dual character of matter

(b) Heisenberg's uncertainty principle

(c) Schrodinger wave equation

(d) All the above three

Q.5 Electron density in an orbital is correctly described by-

(a) ψ^2 (b) ψ

(c) $\psi^2 | \psi$ (d) None

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

Space for Rough Work

Q.6 The maximum number of atomic orbitals associated with a principal quantum number 5 is–

(a) 9 (b) 12 (c) 16 (d) 25

Q.7 Beryllium's fourth electron will have the four quantum numbers –

	n	ℓ	m	s
(a)	1	0	0	1/2
(b)	1	1	1	1/2
(c)	2	0	0	–1/2
(d)	2	1	0	+1/2

Q.8 For a given value of n (principal quantum number), the energy of different subshells can be arranged in the order of :

(a) f > d > p > s (b) s > p < d > f
(c) f > p > d > s (d) s > f > p > d

Q.9 Correct set of four quantum numbers for the outermost electron of rubidium (Z = 37) is -

(a) 5, 0, 0, 1/2 (b) 5, 1, 0, 1/2
(c) 5, 1, 1, 1/2 (d) 6, 0, 0, 1/2

Q.10 The order of increasing energies of the orbitals follows -

(a) 3s, 3p, 4s, 3d, 4p (b) 3s, 3p, 3d, 4s, 4p
(c) 3s, 3p, 4s, 4p, 3d (d) 3s, 3p, 3d, 4p, 4s

Q.11 The total spin resulting from a d^7 configuration is -

(a) 3/2 (b) 1/2 (c) 2 (d) 1

Q.12 Choose the correct options –

(a) Shapes of orbitals are functional representation of mathematical solutions of Schrodinger equations. They do not represent any picture of electric charge on matter.

(b) Smaller the wavelength of the electron wave, more is the resolving power of the electron microscope.

(c) Uncertainty in measurement is not due to lack of any experimental technique but due to nature of subatomic particle itself.

(d) All of these

Q.13 Given : The mass of electron is 9.11×10^{-31} kg
Plank constant is 6.626×10^{-34} Js,
the uncertainty involved in the measurement of velocity within a distance of 0.1 Å is

(a) $5.79 \times 10^{7}\ ms^{-1}$ (b) $5.79 \times 10^{8}\ ms^{-1}$
(c) $5.79 \times 10^{5}\ ms^{-1}$ (d) $5.79 \times 10^{6}\ ms^{-1}$

Q.14 Calculate momentum of radiations of wavelength 0.33 nm.

(a) 2.01×10^{-24} kg m sec^{-1}
(b) 2.01×10^{-22} kg m sec^{-1}
(c) 2.01×10^{-18} kg m sec^{-1}
(d) 4.01×10^{-24} kg m sec^{-1}

Q.15 The orbital having m = – 2 should not be present in the following sub-shell

(a) d (b) f (c) g (d) p

Q.16 Calculate the wavelength of a moving electron having 4.55×10^{-25} J of kinetic energy-

(a) 6.27×10^{-7} meter (b) 7.27×10^{-6} meter
(c) 6.27×10^{-7} meter (d) 12.27×10^{-7} meter

Q.17 The minimum energy required to overcome the attractive forces between electron and surface of Ag metal is 7.52×10^{-19} J. What will be the maximum K.E. of electron ejected out from Ag which is being exposed to U.V. light of $\lambda = 360$ Å –

(a) 36.38×10^{-19} Joule (b) 6.96×10^{-19} Joule
(c) 57.68×10^{-19} Joule (d) 67.68×10^{-19} Joule

Q.18 In hydrogen atom, an electron in its normal state absorbs two times of the energy as it requires to escape (13.6 eV) from the atom. The wavelength of the emitted electron will be -

(a) 1.34×10^{-10} m (b) 2.34×10^{-10} m
(c) 3.46×10^{-10} m (d) 4.44×10^{-10} m

Q.19 The wavelength of a 150 g rubber ball moving with a velocity 50 m sec^{-1} is –

(a) 4.83×10^{-33} cm (b) 8.83×10^{-33} cm
(c) 8.83×10^{-31} cm (d) 8.83×10^{-30} cm

RESPONSE GRID					
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	

Space for Rough Work

Q.20 An electron beam can undergo diffraction by crystals. Through what potential should a beam of electrons be accelerated so that its wavelength becomes equal to 1.54Å

(a) 63.3 volt (b) 43.3 volt
(c) 33.3 volt (d) 53.3 volt

Q.21 Which of the following set of quantum numbers are permitted?

(a) $n = 3, \ell = 2, m = -1, s = 0$
(b) $n = 2, \ell = 2, m = +1, s = -½$
(c) $n = 2, \ell = 2, m = +1, s = +½$
(d) $n = 3, \ell = 2, m = -2, s = +½$

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct
(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.22 Choose the correct statements –

(1) Designation for the orbital with the quantum number $n = 3, \ell = 1, m = -1$ may be $3p_x$ or $3p_y$
(2) Designation for the orbital with the quantum number $n = 4, \ell = 2, m = +2$ may be $4d_{xy}$ or $4d_{x^2-y^2}$
(3) Designation for the orbital with the quantum number $n = 5, \ell = 0, m = 0$ may be 5s
(4) Designation for the orbital with the quantum number $n = 2, \ell = 1, m = 0$ may be $3p_z$

Q.23 Choose the correct options related to no. of electrons in an atom with the following quantum numbers –

(1) $n = 4, \ell = 1$; 4
(2) $n = 2, \ell = 1, m = -1, s = +½$; 1
(3) $n = 3$; 9
(4) $n = 4, \ell = 2, m = 0$; 2

Q.24 Choose the correct options –

(1) In case of half filled and completely filled orbitals, the exchange energy is maximum and is greater than the loss of orbital energy due to the transfer of electron from a higher to a lower sublevel.
(2) The greater the number of possible exchanges between the electrons of parallel spins present in the degenerate orbitals, the higher would be the amount of energy released and more will be the stability.
(3) Binding energy is the measure of stability of the nucleus.
(4) If the value of binding energy is negative then the stability order is : Product nucleus > Reactant nucleus.

DIRECTIONS (Q.25-Q.27) : Read the passage given below and answer the questions that follows :

Einstein had suggested that light can behave as a wave as well as like a particle i.e. it has dual character. In 1924, de-Broglie proposed that an electron behaves both as a material particle and as a wave. This proposed a new theory wave mechanical theory of matter. According to this theory, the electrons, protons and even atom when in motion possess wave properties. According to de-Broglie, the wavelength associated with a particle of mass m, moving with velocity v is given by the relation, $\lambda = \frac{h}{mv}$, where h is Planck's constant.

Q.25 K.E. of the electron is 4.55×10^{-25} J. Its de Broglie wave length is -

(a) 4700 Å (b) 8300 Å
(c) 7200 Å (d) 7400 Å

Q.26 For particles having same kinetic energy, the de Broglie wavelength is -

(a) directly proportional to its velocity
(b) inversely proportional to its velocity
(c) independent of velocity and mass
(d) unpredictable.

RESPONSE GRID					
	20.ⓐⓑⓒⓓ	21.ⓐⓑⓒⓓ	22.ⓐⓑⓒⓓ	23.ⓐⓑⓒⓓ	24.ⓐⓑⓒⓓ
	25.ⓐⓑⓒⓓ	26.ⓐⓑⓒⓓ			

Space for Rough Work

Q.27 Velocity of helium atom at 300K is 2.40×10^2 meter per sec. What is its wavelength (mass number of helium is 4)?

(a) 0.416nm (b) 0.83nm (c) 803Å (d) 8000Å

DIRECTIONS (Q. 28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(c) Statement -1 is False, Statement-2 is True.

(d) Statement -1 is True, Statement-2 is False.

Q.28 **Statement 1 :** If an electron is located within the range of 0.1Å then the uncertainty in velocity is approximately 6×10^6 m/s.

Statement 2 : Trajectory (path of motion) of above electron can be defined. ($h = 6.6 \times 10^{-34}$, $m_e = 9.1 \times 10^{-31}$ kg)

Q.29 **Statement 1 :** Threshold frequency is a characteristic for a metal.

Statement 2 : Threshold frequency is a maximum frequency required for the ejection of electron from the metal surface.

Q.30 **Statement 1 :** Splitting of the spectral lines in the presence of magnetic field is known as stark effect.

Statement 2 : Line spectrum is simplest for hydrogen atom.

RESPONSE GRID	27.ⓐⓑⓒⓓ	28.ⓐⓑⓒⓓ	29.ⓐⓑⓒⓓ	30.ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 4 - CHEMISTRY			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	40	Qualifying Score	56
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

CHEMISTRY SOLUTIONS (04)

(1) **(d)** $\lambda = \frac{h}{mv} = \frac{6.6\times10^{-34}}{3.3\times10^{-24}} = 2\times10^{-10} = 2Å$

(2) **(c)** $\Delta x = \frac{h}{4\pi \times \Delta p} = \frac{6.63\times10^{-34}}{4\times3.14\times10^{-5}}$

$= 5.27\times10^{-30}$ m

(3) **(a)** According to Heisenberg's uncertainty principle,

$\Delta x \,.\, m\,\Delta v = \frac{h}{4\pi}$

or $m = \frac{h}{4\pi\Delta x.\Delta v}$

$= \frac{6.625\times10^{-34}}{4\times3.143\times10^{-10}\times5.27\times10^{-24}}$

$= 0.099$kg.

(4) **(d)** Wave mechanical model of atom is based upon all the above.

(5) **(a)** The correct representation is described by ψ^2.

(6) **(d)** The number of orbitals in a principal shell $= n^2 = 5^2 = 25$.

(7) **(c)** It is $2s^1$.

(8) **(a)** It is the rule.

(9) **(a)** Its configuration is $5s^1$.

(10) **(a)** Follow $(n + \ell)$ rule.

(11) **(a)** For d^7, three unpaired electrons, spin $= 3\times\frac{1}{2} = \frac{3}{2}$

(12) **(d)** All the statements are correct.

(13) **(d)** We know that $\Delta x \,.\, \Delta p \geq \frac{h}{4\pi}$

$\Delta x.m\Delta v > \frac{h}{4\pi}$

$\Delta v > \frac{h}{4\pi\Delta x m}$

$\Delta v = \frac{6.626\times10^{-34}}{4\pi\times0.1\times10^{-10}\times9.11\times10^{-31}}$

$= \frac{66}{4\pi\times9}\times10^{7} = 5.79\times10^{6}$ m/sec

(14) **(a)** $\lambda = \frac{h}{mu}$

$\therefore \quad mu = \frac{h}{\lambda} = \frac{6.625\times10^{-34}}{0.33\times10^{-9}}$

$= 2.01\times10^{-24}$ kg m sec^{-1}

(15) **(d)** For p sub-shell, $m = -1, 0, +1$.

Therefore, $m = -2$ orbital will not be present in p sub-shell.

(16) **(b)** Kinetic energy $= (\frac{1}{2}mu^2) = 4.55\times10^{-25}$ J

$\therefore \quad u^2 = \frac{2\times4.55\times10^{-25}}{9.108\times10^{-31}}$

$\therefore \quad u = 10^3$ m sec^{-1}

$\therefore \quad \lambda = \frac{h}{mu} = \frac{6.625\times10^{-34}}{9.108\times10^{-31}\times10^{3}}$

$= 7.27\times10^{-7}$ meter

(17) **(b)** Energy absorbed $= \frac{hc}{\lambda}$

$= \frac{6.625\times10^{-27}\times3.0\times10^{10}}{360\times10^{-8}}$

$= 5.52\times10^{-11}$ erg $= 5.52\times10^{-18}$ Joule

$\therefore$ Maximum K.E. of the electron ejected

$= (7.52\times10^{-19}) - (0.552\times10^{-19})$

$= 6.96\times10^{-19}$ Joule

(18) **(c)** Energy absorbed by an atom $= 2\times13.6 = 27.2$ eV

Energy consumed in escape $= 13.6$ eV

Energy converted into K.E. $= 13.6\times1.6\times10^{-19}$ J

$v = \sqrt{\frac{2KE}{m}} = \sqrt{\frac{2(13.6\times1.6\times10^{-19})}{9.1\times10^{-31}}}$

$v = 2.18\times10^{6}$ ms^{-1}

$\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}}{9.1\times10^{-31}\times2.1\times10^{6}} = 3.46\times10^{-10}$ m

(19) **(b)** $\because \lambda = \frac{h}{mu}$

Given $u = 50$ m sec^{-1} $= 50\times10^2$ cmsec^{-1}; $m = 150$ g

$\therefore \lambda = \frac{6.625\times10^{-27}}{150\times50\times10^{2}} = 8.83\times10^{-33}$ cm

(20) **(a)** We know that $\frac{1}{2}mu^2 = eV$

and $\lambda = \frac{h}{mu}$ or $u = \frac{h}{m\lambda}$ or $u^2 = \frac{h^2}{m^2\lambda^2}$

$\therefore \quad \frac{1}{2}m\times\frac{h^2}{m^2\lambda^2} = eV$

or $V = \frac{1}{2}m\times\frac{h^2}{m^2\lambda^2\times e} = \frac{1}{2}\times\frac{h^2}{m\lambda^2\times e}$

Substituting the values, we get

$$V = \frac{1}{2} \times \frac{(6.62 \times 10^{-34})^2}{9.108 \times 10^{-31} \times (1.54 \times 10^{-10})^2 \times 1.602 \times 10^{-19}}$$

= 63.3 volt

(21) (d)

(a) This set of quantum number is not permitted as value of 's' cannot be zero.

(b) This set of quantum nmnber is not permitted as the value of 'ℓ' cannot be equal to 'n'.

(c) This set of quantum number is not permitted as the value of 'ℓ' cannot be equal to 'n'.

(d) This set of quantum number is permitted.

(22) (a)

(1) Since $\ell = 1$ corresponds to p-orbital and $m = -1$ shows orientation either in x or y axis, thus this orbital refers to $3p_x$ or $3p_y$

(2) $4d_{xy}$ or $4d_{x^2-y^2}$

(3) 5s

(4) $2p_z$

(23) (c)

(1) $\ell = 1$ refers to p - subshell which has three orbitals (p_x, p_y and p_z) each having two electrons. Therefore, total number of electrons are 6.

(2) $\ell = 1$ refers to p - subshell, $m = -1$ refers to p_x or p_y orbital whereas, $s = +½$ indicates for only 1 electron.

(3) For n = 3, l = 0, 1, 2

$\ell = 0$ m = 0	2 electrons
$\ell = 1$ m = −1	6 electrons
$\ell = 2$ m = −2, −1, 0, +1, +2	10 electrons
Total electrons	18 electrons

Alternatively, number of electrons for any energy level is given by $2n^2$ i.e. $2 \times 3^2 = 18$ electrons

(4) $\ell = 2$ means d-subshell and m = 0 refers to d_{z^2} orbital

∴ Number of electrons are 2.

(24) (b)

(3) Binding energy per nucleon is the measure of stability of the nucleus.

(4) If the value of binding energy is negative then the stability order is :
Product nucleus < Reactant nucleus

(25) (c) $\lambda = \dfrac{h}{\sqrt{2mKE}}$

(26) (a) $\lambda = \dfrac{h}{mv}$ $\quad KE = \dfrac{1}{2} mv^2$

$mv = \dfrac{2KE}{v}$; $\therefore \lambda = \dfrac{h}{\frac{2KE}{v}}$; $\lambda = h\left(\dfrac{v}{2KE}\right)$

(27) (a) $\lambda = \dfrac{h}{mv}$

Mass of helium $= \dfrac{4.0 \times 10^{-3}}{6.023 \times 10^{23}}$ kg. and

$h = 6.62 \times 10^{-34}$

$\lambda = 6.62 \times 10^{-34} \times \dfrac{6.023 \times 10^{23}}{4.0 \times 10^{-3}} \times \dfrac{1}{2.4 \times 10^2}$

$= 0.416 \times 10^{-9}$ meter

$\lambda = 0.416$nm

(28) (d) $m\Delta V \Delta x = \dfrac{h}{4\pi}$

$$\Rightarrow \Delta V = \frac{6.62 \times 10^{-34}}{9.1 \times 10^{-31} \times 4 \times 3.14 \times 10^{-11}} = 6 \times 10^6 \text{ m/s}$$

As uncertainty in velocity is very high so we cannot define the trajectory of an electron.

(29) (d) S-1 is true but S-2 is false. Threshold frequency is a minimum frequency required for the emission of electrons from the metal surface.

(30) (c) Statement 1 is false but statement-2 is true. Splitting of the spectral lines in the presence of magnetic field is known as Zeeman effect or in electric field it is known as Stark effect. The splitting of spectral lines is due to different orientations which the orbitals can have in the presence of magnetic field.