ACTIVITY MEMORANDA

Organic Chemistry

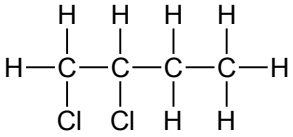
QUESTION 9 THERE ARE ALKYNES OF ANSWERS TO THESE

8.1 There is at least one double/triple bond in the molecule. ✓ (1)

8.2

9.2.1. Addition ✓ (1)

9.2.2. Substitution ✓ (1)

8.3  ✓✓ (2)

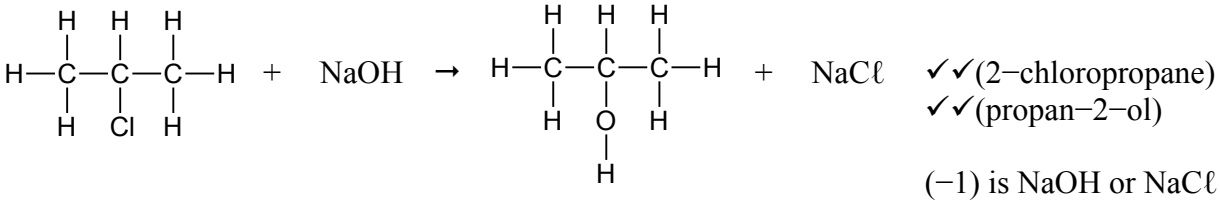
8.4 Heat / UV light ✓ (1)

8.5 Propane ✓ (1)

8.6 HCℓ OR hydrogen chloride ✓ (1)

8.7 Type: elimination ✓
Name: deydrohalogenation ✓ (2)

8.8 Propene ✓✓ (2)

8.9 
✓✓(2−chloropropane)
✓✓(propan−2−ol)

(−1) is NaOH or NaCℓ not written (4)

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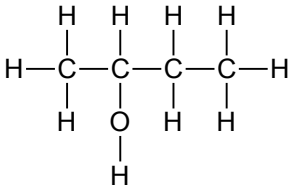
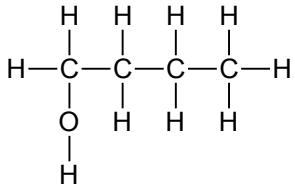
QUESTION 10 YOU'RE ALMOST DONE, YOU'VE SULFURED ENOUGH

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

10.2 Double carbon-carbon bond ✓ (1)

10.3 Elimination ✓ (1)

10.4 Hydration ✓ (1)

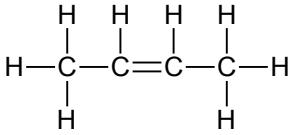
10.5  OR  ✓✓ (2)

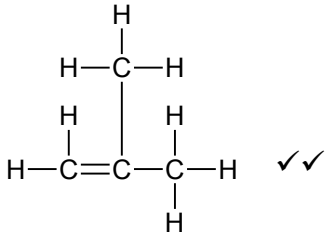
10.6 Estrification ✓ (1)

10.7 Butyl ethanoate ✓✓ (2)

10.8
- Compound W has London forces and compound X has hydrogen bonds ✓
- Hydrogen bonds are stronger than London forces ✓
- Therefore, more energy is needed to separate the molecules of compound X ✓
- Therefore, compound X has a higher viscosity ✓ (4)

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

10.10 
Positional Isomer

OR  ✓✓

Chain Isomer ✓ (3)

10.11 Dehydration ✓ (1)

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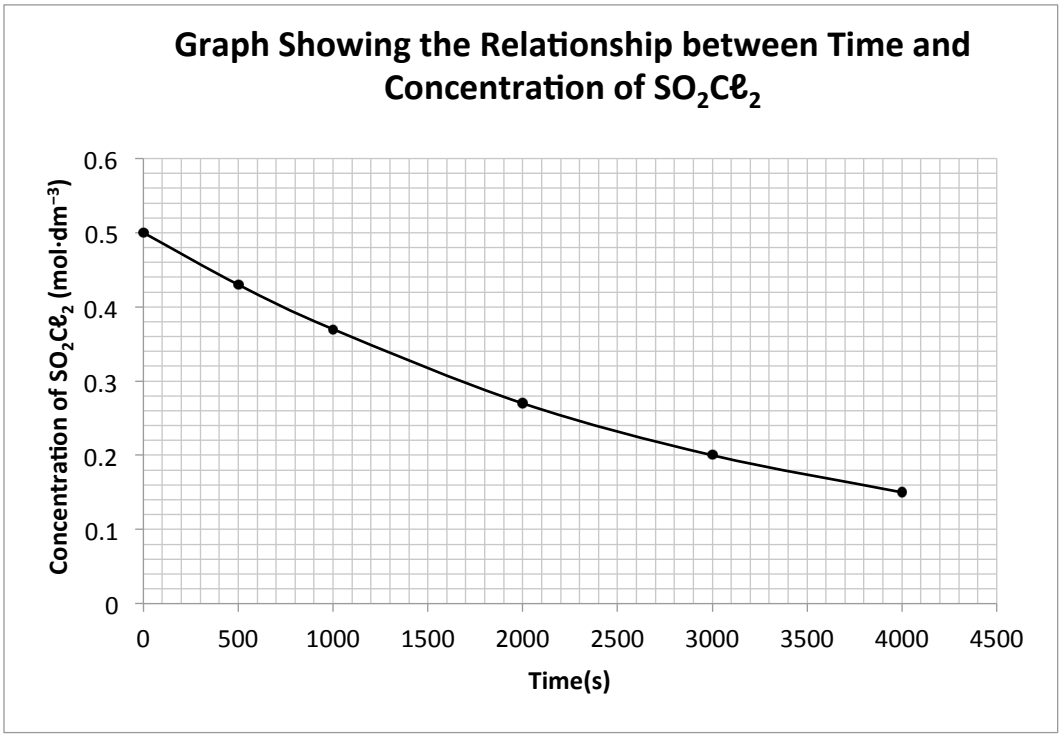
QUESTION 3 CHEMISTS HAVE ALL THE SOLUTIONS

3.1 What is the relationship between time and the concentration of $SO_2C\ell_2$? OR What is the rate of dissociation of $SO_2\ C\ell_2$? ✓ (1)

3.2 Concentration of $SO_2C\ell_2$ ✓✓ (2)

3.3 Temperature / pressure / volume / absence of a catalyst ✓ (1)

3.4



Heading ✓
Scale ✓
Axes labeled ✓
Points ✓✓
Best fit line ✓

(6)

3.5 The instantaneous reaction rate is equal to the gradient of the tangent to the curve ✓✓ (2)

3.6
- As time goes on, the concentration of the $SO_2C\ell_2$ decreases ✓
- Thus, the number of collisions between the reactant particles decreases ✓
- The chance of successful collisions decreases ✓
- Decreasing the reaction rate ✓ (4)

3.7 1 700 s ± 100 s ✓ (1)

3.8 The gradient of the graph would increase ✓ and the final concentration would be reached at a lower time ✓. (2)

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Equilibrium

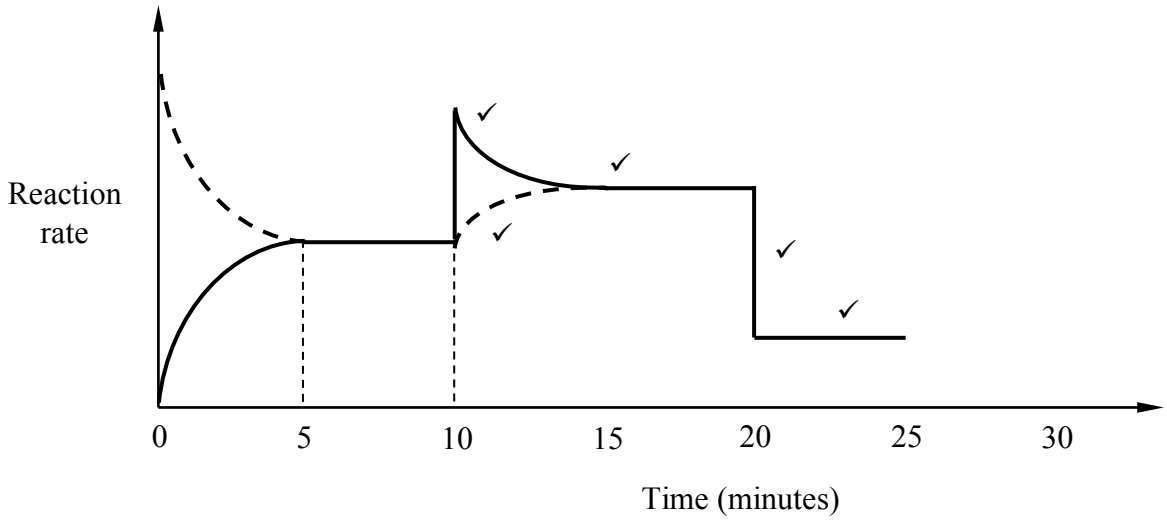
QUESTION 4 I HAVE NO PUNS ABOUT NITROGEN MONOXIDE

4.1 Forward reaction ✓ because the reaction rate increases / there were only products at the start of the reaction ✓ (2)

4.2 K_c <<1 ✓
The amount of reactants are greater than the amount of products ✓ (2)

4.3 5 minutes ✓ (1)

4.4



(5)

4.5 Equal to ✓✓ (2)

4.6
- Both the forward and reverse reaction rates will initially decrease ✓
- The rate of the forward reaction will decrease more as the forward reaction is endothermic ✓
- Thus, the reverse reaction is initially favoured ✓
- Decreasing the yield of NO ✓ (4)

4.7 $K_c = \frac{[NO]^2}{[N_2][O_2]}$ ✓✓ (2)

4.8 Concentrations:

R	N_2	+	O_2	⇌	2NO	
I	0		0		8	✓
C	$+x$		$+x$		$-2x$	✓
E	x		x		$8-2x$	

$K_c = \frac{[NO]^2}{[N_2][O_2]}$
$(4{,}8\times10^{-4}) = \frac{(8-2x)^2}{(x)(x)}$ ✓✓
$x = [N_2] = 3{,}96\ \text{mol·dm}^{-3}$ ✓ (5)

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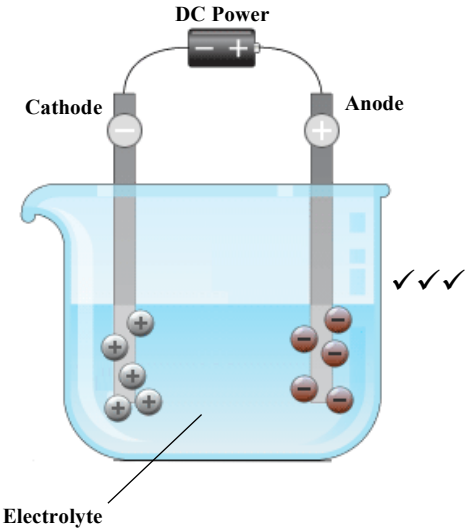
Electrochemistry

QUESTION 6 **IF YOU'RE NOT PART OF THE SOLUTION, YOU ARE PART OF THE PRECIPITATE**

6.1



✓✓✓ (3)

6.2 Electrical energy to chemical energy. ✓✓ (2)

6.3
- H_2O ✓
- Mg^{2+} ✓
- $C\ell^-$ ✓
- H_3O^+ and OH^- ✓ (4)

6.4 The electrode at which oxidation takes place. ✓ (1)

6.5 $2C\ell^- \rightarrow C\ell_2 + 2e^-$ ✓✓ (2)

6.6 The two competing reactions at the cathode are:

$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$ $E^0 = -0,83$ V

$Mg^{2+} + 2e^- \rightarrow Mg$ $E^0 = -2,37$ V

- The reduction potential of H_2O is much more positive than that of Mg^{2+} (OR H_2O is a much stronger oxi
- Despite the fact that there is a very high concentration of Mg^{2+} ions and thus they compete for collisions

6.7 $2H_2O(\ell) + MgC\ell_2(aq) \rightarrow H_2(g) + Mg(OH)_2(aq) + C\ell_2(g)$ ✓✓✓ (3)

6.8 At the anode: bubbles of yellow-green chlorine gas ✓
At the cathode: bubbles of hydrogen gas ✓ (2)

6.9 Cathode: the blue colour is due to the OH^- ions and thus basic solution produced ✓
Anode: the chlorine gas produced here bleaches the electrolyte, i.e. it reacts with and consumes the litmus ✓ (2)

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QUESTION 7 **A SALT AND BATTERY**

7.1 • To change the surface properties, e.g. making the metal more conductive ✓

• To protect the metal from corrosion ✓
• To change its mechanical properties, e.g. make it stiffer or harder (2)

7.2 Cathode ✓ (1)

7.3 $Rh^{3+} + 3e^- \rightarrow Rh$ ✓✓ (2)

7.4 To increase the conductivity of the electrolyte ✓ (1)

7.5 The steel hook would corrode in the acidic electrolyte ✓✓ (2)

7.6 $n(Rh) = \frac{m}{M} = \frac{(0.288)}{(103)} = 2{,}796\times10^{-3}\text{mol}$ ✓conversion ✓
$n(e^-) = n(Rh)\times3 = (2{,}796\times10^{-3})\times3$ ✓$= 8{,}388\times10^{-3}\text{mol}$
$Q = nF = (8{,}388\times10^{-3})(96500)$ ✓ $= 809{,}476\ C$
$\Delta t = \frac{Q}{I} = \frac{(809{,}476)}{(1{,}5)}$ ✓ $= 539{,}65\ s$ ✓ (6)

7.7

7.7.1. In order to ensure the concentration of Rh^{3+} ions remains high, in order to ensure they compete effectively for collisions with the cathode instead of, e.g. H_2O ✓✓ (2)

7.7.2. Rhodium is an extremely expensive metal and so it would cost very much to use a pure rhodium electrode ✓✓. This is not really necessary as the amount of rhodium plated is so small that the concentration of Rh^{3+} ions in the solution would not decrease very much ✓. (3)

[19]

QUESTION 8 THIS IS PRETTY BASIC STUFF

8.1 Concentrated (saturated) sodium chloride solution ✓ (1)

8.2 Any suitable use, e.g. purification of water ✓ (1)

8.3 B – $C\ell_2$ gas ✓
C – H_2 gas ✓
E – (33 %) NaOH solution ✓ (3)

8.4 30 % sodium hydroxide solution ✓ (1)

8.5 It prevents the $C\ell_2$ and H_2 gases from mixing, which would create an explosive mixture OR it prevents the OH^- ions from flowing back into the cathode chamber and reacting with the $C\ell_2$ gas and forming an unstable compound. ✓✓ (2)

8.6 The membrane does not allow $C\ell^-$ ions through ✓ and so the sodium hydroxide is not contaminated with sodium chloride ✓. (2)

[10]

Acids and Bases

QUESTION 5 THE CHEMIST SURVIVED THE FAMINE BY SUBSISTING ON TITRATIONS

5.1 $C_2H_5COOH + H_2O \rightleftharpoons C_2H_5COO^- + H_3O^+$ ✓✓ (2)

5.2 Weak ✓ (1)

5.3 $C_2H_5COOH + NaOH \rightarrow C_2H_5COONa + H_2O$ ✓✓ (2)

5.4 The reaction of a salt with water where water itself is decomposed. ✓✓ (2)

5.5 $C_2H_5COO^- + H_2O \rightleftharpoons C_2H_5COOH + OH^-$ ✓
• The propanoate ion hydrolyses water to a significant extent because propanoic acid is a weak acid and ionizes only partially in solution ✓
• The sodium ion does not hydrolyse water to any significant extent as sodium hydroxide (the product) is a strong base and is always fully dissociated in solution ✓
• Therefore, there is an excess of hydroxide ions in solution, making it basic ✓
• and phenolphthalein should be chosen as the indicator ✓ (5)

5.6 $K_w = [H_3O^+][OH^-]$ ✓
$(10^{-14}) = (2\times0,4)[OH^-]$ ✓✓
$[OH^-] = 1,25\times10^{-14}$ mol·dm^{-3} ✓ (4)

5.7 A logarithmic scale used as a measure of the concentration of hydronium ions in solution. ✓✓ (2)

5.8 Sulfuric acid OR H_2SO_4 ✓✓ (2)

5.9 $HIn + H_2O \rightleftharpoons In^- + H_3O^+$ ✓✓ (2)

5.10 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)

5.11 • The addition of acid results in an increase in the concentration of H_3O^+ ions
• Le Châtelier's principle predicts the system will respond by decreasing the concentration of H_3O^+ ions ✓
• Thus, the reverse reaction is favoured as it consumes H_3O^+ ions ✓
• Thus, the amount of protonated indicator (HIn) increases and the amount of deprotonated indicator (In^-) decreases ✓
• The colour changes from blue to more yellow (green) ✓ (5)

5.12 • $n_{H_2SO_4} = cV = (0,4)(0,02) = 0,008$ mol ✓
• $n_{KOH} = n_{H_2SO_4}\times\frac{2}{1} = (0,008)\times\frac{2}{1} = 0,016$ mol ✓
• $m_{KOH} = nM = (0,016)(56) = 0,896$ g ✓
• $mass\ \% = \frac{0,896}{30\times1}\times100$ ✓ $= 2,99\ \%$ ✓ (5)

Fertilizer Industry

QUESTION 10

10.1 $4NH_3(q) + 5\ O_2(aq)$ ✓⟶ $4NO(g) + 6H_2O(g)$ ✓ ✓ (3)

10.2 Pt or Platinum ✓ (1)

10.3 Catalytic oxidation of NH_3 ✓✓ (2)

10.4 HNO_3 ✓ (1)

10.5 Ostwald (process). ✓ (1)

10.6 - Brown or yellow scorching around the edges of the leaves. ✓
- Flowers become dull and sparse. ✓
- Fruit yield low and of poor quality. (2)

[10]