EXAM PAPERS PRACTICE

Boost your performance and confidence with these topic-based exam questions

Practice questions created by actual examiners and assessment experts

Detailed mark scheme

Suitable for all boards

Designed to test your ability and thoroughly prepare you

Time allowed
55 Minutes

Score /46

Percentage %

CHEMISTRY

AQA
AS & A LEVEL

Mark Scheme

3.1 Physical chemistry

1 (a) (i) M1 c(oncentrated) phosphoric acid / c(onc.) H_3PO_4
OR c(oncentrated) sulfuric acid / c(onc.) H_2SO_4

*In **M1**, the acid must be concentrated.*
Ignore an incorrect attempt at the correct formula that is written in addition to the correct name.

M2 Re-circulate / re-cycle the (unreacted) ethene (and steam) / the reactants
OR pass the gases over the catalyst several / many times

*In **M2**, ignore "remove the ethanol".*
Credit "re-use".

2

(ii) M1
(By Le Chatelier's principle) the equilibrium is driven / shifts / moves to the right / L to R / forwards / in the forward direction

M2 depends on a correct statement of M1
The equilibrium moves / shifts to

- oppose the addition of / increased concentration of / increased moles / increased amount of water / steam
- to decrease the amount of steam / water

Mark M3 independently
M3 Yield of product / conversion increase ***OR*** ethanol increases / goes up / gets more

3

(iii) M1 Poly(ethene) / polyethene / polythene / HDPE / LDPE

M2 At higher pressures
More / higher cost of electrical energy to pump / pumping cost
OR
Cost of higher pressure equipment / valves / gaskets / piping etc.
OR expensive equipment

*Credit all converse arguments for **M2***

2

(b) M1 for balanced equation

M2 for state symbols in a correctly balanced equation

$$2C(s \text{ / graphite}) + 3H_2(g) + \tfrac{1}{2}O_2(g) \longrightarrow CH_3CH_2OH(l)\ (C_2H_5OH)$$

Not multiples but credit correct state symbols in a correctly balanced equation.

Penalise C_2H_6O but credit correct state symbols in a correctly balanced equation.

2

(c) (i) M1 The enthalpy change / heat change at constant pressure when 1 mol of a compound / substance / element

*If standard enthalpy of formation **CE=0***

M2 is burned / combusts / reacts completely in oxygen
OR burned / combusted / reacted in excess oxygen

M3 with (all) reactants and products / (all) substances in standard / specified states
OR (all) reactants and products / (all) substances in normal states under standard conditions / 100 kPa / 1 bar and specified T / 298 K

*For **M3***
Ignore reference to 1 atmosphere

3

(ii) M1

Correct

answer gains full marks

<u>ΣB(**reactants**) − ΣB(**products**) = *ΔH*</u>

Credit 1 mark for (+) 1279 (kJ mol^{-1})

OR
<u>Sum of bonds broken − Sum of bonds formed = ΔH</u>
OR
B(C-C) + B(C-O) + B(O-H) + 5B(C-H) + 3B(O=O) (LHS)
− 4B(C=O) − 6B(O−H) (RHS) = <u>*ΔH*</u>

M2 (also scores **M1**)
348+360+463+5(412)+3(496) [LHS = **4719**]
(2060) (1488)
− 4(805) − 6(463) [RHS = − **5998**] = *ΔH*
(3220) (2778)
OR using only bonds broken and formed (**4256 − 5535**)

For other incorrect or incomplete answers, proceed as follows

- *check for an arithmetic error (AE), which is either a transposition error or an incorrect multiplication; this would score 2 marks (**M1** and **M2**)*
- *If no AE, check for a correct method; this requires either a correct cycle with 2C and 6H and 7O OR a clear statement of **M1** which could be in words and scores <u>**only M1**</u>*

M3
ΔH= <u>**− 1279**</u> (kJ mol^{-1})

*Allow a maximum of one mark if the only scoring point is LHS = 4719 **OR** RHS = 5998*

Award 1 mark for +1279

Candidates may use a cycle and gain full marks

3

(d) (i) Reducing agent ***OR*** reductant ***OR*** electron donor
OR to reduce the copper oxide

Not "reduction".

Not "oxidation".

Not "electron pair donor".

1

(ii) CH_3COOH

1

[17]

2 (a) $q = 500 \times 4.18 \times 40$

Do not penalise precision.

1

$= 83600$ J

Accept this answer only.
Ignore conversion to 83.6 kJ if 83600 J shown.
Unit not required but penalise if wrong unit given.
Ignore the sign of the heat change.
An answer of 83.6 with no working scores one mark only.
An answer of 83600 with no working scores both marks.

1

(b) Moles (= 83.6 / 51.2) = 1.63

Using 77400 alternative gives 1.51 mol
Allow (a) in kJ / 51.2
Do not penalise precision.

1

Mass = 1.63 × 40(.0) = 65.2 (g)

Allow 65.3 (g)

Using 77400 alternative gives 60.4 to 60.5
Allow consequential answer on M1.
1 mark for M_r (shown, not implied) and 1 for calculation.
Do not penalise precision.

2

(c) Molarity = 1.63 / 0.500 = 3.26 mol dm–3

Allow (b) M1 × 2

Using 1.51 gives 3.02

1

(d) Container splitting and releasing irritant / corrosive chemicals

Must have reference to both aspects; splitting or leaking (can be implied such as contact with body / hands) ***and*** *hazardous chemicals.*

Allow 'burns skin / hands' as covering both points

Ignore any reference to 'harmful'.

Do not allow 'toxic'.

1

(e) (i) $4Fe + 3O_2 \rightarrow 2Fe_2O_3$

Allow fractions / multiples in equation.

Ignore state symbols.

1

(ii) Iron powder particle size could be increased / surface area lessened

Decrease in particle size, chemical error = 0 / 3

Change in oxygen, chemical error = 0 / 3

1

Not all the iron reacts / less reaction / not all energy released / slower release of energy / lower rate of reaction

Mark points M2 and M3 independently.

1

Correct consequence of M2

An appropriate consequence, for example

- *too slow to warm the pouch effectively*

- *lower temperature reached*
- *waste of materials*

1

(f) (i) Conserves resources / fewer disposal problems / less use of landfill / fewer waste products

Must give a specific point.

Do not allow 'does not need to be thrown away' without qualification.

Do not accept 'no waste'.

1

(ii) Heat to / or above 80 °C (to allow thiosulfate to redissolve)

Accept 'heat in boiling water'.

If steps are transposed, max 1 mark.

1

Allow to cool before using again

Reference to crystallisation here loses this mark.

1

[14]

3 (a) (i) $2C_6H_{12}O_6 \longrightarrow 3CH_3COCH_3 + 3CO_2 + 3H_2O$

Or multiples

1

(ii) to speed up the reaction
OR
(provide a) catalyst or catalyses the reaction or biological catalyst
OR
release / contain / provides an enzyme

Ignore "fermentation"

Ignore "to break down the glucose"

Not simply "enzyme" on its own

1

(b) (i) $CH_3CH(OH)CH_3 + [O] \longrightarrow CH_3COCH_3 + H_2O$

Any correct representation for the two organic structures.
Brackets not essential.

Not "sticks" for the structures in this case

1

(ii) Secondary (alcohol) OR 2° (alcohol)

1

(c) **M1** $q = m\ c\ \Delta T$

OR $q = 150 \times 4.18 \times 8.0$

Award full marks for correct answer

*In **M1**, do not penalise incorrect cases in the formula*

M2 = (±) 5016 (J) ***OR*** 5.016 (kJ) ***OR*** 5.02 (kJ)
(also scores M1)

M3 This mark is for dividing correctly the number of kJ by the number of moles and arriving at a final answer in the range shown.
Using 0.00450 mol

therefore ΔH = **− 1115** (kJ mol^{-1})

***OR* − 1114.6 to − 1120** (kJ mol^{-1})

Range (+)1114.6 to (+)1120 gains 2 marks

BUT − 1110 gains 3 marks and +1110 gains 2 marks

AND − 1100 gains 3 marks and +1100 gains 2 marks

Award full marks for correct answer

*In **M1**, do not penalise incorrect cases in the formula*

*Penalise **M3** ONLY if correct numerical answer but sign is incorrect; **(+)1114.6 to (+)1120 gains 2 marks***

*Penalise **M2** for arithmetic error and mark on*

If ΔT = 281; score q = m c ΔT only

*If c = 4.81 (leads to 5772) penalise **M2** ONLY and mark on for **M3** = − 1283*

*Ignore incorrect units in **M2***

*If units are given in **M3** they must be either kJ or kJ mol^{-1} in this case*

3

(d) **M1** The enthalpy change / heat change at constant pressure when 1 mol of a compound / substance / element

M2 is burned / combusts / reacts completely in oxygen
OR
burned / combusted / reacted in excess oxygen

M3 with (all) reactants and products / (all) substances in standard / specified states

OR
(all) reactants and products / (all) *substances in normal states under standard conditions* / 100 kPa / 1 bar and specified T / 298 K

*For **M3***

Ignore reference to 1 atmosphere

3

(e) **M1**
$\sum$ B **(reactants)** − $\sum$ B **(products)** = Δ*H*
OR
Sum of bonds broken − Sum of bonds formed = Δ*H*
OR
2B(C−C) + B(C=O) + 6B(C−H) + 4B(O=O) (LHS)

− 6B(C=O) − 6B(O−H) (RHS) = Δ*H*

M2 (also scores **M1**)
2(348)+805+6(412)+4(496) [LHS = **5957**]

(696) (2472) (1984)

− 6(805) − 6(463) [RHS = (−) **7608**] = Δ*H*

(4830) (2778)

OR using only bonds broken and formed (**5152 − 6803**)

M3
ΔH= **− 1651** (kJ mol^{-1})

Candidates may use a cycle and gain full marks.

Correct answer gains full marks

Credit 1 mark for (+) 1651 (kJ mol^{-1})

For other incorrect or incomplete answers, proceed as follows

- *check for an arithmetic error (AE), which is either a transposition error or an incorrect multiplication / addition error; this would score 2 marks (**M1** and **M2**)*
- *If no AE, check for a correct method; this requires either a correct cycle with $4O_2$, $3CO_2$ and $3H_2O$ OR a clear statement of **M1** which could be in words and scores **only M1***

Allow a maximum of one mark if the only scoring point is LHS = 5957 (or 5152) OR RHS = 7608 (or 6803)

Award 1 mark for + 1651

3

(f) **For the two marks M1 and M2, any two from**

- heat loss or not all heat transferred to the apparatus or heat absorbed by the apparatus or (specific) heat capacity of the apparatus not considered
- incomplete combustion / not completely burned / reaction is not complete
- The idea that the water may end up in the gaseous state (rather than liquid)
- reactants and / or products may not be in standard states.
- MBE data refers to gaseous species but the enthalpy of combustion refers to liquids in their standard states / liquid propanone and liquid water in standard states
- MBE do not refer to specific compounds OR MBE values vary with different compounds / molecules OR are average / mean values taken from a range of compounds / molecules

Apply the list principle but ignore incomplete reasons that contain correct chemistry

Ignore "evaporation"

Ignore "faulty equipment"

Ignore "human error"

Not enough simply to state that "MBE are mean / average values"

2

[15]