

MARK SCHEME

GCSE

CHEMISTRY

AQA - COMBINED SCIENCE

C5 - TEST 5

ENERGY CHANGES

Advanced

Mark schemes

- 1.** rises as energy needed for bond breaking (of reactants) 1
- called activation energy **or** correctly labelled on diagram 1
- bond making (to form products) releases energy 1
- called exothermic reaction **or** more energy given out than taken in **or** releases heat to the surroundings 1
- [4]**

- 2.** (a) *correct answer with or without working = 3 marks*
- M1: (bonds broken) = 2148 (kJ) 1
- M2: (bonds made) = 2354 (kJ) 1
- M3: change in energy
= (-) 206 (kJ)
ecf
ignore sign 1
- (b) energy released from forming new bonds is greater than energy needed to break existing bonds
- allow the energy needed to break bonds is less than the energy released in forming bonds*
- do **not** accept energy needed to form bonds* 1

[4]

- 3.** (a) (i) $\Delta T = (64 - 17) = 47 \text{ }^\circ\text{C}$ 1
- $750 \times 4.2 \times 47$
allow ecf using their ΔT 1
- 148 050
*correct answer gains 3 marks with **or** without working*
ignore sign
allow 148.05 kJ
allow 148 kJ 1

1

(ii) 1085.7

correct answer gains 2 marks with or without working.

allow answer in range 1080 – 1089 for 2 marks

allow answer in range 1080000 – 1089000 for 1 mark

if answer is incorrect allow $6/44 = 0.136$ mol for 1 mark

allow $(44 \times \text{their (a)(i)}) / (6 \times 1000)$ correctly calculated for 2 marks

allow $(44 \times \text{their (a)(i)}) / 6$ correctly calculated for 1 mark

If they have used the given value of 144 000:

Allow any answer in range 1051 - 1059 for 2 marks with or without working.

allow any answer in range 1051000 – 1059000 for 1 mark

2

(iii) repeat the experiment and then calculate the mean

1

any **one** from:

- use a lid
- insulate the beaker
*do **not** allow flammable insulation*
- stir
- prevent draughts

1

(iv) inaccuracies likely to have similar effects

allow systematic errors

1

(b) (i) 8530

correct answer gains 3 marks with or without working.

If answer is incorrect;

$(6 \times 803) = \underline{4818}$ gains 1 mark

$(8 \times 464) = \underline{3712}$ gains 1 mark

correct addition of their calculated values gains 1 mark (ecf)

3

(ii) $6481 - 8530 = (-) 2049$

ignore sign

allow ecf from (b)(i)

1

[12]

4.

(i) Bonds broken

4 × (C – H)

2 × (O = O)

each for 1 mark

Bonds formed

2 × (C = O)

4 × (O – H)

each for 1 mark

4

(ii) Total energy change in breaking bonds

(4 × 413) + (2 × 498)

each gains 1 mark

Total energy change in forming bonds

(2 × 805) + (4 × 464)

but

to break bonds = 2648

to form bonds = 3466

each gains 2 marks

4

(iii) nett energy transfer = 818 (kJ)

this energy is released in the reaction/is an exothermic reaction

(credit answers consistent with (ii) or derived from the initial information)

each for 1 mark

2

[10]

5.

(a) (i) (-)810

ignore sign

correct answer gains 3 marks with or without working

if the answer is incorrect look at the working up to a maximum of two

• *bonds broken = (4 × 414) + (2 × 498) = 2652 kJ*

• *bonds formed = (2 × 803) + (4 × 464) = 3462 kJ*

• *correct subtraction of their bonds formed from their bonds broken*

3

(ii) because energy needed to break the bonds

1

is less than the energy released when bonds are formed

1

(b) to provide activation energy

or

to break bonds

1

[6]

6.

(a) energy of product greater than energy of reactants

allow converse

allow energy = heat

*do **not** accept temperature for energy*

allow product / nitrogen oxide is higher than reactants

allow less energy / heat given out than taken in

allow energy / heat is taken in / gained

allow ΔH is positive

1

(b) (minimum) energy needed to start the reaction / overcome energy barrier

accept (minimum) energy needed for a collision to be successful

1

(c) (i) *correct answer with or without working= 3 marks*

bonds broken = $945 + 498 = 1443$ (kJ)

1

bonds made = $2 \times 630 = 1260$ (kJ)

1

energy change = $1443 - 1260 = (+) 183$

ignore sign

allow ecf

1

(ii) energy released forming new bonds is less than energy needed to break existing bonds owtte

allow converse

accept energy change (ΔH) is + / positive

*do **not** accept energy needed to form new bonds is less than energy needed to break existing bonds*

1

[6]

7.

(a) $(1) + 3 \rightarrow 2 + 3$

accept correct multiples

1

- (b) any **three** from
- to react particles must collide
 - with sufficient energy
 - reference to activation energy
 - (to cause) bond breaking
- 3
- (c) (i) $(436 \times 2) + 498$
- 1
- $= 1370$ (kJ)
- accept $(436 \times 2) + 498$ or 934 kJ for one mark*
- allow 2 marks for 1370 if no working*
- or correct working is shown*
- 1
- (ii) calculation of bond energy or product
- 1
- $464 + 464 = 928 \times 2 = 1856$
- incorrect calculation = 0 marks*
- correct deduction
- allow deduction on ecf exothermic / endothermic on own without calculation are neutral*
- 1

[8]

8.

- (a) breaking of C-H bonds
 breaking of O-O bonds
 making of C-O bonds
- for 1 mark each*
- making of H-O bonds
- 4
- (b) X energy needed to break bonds
 has to be **supplied**/activation energy
- Y energy released when bonds form
- Z = Y-X
- overall, energy is released/reaction is exothermic
- each for 1 mark*
- 5

[9]

9.

ideas that

- x = the energy required / taken in / used* to break the bonds of water / reactant [*not used up / formed]
gains 1 mark
 - **but** = the energy required taken in / used to break the bonds in water **or** activation energy
gains 2 marks
 - y = the energy released given out when bonds form
gains 1 mark
 - **but** = the energy released / given out when hydrogen / oxygen form
gains 2 marks
 - $z = 1856 - 1370$ or $(+)486$ kJ
for 1 mark
- or** difference between x and y **or** net energy transferred
- overall, energy is taken in / absorbed in the reaction
or the reaction is endothermic **or** energy required to break existing bonds is $>$ energy released when new bonds form
for 1 mark

[6]

10.

- (a) *idea that*
existing bonds must first be broken
for 1 mark

(*credit* molecules / atoms more likely to react when they collide)
energy is released when new bonds form
gains 1 mark

but more energy is released when new bonds form
gains 2 marks

or overall reaction exothermic
this breaks more bonds so the reaction continues
for 1 mark

max 4

- (b)
- reactant level higher than product level (names of reactants and products not required)
 - indication that activation energy required (i.e. the “hump”)
 - any correct indication of nett energy change

(i.e. between product and reactant levels even if other marks not gained)

for 1 mark each

3

[7]