Year 11 Chemistry Semester 2 Exam 2009 Solutions

Section One

1	(c)	**14**	(b)
2	(a)	**15**	(c)
3	(b)	**16**	(a)
4	(c)	**17**	(b)
5	(d)	**18**	(d)
6	(c)	**19**	(b)
7	(c) or (d)	**20**	(c)
8	(a)	**21**	(a)
9	(c)	**22**	(c)
10	(a)	**23**	(b)
11	(d)	**24**	(c)
12	(c)	**25**	(a)
13	(c)		

[50]

Section Two

1. *[1 mark for correct species, 1 mark for balanced equation]*
Do not penalise for missing or incorrect state symbols
Maximum 1 mark if molecular or formula equation used

(a) $Ag^+ + NaCl \rightarrow AgCl + Na^+$ [2]

(b) $2\ H^+ + CO_3^{2-} \rightarrow CO_2 + H_2O$ [2]

(c) $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ [2]

(d) $Cl_2 + 2I^- \rightarrow 2Cl^- + I_2$ [2]

(e) $Br_2 + C_6H_{10} \rightarrow$ 1,2-dibromocyclohexane [2]

[12 marks]

2. (a) iron(III) oxide [1]

(b) carbon monoxide [1]

(c) sodium hydrogen sulfate [1]

(d) ethene (or ethylene) [1]

[4 marks]

3.

Bronze	**M**	Iodine	**CM**
Diamond	**CN**	Magnesium sulfate	**I**
Silicon dioxide	**CN**	Hydrogen peroxide	**CM**
Dry ice (CO_2)	**CM**	Benzene	**CM**

[4 marks]

4. *Majority of observations required.*

(a) A blue, luminous flame. [1]

(b) A colourless gas is evolved. [1]

(c) Black solid dissolves to form a blue/green coloured solution. [1]

(d) White solid dissolves to form a colourless solution. [1]

[4 marks]

5. Many examples possible. "Use" must relate to specific "property".

Substance	**Property (some examples)**	**Related use (some examples)**
Copper	• ductile • malleable • relatively weak reductant	↔ electrical wiring ↔roofing, pots ↔coins
NaOH	• strong base • Strong base • forms complex ions	↔making soap ↔paint stripper/ drain cleaner ↔dissolving of alumina
Iron	• high tensile strength • good reductant • magnetic • good thermal conductor	↔bridge building ↔sacrificial anode ↔magnet ↔cooking
Ammonia	• weak base • solubilises metal hydroxides • forms ammonium salt	↔cleaning agent ↔extraction in mining ↔fertilisers/explosives

[8 marks]

6. (a) For a substance to be an electrical conductor charged particles must be free to move. [1]
Calcium nitrate is an ionic compound with ions tightly bound in fixed position in the solid state solid (non conductor).
[1]
In the liquid and aqueous states the ions are free to move and therefore conduct charge. [1]

(b) In aqueous solution hydrogen nitrate molecules ionise fully. [1]

$HNO_3 \rightarrow H^+ + NO_3^-$ [1]

[5 marks]

7. $m(F^-)_{\text{in glass of water}} = 0.950 \times 10^{-3} \times (150/1000) = 0.0001425$ g [1]

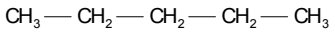
$n(F^-)_{\text{in glass of water}} = m/M = 0.0001425 / 19.00 = 0.00000750$ mol [1]

Number of F^- ions in 150 mL glass of water $= n \times N_A$
$= 7.50 \times 10^{-6} \times 6.022 \times 10^{23}$
$= \mathbf{4.52 \times 10^{18}}$ [1]

[3 marks]

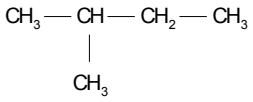
8.

(i) **Three** structural isomers of C_5H_{12}



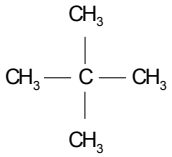
[1]

pentane [1]



[1]

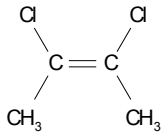
methylbutane [1]



[1]

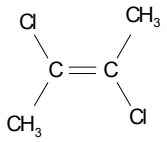
dimethylpropane [1]

(ii) **Two** geometric isomers of $C_4H_6Cl_2$



[1]

cis-2,3-dichloro-2-butene [1]

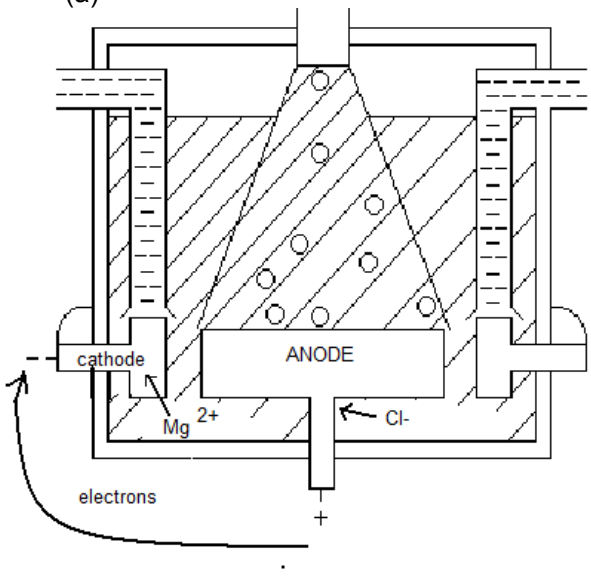


[1]

trans-2,3-dichloro-2-butene [1]

[10 marks]

9. (a)



.

[4]

(b) Products are **magnesium**, and **chlorine** (Cl_2) [*must state both*] [1]

(c) $Mg^{2+} + 2Cl^- \rightarrow Mg + Cl_2$ [2]

[7 marks]

10. $A_r(Ga) = 69.9 = (68.9x) + [70.7 (100 – x)] / 100$ [1]

Therefore, $6990 = 68.9x + 7070 - 70.7x$

$-80 = -1.8x$

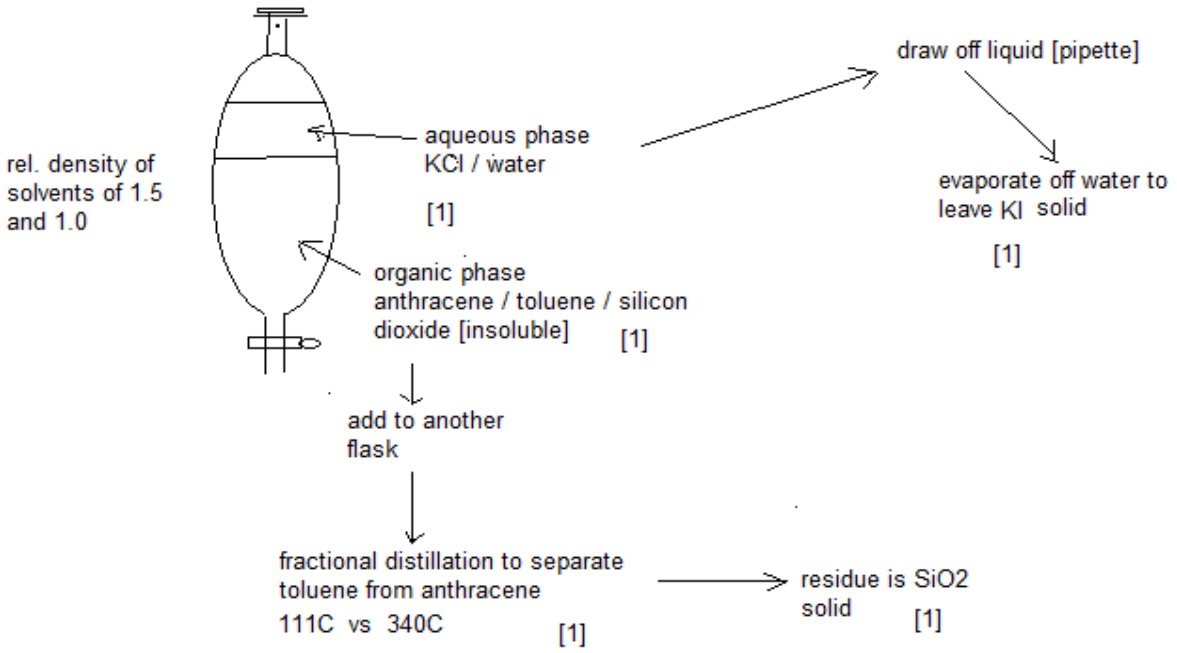
$x = 44.4$ [1]

% Abundance of ^{69}Ga = **44.4%**
% Abundance of ^{71}Ga = **55.6%** [1]

[3 marks]

11. Different approaches possible.

Use a separating funnel to separate an aqueous fraction from the organic solvent fraction (toluene). Both 'fractions' are immiscible.



12. (a) Reduce the commercial [PO_4^{3-}] in detergents and fertilisers OR reduce runoff into streams OR treat detergent effluent to remove phosphates [precipitation] before water enters streams. [1]

(b) $n(PO_4^{3-}) = 0.123 / (30.97 + 4 \times 16.00) = n(P) = 1.295 \times 10^{-3}$ mol [1]

$m(P) = 1.295 \times 10^{-3} \times 30.97 = 0.0401$ g [1]

%P = 0.0401 / 0.970 x 100% = **4.14%** [1]

(c) Add Mg^{2+} or Ca^{2+} (or any other soluble ionic substance containing a suitable ion) [1]
$3Mg^{2+} + 2\ PO_4^{3-} \rightarrow Mg_3(PO_4)_2\ (s) \downarrow$ [1]

[6 marks]

13. (a) $n(H_2) = v / V_{M\,@\,S.T.P.} = 4200 / 24.41 =$ **187 mol** [1]
(accept 2, 3 or 4 significant figures)

(b) Temp. decreases → balloon will contract. [½]
Pressure decreases → balloon will expand. [½]
Pressure effect is greater than effect of temperature [1]
therefore net expansion will result in balloon bursting.

(c) H_2 gas has lower density than air.
The balloon will rise due to its buoyancy in air. [1]
[4 marks]

14. $[Ag_2S(s) + 2e^- \rightarrow 2Ag(s) + S^{2-}(aq)] \times 3$

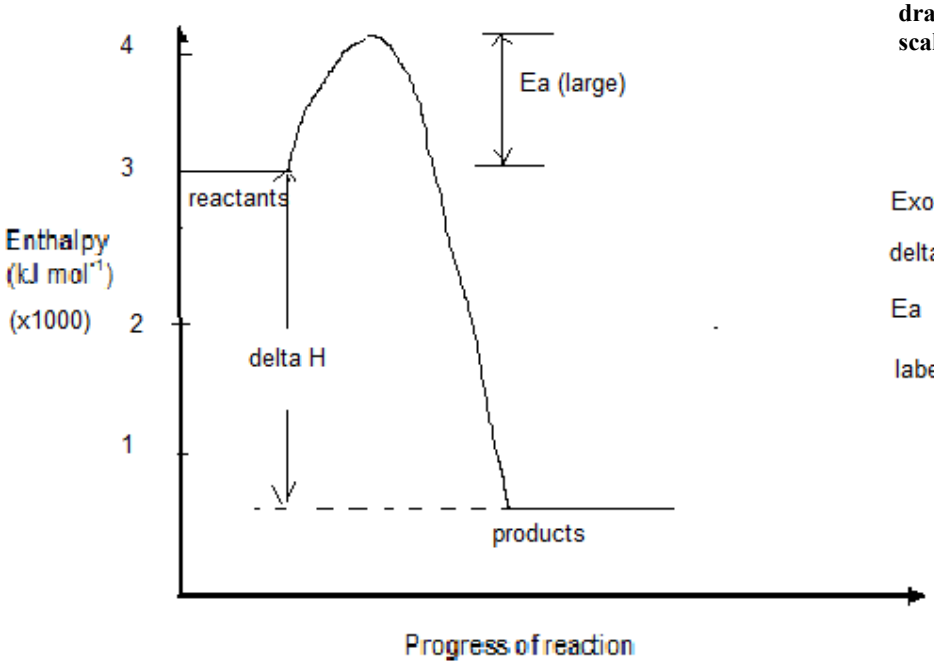
$[Al(s) \rightarrow Al^{3+}(aq) + 3e^-] \times 2$ [1]

$3Ag_2S + 2Al \rightarrow 6Ag + 3S^{2-} + 2Al^{3+}$ [1]

[2 marks]

SectionThree

1. (a)



Minus ½ if diagram not drawn to scale

Exothermic [1]
delta H [1]
Ea [1]
labels / axes [1]

(b) The intermolecular bonding is relatively **strong** (H bonding) [1]

(c) Ethylene glycol lowers the freezing point of the fluid in the cooling pipes. [1]

1. (d) m(C) = 12.01 / 44.01 x 4.40 = 1.2008 g

%C $_{\text{in 3.10 g}}$ = 1.2008 / 3.10 x 100% = **38.73%** [1]

m(H) = 2 x 1.008 / 18.016 x 2.70 = 0.3021 g

%H $_{\text{in 3.10 g}}$ = 0.3021 / 3.10 x 100% = **9.75%** [1]

%H = 100 – 38.74 - 9.75 = **51.52%** [1]

	C	:	H	:	O	
n	38.73 / 12.01		9.75 / 1.008		51.52 / 16.00	
n	3.225		9.673		3.220	(÷ 3.22) [1]
n	1		3		1	

EF = CH_3O [1]

(e) n(EG) = 0.0724/ 22.41 = 3.231 x 10^{-3} mol
M(EG) = m(EG)/ n(EG) = 0.200/ 3.231 x 10^{-3} = 61.90 [1]

EFM(CH_3O) = (12.01+3x1.008+16.00)= 31.03
MFM/EFM = 61.90/ 31.03 = 1.99 ≈ 2
MF = 2 x EF [1]

MF (ethylene glycol) = $C_2H_6O_2$ [1]

[14 marks]

2. (a) <u>reductant</u> is metal [1]

<u>oxidant</u> is H^+ [1]

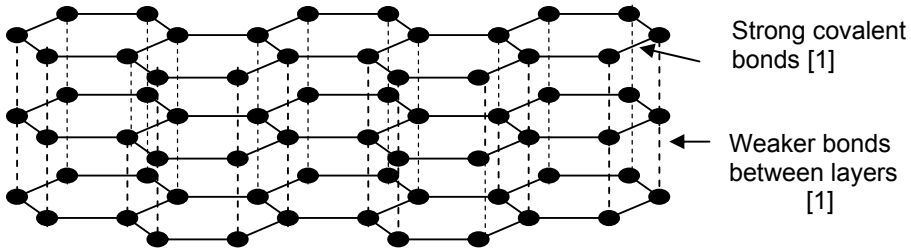
(b) Hydrogen gas (H_2) [1]

(c) $2H_2 + O_2 \rightarrow 2H_2O$ [1]

(d) Zinc [1]

(e) $CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$ [2]

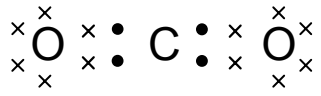
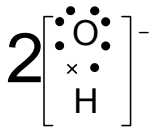
(f) diagram [1]



2. (g) electrical conductor [1]

light weight (low density) [1]

(h)

CO_2	 [2]
$Ca(OH)_2$	Ca^{2+}  [2]

(i) $C + O_2 \rightarrow CO_2$
$n(C)_{\text{reacted}} = n(O_2)_{\text{reacted}} = n(CO_2)_{\text{produced}}$ [1]

$n(C) = 0.350 / 12.01 = 0.02914$ mol [1]

$n(O_2) = 0.150 / 22.41 = 0.006693$ mol [1]

SR is 1:1 and AR is 4.35:1
oxygen is the limiting reagent (LR) [1]

$v(CO_2)_{\text{produced}} = 0.00693 \times 22.41 =$ **0.150 L** [1]

(j) ammonium chloride [1]

(k) manganese (IV) oxide OR manganese dioxide [1]

[23 marks]

3. (a) $Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$ [1]

(b) The mass was weighed several times to see that mass was constant
i.e. all of the water had been removed [weigh to constant mass] [1]

(c) $m(BaSO_4)_{\text{recovered}} = 19.0$ mg [1]

$m(Ba) = 137.3 / 233.36 \times 19.0 =$ **11.2 mg** [1]

(d) $[Ba^{2+}] = 11.2$ mg per 400 mL

$= 11.2 \times 1000 / 400$ mg per kg solution [1]

= **28.0 mg/L** [1]

(e) The concentration of barium ions is 14 times the level accepted in drinking water. [1]

3. (f) Other ions which also form precipitates include Pb^{2+}, Ca^{2+}, Sr^{2+} and Ag^{+} (only one needed) [1]

(g) <u>independent variable</u> : <u>time</u> (in days) [1]

<u>dependent variable</u> : $[Ba^{2+}]$ (in mg/L) [1]

(h) Sampling technique need to be sound:

- Sampling (400 mL) from the same spot in the pond [1]
- Period of time with no rainfall
- No other influences [another industry]

Laboratory work needs to be consistent and accurate:

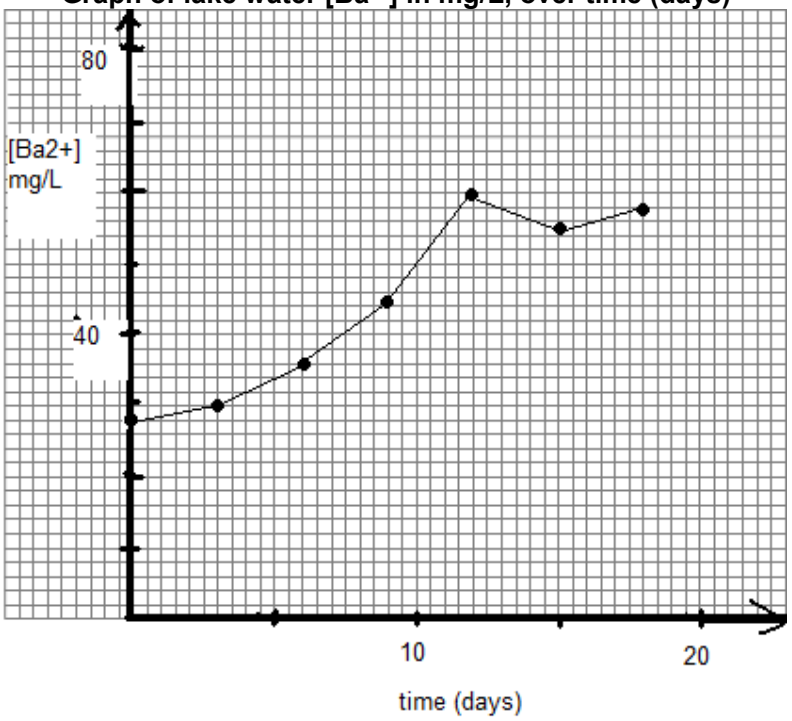
- Method of filtering and drying precipitate [1]
- Same weighing balance

(i) Safety of handling barium samples:

- Safety glasses [1]
- Gloves / breathing mask [1]

(j) Heading [1], units [1], scale [1], axes [1], points connected [1]

Graph of lake water $[Ba^{2+}]$ in mg/L, over time (days)



(k) <u>Conclusions</u> (a number can be made- only 1 needed):

- $[Ba^{2+}]$ were at a dangerous level (above 50 mg/L) from day 10.
- $[Ba^{2+}]$ generally increased over the time period
- $[Ba^{2+}]$ fluctuated over the time period
- Water quality not suitable for human consumption [2]

3. (l) Possible environmental impacts (any two):

- Loss of flora and fauna
- Food chains/webs changed
- Health of animals affected

[2]

[23 marks]