Candidate evidence

Question 1(b)(i)

Candidate 1

the amount of energy required to remove the 1st electron from an outer shell.

Candidate 2

The energy required to remove one mole of electrons from one mole of gaseous non-metal atoms to form positive gaseous non-metal ions.

Candidate 3

the energy required to remove 1 electron from every atom in 1 mol of gaseous atoms.

Question 1(b)(ii)

Candidate 1

Increased number of elections shells causing a ~~Shetit~~ sheilding/ screaning effect.

Candidate 2

going down the group.

the first ionisation energy decreases as you go down the group as there are more shells which means the electrons do not have as strong as pull to the nucleus as those with less shells so requires less energy 1

* as you decrease dow the group it

(c) Hydrogen halides are diatomic molecules formed between hydrogen and the elements fluorine, chlorine, bromine and iodine.

Question 1(c)(i)

Candidate 1

Hydrogen bonding arises through ~~as~~ permenent dipoles where Hydrogen can ~~bond~~ interact with Nitrogen, Oxygen or Fluorine.

Candidate 2

Hydrogen Bonding:
- it arises when Hydrogen bonds ~~with~~ form with elements with high electronegativities i.e. Nitrogen, oxygen & Fluorine

Candidate 3

Hydrogen bonding, and it arises due to the difference ~~its~~ in electronegativity of the atoms.

Candidate 4

Hydrogen bonding. Arises when there is a permanent dipole on the hydrogen which attracts ~~the~~ a permanent dipole ~~of~~ ~~another~~ on a different molecule causing a strong intermolecular force to be created between them.

Candidate 5

~~Hyd~~ Hydrogen bonds. This occurs when a hydrogen atom is bonded to a atom with very high electronegativities (~~hyd~~ flourine, oxygen or Nitrogen for example.)

Candidate 6

Hydrogen bonding is present in HF ~~as~~ hydrogen bonding only occurs between N, O and F ~~m~~ elements

Question 1(c)(ii)

Candidate 1

There are more London dispersion forces formed between the molecules, the reaction required's more energy to break these intermolecular forces.

There are more electron shells added, this means that more energy will be required to break apart the atom because more electrons must be taken from the pull of the nucleus.

Candidate 2

* because the strength of the forces between the molecules increase, making them more difficult to break.
* the strength of the ~~diatomic~~ ~~molecules~~ covalent bonds ~~in~~ are increasing, within the diatomic elements

Candidate 3

The Boiling point increases from HCl to HI because as you go down the molecules get bigger and So the boiling points also increase. HCl has the lowest Boiling point because it's the Smallest molecule, HI has the highest Boiling point because it's the largest molecule.

Question 2(b)(i)

Candidate 1

~~n = 0.04~~
~~m = 4.6g~~
~~GFM = 122.6~~

~~2.3 n = 0.06~~

122.6g → 24 liters
1g → 0.1956... liters
4.6g → 0.9 liters

Candidate 2

$2KClO_{3(s)} \longrightarrow 3O_{2(g)} + 2KCl_{(s)}$

gfm = 122·6 volume

m = 4·6 n = 0·0563

$n = \frac{4\cdot6}{122\cdot6}$

n = 0·0375

0·0375 ⟶ 0·046

0·0563 ⟶ x

0·0375x = 0·046 × 0·0563

$x = \frac{0\cdot00259}{0\cdot0375}$

x = 0·06906

volume of oxygen produced = 0·069 litres

Candidate 3

$n = \frac{v}{mv}$ $n = \frac{m}{gfm}$

$56.28\times10^{-3} = \frac{v}{24}$

$v = 24 \times 56.28\times10^{-3}$ $n = \frac{4.6}{122.6}$

v = 1.34072 $n = 37.52\times10^{-3}$

v = 1.3 Liters

ratio:

2 : 3

$\frac{37.52\times10^{-3}}{2} \times 3 = 56.28\times10^{-3}$

Question 2(b)(iii)

Candidate 1

$n = \frac{m}{GFM}$

$= \frac{5.5}{138.6}$

$= 0.0396$

0.0396 —> 103
÷0.0396
×1
1 ——> 2601.01
= −2601.01 kJ

Candidate 2

$n = \frac{5.5}{138.6} = 0.03968$

$n = 0.0397$

5.5 ⟶ 103
138.6 ⟶ x

$5.5x = 14275.8$

$x = \frac{14275.8}{5.5}$

$x = 2595.56$

$x = 2595.6$

kJ released is = 2595.6

Question 2(b)(iv)

Candidate 1

Increasing the temperature means that more particles have the energy required to react, increasing the rate of reaction.

Increasing the temperature also makes the particles move faster, this means they are more likely to ~~react~~ collide with the correct power and orientation which also increases the rate of reaction.

Candidate 2

increasing the tempretarue leads to ~~an~~ an increase in kinetic energy which leads to more reactants having a kinetic energy greater than the activation ion energy.

Candidate 3

it gives more particles energy greater than or equal to the activation energy.

particles have more energy so more collisions occur.

Candidate 4

* because there is an increase in the kinetic energy, which leads to more successful collisions

* provides more energy to be able to reach the activation energy required in shorter time.

Candidate 5

Increasing temperature, increases the kinetic energy of the particles (reactants) so more particles have energies equal to or greater than the activation energy.

Question 4(c)(ii)

Candidate 1

emulsifyes contain both polar and non-polar parts of their molecule. as a result this mean they can bind with both polar and non-polar molecules and prevents them from seperating.

Candidate 2

Emulsifiers ~~allow the~~ have a hydrophobic tail ~~to~~ that bonds to the non-polar liquid and ~~the~~ a hydrophilic head ~~to~~ that bonds to the polar liquid, this forms a physical connection between the two layers using the emulsifier molecule that prevents the two layers from separating.

Candidate 3

emulsifies ~~have~~ are made of fatty acid groups and hydroxyl groups

the fatty acids dissolve in non-polar substances while the hydroxyl groups dissolve in polar substances

This allows non-polar and polar substances to combine

Candidate 4

emulsifiers suspend droplets of one liquid in another liquid which would prevent them from seperating and keep mixed

Candidate 5

it binds with both the polar and non-polar molecules in the liquids (and acts like a middle man) is stops them from seperatiate as they are now both binded to other molecule...

Candidate 6

emulsifier have a polar part of the molecule and a non-polar part.

since polar substances disolve in other polar substances, polar liquids disolve in the polar part of the emulsifier.

since non-polar substences disolve in other non-polar substances, non-polar liquids disolve in the non-polar part of the emusifier.

Question 6(a)(iii)

Candidate 1

The temperature has exceeded the optimum temperature that catalase is able to function at, if the temperature continues to increase then the active site of the enzyme will be denatured meaning the enzyme will no longer be able to function properly and ~~band onto~~ bind to structures.

Candidate 2

as the temperature increases past a certain point, the ~~proteins~~ enzyme will denature. When this happens the enzyme will change shape & no longer aid the rate of reaction.

Candidate 3

As an enzyme reaches over its optimum pH it begins to denature so the enzyme can no longer bond with the hydrogen peroxide to lower the activation energy

Candidate 4

when sweet potatoes are cooked the amino acids change shape as the bonds denature which causes the food to change in texture this causes a reduction in activity due to the bonds being denatured ~~they~~ there strenth ~~decreases~~ in bonds decrease causing a deduction in activity

Candidate 5

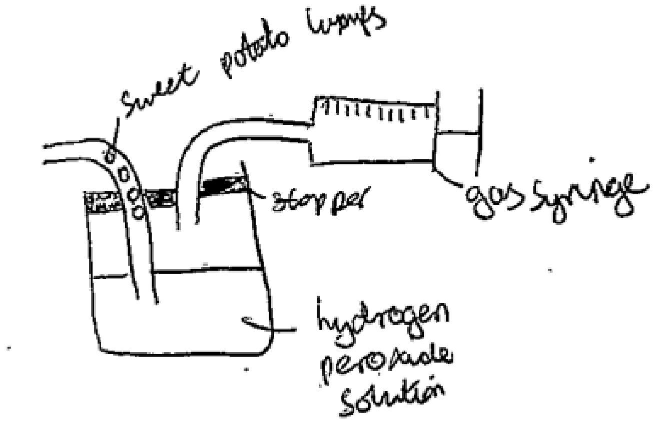
- tempature increase can cause a enzyme to denature after it has hit its optimal tempature for enzyme activity.
- after it denatures it cannolonger be used as a catalistee for the same reaction as the active site of the enzyme has changed shape.

Candidate 6

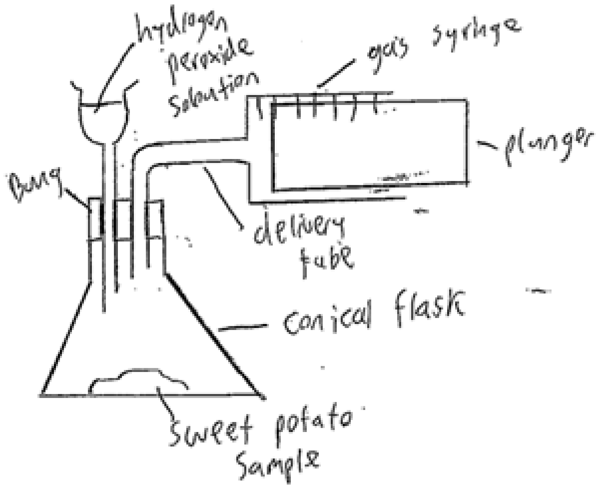
The enzyme becomes denatured. The enzyme structure is held together by intermolecular bonds. When the enzyme is heated, the intermolecular bonds break and the the enzyme is denatured so no longer functions properly.

Question 6(a)(iv)

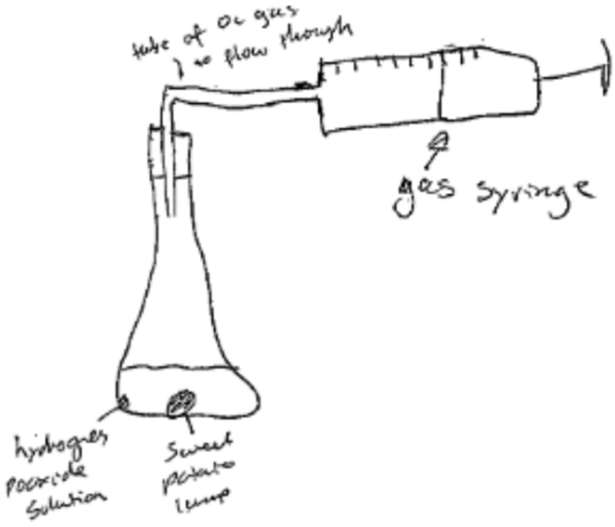
Candidate 1



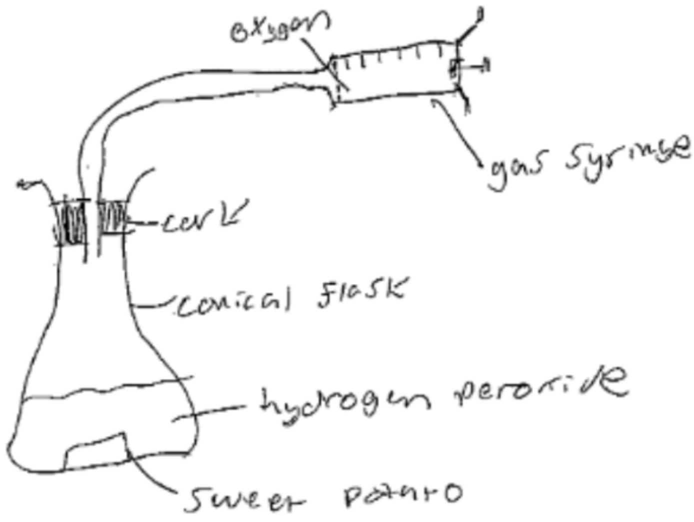
Candidate 2



Candidate 3



Candidate 4

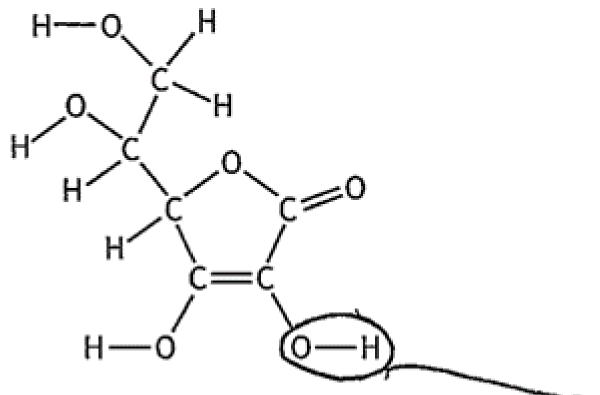


Question 6(b)(ii)

Candidate 1

Vitamin c is a polar molecule and has the ability to form hydrogen bonds. Water is also a polar molecule and has the ability to form hydrogen bonds. Therefore the vitamin c can form hydrogen bonds with water making it water soluble

Candidate 2



water contains hydrogen bonding, this is polar due to hydrogen and water having a large difference in electronegativity.

overall vitamin c is polar, water is also polar and polar solutes dissolve in polar solutions therefore vitamin c dissolves in water, making it water soluble.

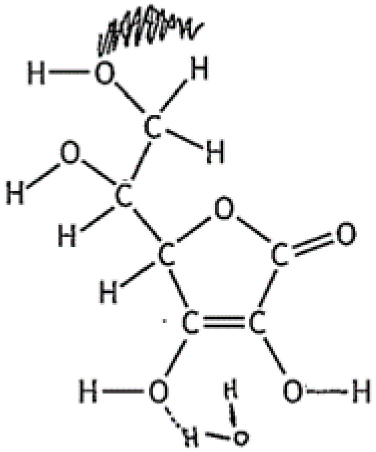
Candidate 3

ZE contains hydroxyl groups which are polar
water is also polar
like dissolves like

Candidate 4

vitamin C contains hydrogen bonding these are strong inter-molecular bonds, ~~they~~ as well as water.
- Because both vitamin C and water contain this hydrogen bonding they are able to disolve
- like disolves like ~~Both molecules~~

Candidate 5



Vitamin C contains some hydroxyl groups in its structure. These groups can form hydrogen bonds with water molecules as shown above by the dotted line so is soluble in the water.

Question 6(c)

Candidate 1

0.2mg – 1g

0.2 – 1×10^{-03} kg

$\frac{1}{1000} = 1\times10^{-3}$

×65 (3 mg per 1 kg) ×65

195mg — 65kg

195mg — 1×10^{-03} ×195

0.2 mg → 1 g s

$= 1\times10^{-03} \times (195$

$= \underline{0.195 \text{ kg}}$

Candidate 2

$$\frac{3}{0\cdot2} = 15$$

$$15 \times 65 = 975\,mg$$

Question 7(a)

Candidate 1

$E_h = cm\Delta t$

$E_h = 4\cdot18 \times 0\cdot1 \times 27$

$E_h =$ ~~[illegible]~~ $11\cdot286\ kJ$

$891 - 11\cdot286 = 879\cdot7$

$879\cdot1 = 4\cdot18 \times m \times 27$

$m = 7\cdot79\,g$

Candidate 2

$E_h = cm\Delta T$

$= 4\cdot18 \times 0\cdot1 \times 27$

$= 11\cdot286\ kJ$

$\Delta H = \frac{E_h}{n}$

$n = \frac{E_h}{\Delta H}$

$= \frac{11\cdot286}{891}$

$= 0\cdot01266\ldots$

$n = \frac{m}{GFM}$

$m = n \times GFM$

$= 0\cdot01266\ldots \times 16$

$= 0\cdot2026\ldots$

$= 0\cdot20\,g$

Question 7(b)

Candidate 1

Bond Breaking

C–H = 412 × 4

O=O = 2 × 498

Total 2644

Bond forming

C–O = 360 × 2

H–O = 463 × 4

Total 2572

Enthalpy change = 2644 − 2572 = 72 kJ mol⁻¹

Candidate 2

4 × (412) + 2 × (498)   2 × (804) + 2 × (463)

= 1648 + 996   = 2534

= 2644

= 2644 + −2534

= 110 kJ mol⁻¹

Candidate 3

$(-\overset{|}{\underset{|}{C}}- + 2(O{=}O)) - (2(C{=}O) + ~~3~~4(H{-}O))$

$= (4 \times 412) + 2(498) - 2(804) \quad 4(~~412~~ 463)$

$= (2644) - (3~~486~~ 460)$

$= ~~4~~ 816 \text{ kJmol}^{-1}$

Candidate 4

C-H O=O C-O H-O

C-H O=O C-O H-O

C-H H-O

C-H H-O

$4 \times 412 = 1648$ $2 \times 498 = ~~986~~ 996$ $2 \times 360 = 720$ $4 \times 463 = 1852$

~~2644~~

$2644 - 2572$

$= 72 \text{ kJmol}^{-1}$

Question 7(c)

Candidate 1

$$\frac{2}{(16+18)} \times 100 = \frac{2}{34} \times 100 = \underline{\underline{5.88\%}}$$

Question 7(e)(i)

Candidate 1

reverse × 4	$C(s) + 3H_2(g) + N_2(g)$	→	$CH_3NHNH_2(\ell)$	$\Delta H = +54\ kJ\ mol^{-1}$
reverse × 5	$N_2(g) + 2O_2(g)$	→	$N_2O_4(\ell)$	$\Delta H = -20\ kJ\ mol^{-1}$
× 4	$C(s) + O_2(g)$	→	$CO_2(g)$	$\Delta H = -394\ kJ\ mol^{-1}$
	~~$H_2(g) + \frac{1}{2}O_2(g)$~~	~~→~~	~~$H_2O(\ell)$~~	~~$\Delta H = -286\ kJ\ mol^{-1}$~~
×12	$H_2O(l)$	→	$H_2O(g)$	$\Delta H = +41\ kJ\ mol^{-1}$

$4CH_3NHNH_2 \rightarrow 4C + 4H + 4N_2 \quad \Delta H = -216\ kJ\ mol^{-1}$

$3N_2O_4 \rightarrow 5N_2 + 5\ 2O_2 \quad \Delta H = +100$

$4C + 4O_2 \rightarrow 4CO_2 \quad \Delta H = -1576$

$12H_2O(l) \rightarrow 12H_2O(g) \quad \Delta H = -492$

$\Delta H = (-216) + (+100) + (-1576) + (-492)$

$= \underline{\underline{-2184\ kJ}}$

Candidate 2

En = (54 × −4) + (~~...~~ −20 × −5) + (−394 × 4) + (41 × 12)

= −1200 kJ

Candidate 3

(4 × 54) + (5 × (−20)) + 394 + (3 × 286) + (3 × (−41))

= 1245 kJ mol⁻¹

Candidate 4

below.

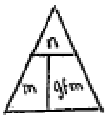
4(~~C(s)~~ + ~~3H₂(g)~~ + $N_2(g)$	→	$CH_3NHNH_2(\ell)$) revert	$\Delta H = +54$ kJ mol^{-1}
$N_2(g)$ + ~~2O₂(g)~~	→	$N_2O_4(\ell)$ revert 5	$\Delta H = +20$ kJ mol^{-1}
4(~~C(s)~~ + ~~O₂(g)~~	→	$CO_2(g)$)	$\Delta H = -394$ kJ mol^{-1}
12 (~~H₂(g)~~ + ~~½O₂(g)~~	→	~~H₂O(ℓ)~~)	$\Delta H = -286$ kJ mol^{-1}
12 (~~H₂O(ℓ)~~	→	$H_2O(g)$)	$\Delta H = +41$ kJ mol^{-1}

+216
+100
−1576
−3432
+492

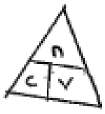
−4200

Question 8(b)

Candidate 1



$n = \frac{m}{gfm} \rightarrow \frac{7}{112} \rightarrow 0{\cdot}0625\,mol^{-1}$ sorbic acid LR



n = ~~[scribbled out]~~
$cv \rightarrow 0{\cdot}25 \times 0{\cdot}5 = 0{\cdot}125\,mol^{-1}$ potassium hydroxide XS

$\therefore 0{\cdot}125 > 0{\cdot}0625$

Candidate 2

$C_6H_8O_2$ 1 : 1 KOH

n = 0·0573 | n = 0·125 present, n = 0·0573 needed
M = 7 | c = 0·5
GFM = 122g | V = 0·25 litres $\frac{250}{1000}$ = 0.25

Therefore sorbic acid is limiting as KOH is an excess

Candidate 3

$n = \frac{m}{gfm}$

$= \frac{7}{112}$

$= 0.06$

$n = c \times v$

= ~~[crossed out]~~

$= 0.25 \times 0.5$

$= 0.125$

0.06 moles of sorbic acid would react with 0.06 moles of potassium hydroxide solution that leaves 0.065 moles of potassium hydroxide solution left proving ~~the~~ that sorbic acid is ~~[crossed out]~~ limiting factor

Candidate 4

$n = \frac{m}{GFM}$

$= \underline{0.0625}$ $(C_6H_8O_2)$

1 : 1

$n = v \times c$

$= 0.05 \times 0.5$

$= 0.125$ (KOH)

~~[crossed out]~~ sorbic acid is limiting by 0.0625 mol

Question 8(c)

Candidate 1

100 cm^3 → 1g
330 cm^3 → 3·3g

0·0126 moles

Ammonium ferric citrate
n = 0·0126
m = 3·3
GFM = 261·8

$n = \frac{m}{GFM}$
$= \frac{3 \cdot 3}{261 \cdot 8}$
=

Candidate 2

% by mass = $\frac{m}{gfm} \times 100$

$0.002\% = \frac{m}{261.8} \times 100$

$\left(\frac{0.002}{100}\right) \times 261.8 = m$

$m = 5.236 \times 10^{-3}$

$\frac{330}{100} = 3.3$ per gram

$n = \frac{m}{gfm}$

$n = \frac{~~5.236\times10^{-3}~~}{261.8}$

~~n = [illegible]~~ $n = 3.8197 \times 10^{-3} \times 3.3$

~~[illegible]~~

12.605×10^{-3}

Question 10(a)(iii)

Candidate 1

They contain no fluorine or Chlorine molecules

Candidate 2

They have no halogens molecules present

Question 11(a)(ii)

Candidate 1

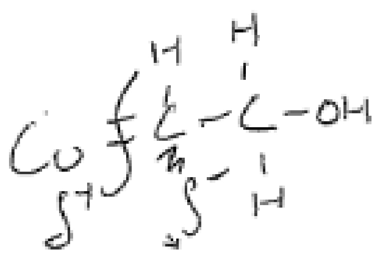
Cu^{2+} CH_3COO^-

2 1

1 2

Cu^{2+} $2CH_3COO^-$

Candidate 2



Candidate 3

$Cu^{2+}CH_3COOH^{2-}$

Candidate 4

S Cu^{2+} CH_3COO^-
V 2 1
S
D 1 2
 1 2
F $Cu^{2+}(CH_3COO^-)_2$

Question 11(b)

Candidate 1

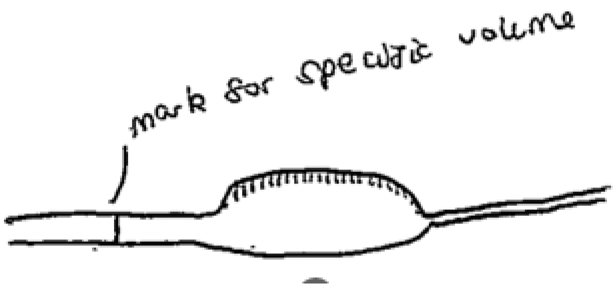
Dissolve the sodium hydroxide Solution in water
transfer quantitively
Rinse the beaker and transfer the rinsings to the flask
Fill the flask upto the line on the volumetric flask

Candidate 2

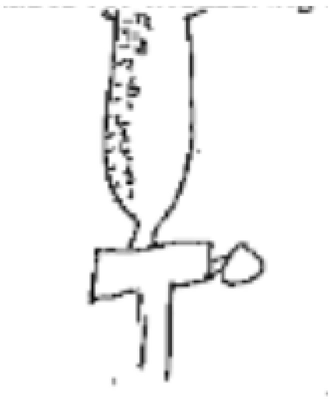
The mass of oxalic acid would be weighed on a balance and this would be added to a little deionised water in a beaker. The contents of the beaker would be added to a 250 cm³ volumetric flask. The beaker is rinsed with more deionised water and this would also be added to the flask. The flask would be topped up with more deionised water up to the mark (bottom of meniscus on mark). Invert the flask to ensure thorough mixing.

Question 11(c)(i)

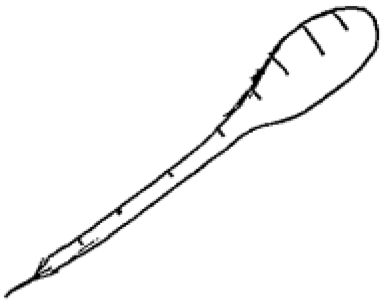
Candidate 1



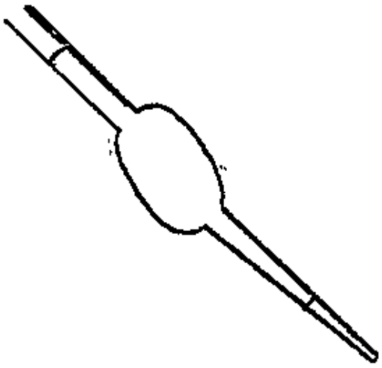
Candidate 2



Candidate 3



Candidate 4



Question 11(d)

Candidate 1

$H_2C_2O_4 (aq) + 2NaOH (aq) \longrightarrow Na_2C_2O_4 (aq) + 2H_2O (l)$

~~25 cm^3~~ 25 cm^3

0·126 mol l^{-1} $c = \frac{n}{V}$

26·75 cm^3

1 mole → 40

0·625 moles

$c = \frac{0{\cdot}625}{0{\cdot}025}$

c = 25 mol l^{-1}

Candidate 2

oxalic acid

$n = cV$

$= 0{\cdot}126 \times$ ~~0·026625~~ 0·02675

~~= 3·4 × 10^{-3} moles~~

$= 3{\cdot}3705 \times 10^{-3}$ moles

1 : 2

$3{\cdot}3705 \times 10^{-3} : 6{\cdot}741 \times 10^{-3}$

$c = \frac{n}{V} = \frac{6{\cdot}74 \times 10^{-3}}{25} = 2{\cdot}7 \times 10^{-4}$ mol l^{-1}

Candidate 3

$n = 0.02675 \times 0.126$

$= 0.0033705... \rightarrow$ (1:2) $= 0.006741$

$c = \frac{0.006741}{0.025}$

$c = 0.26964..$

$= 0.27\ mol\,l^{-1}$

Candidate 4

$\frac{C_1 V_1}{n_1} = \frac{C_2 V_2}{n_2}$

$\frac{25.0}{1000} = 0.025$ litres

$\frac{0.126 \times 0.025}{1} = \frac{C_2 \times 0.2675}{2}$

$\frac{26.75}{1000} = 0.02675$ litres

$= 0.126 \times 0.025 \times 2 = 1 \times 0.2675$

$= 6.3 \times 10^{-3}$ $\quad = 0.2675$

$C_2 = \frac{0.2675}{6.3 \times 10^{-3}} = 4.246\ mol\,l^{-1}$