11th Objective paper hints and solutions PCM PAPER (22.07.2019)

Physics

: HINTS AND SOLUTIONS :

1 (b)

Time constant $= \frac{L}{R}$

$\therefore \left[\frac{L}{R}\right] = [\mathrm{T}]$

$\therefore \left[\frac{R}{L}\right] = [\mathrm{T}^{-1}]$

3 (a)

Energy density $= \frac{Energy}{Volume} = \frac{ML^2T^{-2}}{L^3} = [ML^{-1}T^{-2}]$

Young' s modulus $= \frac{Stress}{Strain} = \frac{ML^{-1}T^{-2}}{M^0L^0T^0} =$ $[ML^{-1}T^{-2}]$

Both have the same dimensions

4 (d)

Coefficient of viscosity $= \frac{F\times r}{A\times v} = \frac{[\mathrm{MLT}^{-2}]\times[\mathrm{L}]}{[\mathrm{L}^2]\times[\mathrm{LT}^{-1}]}$

$= [\mathrm{ML}^{-1}\mathrm{T}^{-1}]$

5 (d)

Charge $=$ Current $\times$ Time $= [AT]$

6 (b)

Positions $x = ka^mt^n$

$$[\mathrm{M}^0\mathrm{LT}^0] = [\mathrm{LT}^{-2}]^m[\mathrm{T}]^n$$

$$= [\mathrm{M}^0\mathrm{L}^m\mathrm{T}^{-2m+n}]$$

On comparing both sides

$$m = 1$$

$$-2m + n = 0$$

$$n = 2m$$

$$n = 2 \times 1 = 2$$

7 (d)

From the expression $= \frac{\text{Power}}{\text{Area}}$ $\left(\because \frac{\text{Energy}}{\text{time}} = \text{power}\right)$

$\frac{\mathrm{W}}{\mathrm{m}^2} = \mathrm{Wm}^{-2}$

$\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi r}$

Or $[\mu_0] = \frac{[F]}{[I_1I_2]} = \frac{[\mathrm{MLT}^{-2}]}{[\mathrm{A}^2]} = [\mathrm{MLT}^{-2}\mathrm{A}^{-2}]$.

8 (a)

$\frac{[\text{Energy}]}{[\text{Volume}]} = \frac{[\mathrm{ML}^2\mathrm{T}^{-2}]}{[\mathrm{L}^3]} = [\mathrm{ML}^{-1}\mathrm{T}^{-2}]$

$[\text{pressure}] = \frac{[\mathrm{MLT}^{-2}]}{[\mathrm{L}^2]} = [\mathrm{ML}^{-1}\mathrm{T}^{-2}]$

9 (b)

$RC = T$

$\because [R] = ML^2T^{-3}A^{-2}]$ and $[C] = [M^{-1}L^{-2}T^4A^2]$

10 (a)

$[\mathrm{B}] = \left[\frac{\text{force}\times\text{length}}{\text{mass}}\right] = \left[\frac{\text{energy}}{\text{mass}}\right] = [\text{latent heat}]$

12 (b)

Subtract 3.87 from 4.23 and then divide by 2.

13 (c)

$P_1 = [ML^2T^{-1}]$

$D_2 = [(2M)(2L)^2(2T)^{-1}]$

$P_2 = 4[ML^2T^{-1}] = 4P_1$

14 (a)

Electric potential $V = \frac{W}{q} = \frac{\text{joule}}{\text{coulomb}} = \frac{\text{newton}\times\text{metre}}{\text{coulomb}}$

$$= \frac{(\text{kg} - \text{ms}^{-2}) \times \text{m}}{\text{coulomb}}$$

$$= \text{kg} - \text{ms}^{-2} \times \text{m} \times \text{coulomb}^{-1}$$

$$\therefore = [\mathrm{ML}^2\mathrm{T}^{-2}\mathrm{Q}^{-1}]$$

15 (c)

Maximum percentage error in $P = 4\% + 2 \times 2\%$
$= 8\%$

16. Conceptual understanding
17. Conceptual understanding
18. Conceptual understanding
19. Conceptual understanding
20. Conceptual understanding
21. Conceptual understanding
22. Conceptual understanding
23. Conceptual understanding
24. Conceptual understanding
25. Conceptual understanding

Chemistry

1 (a)

Given, velocity of particle A=0.05 ms^{-1}

Velocity of particle B=0.02 ms^{-1}

Let the mass of particle $A = x$

$\therefore$ The mass of particle $B = 5x$

de-Broglie's equation is

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

For particle A

$$\lambda_A = \frac{h}{x \times 0.05} \quad \ldots \text{(i)}$$

For particle B

$$\lambda_B = \frac{h}{5x \times 0.02} \quad \ldots \text{(ii)}$$

Eq. (i)/(ii)

$$\frac{\lambda_A}{\lambda_B} = \frac{5x \times 0.02}{x \times 0.05}$$

$$\frac{\lambda_A}{\lambda_B} = \frac{2}{1}$$

or $2:1$

2 (a)

Number of radial nodes $= (n - l - 1)$

For $3s, n = 3, l = 0$(number of radial node=2)

For $2p, n = 2, l = 1$(number of radial node=0)

3 (c)

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

where, Δx =uncertainty in position.

Δp=uncertainty in momentum.

$= 1.0 \times 10^{-5}\text{kg ms}^{-1}$

$$\therefore \ \Delta x \times 1.0 \times 10^{-5} \geq \frac{6.62 \times 10^{-34}}{4 \times 3.14}$$

$$\Delta x \geq \frac{6.62 \times 10^{-34}}{4 \times 3.14 \times 1.0 \times 10^{-5}}$$

$$\geq 5.27 \times 10^{-30}\text{m}$$

4 (a)

It is impossible to determine simultaneously the exact position and momentum of moving particle like electron, proton, neutron.

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

where, Δx=uncertainty in position.

Δp=uncertainty in momentum.

5 (d)

$\text{K}(Z = 19): 1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^1$

In the ground state the value of l can be either zero or one.

Hence, the set (d) of quantum numbers $i.e.$,

$(n = 3, l = 2, m = +2)$cannot possible in the ground state.

6 (c)

For chlorine atom,
electronic configuration

$$= 1s^2, 2s^2, 2p^6, 3s^2, 3p^5$$

For $3p^5$,
$n = 3, l = 1, m = -1, 0, +1$

7 (b)

The maximum number of electron in any orbital is 2.

8 (d)

The values of quantum number will give idea about the last subshell of element. From that value we can find the atomic number of element, $n = 3$ means 3rd-shell

$\left.\begin{matrix} l = 0 \\ m = 0 \end{matrix}\right\}$means subshell

It means it is $3s$-subshell which can have 1 or 2 electrons.
∴ Configuration of element is
$1s^2, 2s^2, 2p^6, 3s^{1-2}$
∴ Atomic $i.e.$, number is 11 or 12.

9 (c)

$n = 4$, means electron is in 4th shell and $l = 2$, means subshell is d. Therefore, the orbital is in $4d$-subshell.

10 (a)

Four quantum numbers are

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

$n = 4$ indicates that the valence electron is present in 4th shell (4th period), $l = 0$ indicates that the valence electron is present in s-subshell. $m = 0$ indicates that the valence electron is present in orbital of s-subshell. $s = +\frac{1}{2}$ indicates that the spining of electron in orbital is clockwise. So, from the above discussion it is clear that valence electron is present in $4s$ subshell as $4s^1$. s^1 indicates that the element is present in IA group. So, the element present in 4th period and IA group is potassium (K).

11 (b)

Total number of orbitals for principal quantum number n is equal to n^2 .

12 (a)

The number of orbitals in an orbit (or shell) $= n^2$
where, n =no. of orbit or shell
Given, $n = 4$
∴ No. of orbitals in the 4th shell $=(4)^2$
$= 16$

13 (c)

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

   → $4s$ energy level.

2. $n = 3, l = 1, m = -1, s = +\frac{1}{2}$

   → $3p$ energy level.

3. $n = 3, l = 2, m = -2, s = +\frac{1}{2}$

   → $3d$ energy level.

4. $n=3, l=0, m=0, s=+\frac{1}{2}$

$\rightarrow 3s$ energy level.

According to aufbau principle, the energy of orbitals (other than H-atom) depend upon $n+1$ value.

$n+l$ for $3d=3+2=5$

So, it is highest energy level (in the given options).

14 (b)
Given, azimuthal quantum number (l)=2
Number of orbital's =($2l$+1)
$=(2\times 2+1)=4+1=5$

15 (c)
$n=4$(4th shell)
$l=2$(d-subshell)
$m_1=-2$(d_{xy} orbital)
$s=+\dfrac{1}{2}(\uparrow)$
Hence, electron belongs to 4d-orbital.

16 (b)
5. $n=2, l=1, m=0$ it is possible

6. $n=2, l=0, m=-1$ it is not possible because if $l-0, m$ must be 0. The value of m totally depends upon the value of $l(m=-l$ to $+l)$.

7. $n=3, l=0, m=-0$ it is possible.

8. $n=3, l=1, m=-1$ it is possible.

17 (d)
The number of electrons $=2n^2$
where, n =principal quantum number.
For $n=2$
Number of electrons $=2(2)^2=8$

18 (a)
Orbital angular momentum
$(\mathrm{L})=\sqrt{l(l+1)}\dfrac{h}{2\pi}$
For d-orbital, $l=2$
$(\mathrm{L})=\sqrt{2(2+1)}\dfrac{h}{2\pi}$
$=\dfrac{\sqrt{6}h}{2\pi}$

19 (c)
Electronic configuration of Mn(25) is
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
$\therefore$ Electronic configuration of Mn^{2+} is
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5$
$\because \mathrm{Mn}^{2+}=[\mathrm{Ar}]3d^5, 4s^0$

$3d^5$ $4s^0$

$= [Ar]$ [↿ | ↿ | ↿ | ↿ | ↿] [ ]

20 (c)

Aufbau principle states that in the ground state of an atom, the orbital with lower energy is filled up first before the filling of the orbitals with a higher energy commences.

Increasing order of energy of various orbitals is

$1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, \ldots$ etc.

Therefore,

[↿] [⥮ | ↿ | ↿]

Is not obeyed by aufbau principle. Without fully filling of s-subshell electrons cannot enter in p-subshell in ground state of atom.

21 (b)

Cr (24): $[Ar]3d^5 4s^1$

Cr^{3+}: $[Ar]3d^3 4s^0$

22 (a)

Electronic configuration of

$_{28}Ni = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^8, 4s^2$

$Ni^{2+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^8, 4s^0$

$_{29}Cu = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^1$

$Cu^{+} = 1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^0$

So, the given configuration is of Cu^{+}.

23 (d)

Subshell having lower value of $(n + l)$ will be of lower energy, where n is the principle and l is the azimuthal quantum number. Thus,

Correct energy value order is

$ns, (n-1)d, np, (n-1)f$.

24 (c)

The atomic number of neon is 10.

G. S. Ne[10]: $1s^2, 2s^2, 2p^6$

E. S. Ne [10]: $1s^2, 2s^2, 2p^5, 3s^1$

Hence, $1s^2, 2s^2, 2p^5, 3s^1$ electronic configuration indicates the excited state of neon.

25 (a)

The ground state configuration of chromium is

$_{24}Cr = [Ar]3d^5 4s^1$

$\therefore \quad _{24}cr^{2+} = [Ar]3d^4 4s^0$

Mathematics :

51	b	56	a	61	a	66	a
52	b	57	a	62	b	67	c
53	d	58	b	63	d		
54	a	59	c	64	b		
55	c	60	c	65	b		

68 (d)

$\sin 6\theta = 3\sin 2\theta - 4\sin^3 2\theta$

$= 3\sin 2\theta - 4.8\cos^3\theta\sin^3\theta$

$= 3\sin 2\theta - 32\cos^3\theta\sin\theta(1-\cos^2\theta)$

$\Rightarrow\ \sin 6\theta = 32\cos^5\theta.\sin\theta - 32\cos^3\theta\sin\theta + 3\sin 2\theta$ ...(i)

But $\sin 6\theta = 32\cos^5\theta\sin\theta - 32\cos^3\theta\sin\theta + 3x$ [given]

On comparing Eqs. (i) and (ii), we get

$3x = 3\sin 2\theta \quad\Rightarrow\quad x = \sin 2\theta$

69 (a)

We have, $\alpha + \beta + \gamma = 2\pi$

$$\Rightarrow \frac{\alpha}{2} + \frac{\beta}{2} + \frac{\gamma}{2} = \pi$$

$$\Rightarrow \frac{\alpha}{2} + \frac{\beta}{2} = \pi - \frac{\gamma}{2}$$

$$\Rightarrow \tan\left(\frac{\alpha}{2} + \frac{\beta}{2}\right) = \tan\left(\pi - \frac{\gamma}{2}\right)$$

$$\Rightarrow \frac{\tan\frac{\alpha}{2} + \tan\frac{\beta}{2}}{1 - \tan\frac{\alpha}{2}\tan\frac{\beta}{2}} = -\tan\frac{\gamma}{2}$$

$$\Rightarrow \tan\frac{\alpha}{2} + \tan\frac{\beta}{2} + \tan\frac{\gamma}{2} = \tan\frac{\alpha}{2}\tan\frac{\beta}{2}\tan\frac{\gamma}{2}$$

70 (a)

$$\sin(\alpha+\beta+\gamma) = \sin\alpha\cos\beta\cos\gamma + \cos\alpha\sin\beta\cos\gamma + \cos\alpha\cos\beta\sin\gamma - \sin\alpha\sin\beta\sin\gamma$$

$$\Rightarrow \sin(\alpha+\beta+\gamma) - \sin\alpha - \sin\beta - \sin\gamma$$

$$= \sin\alpha\,(\cos\beta\cos\gamma - 1) + \sin\beta\,(\cos\alpha\cos\gamma - 1) + \sin\gamma(\cos\alpha\cos\beta - 1)\sin\alpha\sin\beta\sin\gamma$$

$$\Rightarrow \sin(\alpha+\beta+\gamma) - \sin\alpha - \sin\beta - \sin\gamma < 0$$

$$\Rightarrow \sin\,(\alpha+\beta+\gamma) < sin\,\alpha + \sin\beta - \sin\gamma$$

$$\Rightarrow \frac{\sin(\alpha+\beta+\gamma)}{\sin\alpha + \sin\beta + \sin\gamma} < 1$$

71 (b)

$$\frac{\cos 70^\circ}{\sin 70^\circ} + 4\cos 70^\circ = \frac{\cos 70^\circ + 4\sin 70^\circ\cos 70^\circ}{\sin 70^\circ}$$

$$= \frac{\cos 70^\circ + 2\sin 140^\circ}{\sin 70^\circ}$$

$$= \frac{\sin 20^\circ + 2\sin 40^\circ}{\sin 70^\circ}$$

$$= \frac{2\sin 30^\circ\cos 10^\circ + \sin 40^\circ}{\sin 70^\circ}$$

$$\frac{\sin 80^\circ + \sin 40^\circ}{\sin 70^\circ}$$

$$= \frac{2\sin 60^\circ\cos 20^\circ}{\sin 70^\circ}$$

$$= \frac{2\left(\frac{\sqrt{3}}{2}\right)\sin 70°}{\sin 70°} = \sqrt{3}$$

72 (b)

$$\frac{\sin(B+A)+\cos(B-A)}{\sin(B-A)+\cos(B+A)}$$

$$= \frac{\sin(B+A)+\sin(90°-\overline{B-A})}{\sin(B-A)+\sin(90°-\overline{A+B})}$$

$$= \frac{2\sin(A+45°)\cos(45°-B)}{2\sin(45°-A)\cos(45°-B)}$$

$$= \frac{\sin(A+45°)}{\sin(45°-A)} = \frac{\frac{1}{\sqrt{2}}\sin A + \frac{1}{\sqrt{2}}\cos A}{\frac{1}{\sqrt{2}}\cos A - \frac{1}{\sqrt{2}}\sin A}$$

$$= \frac{\cos A + \sin A}{\cos A - \sin A}$$

73 (c)

Given, $2\sec 2\alpha = \tan\beta + \cot\beta$

$$\Rightarrow \quad 2\sec 2\alpha = \frac{\sin^2\beta + \cos^2\beta}{\sin\beta\cos\beta}$$

$$\Rightarrow \quad \frac{2}{\cos 2\alpha} = \frac{1}{\sin\beta\cos\beta}$$

$$\Rightarrow \quad \sin 2\beta = \cos 2\alpha$$

$$\Rightarrow \quad \alpha + \beta = \frac{\pi}{4}$$

74 (d)

$\cos x + \cos^2 x = 1 \;\Rightarrow\; \cos x = \sin^2 x$

Now, $\sin^{12} x + 3\sin^{10} x + 3\sin^8 x + \sin^6 x - 1$

$= \cos^6 x + 3\cos^5 x + 3\cos^4 x + \cos^3 x - 1$

$= (\cos^2 x + \cos x)^3 - 1 = 1 - 1 = 0$

5 (d)

Given that, $ABCD$ is a cyclic quadrilateral

So, $A + C = 180° \;\Rightarrow A = 180° - C$

$\Rightarrow \cos A = \cos(180° - C) = -\cos C$

$\Rightarrow \cos A + \cos C = 0$ ...(i)

Similarly, $\cos B + \cos D = 0$ ... (ii)

On adding Eqs. (i) and (ii), we get

$\cos A + \cos B + \cos C + \cos D = 0$