GCSE
CHEMISTRY

Topic Paper: 5.1 Exothermic and endothermic reactions
Part 1 & 2 Mark Scheme

MARK SCHEME

78 Marks

M1. (a) (i) energy / heat of products less than energy of reactants

allow converse

allow products are lower than reactants

allow more energy / heat given out than taken in

allow methanol is lower

allow energy / heat is given out / lost

allow ΔH is negative

1

(ii) lowers / less activation energy

allow lowers energy needed for reaction
***or** it lowers the peak/ maximum*

*do **not** allow just 'lowers the energy'*

1

(b) (i) (8 ×435) + 497 = 3977

accept: bonds broken: (2 ×435) + 497 = 1367

1

(6 ×435) + (2 ×336) + (2 ×464) = 4210

bonds made: (2 ×336) + (2 ×464) = 1600

1

3977 – 4210 = (–) 233

energy change:

1367 – 1600 = (–) 233

ignore sign

allow ecf

*correct answer (233) = **3** marks with or without working*

1

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

allow converse

*do **not** accept energy needed to form (new) bonds greater than energy needed to break (existing) bonds*

1

[6]

M2. (a) (i) A

1

(ii) B

1

(b) (i) put a lid on (beaker)

any addition to the equipment that would prevent energy loss

or

insulate (top or sides of) beaker

or

use screens to prevent draughts

allow bomb calorimeter

*do **not** allow polystyrene cup*

ignore 'move the crucible'

1

(ii) (temperature change =) 22℃

*correct answer is **2** marks with or without working*

1

(100 ×4.2 ×22 =) 9240

allow ecf from their 22

1

(iii) any **two** from:

a specified
human/measurement error

ignore 1g of glucose insufficient

ignore 100cm^3 of water too much

ignore calculation error

ignore not repeated / anomalous results

water should be stirred

allow thermometer in fixed position

not all of the glucose burns

allow glucose was impure

energy used to heat the
beaker / container

ignore light energy / evaporation

recorded the room temperature (at the beginning)

allow room temperature was higher/different to the temperature of the (cold) water

allow did not measure the water temperature at the beginning

2

(c) any **one** from:

for dietary information

allow consequences of diet

allow for nutritional information

allow eat healthily

ignore balanced diet

ignore to know how much energy is taken in

different foods produce
different amounts of energy

legal requirement

1

[8]

M3. (a) A = energy / enthalpy change / difference

*allow heat change **or** ΔH*

allow energy released

1

B = activation energy / EA

allow definition of activation energy

1

C = carbon dioxide and water

accept products

1

(b) exothermic

allow combustion / redox / oxidation

ignore reduction / burning

1

[4]

M4. (a) either:

calculations: all correct (ethanol = 6, methanol = 3, peanut oil = 10, vegetable oil = 15)

ignore repetition of data from table unqualified

or

implication of correct calculation

(vegetable oil) gives largest temperature / heat increase per gram (owtte)

*allow 'produced most heat in proportion to the fuel used' owtte for **1** mark*

2

(b) any **one** from:

owtte

smoke

ignore references to crops/food

soot

carbon

carbon monoxide

carbon dioxide

global warming / climate change / greenhouse gases

(air) pollution

harmful/poisonous

1

scrub / wash the gases owtte

filter / remove (gases / fumes / appropriate named substance) owtte

(add extra oxygen) can burn more efficiently owtte

use a cleaner fuel owtte

plant more trees or similar linked to CO_2

any sensible answer

'don't burn so much fuel' insufficient alone

ignore extractor fans / air conditioning

1

(c) (i) A

1

(ii) B

1

[6]

M5. (a) low density;
gives out light energy when burnt;
combustion product is not harmful;

any two for 1 mark each

2

(b) attempt to add bond energies;
e.g. adding O-H bond energies
answer = 4 ×464 = 1856

for 1 mark each

2

(c) (i) Group 1:
elements in a group have the same number of electrons in outer shell
first because only one electron
or Group 7:
because needs one electron to complete outer shell

for 1 mark each

2

(ii) forms H^+ ion

for 1 mark

1

(iii) forms molecules;
low melting point (gases);
or form covalent bonds forms H^- ion

for 1 mark

1

[8]

M6. (a) eg plastic (beaker) / insulation / lid / cover **or** any mention of enclosed

any sensible modification to reduce heat loss
ignore prevent draughts
ignore references to gas loss

1

(b) all the substances react **or** all (the substances) react fully / completely **or** heat evolved quickly **or** distribute heat

accept to mix them
'so they react' is insufficient for the mark
accept increase chances of (successful) collisions / collision rate increase
*do **not** accept rate of reaction increase / make reaction faster*

1

(c) experiment 2 **and** different / higher / initial / starting temperature

*accept experiment 2 **and** the room is hotter / at higher temperature*
*do **not** accept temperature change / results higher*

1

(d) temperature change does not fit pattern

*accept anomalous / odd **or** it is the lowest **or** it is lower than the others **or** it is different to the others*
'results are different' is insufficient

1

(e) 7 / 7.0

1

(f) (100 ×4.2 ×7) = 2940

ecf from (e)

1

(g) diagram A **and** reaction exothermic / heat evolved / Δ H is negative / temperature rises

accept energy is lost (to the surroundings)

1

[7]

M7. (a) (i) ΔT = (64 – 17) = 47 ℃

1

750 x 4.2 x 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

(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 x their (a)(i))/(6 x 1000) correctly calculated for **2 marks***

*allow (44 x 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 x 803) = 4818 gains 1 mark
(8 x 464) = 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]

M8. (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 = (2x803) + (4x464) = 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]

M9. (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]

M10. $\frac{17.6}{44}$ (moles) **or** 0.4 (moles) CO_2

1

$\frac{7.2}{18}$ (moles) **or** 0.4 (moles) H_2O

1

empirical formula = CH_2

allow 1C:2H

***or** correct simplest ratio related to elements*

***or** ecf from previous stage*

allow this mark for correct formula alone

1

[3]

M11. (a) electrical

1

(b) using hydrogen saves petrol / diesel / *crude oil*

allow crude oil is non-renewable

ignore hydrogen is renewable

1

using hydrogen (in fuel cells) does not cause pollution

accept no carbon dioxide produced

allow less carbon dioxide produced

allow hydrogen produces only water

1

(c) (i) (–)486

*correct answer with or without working gains **3** marks*

if answer is incorrect:

*(2 ×436) + 498 **or** 1370 gains **1** mark*

*4 ×464 **or** 1856 gains **1** mark*

*correct subtraction of ecf gains **1** mark*

3

(ii) products lower than reactants

1

reaction curve correctly drawn

1

activation energy labelled

1

[9]

M12. exothermic

65.1 kJ of energy given out more energy given out in forming new bonds than taken in in breaking bonds

each for1 mark

[5]