MLC mock answers

Multiple choice

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

section 2

Question 26

a) when bottle opened the pressure drops the system tries to oppse change and increase pressure by favouring the reverse reaction producing CO2(g)
(the system is not likely to reach equilibrium as it is not a closed system)

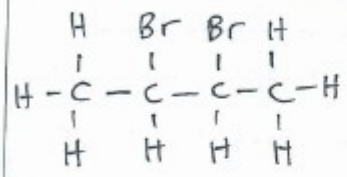
b) to maximise ‘fizz’ you want as much CO2(aq) as possible before the drink is opened -the forward reaction is exothermic and this is the reaction that si favoured when temperature is decreased

Question 27

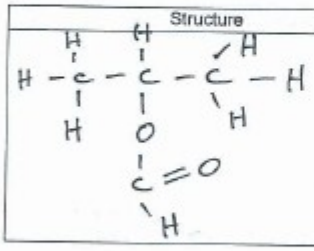
Question 27 **(6 marks)**

Draw structural formulae and give the IUPAC name for the main organic product in each of the reactions described below.

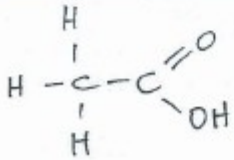
(a) but-2-ene reacts with bromine water in the dark.

Structure	Name
	2,3-dibromobutane

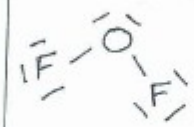
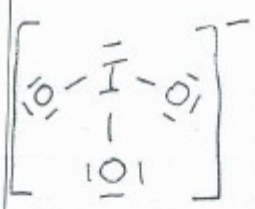
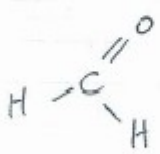
(b) propan-2-ol is warmed with methanoic acid in the presence of concentrated H_2SO_4.

Structure	Name
	2-propyl methanoate

(c) ethanal is warmed with acidified dichromate solution.

Structure	Name
	ethanoic acid

Question 28

Molecule	Structural formula (showing all valence shell electrons)	Shape (sketch or name)
oxygen difluoride F_2O		bent
iodate IO_3^-		pyramidal
methanal HCHO		trigonal planar

Question 29 **(6 marks)**

Place each of the following substances in the appropriate column based on the **most significant type** of intermolecular force present.

CH_3CH_2F PCl_3 NH_3 SiF_4 SO_3 N_2 CH_3OH

dispersion	dipole-dipole interactions	hydrogen bonding
SiF_4 SO_3 N_2	CH_3CH_2F PCl_3	NH_3 CH_3OH

Question 30 (7 marks)

In the process of analysing a sample of cassiterite to determine the tin content, the tin is extracted as Sn^{2+} ions. A titration was performed by adding 0.0170 mol L^{-1} potassium dichromate solution to an acidified solution of Sn^{2+} extracted from a 0.750 g sample of the ore.

$$3Sn^{2+}(aq) + Cr_2O_7^{2-}(aq) + 14H^+(aq) \rightarrow 3Sn^{4+}(aq) + 2Cr^{3+}(aq) + 7H_2O(l)$$

The table below shows the volume required to reach the equivalence point.

	1	2	3
Final volume $K_2Cr_2O_7$(aq) mL	25.65	38.05	27.00
Initial volume $K_2Cr_2O_7$	3.00	16.61	5.58
titre mL	22.65	21.44	21.42

(a) Explain what is meant by the term equivalence point. (1 mark)

The point when you have stoichiometrically equivalent amounts of both reactants

(b) Complete the table above and calculate the average titre. (2 marks)

Average titre 21.44 + 21.42 /2 == 21.43mL

b) percentage by mass Sn in sample

v $Cr_2O_7^{2-}$ = 21.43mL c = 0.017

n $Cr_2O_7^{2-}$ = cv = (0.017)(0.02143) = 0.000364mol

n Sn^{2+} = 3/1 x n $Cr_2O_7^{2-}$ = 3 x 0.000364 = 0.00109mol

n Sn = nSn^{2+} = 0.00109mol

mass Sn = 0.00109 x 118.7 = 0.1297g

% Sn = 0.1297/0.75 x 100 = 17.3%

Question 31

$Sr(OH)_2 \rightarrow Sr^{2+} + 2OH^-$

0.02 0.04M

$[H+] = 1 \times 10^{-14} / [OH-] = 1 \times 10^{-14} / 0.04 = 2.5 \times 10^{-13}$

$pH = -\log 2.5 \times 10^{-13} = 12.6$

Question 32 **(10 marks)**

(a) Complete the table below, giving expected observations for reactions described. If no reaction occurs or no change is observed say 'no visible change'

(6 marks)

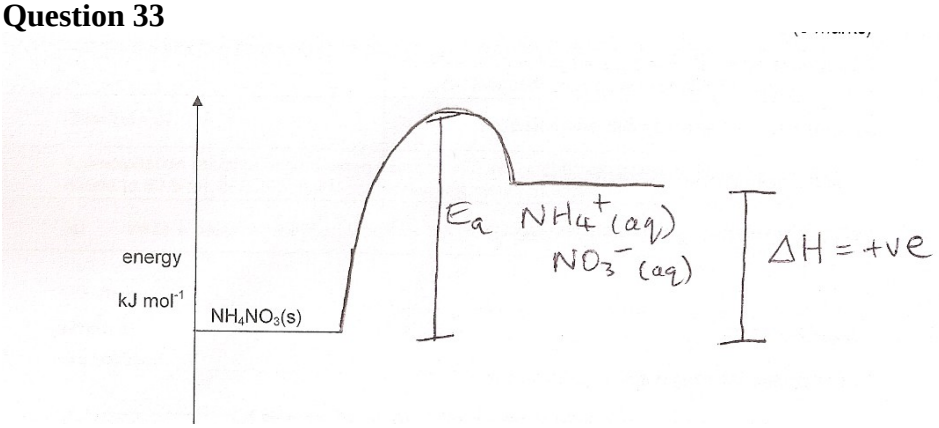
Procedure	Does a reaction occur?	Observations
strontium metal is added to water at 25°C	yes	Silver solid added to colourless soln and colourless odourless gas formed
copper(II)nitrate solution and sodium chloride solution are mixed	No (really yes but it is off syllabus)	Blue solution is added to colourless solution and green solution forms (may accept blue soln forms)
acidified potassium permanganate solution is mixed with a solution of hydrogen sulfide	yes	Purple solution is added to colourless solution and a yellow solid forms, colour of purple solution fades

b) give equations for any reactions that occur

$Sr + H_2O \rightarrow Sr^{2+} + H_2 + 2OH^-$

$2MnO_4^- + 6H^+ + 5\,H_2S \rightarrow 2Mn^{2+} + 8H_2O + 5\,S$

Question 33



b) activation energy is the minimum energy needed for a collision to result in a reaction

b) i) $NH_4^+ + H_2O(l) \leftrightarrow NH_3 + H_3O^+$

(ii) $K = \frac{[NH_3][H_3O^+]}{[NH_4^+]}$

(iv) something that instantly drops backward reaction ie drops conc of species on right side of arrow
this would include addition of NaOH as it would react with H_3O^+

(v) value of equilibrium constant would be the same as temp has not changed so K can't have changed

Question 34
There has been a mix up with labelling in the chemical store. The technician must carry out some distinguishing tests to confirm the identity of some compounds.

In the table below give your recommendation for a simple test the technician can carry out to confirm which is which for the following pairs of substances

Chemicals to be identified	**Distinguishing test**	**Observations**
solid ammonium carbonate and solid ammonium chloride	Add dilute HCl	ammonium carbonate would fizz ie produce bubbles
		ammonium chloride no fizz or bubbles
dilute nitric acid and dilute hydrochloric acid	Add silver nitrate solution	nitric acid two colourless soln mix to form colourless soln
		hydrochloric acid white ppt forms

Question 35
Complete the table below by giving the name or chemical formula of a species that matches the description given.

Description	Name or formula
a primary standard used in redox titrations	$H_2C_2O_4$
the conjugate acid of ammonia	NH_4^+
a substance that, when in aqueous solution, is suitable for use in the salt bridge of an electrochemical cell	$NaNO_3$
a substance that exists as discrete molecules	H_2
a strong diprotic acid	H_2SO_4
a material suitable for use as an inert electrode	Graphite or platinum

Question 36
Consider the following reaction at equilibrium.

$$SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g) + 42\ KJ$$

Complete the table below, which describe changes made to the system.
(6 marks)

Change made	Rate of reverse reaction when equilibrium re-established *increases/decreases/no change*	moles of NO compared with original equilibrium *increases/decreases/no change*
pressure is increased	increased	No change
catalyst is added	increased	No change
decreasing the concentration of NO_2	decreased	decreases

Section 3

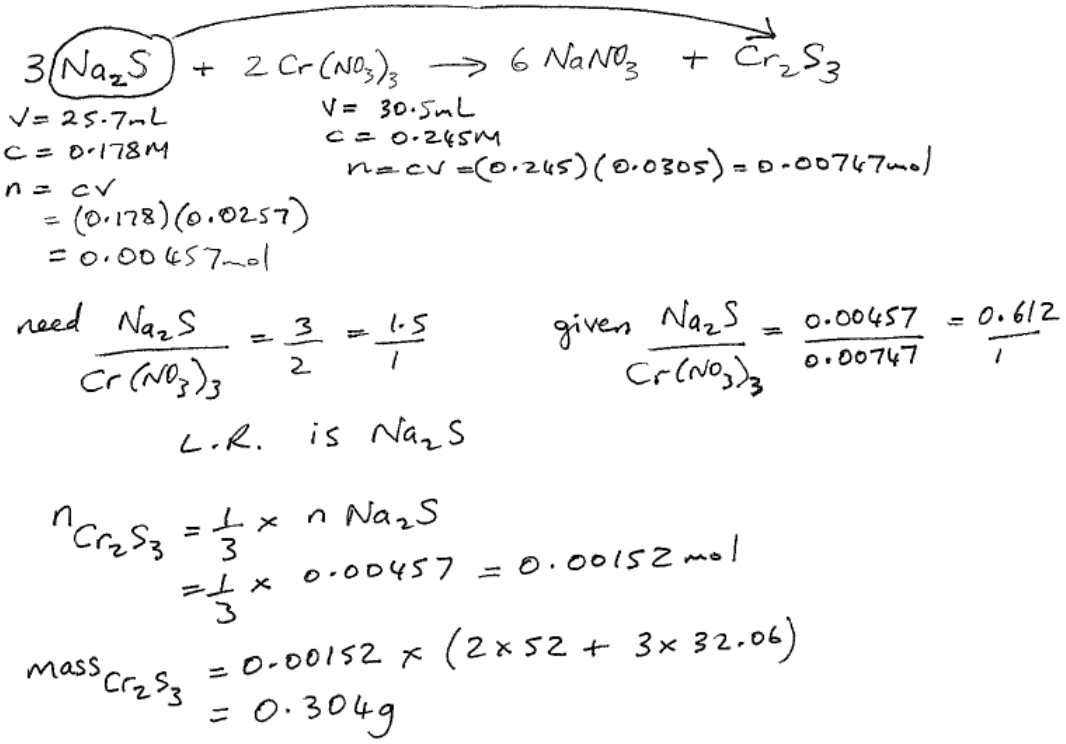
Question 37

a) Equation $2Cr^{3+}(aq) + 3S^{2-}(aq) \rightarrow Cr_2S_3(s)$

observation

a deep green solution is added to a colourless solution and a green solid forms

b)



Question 37

a) phenolphthalein

b) benzoic acid is a weak acid because the equivalence point is basic, this indicates that C6H5COO- will hydrolyse in water to form OH- ions (anions derived from strong acids do not do this)

c) when 10mL of naOH has been added you are not yet at equivalence point and still have reasonable amounts of benzoic acid which reacts with NaOH holding pH steady once all the benzoic acid has reacted there is nothing to absorb OH- and so pH increases

d)

$V = 1.50 \times 10^3 L$

density juice $= 1.09 = \frac{\text{mass}}{\text{vol}} = \frac{\text{mass}}{1.50 \times 10^3 \times 10^3}$ (convert to mL because of density units)

$\Rightarrow$ mass juice $= 1.635 \times 10^6 g$

$800 ppm = \frac{\text{mass acid (g)}}{\text{mass juice (g)}} \times 10^6 = \frac{\text{mass acid}}{1.635 \times 10^6} \times 10^6$.

$\Rightarrow$ mass acid $= 1308 g$

$= 1.31 \times 10^3 g$

Question 38

a) i) Cd

ii) NiO(OH)

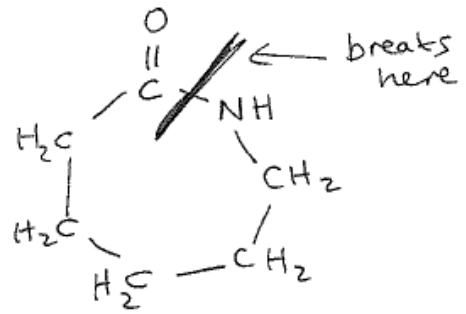
iii) $2NiO(OH) + 2H_2O + Cd \rightarrow Cd(OH)_2 + 2Ni(OH)_2(s)$

iv) 1.3 V

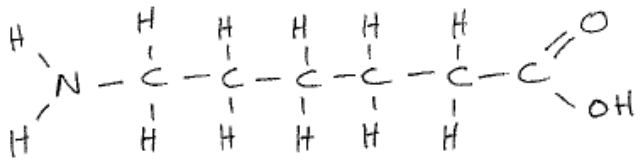
v) No hydroxide ions are produced and consumed in reaction so no change to$[H^+]$ and so no change to pH

vi) Products kept in close proximity to electrodes

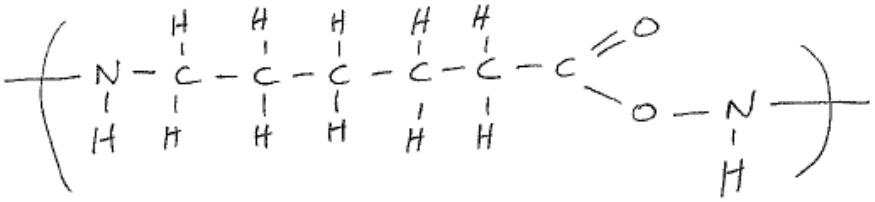
b)



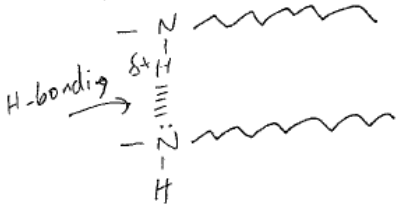
ii)



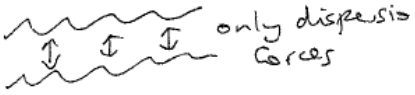
iii)



c) there will be H-bonding between nylon molecules as shown in diag below

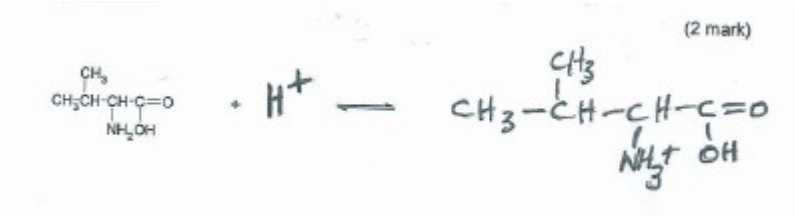


polythene will only have dispersion forces between the molecules



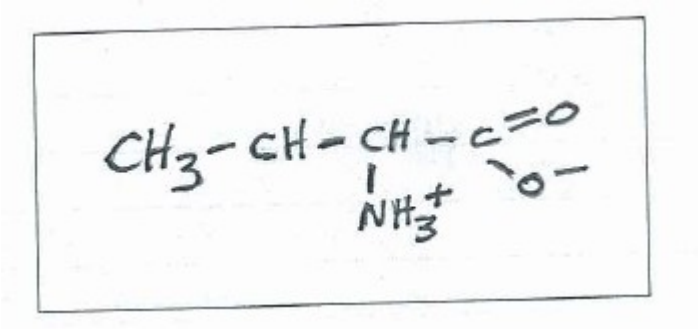
Question 39

a)



b) the conductivity in solution suggests presence of charged particles in solution, this suggests some ionic bonding (be careful I think this would still be classified as a covalent molecular substance ?? check)

ii)



d) i)

qualitative means they investigate reactions to determine properties and hence structure

quantitative means numerical data is collected to help determine molar mass etc

ii)

	C	H	N	O
mass	$\frac{12.01}{44.01} \times 6.443$ 1.758	$\frac{2.016}{18.016} \times 3.077$ 0.3443	* see below	
%	$\frac{1.758}{3.567} \times 100$ 49.29%	$\frac{0.3443}{3.567} \times 100$ 9.653%	$\frac{0.4875}{2.545} \times 100$ 18.86%	$100 - (49.29 + 9.653 + 18.86)$ $= 22.197\%$
moles (assume 100g)	$\frac{49.29}{12.01}$ 4.104	$\frac{9.653}{1.008}$ 9.576	$\frac{18.86}{14.01}$ 1.346	$\frac{22.197}{16}$ 1.387
ratio	$\frac{4.104}{1.346}$ 3	$\frac{9.576}{1.346}$ 7.1	$\frac{1.346}{1.346}$ 1	$\frac{1.387}{1.346}$ 1

EF is $C_3H_7N_2H_2$

* $NH_3 + HCl \rightarrow NH_4Cl$.

$V = 100mL$
$C = 0.650M$
$n = 0.065$ ← this is in excess so not all of it reacts

$HCl + NaOH \rightarrow H_2O + NaCl$

$c = 1.09$
$v = 27.70$
$n = 0.0302$

$n_{HCl \text{ reacting with } NH_3} = 0.065 - 0.0302 = 0.0348 \text{ mol}$

$n_{NH_3} = 0.0348$

$n_N = 0.0348$

$mass_N = 0.488g$

iii)

iii) $PV = nRT$

$(102.0)(0.319) = n(8.315)(468)$

$\Rightarrow n = 0.00836$

$0.00836 = \frac{1.224}{\text{molar mass}}$

$\Rightarrow$ molar mass $= 146.4$

EF mass $= 73$

$\frac{\text{MF mass}}{\text{EF mass}} = \frac{146.4}{73} = 2$ $\therefore$ MF is $C_6H_{14}N_2O_2$

Question 40

(i) Step 1 $2Br^- + Cl_2 \rightarrow Br_2 + 2Cl^-$

Step 2 $Br_2 + 2e^- \rightarrow 2Br^- \;) \times 2$

$2H_2O + SO_2 \rightarrow SO_4^{2-} + 4H^+ + 4e^-$

$2Br_2 + 2H_2O + SO_2 \rightarrow 4Br^- + SO_4^{2-} + 4H^+$

ii) the Br- ions in seawater are in very low concentration and the steps are needed to concentrate th Br-

iii) it is used in car batteries and in the manufacture of fertilisers

b) increase in boiling points of halogens down the group is due to increased dispersion forces resulting from larger molecules with more electrons

ii) HF has higher boiling point than other hydrogen halides as H-bonding is present between HF molecules whereas the other hydrogen halides do not have H-bonding the steady increase in boiling point after HF is due to increased dispersion forces

c) i) it contains a double or triple bond
ii) saturated

the Br_2 dissolves in hydrocarbon layer after shaking because the dispersion forces between the Br_2 molecules and hydrocarbon molecules are sufficiently strong to overcome the dispersion forces between the Br2 molecules and the dispersion forces between the hydrocarbon molecules

d)

$n_{I_2} = cv = (0.3)(0.02) = 0.006\,mol$

$n_{\text{cervonic acid}} = \frac{0.328}{328} = 0.001\,mol$

acid : I_2 ratio is

1 : 6

1 mole I_2 needed to convert each double bond to a single bond hence number of double bonds is 6

ii)