



eduresourceza.com

- 1.1 C ($10\text{cm}^3 \text{Xe} + 20\text{cm}^3 \text{XeF}_2$) 1.2 B (3mol N_2 from rxn 1 + $0,2\text{mol N}_2$ from rxn 2; then $3,2 \times N_A$)
 1.3 D 1.4 B 1.5 C 1.6 D 1.7 A 1.8 D 1.9 B 1.10 A

[2 x 10 = 20]

2.1 Transfer of electrons✓ (from metal to non-metal to form ions) and subsequent electrostatic attraction✓ eg NaCl✓. (3)

2.2 $\text{H}_2\text{O}(\text{s})$ consists of a lattice of **H_2O molecules**✓ held together with **hydrogen bonding** imfs. ✓

$\text{I}_2(\text{s})$ consists of a lattice of **I_2 molecules**✓ held together with **London imfs.** ✓

$\text{Mg}(\text{s})$ consists of **positive kernels**✓ and a **sea of delocalised electrons**✓ held together by electrostatic **metallic bonds.** ✓

The **stronger the imfs** / bonds between particles, the **more energy** is required to overcome them✓ and the higher the mp will be.

Metallic bonds much stronger than imfs✓ ∴ highest mp.

I_2 has a much **bigger electron cloud**✓ than H_2O ∴ strong temporary dipoles and the **London imfs are stronger than the hydrogen bonding imfs** between H_2O molecules. ✓

(11)

[14]

3.1.1 As the reactants are used up✓ there will be fewer collisions per second thus the rate of reaction will decrease. ✓

3.1.2 When the limiting reactant (acid) is used up✓, the reaction stops. ✓

3.2 $n(\text{Mg}) = m/M = 0,396 / 24,3 = 0,016 \text{ mol}$ $n(\text{CH}_3\text{COOH}) = CV = 0,6 \times 0,03 = 0,018 \text{ mol}$ ✓

0,018 mol ethanoic acid reacts with $0,018/2 = 0,009 \text{ mol Mg}$ (2:1) ✓ ∴ Mg in excess

3.3.1 Line starts at origin and is steeper (higher conc) ✓; since $CV = 0,8 \times 0,02 = 0,016 \text{ mol}$ ✓ line must level out on the 8th line✓ up since amount of LR is 0,016 / 0,018 or 8/9 times as much. (5)

3.3.2 Line starts at origin and is steeper✓ (greater surface area of solid); line ends on same line✓ since Mg was in excess (more Mg will not make more product) (3)

(2)

[14]

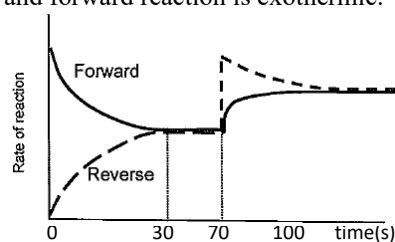
4.1 Line starts at same place as for X✓ but decreases faster levelling out at 30s approx. ½ way between the two lines✓ (mole ratio 1:2 ∴ Y used up twice as fast. (2)

4.2 Increasing the temp causes an endothermic reaction to be favoured✓ because it will decrease the temp. ✓

From graph at 70 s, [X] increases and [XY₂] decreases✓ ∴ reverse is favoured✓ ∴ reverse is endothermic and forward reaction is exothermic. ✓

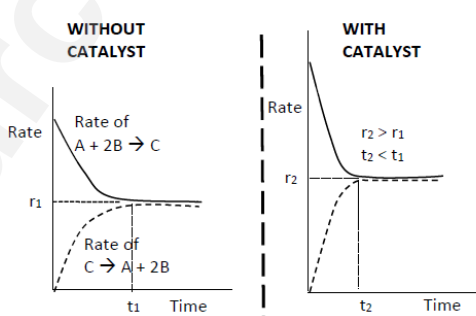
(5)

4.3



Rate_{rev} increasing✓; rate_{fwd} decreasing✓;
 rates equal from 30s to 70s✓; both rates increase at 70s✓ but rate_{rev} increases more ✓ (favoured); rates equal from 100 s. ✓ (6)

4.4



Draw two new lines✓✓ and label:
 Both rates higher at equilibrium✓;
 equilibrium reached sooner✓ (4)

5.1.1 2,2,4-trimethyl✓pentane✓

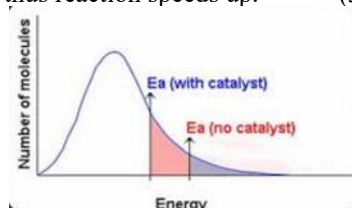
5.1.2 Compounds with same molecular formula✓ but different structural formula. ✓

5.1.3 chain isomer✓

5.1.4 Both have **London forces**✓ between their molecules. Unbranched octane molecules have a **larger interacting surface** than branched molecules of isooctane. ✓ Octane has a longer unbranched chain ∴ can develop **larger temporary dipoles** than isooctane. ∴ octane has **stronger London forces**✓ which require **more energy** to overcome✓ ∴ octane has the higher boiling point. (4)

5.1.5 fractional distillation✓; the lower boiling point isooctane will boil off first✓; then it is condensed and collected before the octane starts boiling. ✓ (3)

5.1.6 Adding a catalyst lowers E_a ✓ ∴ more molecules✓ (shaded area) have sufficient energy to react, ✓ thus reaction speeds up. (3)



5.1.7 $2 \text{C}_8\text{H}_{18} + 25 \text{O}_2 \rightarrow 16 \text{CO}_2 + 18 \text{H}_2\text{O}$ bal✓

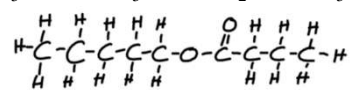
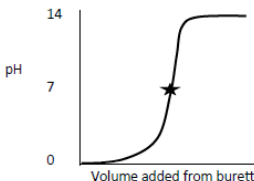
5.1.8 to increase the surface area of the catalyst (more effective) (4)

5.1.9 Add bromine✓; the reddish-brown colour will disappear immediately✓ due to the fast✓ addition reaction✓ at the double bond. (4)

5.1.10 it is unbranched✓ (1)

5.1.11 It mixes with oil due to non-polar✓ hydrocarbon chain✓ and mixes with water due to polar✓ -COOH end✓ (thus provides a bonding bridge between oil and water) OR refer to H-bonding with H_2O and London imf's to mix with oil (4)

5.2 BP Propanol > propanal > butane✓✓ Propanol has strong✓ hydrogen bonding imfs✓ ∴ more energy required to overcome them. Propanal has weaker dipole-dipole imfs✓ and butane has London imfs✓ which are the weakest. (6)

- 5.3.1 dehydration✓ (1)
- 5.4.1 esterification✓ (1)
- 5.3.2 $\text{CH}_3\text{CHOHCH}_3 \rightarrow \text{CH}_2=\text{CHCH}_3 + \text{H}_2\text{O}$ ✓ (3)
- 5.4.2  (2)
- [42]
- 6.1.1 $\text{HNO}_3 + \text{NaOH} \rightarrow \text{NaNO}_3 + \text{H}_2\text{O}$ ✓ (3)
- 6.1.2 A substance in which the hydrogen of an acid has been replaced by a cation. ✓✓ Sodium nitrate. ✓ (3)
- 6.1.3
- SA (in flask) vs SB (in burette)
- 
- AXES not labelled (-1)
- S-Shape of curve✓
- Starts near pH zero✓
- Ends near pH 14✓
- End point at pH 7✓ (4)
- 6.1.4 Neither Na^+ nor NO_3^- react with water✓✓ $\therefore$ pH remains 7 (2)
- 6.1.5 Leave out 1st result. ✓ or 0/2
Average of 19,90 and 20,00
= 19,95 cm^3 ✓ (2)
- 6.1.6 $n(\text{NaOH}) = CV = 0,08 \times 19,95 \times 10^{-3} = 0,0016 \text{ mol}$ ✓ $\therefore n(\text{HNO}_3) = 0,0016 \text{ mol (1:1)}$ ✓
 $C(\text{HNO}_3) = n/V = 0,0016 / 25 \times 10^{-3} = 0,064 \text{ mol.dm}^{-3}$ ✓
But dilution: $C_i V_i = C_f V_f \therefore C_i(10) = 0,064(250) \therefore C_i = 1,6 \text{ mol.dm}^{-3}$ ✓✓
Now, $m = nM = 1,6 \times 63 = 100,5 \text{ g} \therefore 100,5 \text{ g.dm}^{-3}$ ✓ $\therefore$ this acid is suitable (6)
- 6.1.7 Yes redox✓ electrons are transferred OR the oxidation numbers change✓ (2)
- 6.1.8 $n(\text{N}_2\text{O}_4) = V/V_m = 40 \times 10^{-3} / 22,4 = 0,0018 \text{ mol}$ ✓ $\therefore n(\text{HNO}_3) = 0,0018 / 3 \times 4 = 0,0024 \text{ mol}$ ✓
 $m(\text{HNO}_3) = nM = 0,0024 \times 63 = 0,15 \text{ g}$ ✓ BUT yield is 75% $\therefore 75\% \text{ of } 0,15 = 0,11 \text{ g}$ ✓ (5)
- 6.2.1 DABC i.e. pH of $\text{H}_2\text{SO}_4 < \text{HNO}_3 < \text{CH}_3\text{COOH} < \text{KOH}$ ✓✓ H_2SO_4 and HNO_3 are strong acids✓ $\therefore$ ionise completely and will have higher $[\text{H}_3\text{O}^+]$ ✓ and lower pH than CH_3COOH which is a weak acid✓ and only ionizes partially. KOH is a strong base✓ $\therefore$ will have the highest pH. H_2SO_4 is diprotic✓ $\therefore$ will have higher $[\text{H}_3\text{O}^+]$ ✓ and thus lower pH than HNO_3 . (8)
- 6.2.2 Strong acid $\therefore$ ionises completely $\therefore [\text{H}_3\text{O}^+] = 2 \times 0,2 = 0,4 \text{ mol.dm}^{-3}$ ✓ (diprotic)
 $[\text{OH}^-] = K_w / [\text{H}_3\text{O}^+] = 1 \times 10^{-14} / 0,4 = 2,5 \times 10^{-14} \text{ mol.dm}^{-3}$ ✓ (3)
- 6.2.3 ionisation✓ (1)
- 6.2.4 hydronium ion (or oxonium or hydroxonium)✓ (1)
- 6.2.5
- | | $\text{CH}_3\text{COOH} + \text{H}_2\text{O}(\ell)$ | $\rightleftharpoons$ | $\text{CH}_3\text{COO}^- + \text{H}_3\text{O}^+$ | |
|---------|---|----------------------|--|---------|
| initial | 0,2 | | 0 | |
| change | -0,002✓ | | +0,002 | +0,002✓ |
| equil | 0,198✓ | | 0,002 | 0,002 |
- $$K_a = \frac{[\text{CH}_3\text{COO}^-][\text{H}_3\text{O}^+]}{[\text{CH}_3\text{COOH}]} = \frac{(0,002)(0,002)}{(0,198)} = 2 \times 10^{-5}$$
- ✓ (5)
- 6.2.6 A reaction which transforms chemical potential energy✓ into thermal energy. ✓ (2)
- 6.2.7 Reverse✓ endothermic✓ reaction will be favoured to lower the temperature✓ $\therefore K_a$ will decrease. ✓ (4)
- [51]
- 7.1.1 $E^\circ_{\text{cell}} = E^\circ_c - E^\circ_a \therefore 1,4 = 1,36 - E^\circ_a \therefore E^\circ_a = -0,04\text{V}$ ✓ $\therefore \text{Fe}/\text{Fe}^{3+}$ ✓ (4)
- 7.1.2 (c/o anode from 7.1.1) $\text{Fe}/\text{Fe}^{3+}(\text{aq}, 1 \text{ mol.dm}^{-3}) \parallel \text{Cl}_2(\text{g}, 1 \text{ atm})/\text{Cl}^-(\text{aq}, 1 \text{ mol.dm}^{-3}) \parallel \text{Pt}$ ✓ at 25°C ✓ order✓ (-1 per error) (5)
- 7.1.3 volts are lost due to internal resistance of cell✓ (1)
- 7.1.4 use a shorter wider salt bridge OR use more concentrated electrolyte in the salt bridge✓✓ (2)
- 7.1.5 AgCl ✓ (1)
- 7.1.6 $[\text{Cl}^-]$ is decreasing✓ $\therefore$ the reaction which makes more Cl^- ✓ i.e. forward reaction, ✓ is favoured (c/o from 7.1.1) (3)
- 7.2.1 electrolytic✓ (1)
- 7.2.2 electrical energy (from power source) being converted into chemical energy✓✓ (2)
- 7.2.3 (a) A✓ (b) B✓ (2)
- 7.2.4 (a) Remains the same✓; Cu^{2+} produced at anode in same ratio as Cu^{2+} deposited at cathode (onto bracelet)✓ $\therefore [\text{Cu}^{2+}]$ remains constant. ✓ (3)
- (b) $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$ ✓✓ (2)
- 7.2.5 (a) it contains precious metals (Ag)✓ (1)
- (b) Ni is stronger RA than Cu✓ $\therefore$ also gets oxidised at anode to form Ni^{2+} ions in solution✓. At the cathode, Cu^{2+} is stronger OA than Ni^{2+} ✓ $\therefore \text{Cu}^{2+}$ is preferentially reduced while Ni^{2+} remains in solution. ✓ (4)
- 7.3.1 Membrane only allows positive ions (Na^+) to pass through✓ $\therefore$ the OH^- ions formed at cathode✓ cannot come into contact with $\text{Cl}_2(\text{g})$ produced at anode. ✓ (3)
- 7.3.2 Y✓; the Cl^- from brine is oxidised✓ to Cl_2 at positive anode (water is reduced at X, the negative cathode) (2)
- 7.3.3 (a) $\text{H}_2(\text{g})$ ✓ (b) $\text{Cl}_2(\text{g})$ ✓ (c) $\text{NaOH}(\text{aq})$ ✓ (3)
- 7.3.4 $2 \text{NaCl} + 2 \text{H}_2\text{O} \rightarrow \text{Cl}_2 + \text{H}_2 + 2 \text{NaOH}$ reac✓ prod✓ bal✓ (3)
- [42]