MEGA LECTURE

TOPIC 4 TEST MS

1. (a) enthalpy (or energy) to break (or dissociate) a bond; **1**

averaged over different molecules (environments); **1**

enthalpy (or heat energy) change when one mole of a compound; **1**

is formed from its elements; **1**

in their standard states; **1**

(b) enthalpy change = Σ(bonds broken) – Σ(bonds formed) or cycle; **1**

= 4 × 388 +163 + 2 × 146 + 4 × 463 – (944 + 8 × 463); *(or similar)* **1**

= –789; **1**

(+ 789 scores 1 only)

(c) (i) zero; **1**

(ii) *AH* = Σ (enthalpies of formation of products) –Σ (enthalpies of formation of reactants) **1**

= 4 × –242-(75 + 2 × –133); **1**

= –777; **1**

(+ 777 scores one only)

(d) mean bond enthalpies are not exact **1**

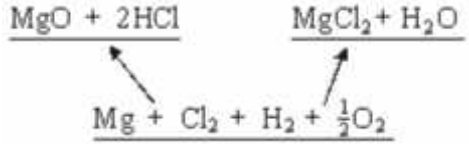
(or indication that actual values are different from real values)

[13]

2. (a) enthalpy change (or enthalpy of reaction) is independent of route **(1)**

$\Delta H = \Sigma\Delta H_f$ prods - $\Sigma\Delta H_f$ reactants (or cycle) **(1)**

minimum correct cycle is:



ΔH = -642 – 286 – (–602 + 2 × –92) **(1)**

= –142 (kJ mol^{-1}) **(1)**

penalise this mark for wrong units

+142 scores 1 mark out of the last three

4

(b) $\Delta H = mcT$ **(1)** (or $mc\Delta T$)

= 50 × 4.2 × 32 = 6720 J = 6.72kJ **(1)**

mark is for 6720 J or 6.72 kJ

moles HCl = $\frac{\text{vol}}{1000}$ × conc = $\frac{50}{1000}$ × 3 **(1)**

= 0.15 **(1)**

if error here mark on conseq.

Therefore moles of MgO reacted = moles HCl/2 **(1)**

(mark is for /2, CE if not /2)

= 0.15/2 = 0.075

Therefore ΔH = 6.72/0.075 **(1)**

= –90 kJ (mol^{-1})

kJ must be given, allow 89 to 91

*value **(1)***

*sign **(1)**; this mark can be given despite CE for /2*

8

Note various combinations of answers to part (c) score as follows:

–89 to –91 kJ **(8)** (or –89000 to 91000J)

*no units **(7)***

+89 to +91 kJ **(7)** (or + 89000 to +91000J)

*no units **(6)***

–44 to –46 kJ **(5)** (or -44000 to -46000J)

*no units **(4)** if units after 6.72 or 6720 (5)*

+44 to +46 kJ **(4)** (or +44000 to + 46000)

if no units and
*if no units after 6.72 or 6720 **(3)***
*otherwise check, could be **(4)***

[12]

3. (a) (i) $1/2\ N_2 + 3/2\ H_2 \rightarrow NH_3$ **(1)**

Ignore s s

(ii) ΔH = (Σ)bonds broken – (Σ)bonds formed **(1)**
= 1/2 × 944 + 3/2 × 436 – 3 × 388 **(1)**
= –38 kJ mol^{-1} **(1)**

Ignore no units, penalise wrong units
Score 2/3 for -76
1/3 for +38
Allow 1/3 for +76

4

(b) 4 (C–H) + (C=C) + (H–H) – (6 (C–H) + (C–C)) = –136 **(1)**
OR (C=C) + (H–H) – ((C–C) + 2 (C–H)) = –136
2 (C–H) = 836 **(1)**
(C–H) = 418 (kJ mol^{-1}) **(1)**

Note: allow (1) for –836
another (1) for –418
→

3

[7]

4. (a) $C_3H_6O + 4O_2 \rightarrow 3CO_2 + 3H_2O$ **(1)** (or multiple) 1

$\frac{1.45}{58}$

(b) (i) **(1)** = 0.0250 **(1)**

allow 0.025
allow conseq on wrong M_r

1.45/100, CE; $\frac{1.45}{58.1}$ *C.E.*

(ii) heat released = mcΔT
= 100 × 4.18 × 58.1 **(1)**

if 1.45 used in place of 100 CE = 0

= 24300 J **(1)** (or 24.3kJ)

allow 24200 to 24300
ignore decimal places
units tied to answer

If use 0.1 × 4.18 × 51.8 allow ½ for 24.3 with no

units

(iii) $\frac{24.3}{0.0250}$ = –972 (kJ mol^{-1}) **(1)**

allow –968 to –973
allow +972
allow conseq
allow no units
penalise wrong units

5

(c) (i) Heat loss **(1)** or energy loss

do not allow incomplete combustion

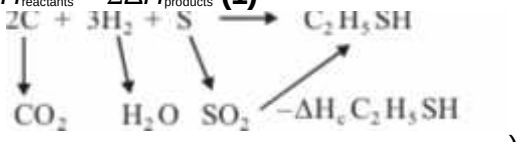
(ii) *Difference*: more negative **(1)** (or more exothermic)

QoL mark

Explanation: heat (*or energy*) released when water vapour condenses **(1)**
or heat/energy required to vaporise water
or water molecules have more energy in the gaseous state

3

(d) $\Delta H = \Sigma \Delta H_{reactants} - \Sigma \Delta H_{products}$ **(1)**



(or cycle)

$= (2 \times -394) + (3 \times -286) + (-297) - (-1170)$ **(1)**
$= -773$ **(1)**

ignore units even if wrong

Allow 1/3 for +773

3

[12]

5. D **[1]**

6. D **[1]**

7. B **[1]**

8. C **[1]**

9. A **[1]**

10. A **[1]**