CHEM1611 Answers to Problem Sheet 2

1.

(a)	S	**$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$**
(b)	Cu(II)	**$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0\ 3d^9$**
(c)	V(III)	**$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0\ 3d^2$**
(d)	Br^-	**$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6$**
(e)	Ca^{2+}	**$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$**

2. **The energy of electromagnetic radiation with frequency ν is given by:**

$$E = h\nu$$

where h = 6.626 × 10^{-34} J s (Planck's constant) so the frequency is given by:

$$\nu = E/h$$

The frequency of the light capable of ionizing hydrogen is therefore:

$$\nu = (2.18 \times 10^{-18}\ \text{J}) / (6.626 \times 10^{-34}\ \text{J s}) = \underline{3.29 \times 10^{15}\ \text{s}^{-1}}$$

The wavelength (λ), frequency (ν) and the speed of light (c) are linked:

$$c = \lambda\nu$$

This can be rearranged to give:

$$\lambda = c / \nu$$

The wavelength corresponding to the frequency above is therefore:

$$\lambda = (3.00 \times 10^{8}\ \text{m s}^{-1}) / (3.29 \times 10^{15}\ \text{s}^{-1}) = \underline{9.12 \times 10^{-8}\ \text{m}\ \ \text{(or 91.2 nm)}}$$

3.

	n	l	m_l	m_s	
(a)	1	0	0	½	**Valid – an 'up-spin' electron in a 1s orbital.**
(b)	4	4	3	- ½	**Invalid – *l* can take values from (*n*-1) to 0. As *n* = 4, l_{max} = 3.**
(c)	2	1	-1	½	**Valid – an 'up-spin' electron in one of the 2p orbitals**
(d)	3	2	0	0	**Invalid – m_s must be + ½ or – ½**

(e)	2	1	1	½	**Valid – an 'up-spin' electron in one of the 2p orbitals**
(f)	6	2	-2	½	**Valid – an 'up-spin' electron in one of the 6d orbitals**

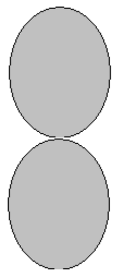
4. **(c) chromium, manganese, iron, cobalt, nickel**

5. (a) $^{2}_{1}H + ^{20}_{10}Ne \rightarrow ^{18}_{9}F + ^{4}_{2}He$

   (b) $^{18}_{9}F \rightarrow ^{18}_{8}O + ^{0}_{1}e^{+}$

6. **The waves must be standing waves that are**
   - **continuous**
   - **single valued**
   - **multiples of a whole number of half wavelengths**

7.



8. **Pauli exclusion principle - no two electrons can have an identical set of four quantum numbers. i.e. there are a maximum of 2 electrons in any one orbital.**

9.

NaBr	**sodium bromide**
SO_3	**sulfur trioxide**
N_2O_5	**dinitrogen pentoxide**
$Fe(OH)_2$	**iron(II) hydroxide**
$Fe(OH)_3$	**iron(III) hydroxide**
ICl_3	**iodine trichloride**