

**THE OPEN UNIVERSITY OF SRI LANKA**  
Foundation Programme in Science/Continuing Education Programme  
2008/2009  
**PSF 1303/PSE 1303 – CHEMISTRY – LEVEL I**

**HOME ASSIGNMENT I**

- 1 (a) Write the electronic configuration ( $1S^2, 2S^2, \dots$ ) of the following ions and elements  
(i) Na      (ii)  $Mg^{2+}$       (iii) Cl      (iv)  $S^{2-}$       (v) Zn      (vi)  $Ni^{2+}$
- (b) An electron in a hydrogen atom is present finds it self in the fourth energy level  
(i) Write down a list of the orbitals that it might be in  
(ii) Can it be in all of these orbitals at once  
(iii) Identify which orbital it is in
- (c) Why is it always the case that the 2<sup>nd</sup> ionization energy of oxygen is larger than the 1<sup>st</sup> ionization energy, the 3<sup>rd</sup> ionization energy larger than the 2<sup>nd</sup> ionization energy.
- (d) Draw dot-and-cross diagrams of the following molecules  
(i)  $CCl_4$       (ii)  $C_2F_4$       (iii)  $CO_3^{2-}$       (iv)  $BCl_3$
- (e) Which of the halogen would you expect to have the highest polarisability:  
Fluorine, Chlorine, Bromine or Iodine. Briefly explain your answer
- (f) The abundance of these isotopes in a sample of neon were found to be 90.92 %  $^{20}Ne$ , 0.26 %  $^{21}Ne$ , and 8.82 %  $^{22}Ne$ . Calculate the relative atomic mass of neon
2. (a) A compound P contains 29.1 % sodium 40.5 % sulphur and 30.4 % oxygen.  
Calculate the empirical formula of P [ S-32, O-16, Na-23, ]
- (b) Write balanced chemical equations to show the reaction of the following elements with oxygen  
(i) Al      (ii) P      (iii) Si
- (c) Write the balance chemical equation to show the reaction of the following compounds with water  
(i)  $AlCl_3$       (ii)  $PCl_5$       (iii)  $SiCl_4$
- (d) 500.0  $cm^3$  of nitric acid were neutralized by 10.6 g of anhydrous sodium carbonate.  
The equation for the reaction is  
 $Na_2CO_{3(s)} + 2 HNO_{3(aq)} \longrightarrow 2 NaNO_{3(aq)} + CO_{2(g)} + H_2O_{(l)}$   
What was the concentration of the acid in terms of  
(i)  $mol\ dm^{-3}$       (ii) molality      (iii)  $g\ dm^{-3}$
- (e) 25.0  $cm^3$  of a solution of potassium chloride was put in a conical flask and a few drops of yellow potassium chromate(VI) indicator added and silver nitrate of concentration 0.02  $mol\ dm^{-3}$  was run in from a burette until the indicator gave a permanent red colour to the solution. The burette reading was 22.5  $cm^3$ . Calculate the concentration of the chloride solution
- (f) Calculate the volume of 0.05  $mol\ dm^{-3}$   $KMnO_4$  solution required to oxidize 2.0g of  $FeSO_4$  in a dilute acid solution

පැවරුම I

(1) (a) පහත දැක්වෙන මූලද්‍රව්‍ය හා අයන වල ඉලෙක්ට්‍රෝනික (1s<sup>2</sup> 2s<sup>2</sup> ... ආකාරයෙන්) ව්‍යාකරණය ලියන්න.

- (i) Na      (ii) Mg<sup>2+</sup>      (iii) Cl      (iv) S<sup>2-</sup>      (v) Zn      (vi) Ni<sup>2+</sup>

(b) හයිඩ්‍රජන් පරමාණුවක භාගර්ෂක ශක්ති ව්‍යවස්ථා ඉලෙක්ට්‍රෝන සංඛ්‍යා දැක්ව.

(i) එම ඉලෙක්ට්‍රෝනය පවතින පැති ආක්ෂික ලියන්න.

(ii) මෙම ඉලෙක්ට්‍රෝනය ඉහත සඳහන් කළ ආක්ෂික සියල්ලෙහි එකවර පවතින හැකිද?

(iii) ඉහත සඳහන් ආක්ෂික අතුරින් එම ඉලෙක්ට්‍රෝනය පවතින හැකි ආක්ෂික මොනවාද?

(c) පළමු වරම බන්ධන ශක්ති දෙවන අයනීකරණ ශක්තිය පළමු අයනීකරණ ශක්තියට වඩා වැඩි වන විට එම මූලද්‍රව්‍ය අයනීකරණ ශක්තිය දෙවන අයනීකරණ ශක්තියට වඩා වැඩි වන විට පවතී.

(d) පහත සඳහන් හැඳුණ අතුරින් වැඩිම ප්‍රමාණයක් දැක්වෙන්නේ කුමකද? ලිතියම්, සෝඩියම්, කැල්සියම්, අයඩීන්, බ්‍රෝමීන්, ජලජීවීන්.

(f) නියෝන්හි <sup>20</sup>Ne සමස්ථතියෙන් 90.92% ක්ද <sup>22</sup>Ne සමස්ථතියෙන් 8.82% ක්ද වනු ලබන බව පෙනේ. නියෝන්හි සාමාන්‍ය පරමාණුක ස්කන්ධය ගණනය කරන්න.

2) (a) 29.1% ක් සෝඩියම්, 40.5% ක් ප්‍රෝටියම් හා 30.4% ක් කැල්සියම් වලින් සමන්විත වූ P නම් සංයෝගයක් ඇති මෙම P සංයෝගයේ ආණුපාතික සූත්‍රය ගණනය කරන්න.

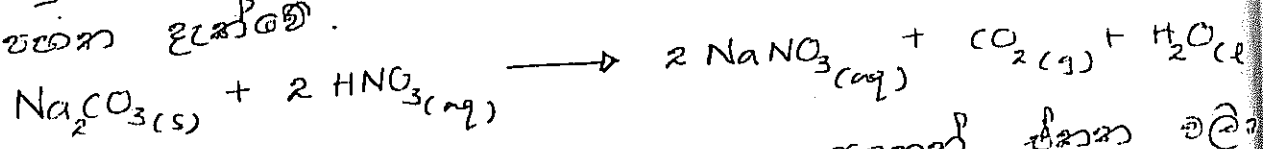
(b) පහත සඳහන් මූලද්‍රව්‍ය බන්ධන සමඟ දැක්වූ ප්‍රතික්‍රියා  
 අදාළ කුලීන රසායනික සමීකරණ ලියන්න.

(i) Al (ii) P (iii) Si

(c) පහත සඳහන් සංයෝග වලට සමඟ දැක්වූ ප්‍රතික්‍රියා  
 සඳහා කුලීන රසායනික සමීකරණ ලියන්න.

(i)  $AlCl_3$  (ii)  $PCl_5$  (iii)  $SiCl_4$

(d) තයිට්‍රේෂන් අම්ලයේ  $500.0 \text{ cm}^3$  හි පරිමාවක් උදාහරණ නිරීක්ෂණයක් සිදු කළ විට  $10.6 \text{ g}$  ක් වැය විය. පහත ප්‍රතික්‍රියාවට අදාළ කුලීන රසායනික සමීකරණ පහත දැක්වේ.



තයිට්‍රේෂන් අම්ලයේ සාන්ද්‍රණය පහත සඳහන් ඒකක වලින් ගණනය කරන්න.

(i)  $\text{mol dm}^{-3}$  (ii) මෝලියනාමය (iii)  $\text{g dm}^{-3}$

(e) පොලිමරයක් නිලෝරයිඩ් ප්‍රාග්ධනයක  $25.0 \text{ cm}^3$  හි පරිමාවක් තිබේ. එයට ජලයේ දියවීමට පෙරුණු නිලෝරයිඩ් (VI) ද්‍රව්‍යයෙන් බර කිහිපයක් එකතු කර සාන්ද්‍රණය  $0.02 \text{ mol dm}^{-3}$  වූ සිල්වර් නයිට්‍රේට් ප්‍රාග්ධනයක් සමඟ අනුමාපනය කරන ලදී. බියුරෙට්ටු නිලෝරයිඩ්  $22.5 \text{ cm}^3$  ක් විය. නිලෝරයිඩ් ප්‍රාග්ධනයේ සාන්ද්‍රණය ගණනය කරන්න.

(f) නිලෝරයිඩ්  $FeSO_4$  ප්‍රාග්ධනයක්  $2.0 \text{ g}$  ක් බන්ධන කිරීමට අවශ්‍ය, සාන්ද්‍රණය  $0.05 \text{ mol dm}^{-3}$  වූ  $KMnO_4$  ප්‍රාග්ධනයක් අවශ්‍ය පරිමාව ගණනය කරන්න.



(அ) ஒரு கோவை P 29.1% கோடியம் 40.5% சீயம், 30.4% ஆக்சிசன் சம்பள வற்றி கொண்டது. P யின் அறுபடி ஒத்திரம் யாது? [S-32, O-16, Na-23]

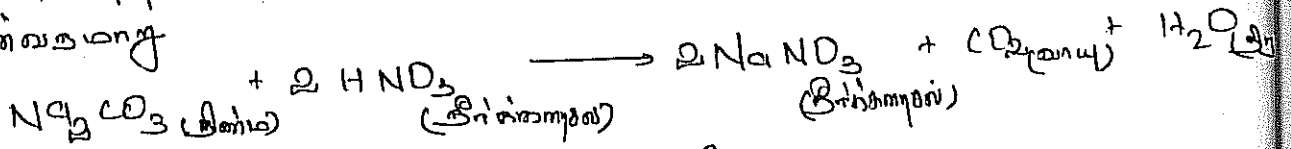
(ஆ) பின்வரும் மூலகங்கள் ஆக்சிசனுடன் ஒருபிழை நாக்வகங்களின் சமன்படுத்தப்பட்ட ஆகாய சமன்பாட்டை அழுதுக?

- ① Al      ② P      ③ Si

(இ) பின்வரும் கோவைகள் தீவற்ற நாக்வகமடையுமே போது நக விழுகு நாக்வகத்திற்கான சமன்படுத்தப்பட்ட ஆகாய சமன்பாட்டை அழுதுக?

- ① Al<sub>2</sub>      ② P<sub>2</sub>      ③ SiCl<sub>4</sub>

(ஈ) 500.0 cm<sup>3</sup> ஒத்திரிக் கவிலமொன்று 10.6 g தீவற்ற கோடியம சமன்படுத்தினால் அதிமலப்படுத்தப்பட்டது. அதற்கான நாக்வக பின்வருமாறு



அவ்வத்தின் செறிவு பின்வரும் அவகமில் யாது?

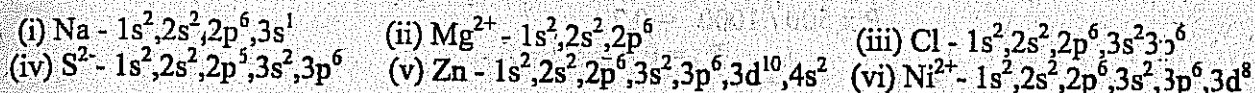
- (i) mol dm<sup>-3</sup>      (ii) மலவத்திகள்      (iii) g dm<sup>-3</sup>

(உ) 25.0 cm<sup>3</sup> பெட்டாசியம் குமொன்றுக்கு ஒரு கூடிய குமெவ விழும் சமன்படுத்தப்பட்டது. அதற்கு மலசம் தீவற்ற பெட்டாசியம் குமொமேர் (VI) காட்டி சிறு குமிகன் கிடப்பட்டது. அதற்கு 0.02 mol dm<sup>-3</sup> வெள்ளி ஒத்திரேற்ற கருசல் ஒரு அமவி யலிக்கு காட்டி சமைய தீவற்ற மலசம் மலசம் கிடப்பட்ட அமவி வரசியு 22.5 cm<sup>3</sup> ஆகும். குமொன்றுக்கு கருசலின் செறிவை காண்க?

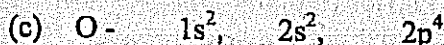
(ஊ) தீவற்ற அமவி உலகத்தில் 2.0 g FeSO<sub>4</sub> மல நுதிமலப்பட்டு மலசமல 0.05 mol dm<sup>-3</sup> KMnO<sub>4</sub> கருசலின் கமவமவை கம

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**HOME ASSIGNMENT I Answer Guide**

1 (a)



- (b) (i)  $4s, 4p_x, 4p_y, 4p_z$ , and five 4d orbitals, Seven 4f orbitals  
 (ii) Can't it will only be in one of them  
 (iii) No for the hydrogen atom all orbitals with the same principle quantum numbers have the same energy [they are degenerate]



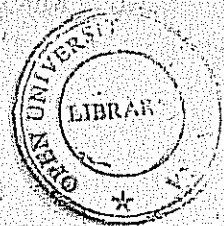
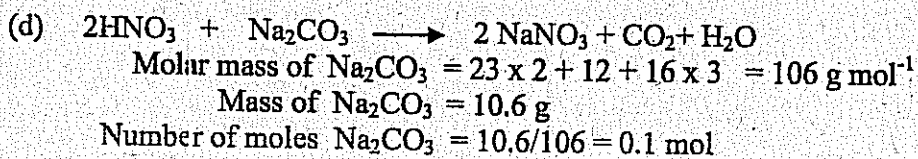
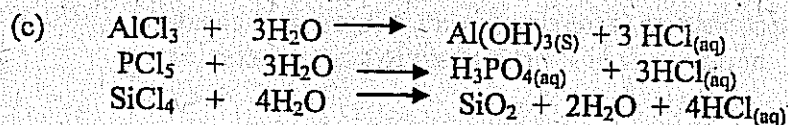
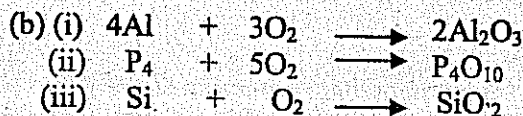
Energy required to remove an electron from completely filled or half filled electron configuration is more than that of other configurations. Once that atom has changed into a +ve ion there is a stronger attraction between the nucleus and the electron that are left [ This shown by measurement of the radii of the ions which are always smaller than their parent atoms] Hence it is more difficult to remove an electron and the ionization energy increases

- (d) Induce has the largest number of electrons the most shielding and the greatest polarizability  
 (e) Not marked  
 (f) Relative atomic mass =  $90.92 \times 20/100 + 0.26 \times 21/100 + 8.82 \times 22/100 = 20.179$

2 (a)

Atoms	Na	S	O
	29.1	40.5	30.4
	23	32	16
	1.265	1.265	1.90
	1.265	1.265	1.265
	1	1	1.5
	2	2	3

Empirical formula is  $Na_2S_2O_3$



Stoichiometry in between



$$\text{Number of moles of HNO}_3 \text{ reacts} = 0.1 \times 2 = 0.2 \text{ mol}$$

$$\text{If the HNO}_3 \text{ acid concentration is } p \text{ mol dm}^{-3}$$

$$p \times 500 / 1000 = 0.2$$

$$p = 0.4 \text{ mol dm}^{-3}$$

$$(ii) \quad \text{Molality mol kg}^{-1} \text{ water density is } 1.0 \text{ g cm}^{-3}$$

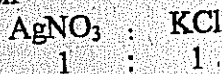
$$\text{There for molality } 0.4 \text{ mol kg}^{-1}$$

$$(iii) \quad = 0.4 \times 63 \text{ g dm}^{-3} = 25.2 \text{ g dm}^{-3}$$



$$\text{Number of moles AgNO}_3 = 0.02 \times 22.50 / 1000$$

Stoichiometry in between



$$\text{If the Cl}^{-1} \text{ acid concentration is } y \text{ mol dm}^{-3}$$

$$y \times 25 / 1000 = 0.02 \times 22.5 / 1000$$

$$y = 0.018 \text{ mol dm}^{-3}$$



$$\text{Molar mass of FeSO}_4 = 56 + 32 + 16 \times 4 = 152 \text{ g mol}^{-1}$$

$$\text{Mass of FeSO}_4 = 2.0 \text{ g}$$

$$\text{Moles of FeSO}_4 = 2.0 / 152 = 0.013 \text{ mol}$$



$$\text{No of MnO}_4 \text{ moles that react with Fe}^{2+} = 0.0026 \text{ mol}$$

$$\text{Volume of KMnO}_4 \quad v \text{ cm}^3$$

$$0.05 \times v / 1000 = 0.0026$$

$$v = 52.0 \text{ cm}^3$$