Structure of atom

SET Self Evaluation Test - 2

1. The correct set of quantum numbers for the unpaired electron of chlorine atom is [IIT 1989; MP PET 2004]

	n	l	m
(a)	2	1	0
(b)	2	1	1
(c)	3	1	1
(d)	3	0	0

2. The orbital diagram in which the Aufbau's principle is violated is

	$2s$	$2p_x$	$2p_y$	$2p_z$
(a)	↑↓	↑↓	↑	
(b)	↑	↑↓	↑	↑
(c)	↑↓	↑	↑	↑
(d)	↑↓	↑↓	↑↓	↑

3. The mass of neutron is nearly [MNR 1988; UPSEAT 1999, 2000, 02]

(a) $10^{-23}\,kg$ (b) $10^{-24}\,kg$

(c) $10^{-26}\,kg$ (d) $10^{-27}\,kg$

4. Which electronic level would allow the hydrogen atom to absorb a photon but not to emit a photon [IIT 1984; CPMT 1997]

(a) $3s$ (b) $2p$

(c) $2s$ (d) $1s$

5. Which of the following is not correct for electron distribution in the ground state [AIIMS 1982]

		$4s$		$3d$			
(a)	$Co(Ar)$	↑↓	↑↓	↑↓	↑	↑	↑
(b)	$Ni(Ar)$	↑↓	↑↓	↑↓	↑↓	↑	↑
(c)	$Cu(Ar)$	↑↓	↑↓	↑↓	↑↓	↑↓	↑
(d)	$Zn(Ar)$	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓

6. If electron, hydrogen, helium and neon nuclei are all moving with the velocity of light, then the wavelengths associated with these particles are in the order [MP PET 1993]

(a) Electron > hydrogen > helium > neon

(b) Electron > helium > hydrogen > neon

(c) Electron < hydrogen < helium < neon

(d) Neon < hydrogen < helium < electron

7. From the given sets of quantum numbers the one that is inconsistent with the theory is [IIT Screening 1994]

(a) $n=3; l=2; m=-3; s=+1/2$

(b) $n=4; l=3; m=3; s=+1/2$

(c) $n=2; l=1; m=0 l s=-1/2$

(d) $n=4; l=3; m=2; s=+1/2$

8. The uncertainty in the position of an electron (mass = 9.1×10^{-28} g) moving with a velocity of $3.0\times10^{4}\,cm\,s^{-1}$ accurate upto 0.001% will be

(Use $\frac{h}{4\pi}$ in the uncertainty expression, where $h=6.626\times10^{-27}\,erg-s$) [IIT 1988; AMU 1999] [CBSE PMT 1995]

(a) $1.92cm$ (b) $7.68cm$

(c) $5.76cm$ (d) $3.84cm$

9. The orbital angular momentum of an electron in s orbital is [IIT 1996; AIEEE 2003; MP PET 2004]

(a) $+\frac{1}{2}.\frac{h}{2\pi}$ (b) Zero

(c) $\frac{h}{2\pi}$ (d) $\sqrt{2}.\frac{h}{2\pi}$

10. Values of the four quantum numbers for the last electron in the atom are $n=4, l=1, m=+1$ and $s=-1/2$. Atomic number of the atom will be

(a) 22 (b) 32

(c) 33 (d) 36

11. The atomic weight of an element is 39. The number of neutrons in its nucleus is one more than the number of protons. The number of protons, neutrons and electrons respectively in its atom would be [MP PMT 1997]

(a) 19, 20, 19 (b) 19, 19, 20

(c) 20, 19, 19 (d) 20, 19, 20

12. 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 [IIT 1999]

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

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

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

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

13. Ground state electronic configuration of nitrogen atom can be represented by [IIT 1999]

(a)

↑↓	↑↓	↑	↑	↑

(b)

↑↓	↑↓	↑	↓	↑

(c)

↑↓	↑↓	↑	↓	↓

(d) 

14. Which of the following statements (s) is (are) correct **[IIT 1998]**

(a) The electronic configuration of Cr is $[Ar]3d^5 4s^1$ (Atomic no. of $Cr = 24$)

(b) The magnetic quantum number may have a negative value

(c) In silver atom, 23 electrons have a spin of one type and 24 of the opposite type (Atomic no. of $Ag = 47$)

(d) The oxidation state of nitrogen in HN_3 is -3

15. The position of both an electron and a helium atom is known within $1.0nm$ and the momentum of the electron is known within $50 \times 10^{-26} kg\, ms^{-1}$. The minimum uncertainty in the measurement of the momentum of the helium atom is **[CBSE PMT 1998; AIIMS 2001]**

(a) $50 kg\, ms^{-1}$ (b) $60\, kg\, ms^{-1}$

(c) $80 \times 10^{-26} kg\, ms^{-1}$ (d) $50 \times 10^{-26} kg\, ms^{-1}$

16. Which of the following pair of orbitals posses two nodal planes

(a) p_{xy}, $d_{x^2-y^2}$ (b) d_{xy}, d_{zx}

(c) p_{xy}, d_{zx} (d) $d_{z^2}, d_{x^2-y^2}$

17. The number of atoms in 0.004 g of magnesium are **[AFMC 2000]**

(a) 4×10^{20} (b) 8×10^{20}

(c) 10^{20} (d) 6.02×10^{20}

18. Which of the following have the same number of unpaired electrons in 'd' orbitals **[Roorkee 2000]**

(a) *Cr* (b) *Mn*

(c) *Fe* (d) *Co*

19. The quantum numbers + 1/2 and – 1/2 for the electron spin represent **[IIT Screening 2001]**

(a) Rotation of the electron in clockwise and anticlockwise direction respectively

(b) Rotation of the electron in anticlockwise and clockwise direction respectively

(c) Magnetic moment of the electron pointing up and down respectively

(d) Two quantum mechanical spin states which have no classical analogue

20. The de-Broglie wavelength of a tennis ball of mass 60 g moving with a velocity of 10 *metres* per second is approximately

(a) 10^{-33} *metres* (b) 10^{-31} *metres*

(c) 10^{-16} *metres* (d) 10^{-25} *metres*

21. Which of the following are isoelectronic and isostructural $NO_3^-, CO_3^{2-}, ClO_3^-, SO_3$ **[IIT Screening 2003]**

[RPMT 2000]

(a) NO_3^-, CO_3^{2-} (b) SO_3, NO_3^-

(c) ClO_3^-, CO_3^{2-} (d) CO_3^{2-}, SO_3

22. The total number of electrons present in all the *s*-orbitals, all the *p*-orbitals and all the *d*-orbitals of cesium ion are respectively

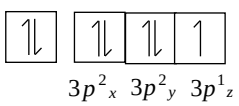
(a) 8, 26, 10 (b) 10, 24, 20

(c) 8, 22, 24 (d) 12, 20, 22

Answers and Solutions

(SET -2)

1. (c) Electronic configuration of Cl is

$[Ne]3s^2 3p^5$ or $[Ne]$ 

So for the unpaired electron $(3p_z^1)$:

$n = 3, l = 1, m = 1, S = +\frac{1}{2}$

2. (b) According to Aufbau principle the orbitals of lower energy (2*s*) should be fully filled before the filling of orbital of higher energy starts.

3. (d) Mass of neutron $= 1.675 \times 10^{-27} kg.$

4. (d) 1*s*-orbital is of lowest energy. Absorption of photon can raise the electron in higher energy state but emission is not possible.

5. (c) The correct electronic configuration

$Cu_{29} = [Ar],\ 4s^1\ \boxed{\uparrow}\quad 3d^{10}\ \boxed{\uparrow\downarrow}\ \boxed{\uparrow\downarrow}\ \boxed{\uparrow\downarrow}\ \boxed{\uparrow\downarrow}\ \boxed{\uparrow\downarrow}$

6. (a) $\lambda \propto \frac{1}{m}, m_e < m_H < m_{He} < m_{Ne}.$

7. (a) When $l = 2, m \neq -3$.

8. (a) $\Delta p = m \times \Delta v$

$$\Delta p = 9.1 \times 10^{-28} \times 3.0 \times 10^4 \times \frac{0.001}{100}$$

$$\Delta P = 2.73 \times 10^{-24}$$

Hence $\Delta x = \frac{h}{\Delta p \times 4\pi} = \frac{6.626 \times 10^{-27}}{2.73 \times 10^{-28} \times 4 \times 3.14}$

$$\Delta x = 1.92\, cm.$$

9. (b) For 2*s* orbital, *l* = 0; azimuthal quantum number is not show angular momentum for the $2s$ orbitals.

Angular momentum $= \sqrt{l(l+1)}\frac{h}{2\pi} = 0$.

10. (d) Atomic number is 36 and element is Kr.

11. (a) K_{19}^{39}, $P = 19$, $E = 19$, $N = 20$

12. (a) $(i)\,4p\ (ii)\,4s\ (iii)\,3d\ (iv)\,3p$ order of increasing energy is $3p < 4s < 3d < 4p.$

13. (a,d) According to Hund's principle.

14. (a,b,c) The oxidation state of nitrogen in HN_3 is $-\frac{1}{3}$.

HN_3: $1 + 3x = 0 \Rightarrow 3x = -1$ or $x = \frac{-1}{3}$

15. (d) The product of uncertainties in the position and the momentum of a sub atomic particle $= h/4\pi$. Since Δx is same for electron and helium so Δp must be same for both the particle *i.e.* $50 \times 10^{-26}\, kg\, ms^{-1}$ (given).

16. (b) d_{xy} and d_{zx} has two modal planes.

17. (c) No. of atoms in magnesium $= \frac{0.004}{24} \times 6.023 \times 10^{23} = 10^{-}$

18. (a,b,c) Cr, Mn and Fe^{3+} have 5 unpaired electron in *d*-orbitals.

$_{24}Cr = 3d^5\, 4s^1 = 5$

$_{25}Mn = 3d^5\, 4s^2 = 5$

$_{26}Fe^{3+} = 3d^5 4s^0 = 5$

19. (a,d) Both statement are correct.

20. (a) $\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{60 \times 10^{-3} \times 10} = 10^{-33} m$

21. (a) NO_3^- and CO_3^{2-} consist of same electron and show same isostructural.

22. (b) $(Cs_{35}) = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2$

$4p^6, 4d^{10}, 5s^2, 5p^6, 6s^1$

$Cs^+ = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2,$

$4p^6, 4d^{10}, 5s^2, 5p^6$

Total no. of e^- in *s*-orbitals $= 10$

Total no. of e^- in *p*-ortbitals $= 24$

Total no. of e^- in *d*-ortbitals $= 20$.

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