Y3 OP END OF YEAR EXAMINATION 2020 (ANSWERS)

Paper 1

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
D	C	A	B	C	B	A	C	D	D
Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
C	A	B	D	D	A	A	C	B	B
Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30
D	B	A	A	C	C	C	B	A	C

Paper 2 Section A

A1(a)(i) Propanol is a flammable liquid. Or
More even heating around the flask

(ii) When evaporation occurs in figure 1.2, the vapours escape into the surroundings so less reactants are available for reaction.
In figure 1.1, the liebig condenser condenses the vapours back into liquid state so more reactants are able to react in the flask to form more product.

(b) (i) to react with the colourless / invisible (spots) to make them visible / coloured / seen

(ii) The spot of sample 2 is more soluble as it has moved higher up the paper than sample 1.

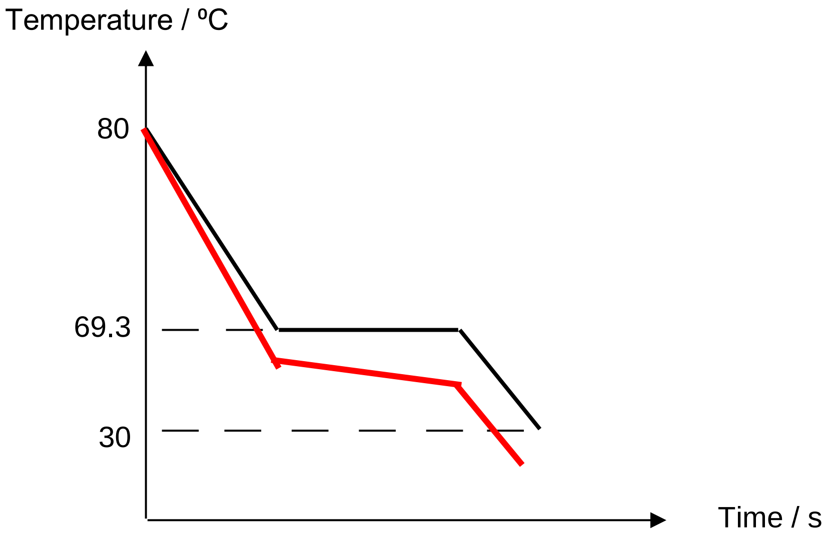
(iii) R_f = distance travelled by sample / distance travelled by solvent front

(iv) sample 1 R_f = 0.20 to 0 .24 (show working) tartaric acid
sample 2 R_f = 0.44 to 0.48 (show working) malic acid

A2(a) The particles roll and slide over each other initially and vibrate at fixed positions thereafter

The particles were closely packed and disorderly arranged initially and become closely packed, orderly arranged.

(b)



(c) The liquid turns into a gas.

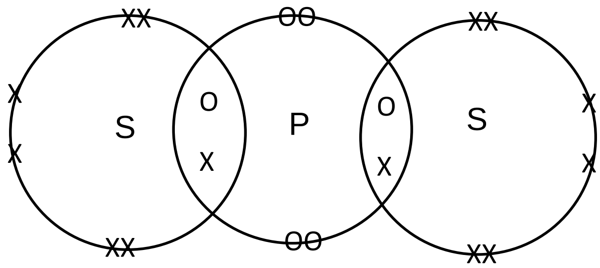
Heat energy is absorbed and overcomes the intermolecular forces of attraction between the particles, causing the particles to move further apart from each other.

A3 (a) 40
2,8,8

A3 (b) R has a **<u>stable electronic configuration</u>, <u>with eight electrons in its valence shell/has an octet electronic configuration</u>**, causing R to be inert.

A3 (c) Atom Q loses two electrons to atom P, causing the electronic configuration of Q to **<u>change from 2,8,2 to 2,8.</u>**

A3 (d)



A3 (e)(i) Isotopes are **atoms of the same element** with the same number of protons but **different number of neutrons**.

Reject: same neutron number/nucleon number

A3 (e)(ii) Isotopes of the same element **possess the same number of valence electrons**.

A4 (a)

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

(b) Clear presentation/Calculating number of moles of both reactants
Comparing molar volume or number of moles
Correct identity of limiting reagent based on working/explanation

Vol ratio of CH_4 : O_2 = 1:2,
10 cm^3 of CH_4 requires 20 cm^3 of O_2 for complete reaction.
20 cm^3 of CH_4 requires 40 cm^3 of O_2 which is less than the 60 cm^3 of O_2 available.
O_2 is in excess and CH_4 is limiting reagent.

(c) Vol ratio of CH_4 : CO_2 = 1:1
Volume of CO_2 produced = 20.0 cm^3

Volume of O_2 remaining = 60 - 40 = 20.0 cm^3
Total volume = 20 + 20 = 40.0 cm^3

(d) Actual volume of CO_2 produced = 0.7 * 20cm^3 = 14.0 cm^3

A5(a) $Ba(NO_3)_2 + K_2SO_4 \rightarrow BaSO_4 + 2KNO_3$

$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$

A5(b) Sulfuric acid/ sodium sulfate <u>solution</u> (any soluble sulfate solution)

A6 (a) **P**: **<u>Copper / Silver / Gold (Any unreactive metal)</u>**

Q: **<u>Hydrogen</u>**

R: **<u>Carbon dioxide</u>**

S: **<u>Sodium chloride</u>**

T: **<u>Iron(II) chloride</u>**

(b)

1. Add **excess iron(II) oxide** to 25 cm^3 of hydrochloric acid in a beaker.

2. **Carry out filtration** to remove the excess iron(II) oxide and collect the filtrate in an evaporating dish.

3. **Heat** the filtrate to obtain a **saturated solution**. Allow the saturated solution to **cool and form crystals**.

4. Carry out filtration to collect the crystals and **wash them** with a little cold **distilled water**. The crystals are then **dried** by pressing them **between sheets of filter paper**.

Section B

B7(a)(i) Similarity: Each silicon atom in silicon carbide is bonded to four carbon atoms while each carbon atom in diamond is bonded to four carbon atoms.

Accept: both are tetrahedral in structure.

Difference: Silicon carbide consists of two elements – carbon and silicon while diamond consists of only carbon atoms.

(a)(ii) Each silicon atom in silicon carbide is bonded to four carbon atoms by <u>**strong covalent bonds throughout the structure**</u>.
<u>**A lot of energy is required to break these strong bonds / the structure is rigid**</u>, making silicon carbide hard.

All four valence electrons of silicon & carbon atoms are used up in covalent bonding. The **structure does not possess mobile valence electrons**, and cannot conduct electricity.

(a)(iii) Used in drills or cutting tools.

(b)(i) Simple covalent structure / simple molecular structure

(b)(ii) There are weak intermolecular forces of attraction between silicon tetrachloride molecules

Little energy is required to overcome these weak forces.

B8 (a) (i) A substance which <u>**dissociates/ionises partially in water**</u> to form a <u>**low concentration of hydrogen ions.**</u>

(a)(ii) Reagent (reactive metals such as Mg/carbonate such as Na_2CO_3) [1m]
Observation (More/Less vigorous bubbling / time taken for solid to disappear is shorter/longer)

Conclusion (strong/weak acid is used => more/less vigorous bubbling) or (shorter/longer time for solid to disappear) [1m]

(b)(i) $3NaOH\ (aq) + H_3PO_4\ (aq) \rightarrow Na_3PO_4(aq) + 3H_2O\ (l)$
1m for balanced equation
1m for state symbols

(b)(ii) Sodium hydrogen phosphate

(b)(iii)

Volume of NaOH/cm^3	Colour of UI	Species/particles present
0	red	H^+, $H_2PO_4^-$, OH^-
20	Orange/yellow	$H_2PO_4^-$, Na^+ OH^-/H^+
40	Violet/purple	HPO_4^{2-}, Na^+ OH^-/H^+

B9 (a)

element	no. of electron shells in the atoms	atomic radius / pm	no. of electron shells when it forms ion	ionic radius / pm
lithium	2	152	1	68
sodium	3	185	2	98
potassium	4	227	3	133

element	no. of electron shells in the atoms	atomic radius / pm	no. of electron shells when it forms ion	ionic radius / pm
fluorine	2	71	2	133
chlorine	3	99	3	181
bromine	4	115	4	196

(Note: 1 pm = 10^{-12} m)

(b) (i) The radius of lithium ion is smaller than the radius of lithium atom.

Reason: The <u>number of electron shell for lithium ion is lesser than lithium atom</u>.
Hence <u>the valence electrons are closer to the nucleus.</u>

(ii) The radius of Li is larger than the radius of F.

Reason: Fluorine has a more protons in the nucleus and there is <u>a stronger attractive forces of attraction between the valence electrons and the nucleus of Fluorine. Hence atomic radius is smaller.</u>

(c) (i) The reactivity decreases down Group VII elements.

(ii)

positions	appearance
P	Reddish brown vapour formed
Q	Dark purple vapour formed Accept: purple vapour
R	Black solid formed

Paper 3 Marking Scheme

Question 1:

(a)

test no.	test	observations
1 (a)	To a portion of **P**, add an equal volume of aqueous barium nitrate.	**White ppt formed**
1 (b)	Add dilute nitric acid to the mixture from 1(a).	**White ppt dissolves [to form colourless solution** **Effervescence observed which forms a white ppt in limewater Presence of CO_2 gas**
2(a)	To a portion of **P**, add a few drops of aqueous silver nitrate.	**White ppt formed**
2(b)	Add dilute nitric acid to the mixture from 2(a).	**White ppt is insoluble in nitric acid** **Bonus:** - **Decreased in quantity OR** - **Effervescence observed which forms a white ppt in limewater OR** - **Presence of CO_2 gas**

The formula of the impurity present in **P** is **NaCl**……………………

(i) **$Cl^-(aq) + Ag^+(aq) \rightarrow AgCl(s)$**
(this answer should be based on the unknown anion and not the known)

(b) **Results**:

Titration number			
Final burette reading / cm^3			
Initial burette reading / cm^3			
Volume of **Q** used / cm^3			
Best titration results (✓)			

Summary

Tick (✓) the best titration results.

Using these results, the average volume of **Q** required was ………….. cm^3.

(2 dp)

Volume of solution **P** used was …………… cm^3. **(1 dp)**

(c) **No of moles of HCl = conc x dm3**
use mole ratio to find
No. moles of Na_2CO_3 = ½ x no of moles of HCl
Concentration of Na_2CO_3 =

concentration of sodium carbonate in **P** ………………….………… mol/dm^3.

(d) **answer to (c) x 106 =**

mass of sodium carbonate present in 1.00 dm^3 of solution **P** is …………g

(e) **answer to (d) / 6 x 100%**

percentage by mass of sodium carbonate in the impure sample is ………..…….

(f) **$2M_PV_P = M_QV_Q$**

Volume of P in conical flask would be greater than 25.0 cm^3
Volume of Q is required would be greater
No. of moles calculated for Q and P would be greater
Therefore concentration of P would be greater

3 **Determine volume of gas collected / mass lost**
Calculate no. of moles of CO_2
Compare mole ratio to Na_2CO_3
Determine mass of Na_2CO_3
Determine percentage purity stating the formula

Method 1:

- Add **excess hydrochloric acid** to a conical flask containing 25.0 cm^3 of the impure sodium carbonate solution of concentration 6.00 g/dm^3.
- Stopper the conical flask and link it to a gas syringe. Collect the carbon dioxide gas formed and **record the volume of gas collected when there is no further change in the volume of gas in the syringe. Let the volume be V cm^3.**
- Calculate the **number of moles of gas formed by dividing the volume of gas in dm^3 by 24 dm^3. Let the number of moles be P mol.**
- **Compare the mole ratio of sodium carbonate to carbon dioxide** from the equation. The ratio is 1 : 1. Thus **the number of moles of sodium carbonate in 25.0 cm^3 is P mol.**
- **Determine the mass of sodium carbonate in 25.0 cm^3 by multiplying P by the Mr of sodium carbonate. Let the mass be Q g.**
- **Calculate the mass of sodium carbonate in 1 dm^3 of the solution by dividing Q by (25/1000). Let the mass by R g.**

  The % purity of sodium carbonate in the solution is R divided by 6.00 multiplied by 100%.

Method 2:

- Place a conical flask containing 25.0 cm^3 of the impure sodium carbonate solution of concentration 6.00 g/dm^3 onto an electronic balance. Add **excess hydrochloric acid** to the conical flask and measure the mass at the start.
- Stopper the conical flask with a cotton wool plug. Record the mass of the conical flask and its contents once there is no further change in mass and no effervescence is produced. Record the final reading of mass. Determine the change in mass. The change in mass is equal to the mass of carbon dioxide lost. **Let the mass of carbon dioxide gas lost be M g.**
- Calculate the **number of moles of gas formed by dividing M by the Mr of carbon dioxide (44). Let the number of moles be P mol.**
- **Compare the mole ratio of sodium carbonate to carbon dioxide** from the equation. The ratio is 1 : 1. Thus **the number of moles of sodium carbonate in 25.0 cm^3 is P mol.**
- **Determine the mass of sodium carbonate in 25.0 cm^3 by multiplying P by the Mr of sodium carbonate. Let the mass be Q g.**
- **Calculate the mass of sodium carbonate in 1 dm^3 of the solution by dividing Q by (25/1000). Let the mass by R g.**

  The % purity of sodium carbonate in the solution is R divided by 6.00 multiplied by 100%.