Chemistry 12 Trial Exam 4
Final- SOLUTIONS

TEE CHEMISTRY

Semester 2 Examination
SOLUTIONS

PART 1

1. c	6. a	11. c	16. c	21. b	26. c
2. b	7. c	12. a	17. c	22. c	27. b
3. d	8. d	13. c	18. b	23. c	28. d
4. d	9. b	14. b	19. d	24. c	29. b
5. d	10. c	15. a	20. c	25. d	30. b

PART 2

1. (a) $3CH_3C(=O)H + Cr_2O_7^{2-} + 8H^+ \rightarrow 3CH_3C(=O)OH + 2Cr^{3+} + 4H_2O$

Colour changes from orange to green.
Smell of vinegar detected.

(b) $Cr_2O_{3(s)} + 6H^+_{(aq)} \rightarrow 2Cr^{3+}_{(aq)} + 3H_2O_{(\ell)}$

Solid dissolves to produce a deep green solution.

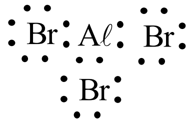
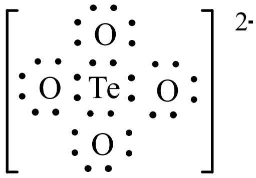
(c) $Ni_{(s)} + Cu^{2+}_{(aq)} \rightarrow Ni^{2+}_{(aq)} + Cu_{(s)}$

Metal covered with black or brown precipitate.
Solution changes from blue to green over time.

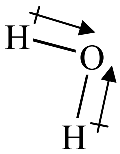
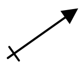
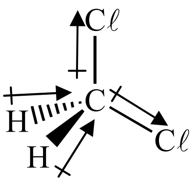
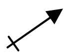
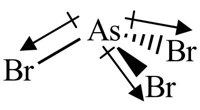
(d) $CH_3COO^-_{(aq)} + H^+_{(aq)} \rightarrow CH_3COOH_{(aq)}$

No visible change but smell of vinegar detected.

2.

Species	Electron dot diagram	Bond angles
EXAMPLE: beryllium difluoride (BeF_2)		equal to 180°
Selenium dioxide (SeO_2)		slightly less than 120°
molecular aluminium bromide ($A\ell Br_3$)		equal to 120°
tellurate ion (TeO_4^{2-})		equal to 109.5°
	1 mark each	1 mark

3.

Species	Shape and Polarity of Bonds	Net Polarity
EXAMPLE Water		
dichloromethane		
Arsenic tribromide		

4.

Substances	Chemical Test	Observations
Solid potassium nitrate and Solid magnesium nitrate	1. Dissolve in a little water 2. Add any of CO_3^{2-} , OH^- or S^{2-}	For potassium nitrate *no visible change* For magnesium nitrate *white ppt formed*
Solid sodium sulfide and Solid sodium nitrate	Add $HC\ell$ solution OR Dissolve in a little water then add a solution containing a metal ion such as Cu^{2+}, Fe^{2+}, Zn^{2+} or any other ion that forms an insoluble sulphide.	For sodium sulfide *Produces smell of rotten eggs* *OR* Produces a precipitate (colour depends on metal ion used) For sodium nitrate *No smell detected* *Or* No Precipitate produced

5.

for pH = 8.50

$[H^+] = 3.16 \times 10^{-9}$ mol L^{-1}

Therefore $[OH^-] = \dfrac{10^{-14}}{3.16 \times 10^{-9}} = 3.16 \times 10^{-6}$ mol L^{-1}

$n(OH^-) = cV = 3.16 \times 10^{-6} \times V$ mol

for pH = 3.60

$[H^+] = 2.51 \times 10^{-4}$ mol L^{-1}

$n(H^+) = cV = 2.51188 \times 10^{-4} \times V$ mol

$n(H^+)_{\text{on mixing}} = n(H^+) - n(OH^-) = (2.51188 \times 10^{-4} - 3.16 \times 10^{-6}$

$= 2.48 \times 10^{-1} \times V$ mol

$$[H^+] = \frac{n}{V} = \frac{2.48 \times 10^{-4} \times V}{2V} = 1.24 \times 10^{-4} \text{ mol } L^{-1}$$

$pH = -\log[H^+] = -\log(1.24 \times 10^{-4})$

$= 3.91$

6. Test tube 1
Solution turned blue.

Test tube 2
(a) Solution turned pink.

(b) As the forward reaction is endothermic (absorbs heat) when cooled (removed heat) a new equilibrium is established so that heat is replaced. This can only happen if the reverse reaction occurs to a greater extent. So more pink $[Co(H_2O)_6]^{2+}$ is produced.

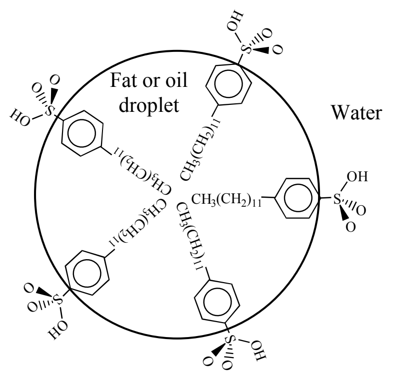
Test tube 3
(a) Solution turns pink.

(b) Concentration of all species is reduced. The rate of the forward reaction will decrease. The rate of the reverse reaction is unlikely to be affected as the collision rate between water and the $[CoC\ell_4]^{2-}$will most probably not change. So more pink $[Co(H_2O)_6]^{2+}$ is produced.

7. (a)

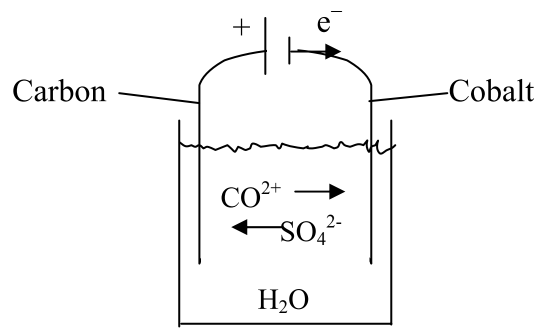
- Water interacts via dipole - dipole attractions with the polar end (sulfonic acid group) and via hydrogen bonding with the OH^- group.
- Oils interact with the non-polar carbon chain via dispersion forces.

(b)



- Non polar end of molecule dissolves in the non-polar oils and fats.
- The sulfonic acid group (polar and capable of H-bonding) dissolves in the water, surrounding and isolating oil droplets which can then be flushed away from the object being cleaned.

8. (a) and (b)



(c)

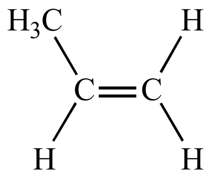
Electrode	Equation
Cathode	$Co^{2+} + 2e^{-} \rightarrow Co$
Anode	$2H_2O \rightarrow O_2 + 4H^{+} + 4e^{-}$

(d) 1. Cathode: electrode would be coated with a silver-grey metal.

2. Anode: bubbles of colour less gas would be produced.

3. Solution: pink colour would fade to colourless.

9. Structure:



Name: propene.

(b) Polypropene.
(c) Addition polymer

10. 1. Mixture is added to hot concentrated NaOH solution. Only ZnO will dissolve.
$ZnO_{(s)} + 2OH^{-}{}_{(aq)} + H_2O \leftrightarrows [Zn(OH)_4]^{2-}{}_{(aq)}$

2. Filter to remove all other solid oxides

3. Add a few crystals of pure $Zn(OH)_2$ or carefully add acid to precipitate $Zn(OH)_2$

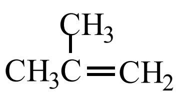
$$H^{+} + OH^{-} \rightarrow H_2O \text{ and } [Zn(OH)_4]^{2-} \underset{\text{Equilibrium shifts to products}}{\leftrightarrows} 2OH + Zn(OH)_{2(s)}$$

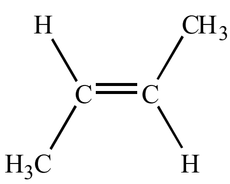
4. Filter to collect $Zn(OH)_2$
5. Heat residue to produce ZnO.

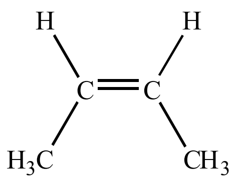
$$Zn(OH)_{2(s)} \xrightarrow{\text{Heat}} ZnO_{(s)} + H_2O$$

11.

$CH_3CH_2CH{=}CH_2$







PART 3

(a) Anode: $2C\ell^- \rightarrow 2C\ell_2 + 2e^-$

Cathode: $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$

(b) $n(C\ell_2) = \frac{PV}{RT} = \frac{200 \times 101.3 \times 1.20}{8.315 \times 295} = 9.911$ mol

$n(e^-) = 2n(C\ell_2) = 2(9.911) = 19.82$ mol

$n(e^-) = \frac{It}{96490}$ therefore $t = \frac{n(e^-) \times 96490}{I}$

$= \frac{19.82 \times 96490}{25.0} = 7.65 \times 10^4$ s

(1.28 × 103 min)

(21.3 h)

(c) Product formed is NaOH.

$n(NaOH) = n(OH^-) = n(e^-) = 19.83$ mol

$m(NaOH) = nM = 19.82 \times 39.998 = 792.76$ g [M(NaOH) = 39.998 g mol^{-1}]

$= 793$ g

2. $Ba^{2+}{}_{(aq)} + SO_4{}^{2-}{}_{(aq)} \rightarrow BaSO_{4(s)}$

$n(BaSO_4) = \frac{m}{M} = \frac{1.78}{233.36} = 7.6277 \text{ x } 10^{-3}$ mol [M($BaSO_4$) = 233.36 g mol^{-1}]

$n(CuSO_4.5H_2O) = n(SO_4{}^{2-}) = n(Ba^{2+}) = n(BaSO_4) = 7.6277 \times 10^{-3}$ mol

$n(CuSO_4.5H_2O) = nM$ [M($CuSO_4.5H_2O$) = 249.69 g mol^{-1}]

$= 7.6277 \times 10^{-3} \times 249.69$

$= 1.9046$ g

m(pure Azurite = m(impure Azurite) - m($CuSO_4.5H_2O$)

= 21.6 - 1.9046

= 19.695 g

% Azurite = $\frac{m(\text{pureAzurite})}{m(\text{impureAzurite})} \times 100 = \frac{19.695}{21.6} \times 100 = 91.2\%$

3.

TRIAL	ROUGH	1	2	3	4
Final Reading (mL)	23.36	23.34	24.01	22.47	23.94
Initial Reading (mL)	0.31	1.04	1.78	1.21	1.56
Amount used (mL)	23.05	22.30	22.23	21.26	22.38

(b) $(MnO^{4-}(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(\ell)) \times 4$

$(CH_3CH_2OH(aq) + H_2O(\ell) \rightarrow CH_3COOH(aq) + 4H^+(aq) + 4e^-) \times 5$

$5CH_3CH_2OH(aq) + 4MnO_4^-(aq) + 12H^+(aq) \rightarrow 4Mn^{2+}(aq) + 5\ CH_3COOH(aq) + 11H_2O(\ell)$

(c) $V(MnO^{4-})_{used} = \frac{22.30 + 22.23 + 22.38}{3} = 22.30$ mL

$n(MnO4^-)_{used} = cV = 0.00930 \times 0.0223 = 2.074 \times 10^{-4}$ mol

$n(CH_3CH_2OH)_{\text{in 20 mL}} = \frac{5}{4} n(MnO^{4-}) = \frac{5}{4}(1.074 \times 10^{-4}) = 2.59 \times 10^{-4}$ mol

$n(CH_3CH_2OH)_{\text{in 1000 mL of dil Solution and therefore in 5.00 mL of wine}} = \frac{1000}{20} \times 2.59 \text{ x } 10^{-4}$

$= 0.01296$ mol

$[CH_3CH_2OH] = \frac{n}{V} = \frac{0.01296}{0.005} = 2.59 \text{ mol L}^{-1}$

(d) $m(CH_3CH_2OH)_{\text{in 1000 mL}} = nM$ $[M(CH_3CH_2OH) = 46.058 \text{ g mol}^{-1}]$

$= 2.59 \times 46.058$

$= 119.399$ g

$\% CH_3CH_2OH_{\text{ by mass}} = \frac{119.399}{960} \text{ x } 100 = 12.4\%$

4. (a) $m(C) = \frac{12.01}{44.01} \times 2.685 = 0.73272$ g

$m(H) = \frac{2.016}{18.016} \times 0.4122 = 0.046125$ g

$m(O) = 1.267 - (0.73272 + 0.046125) = 0.48815$ g

	C	H	O
Mass (g)	0.73272	0.046125	0.48815
n	$\frac{0.73272}{12.01} = 0.061009$	$\frac{0.046125}{1.008} = 0.045759$	$\frac{0.48815}{16.00} = 0.030509$
Simplest ratio	$\frac{0.61009}{0.030509} = 1.999$	$\frac{0.046125}{0.030509} = 1.4998$	$\frac{0.030509}{0.030509} = 1.00$
	4	3	2

empirical formula is $C_4H_3O_2$

(b) $T = 300\ ^oC = 573K$

$P = 101.3\ kPa$ $\qquad n = \frac{PV}{RT} = \frac{101.3 \times 0.153}{8.315 \times 573} = 3.2317 \times 10^{-3}$ mol

$V = 152\ mL = 0.152L$

$R = 8.315$

$n = ?$

$M = 0.5369\ g$ $\qquad M = \frac{m}{n} = \frac{0.5369}{3.2317 \times 10^{-3}} = 1.6613 = 166$

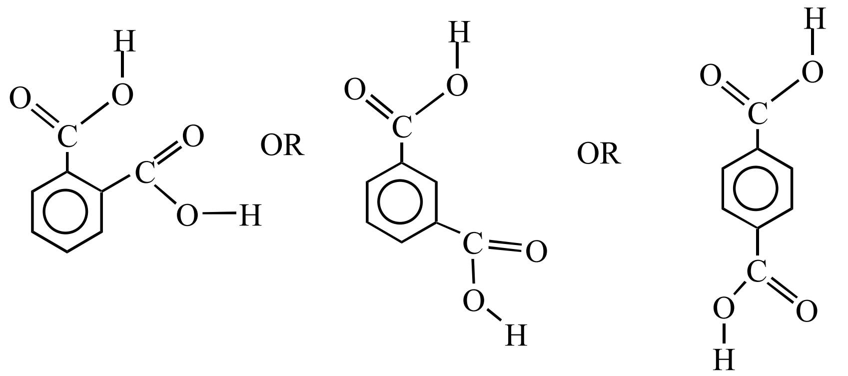
(c) $M(C_4H_3O_2) = 83.064$

$\frac{M(compd)}{M(C_4H_3O_2)} = \frac{166.13}{83.064} = 2.00$

Therefore Molecular formula is $2 \times$ empirical formula

ie $2 \times (C_4H_3O_2) = C_8H_6O_4$

(d)



5. (a) $CaCO_{3(s)} + 2CH_3COOH \rightarrow CO_2 + Ca^{2+} + CH_3COO^- + H_2O$

$m(CH_3COOH) = \frac{4.00}{100} \times 500 = 20.0\ g$

$n(CH_3COOH) = \frac{m}{M} = \frac{20.0}{60.052} = 0.3330$ mol $\qquad [M(CH_3COOH) = 60.052\ g\ mol^{-1}]$

$n(CaCO_3) = \frac{m}{M} = \frac{19.63}{100.09} = 0.1961$ mol $\qquad [M(CaCO_3) = 100.09\ g\ mol^{-1}]$

$n(CH_3COOH)_{\text{required to remove all scale}} = 2n(CaCO_3) = 2(0.1961) = 0.3922$ mol

There is only 0.3330 mole of CH_3COOH therefore CH_3COOH is <u>LR</u>

$n(CO_2) = \frac{1}{2} n(CH_3COOH) = \frac{1}{2}(0.3330) = 0.1665$ mol

$m(CO_2) = nM = 0.1665 \times 44.01 = 7.3286\ g$ $\qquad [M(CO_2) = 44.01\ g\ mol^{-1}]$

$= \underline{7.33\ g}$

(b) $n(Ca^{2+}) = \frac{1}{2} n(CH_3COOH) = \frac{1}{2}(0.3330) = 0.1665$ mol

$[Ca^{2+}] = \frac{n}{v} = \frac{0.1665}{489 \times 10^{-3}} = \underline{0.340\ mol\ L^{-1}}$

For answers to Part 4 please see the Extended Answer Question Answers