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PRELIMINARY EXAMINATIONS AUGUST 2020

PHYSICAL SCIENCES P2

Question 1 Multiple Choice Questions

- 1.1 B
- 1.2 C
- 1.3 D
- 1.4 B
- 1.5 A
- 1.6 A
- 1.7 D
- 1.8 A
- 1.9 D
- 1.10 C

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Question 2 Bonding

- 2.1 Polar covalent bonding: unequal sharing of electrons leading to a dipole forming (2)

2.2

- 2.2.1 H_2 , F_2 , Br_2 (One of in all cases) (1)

- 2.2.2 NH_3 , HF (1)

- 2.2.3 MgO (1)

- 2.2.4 Br_2 , Ne (1)

- 2.2.5 Ag , K (1)

- 2.2.6 SiO_2 (1)
- 2.2.7 NH_3 , HF , HCl , CO (1)
- 2.3
- 2.3.1 Ionic bonding: *a transfer of electrons and subsequent electrostatic attraction* ✓✓ (2)
- 2.3.2 Water is polar molecule✓, polar ends of water surround and pull apart the oppositely charged ions.✓ (2)
- 2.3.3 It will✓. Ethanol is a polar molecule due to the $-\text{OH}$ on the end of the molecule✓. So polar solvent completely disrupts polar/ionic solute.✓ (3)
- 2.4
- 2.4.1 CH_4 and CO_2 are both symmetrical and so are non-polar,✓ therefore only weak London IMF between them✓. Means little energy required to overcome forces and therefore low boiling points✓. SO_2 and H_2O are angular ✓and have EN differences (1,0 and 1,4) ✓so have permanent dipoles which cause stronger attraction. So need more energy to overcome and so higher boiling point✓. (6)
- 2.4.2 Hydrogen bond IMF occurs in H_2O ✓. Stronger force so needs more energy to overcome✓. SO_2 has only dipole-dipole forces.✓ (2)
- [25]

Question 3

- 3.1
- 3.1.1 A (1)
- 3.1.2 (2)
- a. activation energy. *the minimum energy required to start a chemical reaction OR the energy required to form the activated complex* (1)

b. A

3.1.3 $O = N \dots O \dots O = O$ (1)

3.1.4 A (1)

3.2

3.2.1 $CaCO_3$: $n = m/M = 0,5/100 = 5 \times 10^{-3} \text{ mol}$. ✓

Ratio is 2:1 so need 0,01 mol. ✓

HCl: $n = C_v = 0,05 \times 0,25 = 0,0125 \text{ mol}$ ✓ > 0,01 mol so in excess. ✓ (4)

3.2.2 Measure the CO_2 captured or measure loss of mass. ✓✓ (2)

3.2.3 (2)

a. Must collide, with sufficient energy and correct orientation

b. Rate will increase ✓ – since powder form provides a greater surface area ✓ for collisions to occur, better chance of having correct orientation with sufficient energy ✓, so more successful collisions per unit time ✓ ie rate increases. (4)

c. Heat/ increase conc of HCl/catalyst (any 2) (2)

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Question 4

4.1 Although the amounts of reactants and products are constant, the reactions (F and B) are ongoing at equal rates. ✓✓ (2)

4.2

4.2.1

a. $K_c = \frac{[K_2CrO_4]^2}{[K_2Cr_2O_7][NaOH]^2}$ (or ions) ✓✓ (2)

b. decreases. ✓ (1)

4.2.2 Le Chatelier's Principle. 'When an external stress (change in pressure, temperature or concentration) is applied to a system in dynamic chemical equilibrium, the equilibrium point will change in such a way as to counteract the stress' ✓✓ (2)

4.2.3 Stress: increasing $[\text{OH}^-]$ ✓, To relieve stress: reduce OH^- ✓ so rate of forward rxn increases ✓, result: Yellow ✓ (4)

4.2.4 Stress: $[\text{H}^+]$ increases ✓, to relieve stress reduce H^+ ✓ by reacting with OH^- so $[\text{OH}^-]$ reduces so backward reaction rate increases ✓ so more reactant forms so orange ✓ (4)

4.2.5

- a. An insoluble substance that deposits as a solid. ✓
- b. A ✓
- c. The lower the pH (more acidic) the further to the left/rev rxn rate increases ✓ Ba^{2+} reacts with more $\text{Cr}_2\text{O}_7^{2-}$ ✓ so the more insoluble compound forms and less clarity ✓ and vice versa, adding base means higher pH equilibrium is goes more to right ✓ and Ba^{2+} reacts with more CrO_4^{2-} so precipitate forms ✓ so becomes opaque. ✓ (1) (2) (6)

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Question 5

5.1

5.1.1 Able to give off more than one H^+ (1)

5.1.2 Able to both give off and receive an H^+ (1)

5.2

5.2.1 $\text{H}_2\text{SO}_4 \rightarrow \text{H}^+ + \text{HSO}_4^-$ ✓
 $\text{HSO}_4^- \rightarrow \text{H}^+ + \text{SO}_4^{2-}$ ✓ (3)

5.2.2 SO_4^{2-} ✓ (1)

5.3



5.3.2 $K_a = [\text{CH}_3\text{COO}^-] \cdot [\text{H}^+]/[\text{CH}_3\text{COOH}]$ ✓✓ (2)

5.3.3 lower (2)

5.3.4 ethanoic acid partially ionises and the reaction is an equilibrium reaction. ✓ Sulfuric acid ionises completely. ✓ (2)

5.3.5 A strong acid has a weak conjugate base since the equilibrium is far to the right. ✓ The K_a for a strong acid is high and K_b for that conjugate base is low ✓. Weak acid has strong conjugate base – equilibrium is towards the left ✓ and the K_a and K_b are closer together. ✓ (4)

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Question 6

6.1 solution of known concentration ✓✓ (2)

6.2 $n = cV = 0,4 \times 0,25 = 0,1 \text{ mol}$ ✓
 $m = nM = 0,1 \times 58,3 = 5,83 \text{ g}$ ✓ (5)

6.3 $C_1V_1/n_1 = C_2V_2/n_2$ (3)
 $C_a \cdot 36/2 = 0,4 \times 25/1$ ✓
 $C_a = 0,56 \text{ mol} \cdot \text{dm}^{-3}$ ✓

6.4

6.4.1 $0,1 \text{ mol MgCl}_2$ should form $m = nM = 0,1 \times 95,3 = 9,53 \text{ g}$ ✓ (3)

6.4.2 $0,09 \text{ mol}$ ✓ only formed so only $0,09$ of $0,1$ is Mg(OH)_2 so %purity =
 $0,09/0,1 \times 100 = 90,03\%$ ✓ (4)

6.5 acidic ✓✓ (2)

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Question 7

7.1 $\text{Fe}|\text{Fe}^{2+}||\text{Cu}^{2+}|\text{Cu}$ ✓✓ (2)

7.2 $\text{Fe (s)} \rightleftharpoons \text{Fe}^{2+} \text{ (aq)} + 2\text{e}^-$ ✓✓ (2)

7.3 Cu^{2+} ✓✓ (2)

7.4 1mol.dm^{-3} at 25°C (2)

7.5 $E^\ominus_{\text{cell}} = E^\ominus_{\text{cathode}} - E^\ominus_{\text{anode}}$
 $= 0,34\checkmark - (-0,44)\checkmark = 0,78\text{ V}\checkmark\checkmark$ (4)

7.6

7.6.1 Maintain charge balance, complete the circuit ✓✓ (2)

7.6.2 KNO_3 ✓ (1)

7.7 Fe electrode wearing down, losing mass ✓, Cu colour developing, mass increase on anode. ✓ (2)

7.8

7.8.1 The Cu pipes will allow ions to dissolve into the water and Cu^{2+} goes into the radiator ✓. The ions in the water displace the Fe ✓ out of the radiator so it corrodes. Cu has a higher oxidising strength ✓ so will force the Fe to be oxidised. ✓

7.8.2 Hot water will speed up ✓ the reaction by providing more energy ✓ so (4)
 allowing more reactions to take place where more successful collisions per unit time occur. ✓ (3)

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Question 8

8.1 Mercury is an environmental hazard – deposits in food etc. ✓ (1)

8.2

8.2.1 $2\text{Cl}^- (\text{aq}) \rightarrow \text{Cl}_2 (\text{g}) + 2\text{e}^-$ ✓✓ (2)

8.2.2 Oxidation ✓ (1)

8.2.3 Anode ✓ (1)

8.3

8.3.1 reduction ✓ (1)

8.3.2 Mercury ✓ (1)

8.3.3 $2\text{Na} (\text{l}) + \text{Hg} (\text{l}) + 2\text{H}_2\text{O} (\text{l}) \rightarrow 2\text{NaOH} (\text{aq}) + \text{H}_2 (\text{g}) (+\text{Hg} (\text{l}))$.

0 0 +1 -2 +1 -2 +1 0 0 ✓

Na: $0 \rightarrow 1$ – increased – oxidised ✓

H: $+1 \rightarrow 0$ – decreased - reduced ✓ (3)

8.3.4 Na is a stronger reducing agent ✓ than H_2O so it is oxidised ✓ and gives e^- to H^+ to form H_2 gas. ✓ (3)

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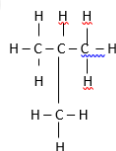
Question 9 Organic chemistry

9.1

a. Alkane E ✓ (1)

b. $\text{C}_n\text{H}_{2n+2}$ ✓ (1)

c. Butane ✓ (1)

d.  ✓✓ (2)

e. Methylpropane ✓✓ (2)

9.2 For compound B (1)

a. Alcohols ✓ (1)

b. Hydroxyl✓

9.3

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

b. A, G ✓✓ (2)

c. A = propyne, ✓ G = propene ✓ (2)

9.4

a. Substitution halogenation.✓✓ (2)

b. Sunlight or heat✓✓ (1)

c. C ✓ (1)

9.5

a. F✓ (1)

b. Ethanoic acid✓ (1)

c. B✓ (1)

d. catalyst✓ (1)

e. D✓ (1)

f. propylethanoate✓ (2)

g. esters ✓ (1)

9.6

9.6.1 B✓ or A✓ (1)

9.6.2 $\text{CH}_3\text{CH}_2\text{OH} \xrightarrow{\text{H}_2\text{SO}_4, \text{HEAT}} \text{CH}_2=\text{CH}_2 + \text{H}_2\text{O}$ ✓✓

Or $\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{OH} \rightarrow \text{CH}_3(\text{CH}_2)_3\text{CH}=\text{CH}_2 + \text{H}_2\text{O}$ (4)

9.7

9.7.1 A✓ (1)

9.7.2 Longer chain allows more IMF ✓ (1)

9.7.3 B (1)

9.7.4 It has hydrogen bonding due to the -O-H in the molecule.✓ (1)

9.8 $\text{CH}_3(\text{CH}_2)_5\text{CH}_3$ ✓ # OF C ✓ SINGLE BONDS (2)

TOTAL: 200

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