Practice Question Set For A-Level
Subject : Chemistry
Paper-2 Topic: Alcohols

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Name of the Student:_____
Max. Marks : 21 Marks **Time : 21 Minutes**

Mark Schemes

Q1.

(a) **M1** $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ **1**

M2 $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$
Allow C_2H_6O for ethanol formula **1**

M3 $2C_2H_5OH + 6O_2 \rightarrow 4CO_2 + 6H_2O$
M1/2/3 *allow multiples*
M3 *$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$* **1**

M4 explains with reference to relevant equations that formation of $C_6H_{12}O_6$ takes in $6CO_2$ and fermentation and combustion of ethanol gives out $6CO_2$
M4 *depends on having appropriate equations in* ***M1/2/3*** *showing 6 CO_2 in and out* **1**

(b) transport (from South America to Europe) produces CO_2 / has C emissions / has larger C footprint
Process to separate ethanol from propanone and butan-1-ol produces CO_2 / has C emissions / has larger C footprint **1**

(c) **M1** 685.5 (686), 668(.25), 595(.33…) in third column of table
M1 *ignore any minus sign on values* **1**

M2 depends on their answer to **M1** − must be the compound giving most energy per mole of CO_2 released (correct **M1** would give ethanol)
M2 *need evidence of attempt to calculate energy released per C atom (i.e. per mole of CO_2 formed)* **1**

(d) **M1** amount propanone = $\frac{1.18}{58.0}$ (= 0.0203 mol) **1**

M2 q = **M1** × 1786 (= 36.3 kJ = 36300 J) **1**

M3 $\Delta T \left(= \frac{q}{mc} = \frac{\text{M2 (in J)}}{260 \times 4.18}\right)$ = 33.4 (°C) (allow 32.8-33.4)
M3 *ignore sign*

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1

M4 final temperature = (22.3 + **M3**) = 55.7 (°C) (allow 55-596)

__M4__ must show a temperature rise

1

Correct answer scores 4 marks

Allow ECF at each stage

(e) **M1** correctly showing how many of which types of bonds are broken / made
(broken) 3(C-C) + 9(C-H) + (C-O) + (O-H) + 6(O=O)
(made) 8(C=O) + 10(O-H)

__M1__ could show broken as:
3(C-C) + 9(412) + (360) + (463) + 6(496)
or 7507 + 3(C-C)
and, could show made as
8(805) + 10(463)
or 11070

1

M2 (bonds broken) − (bonds made) = −2504
7507 + 3(C-C) − 11070 = −2504
3(C–C) = 1059

Allow ECF from __M1__ to __M2__

Ignore incorrect number of C-C bonds in __M1/2__, but should be 3 for __M3__

1

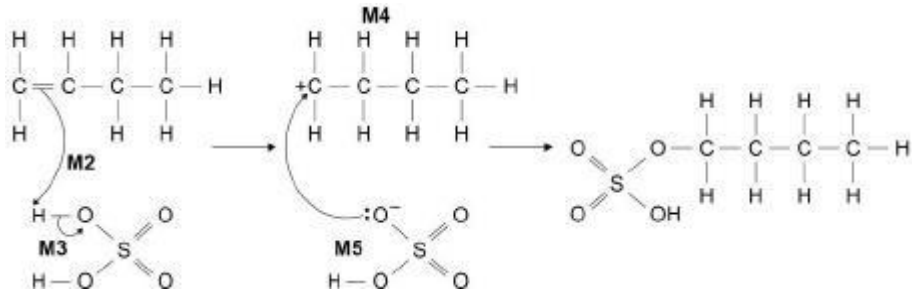
M3 (C–C) = $\frac{\text{M2}}{3}$ = 353 (kJ mol^{-1})

Allow ECF from __M2__ to __M3__ (if __M2__ is negative value, then ignore sign for __M3__)

1

Correct answer scores 3 marks;
265 scores 2 marks if from 4(C-C) bonds
1188 scores 2 marks (not included −2504)
2022 scores 2 marks (using (made − broken))
−353 scores 2 marks
±834 scores 2 marks (use of C-O in CO_2)
±836 scores 1 marks (use of C-O in CO_2 and using (made − broken))

(f) **M1** electrophilic addition



1

M2 must show an arrow from the double bond towards the H atom of the H_2SO_4 molecule

__M2__ ignore partial negative charges on the double bond

1

M3 must show the breaking of the H-O bond in H_2SO_4

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M3 *penalise incorrect partial charges on the H–O bond and penalise formal charges*

1

M4 is for the structure of the correct carbocation

*Penalise **M4** if there is a bond drawn to the positive charge*

1

M5 must show an arrow from the lone pair of electrons on the correct oxygen of HSO_4^- towards the positively charged atom of their carbocation drawn

1

*All arrows are double-headed. Penalise one mark from the total for **2-5** if half headed arrows are used*

Do not penalise the "correct" use of "sticks"

Penalise only once in any part of the mechanism for a line and two dots to show a bond

*For **M2 / 3**, the full structure of H_2SO_4 does not need to be shown, but the key features for the mechanism should be shown and the formula must be correct. Penalise only once in **M2 / 3** an incorrect but genuine attempt at the structure of sulfuric acid*

***Max 3 of 4 marks (M2-5)** for wrong organic reactant or wrong carbocation (ignore structure of product)*

*If attack is shown from C=C to H^+ rather than H_2SO_4, then allow **M2** but not **M3***

*For **M5**, credit attack on a partially positively charged carbocation structure, but penalise **M4** for the structure of the carbocation*

*For **M5**, the full structure of HSO_4^- is not essential, but attack must come from a lone pair on an individual oxygen on HSO_4^-, but the – sign could by anywhere on the ion (eg :OSO_3H^-)*

(g) **M1** formed from less stable carbocation

***M1** must be clear that it is the stability of the carbocation that matters rather than the stability of the alcohol*

1

M2 formed from primary rather than secondary carbocation

***M2** allow 1 mark for primary carbocation is less stable than secondary carbocation even if not clear that product is formed from a carbocation (but must be clear that the alcohols are not the carbocations)*

1

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