



O Level Chemistry

CHEMICAL ENERGETICS

5070-THEORY

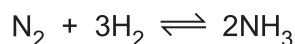
2026 EDITION

Q1

5070/21/O/N/23/Q6(b)(i)-(ii)

3 marks

- 6 The equation for the Haber process used in the production of ammonia is shown.



- (b) The forward reaction in the Haber process is exothermic.

- (i) Explain, in terms of bond making and bond breaking, why this reaction is exothermic.

.....

 [2]

- (ii) The transfer of thermal energy in a chemical reaction is called the enthalpy change.

Write the symbol for an enthalpy change. Include the sign for an exothermic enthalpy change.

..... [1]

Q2

5070/22/O/N/23/Q6(a)(i)-(ii)

3 marks

- 6 (a) Steam reacts with carbon to produce carbon monoxide and hydrogen.



The forward reaction is endothermic.

- (i) Explain, in terms of bond making and bond breaking, why this reaction is endothermic.

.....

 [2]

- (ii) The transfer of thermal energy in a chemical reaction is called the enthalpy change.

Write the symbol for an enthalpy change. Include the sign for an endothermic enthalpy change.

..... [1]

Q3

5070/21/O/N/21/Q6(a)

2 marks

- 6 Chlorine reacts with phosphorus to form phosphorus(III) chloride.



The reaction is exothermic.

- (a) Explain in terms of bond breaking and bond forming why the reaction is exothermic.

.....

.....

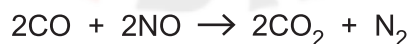
..... [2]

Q4

5070/21/M/J/22/Q6(b)(ii)

2 marks

- (b) Carbon monoxide reacts with nitrogen monoxide as shown in the equation.



- (ii) The reaction between carbon monoxide and nitrogen monoxide is exothermic.

Explain, using ideas about bond breaking and bond forming, why the reaction is exothermic.

.....

.....

.....

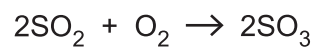
..... [2]

Q5

5070/22/M/J/22/Q7(d)(ii)

2 marks

(d) Sulfur dioxide reacts with oxygen as shown.



(ii) Explain, using ideas about bond breaking and bond forming, why the reaction is exothermic.

.....

.....

.....

..... [2]



Q6

5070/21/O/N/21/Q5(b)

2 marks

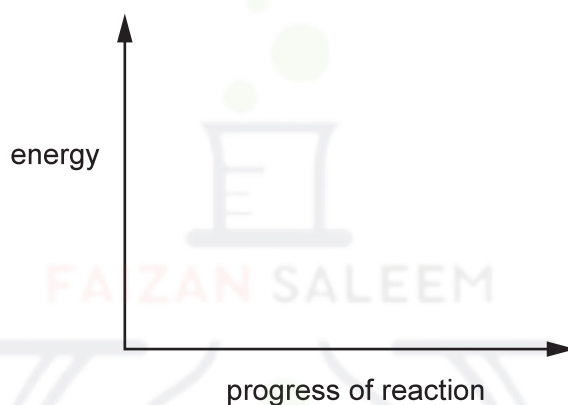
- 5 Magnesium undergoes oxidation when it reacts with aqueous silver nitrate.



- (b) The reaction of magnesium with silver nitrate is exothermic.

Complete the energy profile diagram for this reaction.

Label reactants, products and ΔH .



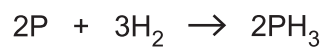
[2]

Q7

5070/22/O/N/21/Q6(a)-(b)

4 marks

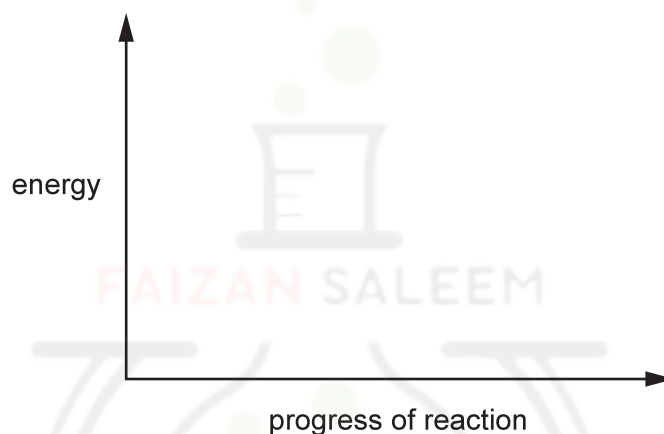
- 6 Phosphorus reacts with hydrogen to produce phosphine, PH_3 .



The reaction is endothermic.

- (a) Complete the energy profile diagram for this reaction.

Label reactants, products and ΔH .



[2]

- (b) Explain, in terms of bond breaking and bond forming, why the reaction is endothermic.

.....

.....

..... [2]

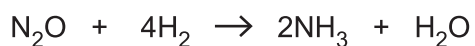
Q8

5070/21/O/N/22/Q4(d)

2 marks

(d) Ammonia is formed by the reduction of nitrogen(I) oxide, N_2O , with hydrogen.

The reaction is exothermic.



Complete and label the energy profile diagram for this reaction to include:

- the reactants and products
- the enthalpy change of the reaction.



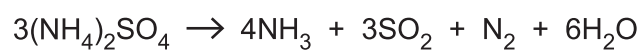
[2]

Q9

5070/22/O/N/22/Q4(e)

2 marks

(e) Ammonium sulfate decomposes when heated. The reaction is endothermic.



Complete and label the energy profile diagram for this reaction to include:

- the reactant and products
- the enthalpy change of the reaction.



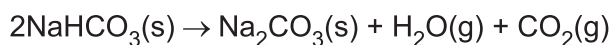
[2]

Q10

5070/21/O/N/25/Q3(a)(i)-(ii)

3 marks

- 3 Sodium hydrogencarbonate decomposes when heated.



- (a) Fig. 3.1 shows the reaction pathway diagram for the decomposition of sodium hydrogencarbonate.

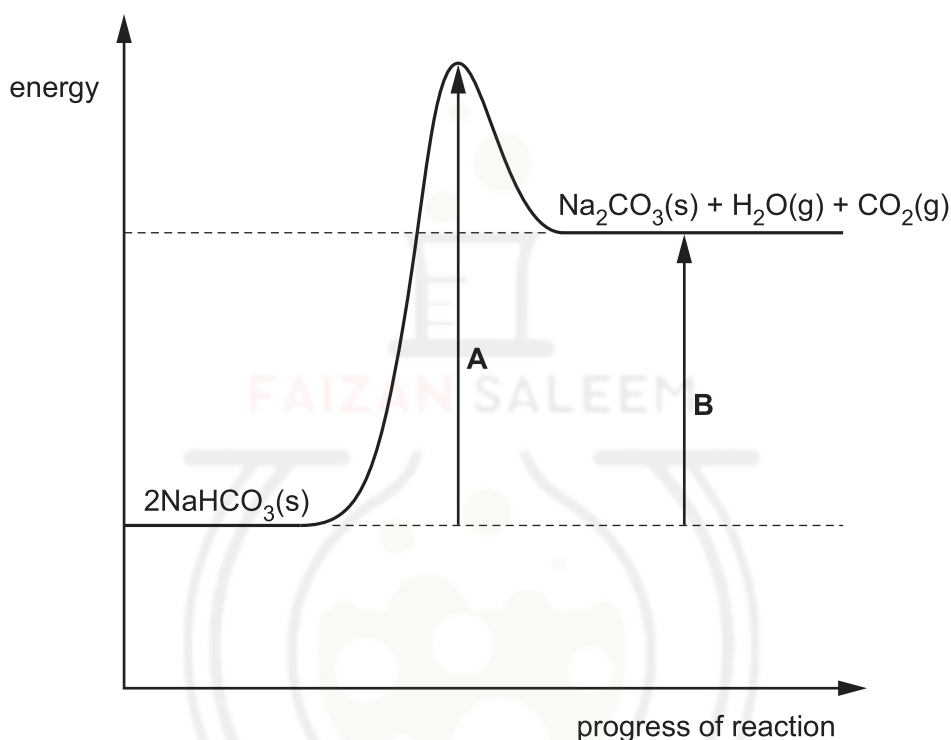


Fig. 3.1

- (i) Identify the energy changes labelled **A** and **B**.

energy change **A**

energy change **B**

[2]

- (ii) Use the reaction pathway diagram to explain why the decomposition of sodium hydrogencarbonate is endothermic.

.....

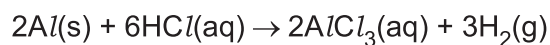
..... [1]

Q11

5070/22/O/N/25/Q3(a)(i)-(ii)

3 marks

- 3 The equation for the reaction between aluminium and dilute hydrochloric acid is shown.



- (a) Fig. 3.1 shows the reaction pathway diagram for this reaction.

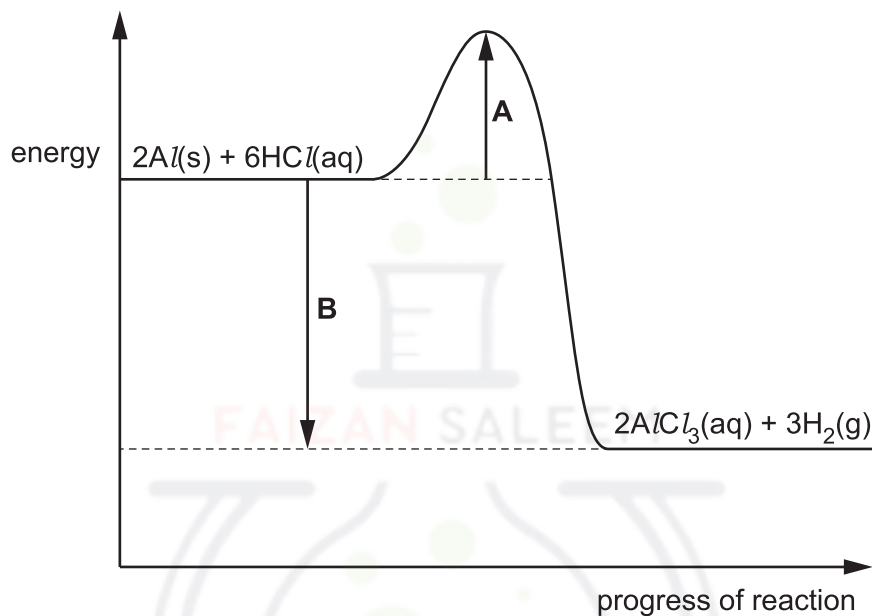


Fig. 3.1

- (i) Identify the energy changes labelled **A** and **B**.

energy change **A**

energy change **B** [2]

- (ii) Use the reaction pathway diagram to explain why the reaction is exothermic.

..... [1]
.....

Q12

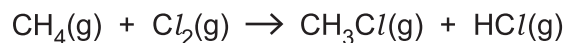
5070/21/M/J/23/Q6(a)

5 marks

6 This question is about the energy changes that take place during chemical reactions.

(a) Methane reacts with chlorine to make chloromethane.

The reaction is exothermic.



Draw, on the axes provided in Fig. 6.1, the reaction pathway diagram for this reaction.

Include labels for the:

- axes
- reactants
- products
- enthalpy change of reaction, ΔH
- activation energy, E_a .



Fig. 6.1

[5]

Q13

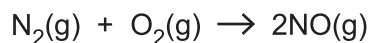
5070/22/M/J/23/Q6(a)

5 marks

6 This question is about the energy changes that take place during chemical reactions.

(a) Nitrogen reacts with oxygen to make nitrogen monoxide.

The reaction is endothermic.



Draw, on the axes provided in Fig. 6.1, the reaction pathway diagram for this reaction.

Include labels for the:

- axes
- reactants
- product
- enthalpy change of reaction, ΔH
- activation energy, E_a .



Fig. 6.1

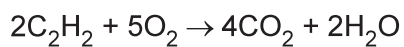
[5]

Q14

5070/21/M/J/24/Q2(d)(i)-(ii)

5 marks

(d) The equation for the complete combustion of ethyne is shown.



This reaction is exothermic.

(i) Explain, using ideas about bond breaking and bond making, why this reaction is exothermic.

.....
.....
..... [2]

(ii) Complete the reaction pathway diagram in Fig. 2.2 for the complete combustion of ethyne.

Label the:

- reactants
- products
- enthalpy change of the reaction, ΔH
- activation energy, E_a .

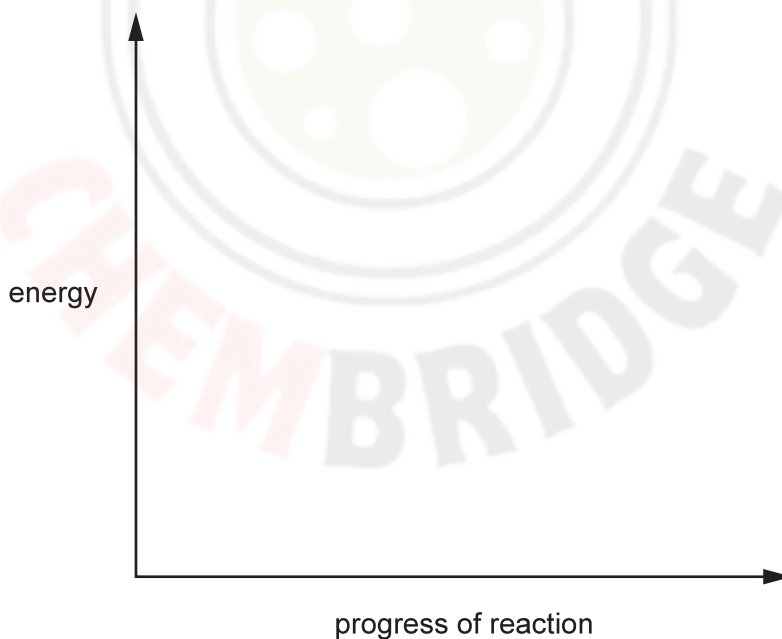


Fig. 2.2

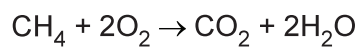
[3]

Q15

5070/22/M/J/24/Q2(c)(i)-(ii)

5 marks

(c) The equation for the complete combustion of methane is shown.



This reaction is exothermic.

- (i) Explain, using ideas about bond breaking and bond making, why this reaction is exothermic.

.....
.....
..... [2]

- (ii) Complete the reaction pathway diagram in Fig. 2.1 for the complete combustion of methane.

Label the:

- reactants
- products
- enthalpy change of the reaction, ΔH
- activation energy, E_a .

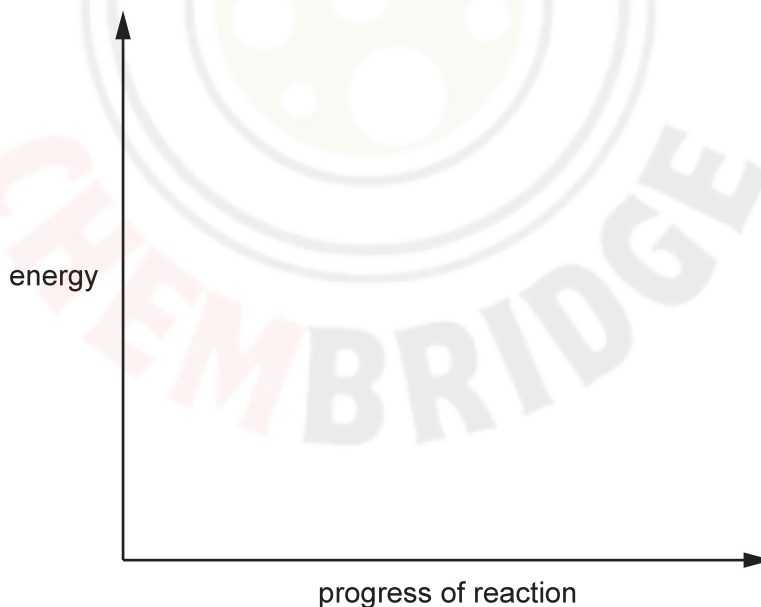


Fig. 2.1

[3]

Q16

5070/21/O/N/24/Q2(b)

3 marks

- (b) Calcium carbonate is added to the blast furnace. The calcium carbonate undergoes thermal decomposition.



The thermal decomposition of calcium carbonate is endothermic.

Complete the reaction pathway diagram in Fig. 2.1 to show:

- the reactant and products
- a labelled arrow for the activation energy, E_a
- a labelled arrow for the enthalpy change, ΔH .

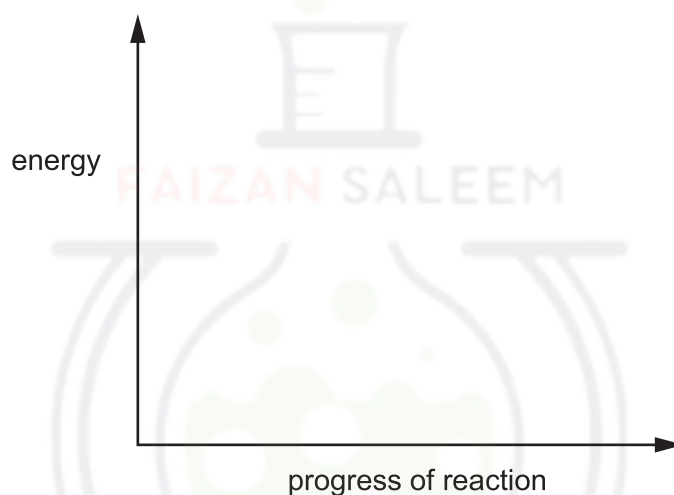


Fig. 2.1

[3]

Q17

5070/22/O/N/24/Q5(d)

3 marks

(d) The reaction of zinc with hydrochloric acid is exothermic.

Complete the reaction pathway diagram in Fig. 5.2 to show:

- the reactants and products
- a labelled arrow for the activation energy, E_a
- a labelled arrow for the enthalpy change, ΔH .



Fig. 5.2

[3]

Q18

5070/21/M/J/23/Q6(b)

3 marks

(b) Hydrogen iodide decomposes to make hydrogen and iodine.



Calculate the enthalpy change of this reaction.

Use the bond energies in Table 6.1.

Table 6.1

bond	bond energy in kJ/mol
H—H	436
I—I	151
H—I	298

enthalpy change of reaction kJ/mol [3]

Q19

5070/22/M/J/23/Q6(b)

3 marks

(b) Hydrogen reacts with bromine to make hydrogen bromide.



Calculate the enthalpy change of this reaction.

Use the bond energies in Table 6.1.

Table 6.1

bond	bond energy in kJ/mol
H—H	436
Br—Br	193
H—Br	366

enthalpy change of reaction kJ/mol [3]

Q20

5070/21/O/N/24/Q4(e)(i)

3 marks

(e) Ethene reacts with bromine at room temperature.

Fig. 4.2 shows the displayed formulae of the reactants and product.

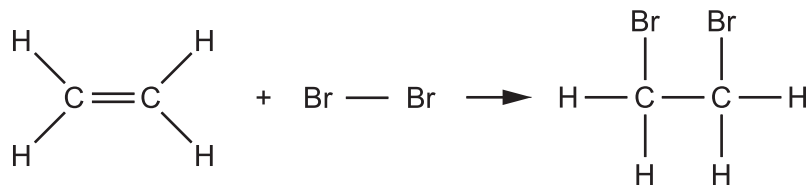


Fig. 4.2

(i) Calculate the enthalpy change of this reaction in kJ/mol.

Use the bond energies in Table 4.1.

Table 4.1

type of bond	C=C	C—H	Br—Br	C—C	C—Br
bond energy in kJ/mol	612	413	193	347	290

enthalpy change = ... kJ/mol
[3]

Q21

5070/22/O/N/24/Q4(d)(ii)-(iii)

4 marks

(d) Propane reacts with chlorine in the presence of ultraviolet light.

Fig. 4.2 shows the displayed formulae of the reactants and products.

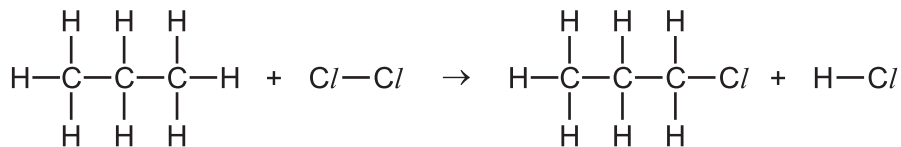


Fig. 4.2

(ii) State the purpose of the ultraviolet light in this reaction.

..... [1]

(iii) Calculate the enthalpy change of this reaction in kJ/mol.

Use the bond energies in Table 4.1.

Table 4.1

type of bond	C—C	C—H	Cl—Cl	C—Cl	H—Cl
bond energy in kJ/mol	347	413	243	346	432

enthalpy change = ... kJ/mol
[3]

Q22

5070/21/M/J/25/Q3(c)-(d)

6 marks

- 3 The equation for the reaction between methane and chlorine is shown in Fig. 3.1.

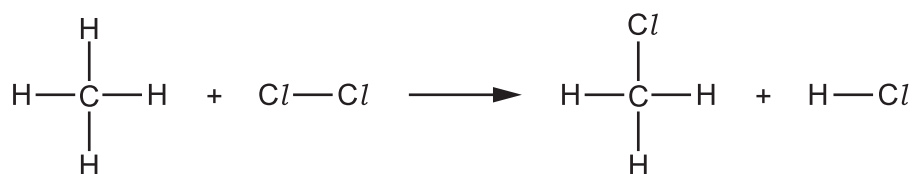


Fig. 3.1

- (c) Table 3.1 shows some bond energies.

Table 3.1

bond	bond energy in kJ/mol
C—H	410
C—Cl	340
Cl—Cl	242
H—Cl	431

Show by calculation that the enthalpy change of the reaction between methane and chlorine, ΔH , is -119 kJ/mol .

[3]

- (d) Complete the reaction pathway diagram in Fig. 3.2 for the reaction between methane and chlorine.

Label the:

- reactants
- products
- enthalpy change of the reaction, ΔH
- activation energy, E_a .

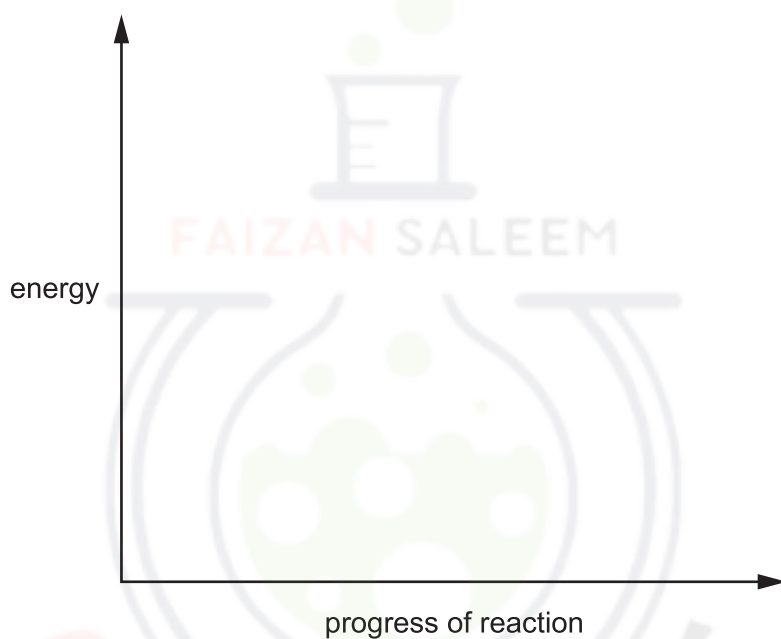


Fig. 3.2

[3]

Q23

5070/22/M/J/25/Q3(b)-(c)

6 marks

- 3 The equation for the reaction between ethene and bromine is shown in Fig. 3.1.

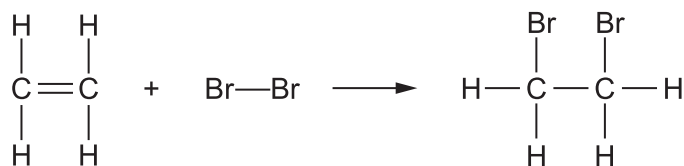


Fig. 3.1

- (b) Table 3.1 shows some bond energies.

Table 3.1

bond	bond energy in kJ/mol
C—H	410
C—C	350
C=C	610
Br—Br	193
C—Br	280

Show by calculation that the enthalpy change of the reaction between ethene and bromine, ΔH , is -107 kJ/mol .

[3]

Q23 continued

5070/22/M/J/25/Q3(b)-(c)

6 total

- (c) Complete the reaction pathway diagram in Fig. 3.2 for the reaction between ethene and bromine.

Label the:

- reactants
- product
- enthalpy change of the reaction, ΔH
- activation energy, E_a .

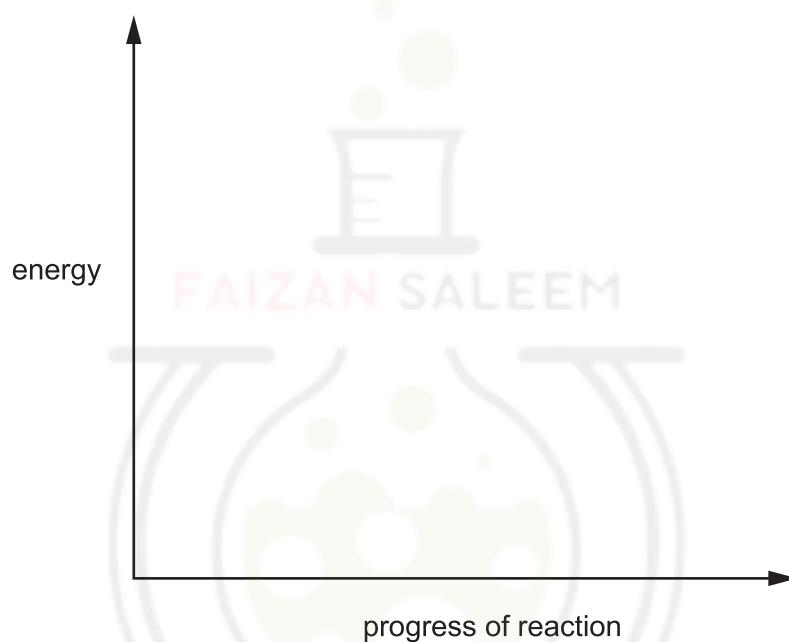


Fig. 3.2

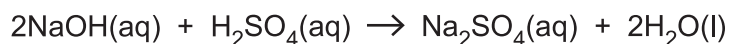
[3]

Q24

5070/42/O/N/21/Q6(b)

1 mark

- 6 When aqueous sodium hydroxide is added to dilute sulfuric acid a reaction occurs.



A student has two solutions.

W is $2.0 \text{ mol/dm}^3 \text{ NaOH}(\text{aq})$.

X is $\text{H}_2\text{SO}_4(\text{aq})$ of unknown concentration.

The student determines the concentration of **X**.

The student:

- transfers 20.0 cm^3 of **W** into a glass beaker
- measures the temperature of **W**
- adds 5.0 cm^3 of **X** to **W** in the beaker
- stirs the mixture
- measures the highest temperature reached
- calculates the increase in temperature
- repeats with different volumes of **X**.

The table shows the results.

experiment	volume of W / cm^3	volume of X / cm^3	temperature increase / $^\circ\text{C}$
1	20.0	5.0	2.7
2	20.0	10.0	5.4
3	20.0	15.0	8.0
4	20.0	20.0	9.1
5	20.0	25.0	7.8
6	20.0	30.0	6.5

- (b) State the evidence in the table that shows that the reaction is exothermic.

..... [1]

Q25

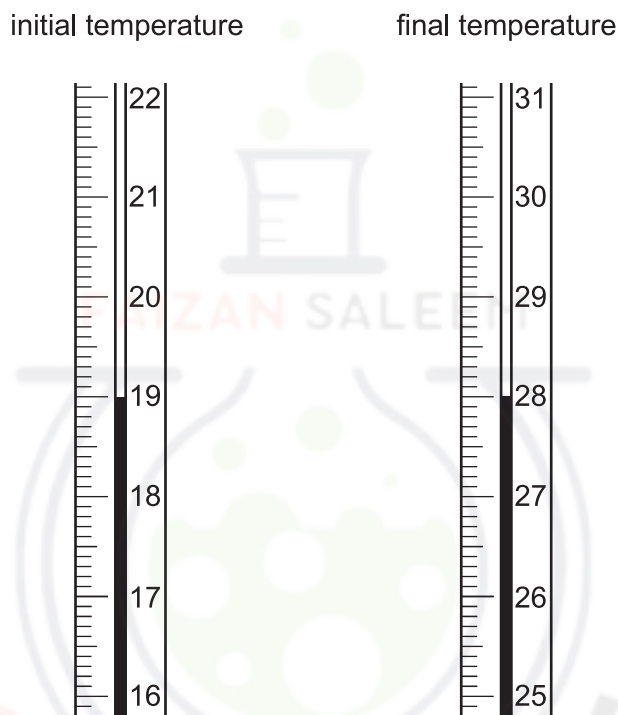
5070/41/M/J/22/Q5(a)-(b)

3 marks

5 A student:

- measures 25 cm^3 of 1.0 mol/dm^3 hydrochloric acid into a glass beaker
- measures the temperature of the hydrochloric acid
- adds 30 cm^3 , an excess, of aqueous potassium hydroxide
- records the maximum temperature the mixture reaches.

(a) The diagram shows the initial and final temperatures.



Use the diagram to complete the table.

initial temperature / °C	
final temperature / °C	
temperature change / °C	

[2]

(b) Use the information in the table in (a) to suggest what type of reaction is taking place.

..... [1]

Q26

5070/42/M/J/24/Q2(a)(i), Q2(b)

5 marks

- 2 A student investigates the temperature change when a solid completely dissolves in water.

The student:

- measures 25 cm^3 of distilled water and pours it into a beaker
- uses a thermometer to measure the initial temperature of the water in the beaker
- records this temperature in Table 2.1 at time 0 s
- adds a sample of the solid to the beaker and starts a stop-watch
- stirs the mixture and records the temperature and time at 60 s intervals for a total of 300 s.

Some of the results are shown in Table 2.1.

Table 2.1

time / s	temperature / °C
0	19.5
60	13.0
120	
180	14.0
240	14.5
300	

- (a) (i) Fig. 2.1 shows the results for 120 s and 300 s.

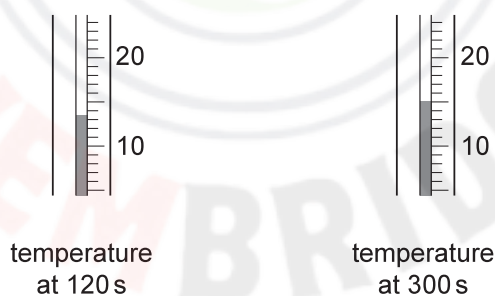


Fig. 2.1

Record the values from Fig. 2.1 to the nearest 0.5 °C in Table 2.1.

[3]

- (b) Describe the energy change when the solid dissolves in water.

Explain how the results in Table 2.1 support your answer.

description

explanation

.....

[2]

Q27

5070/41/O/N/22/Q4

6 marks

4 A student is provided with two bottles labelled **A** and **B** and a supply of dilute hydrochloric acid.

One of the bottles contains 1.00 g of solid potassium carbonate, K_2CO_3 .

The other bottle contains 1.00 g of solid potassium hydrogencarbonate, KHCO_3 .

The reaction between potassium carbonate and dilute hydrochloric acid is exothermic.

The reaction between potassium hydrogencarbonate and dilute hydrochloric acid is endothermic.

Plan experiments using the reaction of each solid with dilute hydrochloric acid to decide:

- which solid is in each bottle
- which reaction has the greatest heat change per gram of solid.

Your plan may use any of the apparatus normally found in a chemistry laboratory but no other chemicals.

Your plan must state all the measurements you need to make.

Your plan must use the same experimental procedure for each solid.

..... [6]

Q28

5070/42/O/N/22/Q4

6 marks

4 A student is provided with two bottles labelled **A** and **B** and a supply of water.

One of the bottles contains 1.00 g of solid potassium chloride, KCl .

The other bottle contains 1.00 g of solid calcium chloride, CaCl_2 .

When potassium chloride dissolves in water the change is endothermic.

When calcium chloride dissolves in water the change is exothermic.

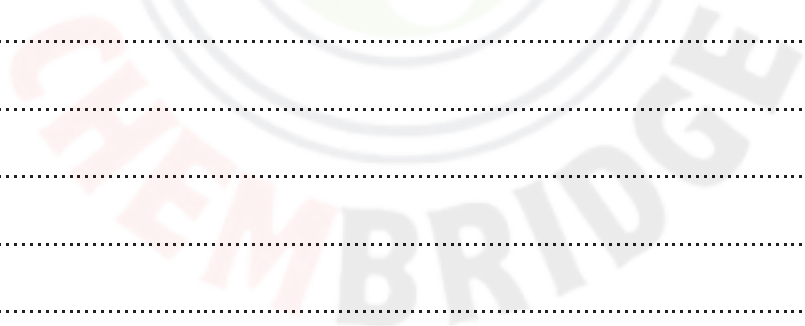
Plan experiments, based on dissolving the solids in water, to decide:

- which compound is in each bottle
- which compound produces the greatest heat change per gram of solid.

Your plan may use any of the apparatus normally found in a chemistry laboratory but no other chemicals.

Your plan must state all the measurements you need to make.

Your plan must use the same experimental procedure for each solid.



[6]

Q29

5070/41/O/N/25/Q4

6 marks

4 Alcohols are used as fuels to heat water.

Plan an experiment to determine which alcohol, methanol or ethanol, releases more thermal energy per gram of alcohol burned.

Your plan should describe the use of an alcohol burner, as shown in Fig. 4.1, to heat water. You should use water, methanol, ethanol and common laboratory apparatus. No other chemicals should be used.

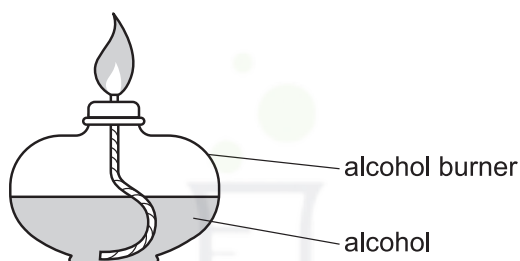


Fig. 4.1

Your plan should include:

- the additional apparatus needed
- the method to use and the measurements to take
- how the measurements are used to determine which alcohol releases more thermal energy per gram burned.

You may draw a diagram to help answer the question.

 CAMBRIDGE

[6]

Q30

5070/42/O/N/25/Q4

6 marks

4 The reaction between a metal and dilute sulfuric acid is exothermic.

Plan an experiment to determine which metal, magnesium or zinc, releases more thermal energy per gram of metal when reacting with excess dilute sulfuric acid.

You are provided with magnesium powder, zinc powder, dilute sulfuric acid and common laboratory apparatus. No other chemicals should be used.

Your plan should include:

- the apparatus needed
- the method to use and the measurements to take
- how the measurements are used to determine which metal releases more thermal energy per gram.

You may draw a diagram to help answer the question.

FAIZAN SALEEM



CHEM BRIDGE

[6]

Q1 5070/21/O/N/23/Q6(b)(i)-(ii)

3 marks

6(b)(i)	bond breaking is endothermic / bond breaking needs energy AND bond making is exothermic / bond making gives energy out (1) more energy is released than absorbed / less energy is absorbed than released (1)	2
6(b)(ii)	$\Delta H -$	1

Q2 5070/22/O/N/23/Q6(a)(i)-(ii)

3 marks

6(a)(i)	bond breaking is endothermic / needs energy AND bond making is exothermic / energy given out (1) more energy is absorbed than released / less energy is released than absorbed (1)	2
6(a)(ii)	$+ \Delta H$	1

Q3 5070/21/O/N/21/Q6(a)

2 marks

6(a)	bond breaking endothermic AND bond making exothermic / energy absorbed to break bonds AND energy released on making bonds (1) more energy released than absorbed (1)	2
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Q4 5070/21/M/J/22/Q6(b)(ii)

2 marks

6(b)(ii)	bond making releases energy and bond breaking absorbs energy (1) more energy released than absorbed (1)	2
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Q5 5070/22/M/J/22/Q7(d)(ii)

2 marks

7(d)(ii)	bond making releases energy and bond breaking absorbs energy (1) more energy released than absorbed (1)	2
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Q6 5070/21/O/N/21/Q5(b)

2 marks

5(b)	reactants on the left and products on the right and reactant line above product line (1) arrow downwards between reactants and products with ΔH label (1)	2
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Q7 5070/22/O/N/21/Q6(a)-(b)

4 marks

6(a)	reactants on the left and products on the right and reactant line below product line (1) arrow upwards between reactants and products with ΔH label (1)	2
6(b)	bond breaking endothermic and bond making exothermic / (thermal) energy absorbed to break bonds and (thermal) energy released on making bonds (1) more energy absorbed than released (1)	2

Q8 5070/21/O/N/22/Q4(d)

2 marks

4(d)	reactants on the left and products on the right and reactant line above product line (1) enthalpy change shown by downward arrow and labelled enthalpy change (1)	2
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Q9 5070/22/O/N/22/Q4(e)

2 marks

4(e)	reactants on the left and products on the right and reactant line below product line (1) arrow vertically upwards between reactants and products with ΔH or enthalpy change label (1)	2
------	--	---

Q10 5070/21/O/N/25/Q3(a)(i)-(ii)

3 marks

3(a)(i)	A activation energy / E_a (1) B enthalpy change / ΔH (1)	2
3(a)(ii)	product level above reactant level	1

Q11 5070/22/O/N/25/Q3(a)(i)-(ii)

3 marks

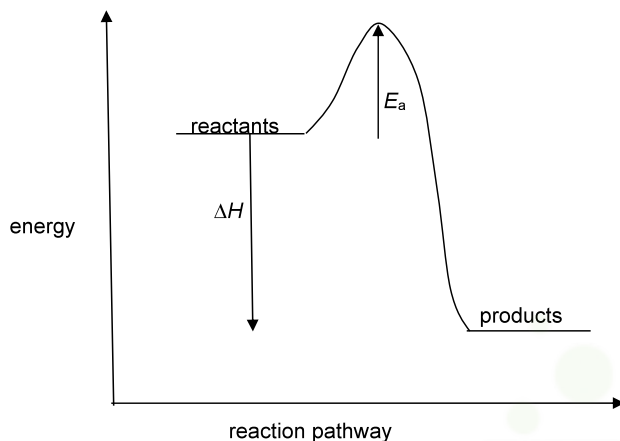
3(a)(i)	A activation (energy) / E_a (1) B enthalpy (change) / ΔH (1)	2
3(a)(ii)	product level below reactant level	1

Q12

5070/21/M/J/23/Q6(a)

5 marks

6(a)



5

correct labels for axes (1)

reactants on a line (1)

product on a line to the right **and** below reactant line (1)

vertical line with arrow and correct label for enthalpy change (1)

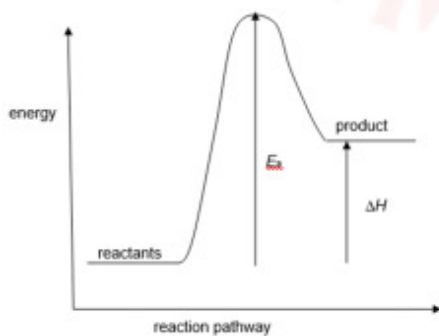
vertical line with arrow and correct label for activation energy (1)

Q13

5070/22/M/J/23/Q6(a)

5 marks

6(a)



5

correct labels for axes (1)

reactants on a line (1)

product on a line to the right **and** above reactant line (1)

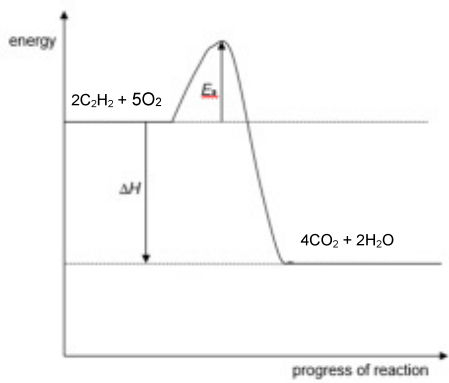
vertical line with arrow and correct label for enthalpy change (1)

vertical line with arrow and correct label for activation energy (1)

Q14

5070/21/M/J/24/Q2(d)(i)-(ii)

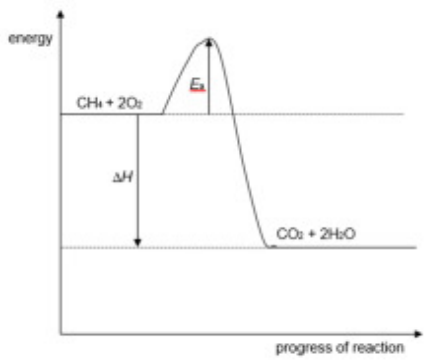
5 marks

2(d)(i)	bond breaking endothermic AND bond making exothermic / energy absorbed to break bonds AND energy released on making bonds (1) more energy released than absorbed (1)	2
2(d)(ii)	 M1 products to right of reactants AND reactant level above product level (1) M2 enthalpy change shown as downward arrow AND labelled as enthalpy change or ΔH (1) M3 activation energy drawn to maximum of energy hump with an upward arrow AND labelled (1)	3

Q15

5070/22/M/J/24/Q2(c)(i)-(ii)

5 marks

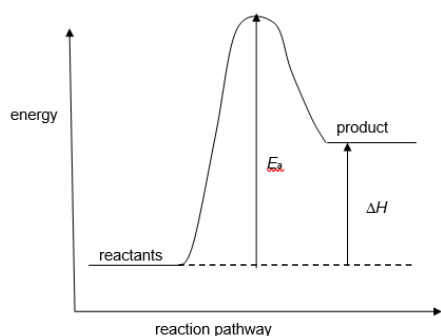
2(c)(i)	bond breaking endothermic AND bond making exothermic / energy absorbed to break bonds AND energy released on making bonds (1) more energy released than absorbed (1)	2
2(c)(ii)	 M1 products to right of reactants AND reactant level above product level (1) M2 enthalpy change shown as downward arrow AND labelled as enthalpy change or ΔH (1) M3 activation energy drawn to maximum of energy hump with an upward arrow AND labelled (1)	3

Q16

5070/21/O/N/24/Q2(b)

3 marks

2(b)



3

M1 reactants to left and products to right and reactant level below product level (1)

M2 activation energy hump between reactants and products and almost vertical upward arrow from reactant energy level to top of energy hump labelled activation energy (1)

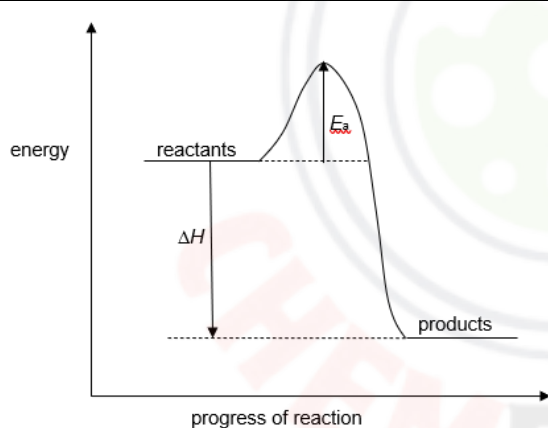
M3 enthalpy change shown between reactants and products as upward arrow labelled enthalpy change (1)

Q17

5070/22/O/N/24/Q5(d)

3 marks

5(d)



3

M1 reactants to left and products to right and reactant level above product level (1)

M2 activation energy hump between reactants and products and almost vertical upward arrow from reactant energy level to top of energy hump labelled activation energy (1)

M3 enthalpy change shown between reactants and products as downward arrow labelled enthalpy change (1)

Q18

5070/21/M/J/23/Q6(b)

3 marks

6(b)

energy associated with bond breaking = 2×298 OR 596 (1)

energy associated with bond forming = $436 + 151$ OR 587 (1)

(enthalpy change = $596 - 587$) = +9 (kJ/mol) (1)

3

Q19 **5070/22/M/J/23/Q6(b)** 3 marks

6(b)	energy associated with bond breaking = $436 + 193$ OR 629 (1) energy associated with bond forming = 2×366 OR 732 (1) (enthalpy change = $629 - 732$) = -103 (kJ/mol)	3
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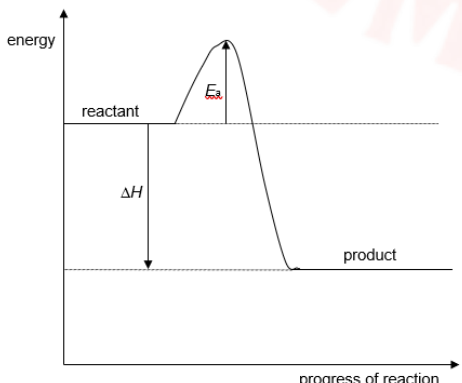
Q20 **5070/21/O/N/24/Q4(e)(i)** 3 marks

4(e)(i)	energy associated with bond breaking $612 + 193$ OR 805 (1) energy associated with bond forming = $347 + 2(290)$ OR 927 (1) (enthalpy change = $+805 - 927$) = -122 (kJ/mol) (1)	3
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Q21 **5070/22/O/N/24/Q4(d)(ii)-(iii)** 4 marks

4(d)(ii)	provides the activation energy (for the reaction)	1
4(d)(iii)	energy associated with bond breaking $413 + 243$ OR 656 (1) energy associated with bond forming = $346 + 432$ OR 778 (1) (enthalpy change = $+656 - 778$) = -122 (kJ/mol) (1)	3

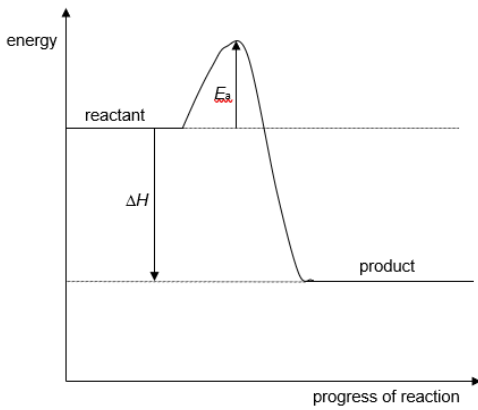
Q22 **5070/21/M/J/25/Q3(c)-(d)** 6 marks

3(c)	energy associated with bond breaking = $410 + 242$ OR 652 (1) energy associated with bond forming = $340 + 431$ OR 771 (1) enthalpy change = $652 - 771$ = (-119 kJ/mol) (1)	3
3(d)	 M1 reactants to left and products to right and reactant level above product level M2 enthalpy change shown between reactants and products as downward arrow labelled enthalpy change M3 activation energy hump between reactants and products and almost vertical upward arrow from reactant energy level to top of energy hump labelled activation energy	3

Q23

5070/22/M/J/25/Q3(b)-(c)

6 marks

3(b)	energy associated with bond breaking = $610 + 193$ OR 803 (1) energy associated with bond forming = $350 + 560$ OR 910 (1) enthalpy change = $803 - 910 = (-107 \text{ kJ/mol})$ (1)	3
3(c)	 M1 reactants to left and products to right and reactant level above product level M2 enthalpy change shown between reactants and products as downward arrow labelled enthalpy change M3 activation energy hump between reactants and products and almost vertical upward arrow from reactant energy level to top of energy hump labelled activation energy	3

Q24

5070/42/O/N/21/Q6(b)

1 mark

6(b)	all the temperatures increases (i)	1
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Q25

5070/41/M/J/22/Q5(a)-(b)

3 marks

5(a)	M1 initial = 19.0 and final = 28.0 (1) M2 temperature change = 9.0 (1)	2
5(b)	exothermic	1

Q26

5070/42/M/J/24/Q2(a)(i), Q2(b)

5 marks

2(a)(i)	M1 13.5°C at 120 seconds: M2 15.0°C at 300 seconds: M3 both values expressed to nearest 0.5	3
2(b)	M1 endothermic / reaction absorbs energy (from the surroundings) M2 temperature decreases	2

Q27

5070/41/O/N/22/Q4

6 marks

	M1 both solids stirred with acid (1) M2 ANY reference to temperature or thermometer (1) M3 equal volumes / concentration (of acid)(1) M4 temperature rise = potassium carbonate(1) M5 temperature fall = potassium hydrogen carbonate(1) M6 largest temperature change = greatest heat change(1)	6
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Q28

5070/42/O/N/22/Q4

6 marks

4	M1 both solids stirred with water (1) M2 ANY reference to temperature or thermometer (1) M3 equal volumes of water(1) M4 temperature rise = calcium chloride(1) M5 temperature fall = potassium chloride(1) M6 largest temperature change = greatest heat change(1)	6
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Q29

5070/41/O/N/25/Q4

6 marks

4	Apparatus any two from M1 measuring cylinder / burette / volumetric pipette M2 thermometer M3 balance M4 suitable container for water to be heated in Method and measurements any three from M5 heat a sample of water using an alcohol burner M6 use same volume/mass of water for both alcohols M7 measure the mass of the spirit burner with alcohol before and after burning M8 measure the temperature of water before and after burning Determination One from M9 temperature change / mass change = temperature change per gram M10 greater temperature change per gram indicates more thermal energy per gram	6
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Q30

5070/42/O/N/25/Q4

6 marks

4	Apparatus any two from M1 measuring cylinder / burette / (volumetric) pipette M2 thermometer M3 balance Method and measurements any two from M4 measure mass of each metal / use the same mass of each metal M5 use same volume of acid OR measure the volume of (dilute sulfuric) acid for each metal and use $mc\Delta T$ M6 measure initial temperature (of dilute sulfuric acid) and measure temperature after reaction (of the mixture) Determination M7 an indication that the final temperature is recorded when the reaction has finished e.g. / effervescence stops / all metal has reacted / temperature stops rising/maximum temperature reached M8 greater temperature change $\div$ mass used indicates greater energy per gram	6
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FAIZAN SALEEM

