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TRINITYHOUSE HIGH SCHOOL LITTLE FALLS

PHYSICAL SCIENCE: PAPER 2

GRADE 12

PRELIMINARY EXAMINATION

13 SEPTEMBER 2018

Time: 3 hours

Examiner: Mr D Du Toit

Total: 200 marks

Moderator: Mr D Brown

MARKING GUIDELINES

QUESTION 1 MULTIPLE-CHOICE QUESTIONS

1.1 C ✓✓

1.2 D ✓✓

1.3 B ✓✓

1.4 A ✓✓

1.5 B ✓✓

1.6 A ✓✓

1.7 A ✓✓

1.8 D ✓✓

1.9 C ✓✓

1.10 B ✓✓

[10 x 2 marks = 20]

QUESTION 2 CHEMICAL BONDING

2.1

2.1.1 A bond that occurs between atoms ✓ within molecules ✓ (2)

2.1.2 a weak force of attraction ✓ between molecules or between atoms of noble gases ✓ (2)

2.2

2.2.1 Hydrogen bond ✓ (1)

2.2.2 Polar ✓ covalent ✓ (2)

2.3

2.3.1 Non-polar (pure) ✓ covalent ✓ (2)

2.3.2

- Hydrogen iodide has bigger molecules/ larger molecular masses/ more electrons ✓
- Forms larger temporary dipoles ✓
- Hydrogen iodide has stronger London forces than HCl ✓
- More energy is required to overcome stronger intermolecular forces ✓ (do not award mark here if they talk about **bonds**)

(4)

2.3.3

- Sodium chloride is a **large/ giant** ionic compound ✓
- There are **many strong electrostatic forces/ ionic bonds** between ions (in the crystal lattice) ✓
- **More energy is required to overcome many strong electrostatic forces** ✓

(3)

[16]

QUESTION 3 REACTION RATES & ENERGY OF REACTIONS

3.1 A burette / an inverted measuring cylinder / gas syringe ✓ (1)

3.2

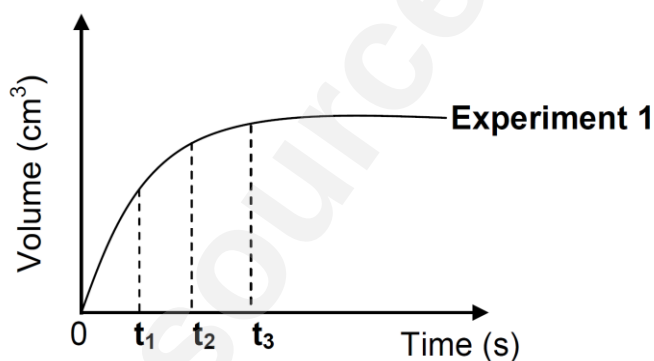
3.2.1 t_1 ✓ (1)

3.2.2 t_3 ✓ (1)

3.3 between t_1 and t_2 ✓ (1)

3.4

3.4.1



Experiment 2:

✓ Graph initially below experiment 1.

✓ Flattens underneath experiment 1.

Experiment 3:

✓ Graph initially above experiment 1.

✓ Flattens with experiment 1.

(4)

3.4.2

- HCl in experiment 3 is more concentrated ✓
- More molecules per unit volume ✓
- More chance of effective collisions ✓
- Higher reaction rate therefore **steeper gradient** ✓

(4)

3.5



- ✓ Reactants
- ✓ Products
- ✓ Balanced (mark if balanced regardless of formula)

(3)

3.5.2

$$n = c \cdot V = 0,2 \times 0,1 = 0,02 \text{ mol}$$

- ✓ Formula
- ✓ Conversion
- ✓ Answer

(3)

3.5.3

$$n = \frac{0,02}{2} = 0,01 \text{ mol}$$

$$m = nM = 0,01(65,4) = >0,65 \text{ g}$$

- ✓ Applying mole ratio (coe from 3.5.1 and 3.5.2)
- ✓ Converting to mass
- ✓ Answer

(>1,31 g if 1:1 ratio coe from 3.5.1)

(3)

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QUESTION 4 CHEMICAL EQUILIBRIUM

4.1

4.1.1 $C(H_2) = 8/10 = 0,8 \text{ mol.dm}^{-3}$ ✓

$C(N_2) = 7/10 = 0,7 \text{ mol.dm}^{-3}$ ✓

$C(NH_3) = 2/10 = 0,2 \text{ mol.dm}^{-3}$ ✓

(1 mark if all values read off correctly) (3)

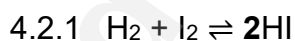
4.1.2 When an external stress (change in pressure, temperature or concentration) is applied to a system in chemical equilibrium ✓, the equilibrium point will change in such a way as to counteract the stress ✓ (2)

4.1.3

- Stress: increase in concentration of H_2 ✓
 - Response: forward reaction favoured ✓
 - Reason: forward reaction uses up H_2 to counteract the stress. ✓
(number of moles of H_2 and N_2 decreases and number of moles of NH_3 increases) ✓
- (4)

4.1.4 Decrease in temperature ✓. K_c increases ✓ (2)

4.2



✓ Reactants

✓ Products

✓ Balanced

(-1 if single arrow used) (3)

4.2.2

	H₂	I₂	2HI
R	1	1	2
I	0,1	0,1	0
C	-0,025	-0,025	+0,05
E	0,075	0,075	0,05

$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$

$$K_c = \frac{(0,05)^2}{(0,075)(0,075)}$$

$$= 0,44$$

✓ Initial moles

✓ Change moles

✓ Equilibrium moles

✓ Equilibrium expression (coe 4.2.1)

✓ Equilibrium expression sub

✓ Answer

(6)

4.2.3 It indicates that the equilibrium favours the reverse reaction, hence more reactants than products ✓

OR

The equilibrium ratio of products to reactants is small/ low yield of products i.e. more reactants than products at equilibrium. ✓

coe from 4.2.2

(1)

4.3

4.3.1 a measure of the extent of a reaction ✓, generally measured by comparing the amount of product against the amount of product that is possible ✓ (2)

4.3.2

4.3.2.1 Low ✓ (1)

4.3.2.2 High ✓ (1)

4.3.3

- The process is done under high temperature and low pressure ✓
- High temperature increases the rate of formation of sulfur trioxide ✓
- Low pressure ensures safety of production ✓
- Low pressure ensures cost effectiveness ✓

(4)

[29]

QUESTION 5 ACIDS & BASES**5.1**

5.1.1 Monoprotic acid ✓ (1)



✓ Reactants

✓ Products (2)

5.1.3 A reaction with water ✓ where water itself is decomposed ✓ (2)

5.1.4 Consider the pairs of ions formed:

- Na^+ is the cation formed from the strong base (NaOH) and does not undergo hydrolysis ✓
- $\text{C}_2\text{H}_5\text{COO}^-$ is the anion formed from the weak acid ($\text{C}_2\text{H}_5\text{COOH}$) and undergoes hydrolysis according to the following reaction:
$$\text{C}_2\text{H}_5\text{COO}^- + \text{H}_2\text{O} \rightleftharpoons \text{C}_2\text{H}_5\text{COOH} + \text{OH}^- \quad \checkmark$$
- Therefore there is an excess of hydroxide ions ✓ in solution, making it basic ✓
- Use phenolphthalein ✓

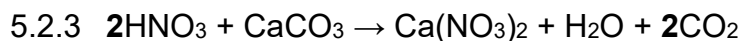
(5)

5.2

5.2.1 Greater than ✓

- Stronger acid ✓
- Ionises completely in solution ✓ (3)

5.2.2 Nitric acid ✓ More free ions in solution ✓ (coe from 5.2.1) (2)



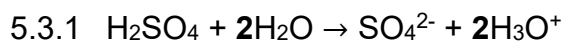
✓ Reactants

✓ Products

✓ Balanced

(3)

5.3

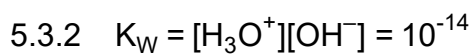


✓ Reactants

✓ Products

✓ Balanced

(3)



$$[0,4][\text{OH}^-] = 10^{-14}$$

$$[\text{OH}^-] = 1,25 \times 10^{-14} \text{ mol.dm}^{-3}$$

✓ Auto-ionisation formula

✓ Substitution

✓ Answer

(3)



(1)

$$5.3.4 \quad n_{H_2SO_4} = cV = (0,4)(0,02) \checkmark = 0,008 \text{ mol } \checkmark$$

$$n_{KOH} = n_{H_2SO_4} \times 2 = (0,008) \times 2 = 0,016 \text{ mol } \checkmark$$

$$c_{KOH} = \frac{0,016}{0,03} = 0,53 \text{ mol.dm}^{-3} \checkmark$$

✓✓ Calculation of number of moles of sulfuric acid

✓ Use molar ratio to calculate number of moles of KOH

✓ Calculate concentration of KOH

(4)

[29]

QUESTION 6 ELECTROCHEMISTRY

6.1



(-1 if double arrow)

6.1.2 Maintains electrical neutrality OR completes the circuit ✓ (1)

6.1.3 Y to X ✓ (1)

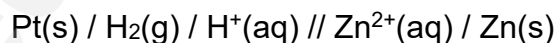
6.1.4 $\text{Zn}(\text{NO}_3)_2 \checkmark$ (or any other electrolyte that will not form a precipitate) (2)

6.1.5

- The negative sign indicates electrons will NOT flow spontaneously from hydrogen to Zn ✓. (or electrons flow from Zn (to hydrogen half-cell) into the positive terminal of the voltmeter)
- Zn (is a stronger reducing agent than H_2 therefore Zn is more readily oxidised and) ACTS as the anode ✓ (even though the hydrogen electrode is CONNECTED as the anode.) (2)

6.1.6 1 atm of pressure ✓ (1)

6.1.7



✓ SHE anode correct

✓ Zn cathode correct

✓ all phase indicators correct

(-1 if notation errors were made) (3)

6.1.8

- Redox reactions are equilibrium/ reversible reactions ✓
- Conditions that affect disturb equilibrium (concentration, temperature and pressure) ✓ affect the emf of the cell ✓ (3)

6.2

6.2.1 Electrical energy to chemical energy (2)

6.2.2 $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$ (2)

6.2.3

$$q = It = (0,9) (10 \times 60) = 540 \text{ C}$$

$$q = nF$$

$$540 = n(96500)$$

$$n = 5,596 \times 10^{-3} \dots \text{mol}$$

$$m = n \times M = 0, 5,596 \times 10^{-3} \dots \times 108 = 0,60 \text{ g}$$

✓ Conversion of mA to A

✓ Conversion of min to s

✓ Current to charge calculation

✓ Charge to moles calculation

✓ Moles to mass

✓ Answer (6)

6.2.4 Al^{3+} ions are a weaker oxidising agent than H_2O ✓ which is preferentially reduced ✓ (2)

6.3

6.3.1 B ✓ (1)

6.3.2 Positive ✓ (1)

6.3.3

- No ✓
- Cu^{2+} is a stronger reducing agent than Cr^{3+} ✓
- Cu^{2+} will be preferably reduced at the cathode ✓ (3)

6.3.4

- ✓ Conversion of moles to mass
- ✓ Answer
- ✓ % Purity
- ✓ Answer 90,49 % (4)

6.4

6.4.1 Al_2O_3 ✓ (1)

6.4.2

- Aluminium oxide has a very high melting point ✓
- Molten cryolite decreases the melting point of aluminium oxide so that the cell can run at a lower temperature ✓ (2)

6.4.3

- Graphite has a high melting point ✓ as it is a giant covalent structure ✓
- OR
- Graphite is a good conductor of electricity ✓ because of delocalised electrons ✓ (2)

6.4.4

- Oxygen reacts with the carbon of the graphite to form carbon dioxide ✓
- Carbon dioxide is a greenhouse gas ✓
- Electrode erodes away ✓ (3)

[44]

QUESTION 7 ORGANIC CHEMISTRY

7.1 a series of similar compounds which have the same functional group and have the same general formula ✓, in which each member differs from the previous one by a single CH₂ unit ✓ (2)

7.2 Alkenes ✓ (1)

7.3 a compound in which there is at least one double and/or triple bond ✓ between carbon atoms. ✓ (2)

7.4

- Add bromine water ✓
- Bromine water decolourises when added to an unsaturated compound and bromine water does not decolourise when added a saturated compound ✓
- Rapid decolourisation of bromine water is a positive result for an alkene/ unsaturated compound/ but-1-ene ✓ (3)

7.5

7.5.1 Addition ✓ (1)

7.5.2 Substitution ✓ (1)

7.6

$$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{H} & & \\ & | & | & | & | & & \\ \text{H} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{H} & \\ & | & | & | & | & & \\ & \text{Cl} & \text{Cl} & \text{H} & \text{H} & & \end{array}$$

✓✓

(2)

7.7 Heat / UV light ✓ (1)

7.8 Propane ✓ (1)

7.9 HCl OR hydrogen chloride ✓ (1)

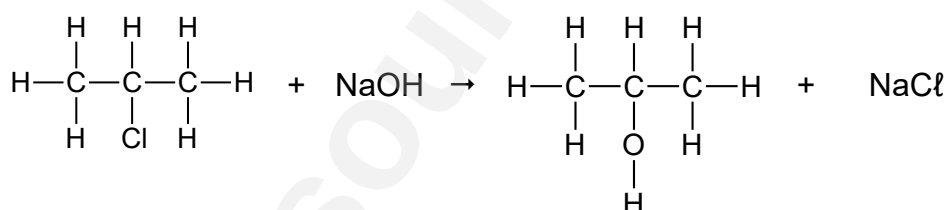
7.10

7.10.1 Type: elimination

Specific name: dehydrohalogenation (2)

7.10.2 Propene ✓✓ (2)

7.10.3



✓✓(2-chloropropane)

✓✓(propan-2-ol)

(-1) is NaOH or NaCl not written (4)

[23]

QUESTION 8 ORGANIC CHEMISTRY (2)

8.1 An atom or a group of atoms ✓ that form the centre of chemical activity in the molecule. ✓ (2)

8.2 Hydroxyl group ✓ (1)

8.3 Substitution ✓ (1)

8.4 Hydration ✓ (1)

8.5 Butan-1-ol OR butan-2-ol ✓✓ (2)

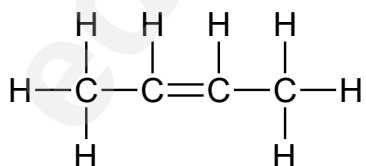
8.6 Esterification/ condensation ✓ (1)

8.7 Butyl ethanoate ✓✓ (2)

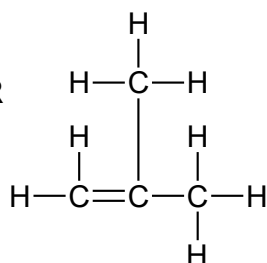
8.8 A compound having the same molecular formula but different structural formulae. ✓✓ (2)

8.9 $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$ OR $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-COOH}$ (2)

8.10



OR



Positional Isomer ✓✓

Chain isomer ✓

8.11 Dehydration ✓ (1)

[18]