



00033

ශ්‍රී ලංකා විවෘත විශ්වවිද්‍යාලය
රසායන විද්‍යා දෙපාර්තමේන්තුව
විද්‍යාවේදී පදනම් පාඨමාලාව /තනි විද්‍යා පාඨමාලාව
1 වන මට්ටම - අවසාන පරීක්ෂණය - 2014/2015
PSF1303/PSE1303 - රසායන විද්‍යාව I
කාලය - පැය 2 1/2 යි.

දිනය - 2015 නොවැම්බර් 17

වේලාව - පෙ.ව. 09.30 - මධ්‍ය.12.00 දක්වා

Planck's constant, $h = 6.63 \times 10^{-34} \text{ Js}$
Velocity of light, $C = 3 \times 10^8 \text{ ms}^{-1}$
Avogadro constant, $L = 6.023 \times 10^{23} \text{ mol}^{-1}$
1 atmosphere = 760 torr = 10^5 Nm^{-2}
Universal Gas constant, $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$
 $\ln_e = 2.303 \log_{10}$

											1 H 1.008								2 He 4.003																
3 Li 6.939		4 Be 9.012												5 B 10.81		6 C 12.01		7 N 14.01		8 O 16.00		9 F 19.00		10 Ne 20.18											
11 Na 22.99		12 Mg 24.31												13 Al 26.98		14 Si 28.09		15 P 30.97		16 S 32.07		17 Cl 35.45		18 Ar 39.95											
19 K 39.10		20 Ca 40.08		21 Sc 44.96		22 Ti 47.90		23 V 50.94		24 Cr 52.00		25 Mn 54.94		26 Fe 55.85		27 Co 58.93		28 Ni 58.71		29 Cu 63.55		30 Zn 65.39		31 Ga 69.72		32 Ge 72.61		33 As 74.92		34 Se 78.96		35 Br 79.90		36 Kr 83.80	

- ප්‍රශ්න හයෙන් (06) හතරකට (04) පිළිතුරු සපයන්න.
- ප්‍රශ්න හතරකට වඩා පිළිතුරු සපයා ඇත්නම්, පිළිතුරු සපයා ඇති අනුපිළිවෙලට පළමු ප්‍රශ්න හතර පමණක් ඇගයීමට ලක් කරනු ඇත.
- ජංගම දුරකථන ප්‍රභවතා සැකීම තහනම්, ඊළා ක්‍රියා විරහිත කොට සුරක්ෂිත ස්ථානයක තබන්න.
- ප්‍රකූමණය කළ නොහැකි ගණක යන්ත්‍රයක් භාවිතා කිරීමට හැක.

01. (a) වායුවක ඝනත්වය 0.0028 g cm^{-3} සහ මොලික ස්කන්ධය 70 g mol^{-1} වේ.

- (i) වායුවෙහි ඝනත්වය kg m^{-3} වලින් ප්‍රකාශ කරන්න.
(ii) වායුවෙහි ඝනත්වය mol dm^{-3} වලින් ගණනය කරන්න. (ලකුණු 15)

- (b) (i) අදාළ සම්කරණ භාවිතා කරමින්, තරංග ආයාමය 500 nm වන කොළ පැහැ ආලෝක කදම්භ රෝටෝන මවුලයක ගතවිය ගණනය කරන්න.
(ii) කොළ ආලෝකයේ සිට රතු ආලෝකය දක්වා යාමේදී තරංග ආයාම විචලනය වන්නේ කෙසේ ද?

(ලකුණු 30)

(c) X නම් කාබනික සංයෝගයෙහි අඩංගු කාබන්, හයිඩ්‍රජන් හා නයිට්‍රජන් හි මොල ප්‍රතිශත පිළිවෙලින් 48.65%, 13.60% සහ 37.75% වේ.

(i) X හි අනුභවික සූත්‍රය නිර්ණය කරන්න.

(ii) X හි මොලික ස්කන්ධය 149 g mol^{-1} නම්, එහි අණුක සූත්‍රය නිර්ණය කරන්න. (ලකුණු 25)

(d) ක්ලෝරීන් හි සමස්ථානිකවල බහුලතාව පහත දී ඇත.

සාපේක්ෂ සමස්ථානික ස්කන්ධය	ප්‍රතිශත බහුලතාව
34.68	60.54
35.89	39.46

(i) ක්ලෝරීන්හි සාපේක්ෂ පරමාණුක ස්කන්ධය ගණනය කරන්න.

(ii) ක්ලෝරීන්හි සමස්ථානික සමාන රසායනික ප්‍රතික්‍රියා පෙත්වන්නේ ඇයිදැයි පහදන්න.

(iii) ක්ලෝරීන්හි ඉලෙක්ට්‍රෝන වින්‍යාසය ලියා දක්වන්න. (ක්ලෝරීන්හි පරමාණුක අංකය = 17) (ලකුණු 30)

02. (a) පහත දී ඇති ප්‍රශ්න ආවර්තිතා වගුවේ පළමු ආවර්ත දෙක තුල අඩංගු මූල ද්‍රව්‍ය දහඅට (18) මත පදනම් වේ. (01 පිටුව බලන්න)

(i) උච්චතම අයනීකරණය පෙන්නුම් කරන්නා වන සාදන මූල ද්‍රව්‍ය දෙක හඳුනා ගන්න.

(ii) ඉතාම ස්ථායී සහසංයුජ ද්විපරමාණුක අණුව සාදන මූලද්‍රව්‍ය මොනවා ද?

(iii) විශාලතම පළමු අයනීකරණ ශක්තිය ඇත්තේ කුමන මූලද්‍රව්‍යයට ද?

(iv) ඉලෙක්ට්‍රෝන උෂ්ණ සංයෝගයක් සාදන මූලද්‍රව්‍ය දෙක හඳුනා ගන්න.

(v) ඉහළම භාපාංකය පෙන්වන මූලද්‍රව්‍යය කුමක් ද? (ලකුණු 30)

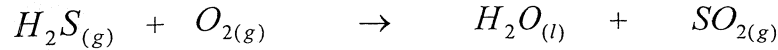
(b) (i) ඇලුමිනියම් ඔක්සයිඩ් උභයගුණි වන අතර බෝරෝන් ඔක්සයිඩ් ආම්ලික වන්නේ ඇයිදැයි පහදන්න.

(ii) Ca(OH)_2 ද්‍රාවණයක් තුළින් CO_2 බුබුලනය කිරීමේදී සිදුවන ප්‍රතික්‍රියාව සඳහා තුලිත සමීකරණය ලියන්න. මෙම ද්‍රාවණය තුළින් වැඩිපුර CO_2 බුබුලනය කිරීමේදී කුමක් සිදුවේ ද? ඒ සඳහා තුලිත රසායනික සමීකරණය ලියන්න.

(ලකුණු 40)

- (c) (i) සෝඩියම් හි දෙවන අයනීකරණ ශක්තිය 4560 kJ mol^{-1} වේ.
මෙම අයනීකරණය විස්තර කරන සමීකරණය ලියන්න. දෙවන අයනීකරණ ශක්ති අගය, පළමු අයනීකරණ ශක්ති අගයට වඩා වැඩි වන්නේ මන්ද?
- (ii) $\text{Na}^+, \text{Mg}^{2+}$ සහ Al^{3+} යන අයනවලට සමාන ඉලෙක්ට්‍රෝන වින්‍යාසයක් ඇතත් ඒවායේ අයනික අරයන් වෙනස් වේ. මෙය පහදන්න. (ලකුණු 30)
03. (a) X, යන මූල ද්‍රව්‍යයේ ඉලෙක්ට්‍රෝන වින්‍යාසය $1s^2 2s^2 2p^6 3s^2 3p^5$ වේ.
- (i) මූලද්‍රව්‍යය හඳුනා ගන්න.
- (ii) X මූලද්‍රව්‍යය සහ සෝඩියම් අතර සෑදෙන සංයෝගයේ සූත්‍රය ලියන්න.
- (iii) මෙම සංයෝගයේ ඔබ බලාපොරොත්තු වන බන්ධන ආකාරය කුමක් ද?
- (iv) X හා සෝඩියම් අතර සාදන සංයෝගය සඳහා තිත් -කතිර සටහන අඳින්න. (ලකුණු 20)
- (b) පහත දී ඇති අණු සඳහා තිත්-කතිර සටන් ඇඳ, සංයුජතා කවච ඉලෙක්ට්‍රෝන යුගල විකර්ෂණ මූලධර්මය (VSEPR) මගින් ඒවායේ හැඩ විස්තර කරන්න.
- (i) PCl_5 (ii) H_2O (iii) SF_6 (ලකුණු 30)
- (c) පහත දී ඇති ප්‍රකාශන සඳහා හේතු දෙන්න.
- (i) දියමන්ති දෘඩ ද්‍රව්‍යයකි.
- (ii) ජලයට ඉහළ තාපාංකයක් ඇත. (ලකුණු 22)
04. (a) පහත සඳහන් දෑ අර්ථ දැක්වන්න.
- (i) බෙන්සීන්වල $\text{C}_6\text{H}_{6(l)}$ සම්මත උත්පාදන එන්තල්පිය ΔH_f°
- (ii) බෙන්සීන් $\text{C}_6\text{H}_{6(l)}$ සම්මත දහන එන්තල්පිය ΔH_c°
- (b) දී ඇති දත්ත උපයෝගී කොටගෙන, බෙන්සීන්- $\text{C}_6\text{H}_{6(l)}$ හි උත්පාදන තාපය ගණනය කරන්න.
- $$\begin{aligned}\Delta H_f^\circ(\text{C}_6\text{H}_6) &= -3267.6 \text{ kJ mol}^{-1} \\ \Delta H_f^\circ(\text{H}_2\text{O}) &= -285.9 \text{ kJ mol}^{-1} \\ \Delta H_f^\circ(\text{CO}_2) &= -393.5 \text{ kJ mol}^{-1}\end{aligned}$$
- (ලකුණු 30)

- (c) (i) ගිනිකඳු පිපිරීමේදී විමෝචනය වන එක් වායුවකි හයිඩ්‍රජන් සල්ෆයිඩ් (H_2S) එම වායුව වාතය හමුවේ ඔක්සිකරණය වී සල්ෆර් ඩයොක්සයිඩ් (SO_2) ලබා දෙයි.



- (i) ඉහත සමීකරණය තුලින් කරන්න.
 (ii) හයිඩ්‍රජන් සල්ෆයිඩ් (H_2S) ඔක්සිකරණය සඳහා වූ එන්තල්පි වෙන, ගණනය කිරීමට හෙස්ගේ වක්‍රය ආදේශන්න.
 හෙස්ගේ වක්‍රය ඇසුරෙන් (H_2S) ඔක්සිකරණය සඳහා වූ එන්තල්පි වෙනස ගණනය කරන්න.

$$\Delta H_f^0(H_2O) = -286 \text{ kJmol}^{-1}$$

$$\Delta H_f^0(H_2S) = -21 \text{ kJmol}^{-1}$$

$$\Delta H_f^0(SO_2) = -297 \text{ kJmol}^{-1} \quad (\text{ලකුණු } 40)$$

- (d) (i) තාපගති විද්‍යාවේ පළමු නීතිය සඳහා ගණිතමය ප්‍රකාශනයක් ලියන්න.
 (ii) ජලය 28.4 g සඳහා තාප ධාරිතාව පුල් වලින් ගණනය කරන්න. (ජලයේ විශිෂ්ට තාප ධාරිතාව $4.184 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$) (ලකුණු 30)

05. (a) (i) පහත දී ඇති සමතුලිතතාව සලකන්න.



ලේ වැටලියර් මූලධර්මය භාවිතයෙන් පහත අවස්ථාවන් සඳහා ඇතිකරන බලපෑම ප්‍රරෝකතනය කරන්න.

- (i) පීඩනය වැඩි කිරීම
 (ii) ඇමෝනියා ඉවත් කිරීම (ලකුණු 20)

- (b) හයිඩ්‍රජන් සහ අයඩින් 0.0015 mol බැගින් වූ මිශ්‍රණයක් සංවෘත නලයක රත් කිරීමේදී සමතුලිත මිශ්‍රණයක් ඇති වේ. මේ ප්‍රතික්‍රියාවට සමීකරණය,



- (i) මෙම ප්‍රතික්‍රියාවට අදාළව K_c සහ K_p යන සමතුලිතතා නියත සඳහා ප්‍රකාශන ලියන්න.
 (ii) ප්‍රතික්‍රියාව සඳහා K_c සහ K_p හි අගයන් සමාන වන්නේ ඇයිදැයි පහදන්න.
 (iii) ප්‍රතික්‍රියා මිශ්‍රණය සෝඩියම් තයෝසල්ෆේට් ($Na_2S_2O_3$) ඵ්‍රවණයක් මගින් අනුමාපනයෙන් මිශ්‍රණයේ අයඩින් සාන්ද්‍රණය නිර්ණය කළ හැකිය. අයඩින් සහ ජලය තයෝසල්ෆේට් ($S_2O_3^{2-}$) අතර ප්‍රතික්‍රියාව සඳහා සමීකරණ ලියන්න.

(iv) 600 K හිදී ඉහත සමතුලිත ප්‍රතික්‍රියාවට අදාළ සංඝටක සාන්ද්‍රණ පහත දී ඇත.

$$[H_2] = 1.71 \times 10^{-3} \text{ moldm}^{-3}$$

$$[I_2] = 2.91 \times 10^{-3} \text{ moldm}^{-3}$$

$$[HI] = 1.65 \times 10^{-5} \text{ moldm}^{-3}$$

මෙම උෂ්ණත්වයේ දී, සාන්ද්‍රණයට අදාළව සමතුලිතතා නියතය (K_c) ගණනය කරන්න.

(ලකුණු 50)

(c) 400 K, ට වඩා ඉහල උෂ්ණත්වයේ දී $A_{(g)}$ විශෝජනය වී ලබා දෙන $B_{(g)}$ සහ $D_{(g)}$ හි සමතුලිතතාවය



ඉහත සමතුලිතතාවය සඳහා සමතුලිතතා නියතයන් වන K_c සහ K_p හි සංඛ්‍යාතමය අගය එකම වේ. ප්‍රතික්‍රියාවේ K_c හා K_p අර්ථ දැක්වමින්, 'a' සංරචකයේ අගය 2 ට සමාන බව පෙන්වා දෙන්න.

(ලකුණු 30)

06. (a) රවුල් නියමය සඳහන් කර එය ගණිතමය ප්‍රකාශනයක් ලෙස ලියා දක්වන්න. (ලකුණු 15)

(b) සංශුද්ධ මෙතනෝල් හා සංශුද්ධ එතනෝල් හි 20°C දී වාෂ්ප පීඩන පිළිවෙලින් 95.0 සහ 45.0 mmHg වේ. පරිපූර්ණව හැසිරේ යැයි උපකල්පනය කළහැකි ප්‍රාචණයක් තුල මෙතනෝල් (CH_3OH) 16.0 g හා එතනෝල් (C_2H_5OH) 92.0 g අඩංගු වේ නම්,

- ප්‍රාචණයේ මෙතනෝල් හා එතනෝල් මොල හාග
- මිශ්‍රණයේ මෙතනෝල් හා එතනෝල් හි ආංශික පීඩන
- මිශ්‍රණයේ සම්පූර්ණ වාෂ්ප පීඩනය
- වාෂ්ප සංයුතිය

ගණනය කරන්න. (සාපේක්ෂ පරමාණුක ස්කන්ධ : C=12.0, H=1.0, O=16.0) (ලකුණු 45)

(c) පරිපූර්ණ ද්වයංගි ප්‍රාචණයක් සඳහා A (තාපාංකය 86°C) හා B (තාපාංකය 100°C) මිශ්‍රණය සඳහා සම්පූර්ණයෙන් නම් කරන ලද තාපාංක - සංයුති කලාප සටහනක් අඳින්න.

(ලකුණු 25)

(d) සුදුසු උදාහරණයක් දෙමින් සංග්‍රහණ ගුණ (colligative property) යන පදයෙන් අදහස් කරන්නේ කුමක්දැයි පහදා දෙන්න.

(ලකුණු 15)

හිමිකම් ඇවිරිණි.



THE OPEN UNIVERSITY OF SRI LANKA
 FOUNDATION PROGRAMME / STAND ALONE COURSE IN SCIENCE
 LEVEL I – FINAL EXAMINATION – 2014/2015
 CHEMISTRY I – PSF 1303 / PSE 1303
 DURATION : 2½ hours.

Date: 17.11.2015

Time: 9.30 am – 12.00 noon

Planck's constant, $h = 6.63 \times 10^{-34} \text{ Js}$

Velocity of light, $C = 3 \times 10^8 \text{ ms}^{-1}$

Avogadro constant, $L = 6.023 \times 10^{23} \text{ mol}^{-1}$

1 atmosphere = 760 torr = 10^5 Nm^{-2}

Universal Gas constant, $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$

$\ln_e = 2.303 \log_{10}$

me																2.505 log10																																																																																																																																																																																																																																				
<table><tr><td>1</td><td colspan="15"></td><td>2</td></tr><tr><td>H</td><td colspan="15"></td><td>He</td></tr><tr><td>1.008</td><td colspan="15"></td><td>4.003</td></tr></table>																1																2	H																He	1.008																4.003	<table><tr><td>3</td><td>4</td><td colspan="10"></td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr><tr><td>Li</td><td>Be</td><td colspan="10"></td><td>B</td><td>C</td><td>N</td><td>O</td><td>F</td><td>Ne</td></tr><tr><td>6.939</td><td>9.012</td><td colspan="10"></td><td>10.81</td><td>12.01</td><td>14.01</td><td>16.00</td><td>19.00</td><td>20.18</td></tr><tr><td>11</td><td>12</td><td colspan="10"></td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td></tr><tr><td>Na</td><td>Mg</td><td colspan="10"></td><td>Al</td><td>Si</td><td>P</td><td>S</td><td>Cl</td><td>Ar</td></tr><tr><td>22.99</td><td>24.31</td><td colspan="10"></td><td>26.98</td><td>28.09</td><td>30.97</td><td>32.07</td><td>35.45</td><td>39.95</td></tr><tr><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td><td>32</td><td>33</td><td>34</td><td>35</td><td>36</td></tr><tr><td>K</td><td>Ca</td><td>Sc</td><td>Ti</td><td>V</td><td>Cr</td><td>Mn</td><td>Fe</td><td>Co</td><td>Ni</td><td>Cu</td><td>Zn</td><td>Ga</td><td>Ge</td><td>As</td><td>Se</td><td>Br</td><td>Kr</td></tr><tr><td>39.10</td><td>40.08</td><td>44.96</td><td>47.90</td><td>50.94</td><td>52.00</td><td>54.94</td><td>55.85</td><td>58.93</td><td>58.71</td><td>63.55</td><td>65.39</td><td>69.72</td><td>72.61</td><td>74.92</td><td>78.96</td><td>79.90</td><td>83.80</td></tr></table>																3	4											5	6	7	8	9	10	Li	Be											B	C	N	O	F	Ne	6.939	9.012											10.81	12.01	14.01	16.00	19.00	20.18	11	12											13	14	15	16	17	18	Na	Mg											Al	Si	P	S	Cl	Ar	22.99	24.31											26.98	28.09	30.97	32.07	35.45	39.95	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr	39.10	40.08	44.96	47.90	50.94	52.00	54.94	55.85	58.93	58.71	63.55	65.39	69.72	72.61	74.92	78.96	79.90	83.80
1																2																																																																																																																																																																																																																																				
H																He																																																																																																																																																																																																																																				
1.008																4.003																																																																																																																																																																																																																																				
3	4											5	6	7	8	9	10																																																																																																																																																																																																																																			
Li	Be											B	C	N	O	F	Ne																																																																																																																																																																																																																																			
6.939	9.012											10.81	12.01	14.01	16.00	19.00	20.18																																																																																																																																																																																																																																			
11	12											13	14	15	16	17	18																																																																																																																																																																																																																																			
Na	Mg											Al	Si	P	S	Cl	Ar																																																																																																																																																																																																																																			
22.99	24.31											26.98	28.09	30.97	32.07	35.45	39.95																																																																																																																																																																																																																																			
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36																																																																																																																																																																																																																																			
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr																																																																																																																																																																																																																																			
39.10	40.08	44.96	47.90	50.94	52.00	54.94	55.85	58.93	58.71	63.55	65.39	69.72	72.61	74.92	78.96	79.90	83.80																																																																																																																																																																																																																																			

- Answer **FOUR (04)** questions out of **SIX (06)** questions.
- If more than four questions are answered, only the **first four relevant answers** in the order written will be considered for marking.
- Mobile phones must be switched off and kept away during examination.
- The use of a non programmable electronic calculator is permitted

- 1 (a). The density of a gas is 0.0028 g cm^{-3} and molar mass of the gas is 70 g mol^{-1} .
- Express the density of the gas in kg m^{-3} .
 - Calculate the concentration of the gas in mol dm^{-3} . (15 marks)
- (b) (i) Using relevant equations, calculate the energy of a mole of photons in a beam of green light of wavelength 500 nm.
- (ii) How does the wavelength vary when going from green light to red light. (30 marks)
- (c). An organic compound X contains mass percentages of carbon, hydrogen and nitrogen as 48.65%, 13.60% and 37.75% respectively
- Deduce the empirical formula of compound X.
 - If the molar mass of the compound X is 149 g mol^{-1} , deduce the molecular formula of compound X (25 marks)

(d) The isotopic abundance of chlorine is given below.

Relative isotopic mass	Percentage abundance
34.68	60.54
35.89	39.46

- Calculate the relative atomic mass of chlorine.
- Explain why the isotopes of chlorine show identical chemical reactions.
- Write down the electron configuration of chlorine (Atomic number of Cl=17)

(30 marks)

2. (a) The following questions are based on the first eighteen (18) elements in the [1st two periods] periodic table (See page 01).

- Identify the two elements that form a bond with the highest ionic character.
- What elements form the most stable covalent diatomic molecule?
- Which element has the highest first ionization energy?
- Identify the two elements that form an electron deficient compound.
- Which element has the highest melting point?

(30 marks)

- Explain why Aluminum oxide is amphoteric whereas Boron oxide is acidic.
- Write down the balanced equation for the reaction when CO₂ is bubbled into a solution of Ca(OH)₂.
What will happen if excess CO₂ is bubbled through this solution? Write the balanced chemical equation.

(40 marks)

- The second ionization energy of sodium is 4560 kJ mol⁻¹. Write down the equation which describes this ionization. Why is the value for the second ionization energy higher than the first ionization energy?
- The ions Na⁺, Mg²⁺ and Al³⁺ have the same electronic configuration but have different ionic radii. Explain.

(30 marks)

3 (a) An element, X, has the electron configuration 1s²2s²2p⁶3s²3p⁵

- Identify the element
- Write the formulae of the compound formed between element X and sodium.
- What type of bonding would you expect in this compound?
- Draw a dot-and-cross diagram for the compound formed between X and sodium.

(20 marks)

(b) Draw a dot-and-cross diagram for each of the following molecules and explain their shapes by using the valence shell electron pair repulsion (VSEPR) theory.

- PCl₅
- H₂O
- SF₆

(30 marks)

(c) Give reasons for the following.

- Diamond is a hard material
- Water has a high boiling point

(22 marks)

(4) (a) Define,

(i) Standard enthalpy of formation ΔH_f° of benzene, $C_6H_{6(l)}$

(ii) Standard enthalpy of combustion ΔH_c° of benzene, $C_6H_{6(l)}$

(b) Calculate the heat of formation of benzene, $C_6H_{6(l)}$,
from the following Information:

$$\Delta H_c^\circ(C_6H_6) = -3267.6 \text{ kJ mol}^{-1}$$

$$\Delta H_f^\circ(H_2O) = -285.9 \text{ kJ mol}^{-1}$$

$$\Delta H_f^\circ(CO_2) = -393.5 \text{ kJ mol}^{-1}$$

(30 marks)

(c) (i) One of the gases emitted when a volcano erupts is hydrogen sulphide (H_2S).

The gas is oxidized in the air to sulphur dioxide (SO_2).



(i) Balance the above equation.

(ii) Draw a Hess's cycle to calculate the enthalpy change for the oxidation of Hydrogen sulphide (H_2S).

(iii) Use the Hess's cycle to calculate the enthalpy change for the oxidation of H_2S .

$$\Delta H_f^\circ(H_2O) = -286 \text{ kJmol}^{-1}$$

$$\Delta H_f^\circ(H_2S) = -21 \text{ kJmol}^{-1}$$

$$\Delta H_f^\circ(SO_2) = -297 \text{ kJmol}^{-1} \quad (40 \text{ marks})$$

(d) (i) Write down the mathematical expression for the first law of thermodynamics.

(iii) Calculate the heat capacity in joules for 28.4 g of water. (specific heat capacity of water is $4.184 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$) (30 marks)

(5) (a) Consider the equilibrium,



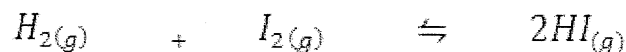
Use Le Chatelier's principle to predict the effect of

(i) Increase in pressure

(ii) Removal of ammonia

(20 marks)

(b) When a mixture containing 0.0015 mol of each of Hydrogen and Iodine is heated in a sealed tube, an equilibrium mixture is formed. The equation for the reaction is,



(i) Write expressions for the equilibrium constants, K_c and, K_p for the reaction.

- (ii) Explain why the values of K_c and K_p for the reaction are the same.
- (iii) The concentration of Iodine in the mixture can be estimated by the titration of the reaction mixture with sodium thiosulphate ($Na_2S_2O_3$) solution. Write an equation for the reaction of Iodine and aqueous thiosulphate ($S_2O_3^{2-}$).
- (iv) The following data gives the concentrations of the components in the above equilibrium reaction at 600 K.

$$[H_2] = 1.71 \times 10^{-3} \text{ moldm}^{-3}$$

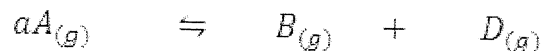
$$[I_2] = 2.91 \times 10^{-3} \text{ moldm}^{-3}$$

$$[HI] = 1.65 \times 10^{-5} \text{ moldm}^{-3}$$

Calculate the equilibrium constant in terms of concentrations (K_c) at this temperature.

(50 marks)

- (c) At temperatures above 400 K, $A_{(g)}$ dissociates to give $B_{(g)}$ and $D_{(g)}$ resulting in the equilibrium,



The equilibrium constants K_c and K_p for the above equilibrium have the same numerical value. Starting with the definitions K_c and K_p for the reaction, show that the balancing coefficient, 'a', for the above equation is equal to 2.

(30 marks)

- 6 (a) State Raoult's law and write down it as a mathematical expression.

(15 marks)

- (b) At 20°C the vapour pressures of pure methanol and pure ethanol are 95.0 and 45.0 mmHg, respectively. A solution, assumed to behave ideally, contains 16.0 g of methanol (CH_3OH) and 92.0 g of ethanol (C_2H_5OH);

Calculate,

- Mole fractions of methanol and ethanol in solution
- Partial pressures of methanol and ethanol in the mixture;
- Total vapour pressure of the mixture.
- Composition of the vapour.

(Given that relative atomic mass of C= 12.0, H= 1.0, O=16.0)

(45 marks)

- (c) Sketch a fully labeled boiling point composition phase diagram for the mixture of A (boiling point 86°C) and B (boiling point 100°C) which forms an ideal binary solution.

(25 marks)

- (d) Giving an appropriate example explain what is meant by the term colligative property.

(15 marks)

DURATION: 2½ hours

Time: 9.30 am – 12.00 Noon

Planck's constant, h; பிளாங்கின் மாறிலி h	=	$6.63 \times 10^{-34} \text{ J s}$
Velocity of light, C; ஒளியின் வேகம் c	=	$3 \times 10^8 \text{ m s}^{-1}$
Avogadro constant, L; அவகாதரோ மாறிலி L	=	$6.023 \times 10^{23} \text{ mol}^{-1}$
1 atmosphere; 1 வளிமண்டல அழுக்கம்	=	$760 \text{ torr} = 10^5 \text{ Nm}^{-2}$
Universal Gas constant, R; வாயு மாறிலி	=	$2.303 \log_{10}$
$\ln_e$	=	$2.303 \log_{10}$

1 H 1.008 2 He 4.003																			
3 Li 6.939 4 Be 9.012														5 B 10.81 6 C 12.01		7 N 14.01 8 O 16.00		9 F 19.00 10 Ne 20.18	
11 Na 22.99 12 Mg 24.31														13 Al 26.98 14 Si 28.09		15 P 30.97 16 S 32.07		17 Cl 35.45 18 Ar 39.95	
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.71	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80		

- Answer **FOUR (04)** questions out of **SIX (06)** questions.
- தரப்பட்ட (6) வினாக்களிலிருந்து (04) வினாக்களுக்கு மட்டும் விடையளிக்க
- If more than four questions are answered, only the **first four relevant answers** in the order written will be considered for marking.
- நான்கிற்கு மேல் விடையளிக்கப்பட்டிருப்பின் நான்கு பொருத்தமான விடைகள் எழுதப்பட்ட ஒழுங்கின்படி புள்ளியிடலுக்கு கருத்தில் எடுக்கப்படும்.
- Mobile phones must be switched off and kept away during examination.
- கையடக்க தொலைபேசிப் பாவனை தடையானது
- The use of a non programmable electronic calculator is permitted
- செயல் நிரற்படுத்தப்படாத கணினிப் பாவனை அனுமதிக்கப்பட்டுள்ளது

1. (a) The density of a gas is 0.0028 g cm^{-3} and molar mass of the gas is 70 g mol^{-1} .

வாயுவொன்றின் அடர்த்தியானது 0.0028 g cm^{-3} மற்றும் மூலக்கூற்றுத் திணிவானது 70 g mol^{-1} .

- (i) Express the density of the gas in kg m^{-3} .

வாயுவினது அடர்த்தியை kg m^{-3} இல் தருக.

- (ii) Calculate the concentration of the gas in mol dm^{-3} .

வாயுவினது செறிவை mol dm^{-3} இல் கணிக்கുക. (15 marks)

- (b) (i) Using relevant equations, calculate the energy of a mole of photons in a beam of greenlight of wavelength 500 nm .

அலைநீளம் 500 nm உடைய பச்சைநிற ஒளிக்கதிரினுடைய ஒரு மூல் போட்டோனிற்கான சக்தியை பொருத்தமான சமன்பாடுகளை உபயோகித்து கணிக்கുക.

- (ii) How does the wavelength vary when going from green light to red light?

பச்சை ஒளியிலிருந்து சிவப்பு ஒளியாக மாற்றமடையும்பொழுது அலைநீளம் எவ்வாறு மாறுபடும்? (30 marks)

- (c) An organic compound X contains mass percentages of carbon, hydrogen and nitrogen as 48.65% , 13.60% and 37.75% respectively

ஓர் சேதனச் சேர்வை X இல் காபன், ஐதரசன் மற்றும் நைதரசன் என்பவற்றின் திணிவு சதவீதம் முறையே 48.65% , 13.60% மற்றும் 37.75%

- (i) Deduce the empirical formula of compound X.

சேர்வை X இனது அனுபவச்சூத்திரத்தைக் கண்டறிக.

- (ii) If the molar mass of the compound X is 149 g mol^{-1} , deduce the molecular formula of compound X

சேர்வை X இனது மூலக்கூற்றுத்திணிவு 149 g mol^{-1} எனின், இச்சேர்வை X இன் மூலக்கூற்று சூத்திரத்தைக் கண்டறிக.

(25 marks)

- (d) The isotopic abundance of chlorine is given below.

குளோரினினது சமதானி இருக்கைகள் கீழே தரப்பட்டுள்ளது.

Relative isotopic mass	Percentage abundance
சார்பளவிலான சமதானி திணிவு	இருக்கை சதவீதம்
34.68	60.54
35.89	39.46

- (i) Calculate the relative atomic mass of chlorine.

குளோரினினது சார்பளவுத்திணிவைக் கணிக்கുക.

- (ii) Explain why the isotopes of chlorine. Show identical chemical reactions.

குளோரின் சமதானிகள் ஒரே மாதிரியான இரசாயனத் தாக்கங்களைக் காட்டுவது ஏன் என விளக்குக.

(iii) Write down the electron configuration of chlorine (Atomic number of Cl = 17)

குளோரினினது இலத்திரனிலையமைப்பை எழுதுக. (Cl இன் அணுவெண் = 17)

(30 marks)

2. (a) The following question are based on the first eighteen (18) elements in the [1st two periods] periodic table (See page 01).

பின்வரும் வினாக்களானது ஆவர்த்தன அட்டவணையில் (முதல் இரு ஆவர்த்தன) முதல் 18 மூலகங்களை அடிப்படையாகக் கொண்டுள்ளது.

(i) Identify the two elements that form a bond with the highest ionic character.

மிகக்கூடிய அயன் இயல்புடைய பிணைப்பை உருவாக்கக்கூடிய இரு மூலகங்களை அடையாளம் காண்க.

(ii) What elements form the most stable covalent diatomic molecule?

மிக உறுதியான பங்கீட்டுவலு ஈரணு மூலக்கூறை உருவாக்கும் மூலகங்கள் யாவை?

(iii) Which element has the highest first ionization energy?

மிகக்கூடிய முதலாம் அயனாக்கற்சக்தி உடைய மூலகம் யாது?

(iv) Identify the two elements that form an electron deficient compound.

இலத்திரன் பற்றாக்குறையான சேர்வையை உருவாக்கக்கூடிய இரு மூலகங்களை அடையாளம் காண்க.

(v) Which element has the highest melting point?

மிகக்கூடிய உருகுநிலையுடைய மூலகம் யாது?

(30 marks)

(b) (i) Explain why Aluminum oxide is amphoteric whereas Boron oxide is acidic.

போரோன் ஓட்சைட்டு அமில இயல்புடையதாக இருக்கையில் அலுமினியம் ஓட்சைட்டானது ஈரியல்புடையதாக இருப்பதற்கான காரணத்தை விளக்குக.

(ii) Write down the balanced equation for the reaction when CO₂ is bubbled into a solution of Ca(OH)₂

Ca(OH)₂ கரைசலினுள் CO₂ இனை செலுத்தும்போது நிகழும் தாக்கத்திற்கான சமப்படுத்தப்பட்ட சமன்பாட்டை எழுதுக.

What will happen if excess CO₂ is bubbled through this solution? Write the balanced chemical equation.

அக்கரைசலினுள் CO₂ இனை மிகையாகச் செலுத்தினால் என்ன நிகழும்? இதற்கான சமப்படுத்தப்பட்ட இரசாயனச் சமன்பாட்டை எழுதுக.

(40 marks)

- (c) (i) The second ionization energy of sodium is 4560 kJ mol^{-1} . Write down the equation which describes this ionization. Why is the value for the second ionization energy higher than the first ionization energy?

சோடியம் இனது இரண்டாம் அயனாக்கற்சக்தியானது 4560 kJ mol^{-1} . இவ் அயனாக்கத்தை விளக்கும் சமன்பாட்டை எழுதுக. இரண்டாம் அயனாக்கற்சக்தி பெறுமானம் முதலாம் அயனாக்கற்சக்தியிலும் அதிகமாக இருப்பதற்கான காரணம் யாது?

- (ii) The ions Na^+ , Mg^{2+} and Al^{3+} have the same electronic configuration but have different ionic radii. Explain.

Na^+ , Mg^{2+} மற்றும் Al^{3+} எனும் அயன்கள் ஒரே இலத்திரனிலையமைப்பைக் கொண்டிருப்பினும் அவற்றின் அயனாரை மாறுபடுவதற்கான காரணம் யாது விளக்குக.

(30 marks)

3. (a) An element, X, has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^5$

X எனும் மூலகத்தினது இலத்திரனிலையமைப்பு $1s^2 2s^2 2p^6 3s^2 3p^5$

- (i) Identify the element

இம்மூலகத்தை இனங்காண்க.

- (ii) Write the formulae of the compound formed between element X and sodium.

மூலகம் X மற்றும் சோடியம் சேர்ந்து உருவாக்கும் சேர்வையின் சூத்திரத்தை எழுதுக.

- (iii) What type of bonding would you expect in this compound?

இச்சேர்வையில் எவ்வகையான பிணைப்பினை நீர் எதிர்பார்ப்பீர்?

- (iv) Draw a dot-and-cross diagram for the compound formed between X and sodium.

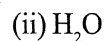
மூலகம் X மற்றும் சோடியத்தால் உருவாகிய சேர்வைக்கான புள்ளி - புள்ளடி வரைபடத்தை வரைக.

(20 marks)

- (b) Draw a dot-and-cross diagram for each of the following molecules and explain their shapes by using the valence shell electron pair repulsion (VSEPR) theory.

பின்வரும் மூலக்கூறுகளின் புள்ளி - புள்ளடி வரைபடத்தை வரைந்து, அவற்றின் கட்டமைப்பை இறுதியோட்டு இலத்திரன் சோடி தள்ளுகை கொள்கையை (VSEPR Theory) பயன்படுத்தி விளக்குக.

(20 marks)



(30 marks)

- (c) Give reasons for the following.

பின்வருவனவற்றிற்கான காரணத்தை விளக்குக.

(20 marks)

- (i) Diamond is a hard material

வைரம் கடினமான பதார்த்தமாகும்

(20 marks)

- (ii) Water has a high boiling point

நீரானது கூடிய கொதிநிலையுடையது

(22 marks)

- (4) (a) Define,

பின்வருவனவற்றை வரையறுக்குக.

- (i) Standard enthalpy of formation of benzene, $C_6H_6(l)$

பென்சீனினது $C_6H_6(l)$ நியம தோன்றல் வெப்பவுள்ளுறை

- (ii) Standard enthalpy of combustion of benzene, $C_6H_6(l)$

பென்சீனினது $C_6H_6(l)$ நியம தோன்றல் வெப்பவுள்ளுறை

- (b) Calculate the heat of formation of benzene, $C_6H_6(l)$, from the following Information:

பின்வரும் தரவுகளைப் பயன்படுத்தி பென்சீனின் $C_6H_6(l)$ தோன்றல் வெப்பத்தைக் கணிக்கുക.

$$\Delta H_f^\circ(C_6H_6) = -3267.6 \text{ kJ mol}^{-1}$$

$$\Delta H_f^\circ(H_2O) = -285.9 \text{ kJ mol}^{-1}$$

$$\Delta H_f^\circ(CO_2) = -393.5 \text{ kJ mol}^{-1}$$

(30 marks)

- (c) One of the gases emitted when a volcano erupts is hydrogen sulphide (H_2S). The gas is oxidized in the air to sulphur dioxide (SO_2).

எரிமலை வெடிப்பின் பொழுது வெளியேற்றப்படும் வாயுக்களில் ஐதரசன் சல்பைட்டு (H_2S) ஒன்றாகும். இவ்வாயு வளியுடன் கந்தகவீரோட்சைட்டாக (SO_2) ஒட்சியேற்றப்படும்.



- (i) Balance the above equation.

மேலேயுள்ள தாக்கத்தைச் சமப்படுத்துக.

- (ii) Draw a Hess's cycle to calculate the enthalpy change for the oxidation of Hydrogen sulphide H_2S

(H_2S) ஐதரசன் சல்பைட்டு ஒட்சியேற்றப்படுவதற்கான எந்தல்பி மாற்றத்தைக் கணிப்பதற்காக எசுவின் (Hess's) சக்கரத்தை வரைக.

- (iii) Use the Hess's cycle to calculate the enthalpy change for the oxidation of H_2S .

எசுவின் சக்கரத்தை உபயோகித்து H_2S ஒட்சியேற்றப்படுவதற்கான எந்தல்பி மாற்றத்தைக் கணிக்கുക.

$$\Delta H_f^0 (H_2O) = -286 \text{ kJmol}^{-1}$$

$$\Delta H_f^0 (H_2S) = -21 \text{ kJmol}^{-1}$$

$$\Delta H_f^0 (SO_2) = -297 \text{ kJmol}^{-1}$$

(40 marks)

- (d) (i) Write down the mathematical expression for the first law of thermodynamics.

வெப்பவியக்கவியலின் முதலாம் விதியை கணித கோவை வடிவில் எழுதுக.

- (ii) Calculate the heat capacity in joules for 28.4 g of water. (Specific heat capacity of water is $4.184 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$)

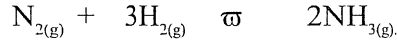
28.4 g நீரின் வெப்பக்கொள்ளளவை யூலில் கணிக்குக.

(நீரின் தனிவெப்ப கொள்ளளவு $4.184 \text{ J g}^{-1} \text{ } ^\circ\text{C}^{-1}$)

(30 marks)

- (5) (a) Consider the equilibrium,

தரப்பட்ட சமநிலையைக் கருதுக.



Use Le Chatelier's principle to predict the effect of

(Le Chatelier's) லீசற்றலியரின் கொள்கையை உபயோகித்து பின்வரும் விளைவுகளை எதிர்வுகூறுக.

- (i) Increase in pressure

அழுக்கம் அதிகரிக்கையில்

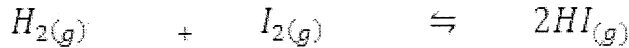
- (ii) Removal of ammonia

அமோனியா வெளியேற்றப்படுகையில்

(20 marks)

- (b) When a mixture containing 0.0015 of each of Hydrogen and Iodine is heated in a sealed tube, an equilibrium mixture is formed. The equation for the reaction is,

ஐதரசன் மற்றும் அயடின் ஒவ்வொன்றும் 0.0015 மூல் அளவுடைய கலவையானது மூடிய குழாயினுள் வெப்பமேற்றப்படுகையில் சமநிலையான கலவையானது உருவாகும். இத்தாக்கத்திற்கான சமன்பாடானது,



- (i) Write expressions for the equilibrium constants, and, for the reaction.

தாக்கத்தின் K_c மற்றும் K_p எனும் சமநிலை மாறிலிகளுக்கான கோவையை எழுதுக.

- (ii) Explain why the values of and for the reaction are the same.

தாக்கத்தின் K_c மற்றும் K_p பெறுமானங்கள் சமமாக இருப்பது ஏன் என விளக்குக.

- (iii) The concentration of Iodine in the mixture can be estimated by the titration of the reaction mixture with sodium thiosulphate ($\text{Na}_2\text{S}_2\text{O}_3$) solution. Write an equation for the reaction of Iodine and aqueous thiosulphate ($\text{S}_2\text{O}_3^{2-}(\text{aq})$).

கலவையிலுள்ள அயடின் செறிவானது தாக்கக் கலவையை சோடியம் தையோசல்பேற்று ($\text{Na}_2\text{S}_2\text{O}_3$) கரைசலுடன் நியமிப்பதன் மூலம் கண்டறியலாம். அயடன் மற்றும் தையோசல்பேற்று நீர்க்கரைசல் ($\text{S}_2\text{O}_3^{2-}(\text{aq})$) இற்கிடையிலான தாக்கத்தை எழுதுக.

- (iv) The following data gives the concentrations of the components in the above equilibrium reaction at 600 K.

600 K இல் மேற்கூறப்பட்ட சமநிலை தாக்கத்திலுள்ள கூறுகளின் செறிவானது கீழே தரப்பட்டுள்ளது.

$$[H_2] = 1.71 \times 10^{-3} \text{ moldm}^{-3}$$

$$[I_2] = 2.91 \times 10^{-3} \text{ moldm}^{-3}$$

$$[HI] = 1.65 \times 10^{-5} \text{ moldm}^{-3}$$

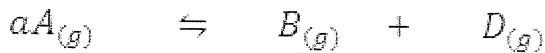
Calculate the equilibrium constant in terms of concentrations (K_c) at this temperature.

இவ்வெப்பநிலையில் செறிவு சார்பாக (K_c) சமநிலை மாறிலியைக் கணிக்குக.

(50 marks)

- (c) At temperatures above 400 K, $A_{(g)}$ dissociates to give $B_{(g)}$ and $D_{(g)}$ resulting in the equilibrium,

400 K இற்கு மேற்பட்ட வெப்பநிலையில் $A_{(g)}$ பிரிகையடைந்து $B_{(g)}$ மற்றும் $D_{(g)}$ ஐ தோற்றுவிக்கும் சமநிலையானது



The equilibrium constants and, for the above equilibrium have the same numerical value. Starting with the definitions and, for the reaction, show that the balancing coefficient, 'a', for the above equation is equal to 2.

மேலேயுள்ள சமநிலைக்கான சமநிலை மாறிலிகள் K_c மற்றும் K_p என்பன ஒரே எண் பெறுமானமுடையவை. தாக்கத்திற்கான K_c மற்றும் K_p என்பவற்றின் வரைவிலக்கணத்தில் இருந்து, சமப்படுத்தல் குணகம் 'a' ஆனது 2 எனக் காட்டுக.

(30 marks)

6. (a) State Raoult's law and write down it as a mathematical expression.

ரவோல்டின் விதியைத் (Raoult's Law) தருக. அதற்கான கணித வடிவ கோவையை எழுதுக. (15 marks)

- (b) At 20°C the vapour pressures of pure methanol and pure ethanol are 95.0 and 45.0 mmHg, respectively. A solution, assumed to behave ideally, contains 16.0 g of methanol (CH_3OH) and 92.0 g of ethanol (C_2H_5OH);

சிறந்த நடத்தையுடையதாகக் கருதப்படும் கரைசலானது 16.0 g மெதனோல் (CH_3OH) மற்றும் 92.0 g எதனோல் (C_2H_5OH) ஐக் கொண்டது. 25 °C இல் தூய மெதனோல் மற்றும் தூய எதனோலின் ஆவியழுக்கம் முறையே 95.0 மற்றும் 45.0 mmHg.

Calculate,

பின்வருவனவற்றைக் கணிக்குக.

- (i) Mole fractions of methanol and ethanol in solution

கரைசலினுள் மெதனோல் மற்றும் எதனோலின் மூல்பின்னம்

- (ii) Partial pressures of methanol and ethanol in the mixture;

கலவையினுள் மெதனோல் மற்றும் எதனோலின் பகுதி அழுக்கம்

- (iii) Total vapour pressure of the mixture.

கலவையின் மொத்த ஆவியழுக்கம்

- (iv) Composition of the vapour

நீராவியின் தொகுப்பு

(Given that relative atomic mass of C= 12.0, H= 1.0, O=16.0)

(சார்பணுத்திணிவு C= 12.0, H= 1.0, O=16.0)

(45 marks)

- (c) Sketch a fully labeled boiling point composition phase diagram for the mixture of A (boiling point) and B (boiling point) which forms an ideal binary solution.

சிறந்த இரு கலவை (Ideal binary) கரைசலைத் தோற்றுவிக்கும் A (கொதிநிலை 86 °C) மற்றும் B (கொதிநிலை 100 °C) கலவையிற்கான முழுதாகப் பெயரிடப்பட்ட கொதிநிலைக்கான கலவை அவத்தை வரைபடத்தை வரைக. (25 marks)

- (d) Giving an appropriate example explain what is meant by the term colligative property.

(மோதுகைக்குள்ளாகும் இயல்பு) அல்லது தொகைசார் இயல்பு (colligative property) எனும் பதத்திலிருந்து விளங்குவது யாது? பொருத்தமான உதாரணம் தந்து விளக்குக.

(15 marks)