KSCP (2000/01) : Quantum Theory

Q3 (a) $n = 4$

n	l	m_l	m_s (or s)	
4	0	0	$+\frac{1}{2}$	4s ($2e^-$)
4	0	0	$-\frac{1}{2}$	
4	1	0	$+\frac{1}{2}$	4p ($6e^-$)
4	1	0	$-\frac{1}{2}$	
4	1	+1	$+\frac{1}{2}$	
4	1	+1	$-\frac{1}{2}$	
4	1	-1	$+\frac{1}{2}$	
4	1	-1	$-\frac{1}{2}$	
4	2	0	$+\frac{1}{2}$	4d ($10e^-$)
4	2	0	$-\frac{1}{2}$	
4	2	+2	$+\frac{1}{2}$	
4	2	+2	$-\frac{1}{2}$	
4	2	+1	$+\frac{1}{2}$	
4	2	+1	$-\frac{1}{2}$	
4	2	-2	$+\frac{1}{2}$	
4	2	-2	$-\frac{1}{2}$	
4	2	-1	$+\frac{1}{2}$	
4	2	-1	$-\frac{1}{2}$	
4	3	0	$+\frac{1}{2}$	4f ($14e^-$)
4	3	0	$-\frac{1}{2}$	
4	3	+3	$+\frac{1}{2}$	
4	3	+3	$-\frac{1}{2}$	
4	3	+2	$+\frac{1}{2}$	
4	3	+2	$-\frac{1}{2}$	
4	3	+1	$+\frac{1}{2}$	
4	3	+1	$-\frac{1}{2}$	
4	3	-3	$+\frac{1}{2}$	
4	3	-3	$-\frac{1}{2}$	
4	3	-2	$+\frac{1}{2}$	
4	3	-2	$-\frac{1}{2}$	
4	3	-1	$+\frac{1}{2}$	
4	3	-1	$-\frac{1}{2}$	

No. of electron which have $s = +\frac{1}{2}$ $= (1 + 3 + 5 + 7)$
$= 16e^-$ (Ans) //

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Q_3 (6) $\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$n_1 = 4 \quad n_2 = 10$

$\therefore \frac{1}{\lambda} = (109678\ cm^{-1})\left(\frac{1}{4^2} - \frac{1}{10^2}\right)$

$\frac{1}{\lambda} = 5758\ cm^{-1}$

$\lambda = 1.737 \times 10^{-4}\ cm$

$= (1.737 \times 10^{-4} \times 10^{+7})\ nm$

$= 1.737 \times 10^{3}\ nm$

$\lambda = 1737\ nm$ (Ans) //

Q_3 (c) Given: $328\ kJ\ mol^{-1}\ Cl_2$ ← must change to $J\ photon^{-1}$, then * only can substitute in $E = h\nu$

$\lambda = ?\ nm$

$E = 328\ kJ\ mol^{-1} = \frac{328 \times 10^3\ J\ mol^{-1}}{6.023 \times 10^{23}\ mol^{-1}} = 5.446 \times 10^{-19}\ J\ photon^{-1}$

$\therefore E = h\nu = \frac{hc}{\lambda}$

$\therefore \lambda = \frac{hc}{E} = \frac{(6.626 \times 10^{-34}\ Js)(3.0 \times 10^8\ ms^{-1})}{(5.446 \times 10^{-19})}$

$= 3.65 \times 10^{-7}\ m$

$= 3.65 \times 10^{-7} \times 10^{9}\ nm$

$\lambda = 365\ nm$ (Ans) //

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