

Energetics (F)

1. What is meant by the **activation energy** in a chemical reaction?

- A The total energy used up when a reaction has stopped.
- B The energy absorbed during a reaction.
- C The energy released during a reaction.
- D The minimum energy needed for a reaction to occur.

Your answer

[1]

2 (a). A student investigates the combustion of ethanol.

Fig. 19.3 shows the apparatus the student uses.

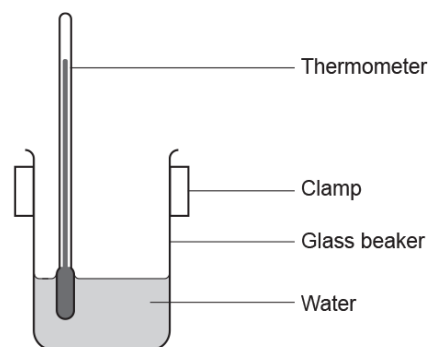


Fig. 19.3

The temperature change is much lower than the textbook value.

Suggest **two** ways that the student could improve the set-up of the apparatus in Fig. 19.3, so the temperature change is closer to the textbook value.

1

2

[2]

(b). A student investigates the energy changes in different reaction mixtures, X, Y and Z. Fig. 19.1 shows the apparatus she uses.

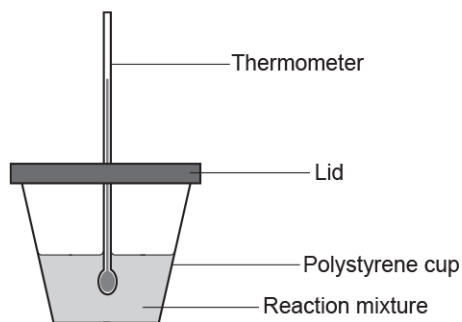


Fig. 19.1

Look at the table of the student's results.

- i. Add the temperature change for each reaction mixture.
Include a + or – sign where relevant.

Reaction mixture	Temperature at start (°C)	Temperature at end (°C)	Temperature change (°C)
X	20.0	25.5
Y	19.0	8.0
Z	20.0	20.0

[1]

- ii. Which reaction mixture has an **endothermic** reaction?

Tick (✓) **one** box.

X

Y

Z

Explain your answer.

[2]

iii. Complete the reaction profile for an **endothermic** reaction in **Fig. 19.2**.

The products have already been added.

Label the:

- reactants
- energy change
- activation energy.

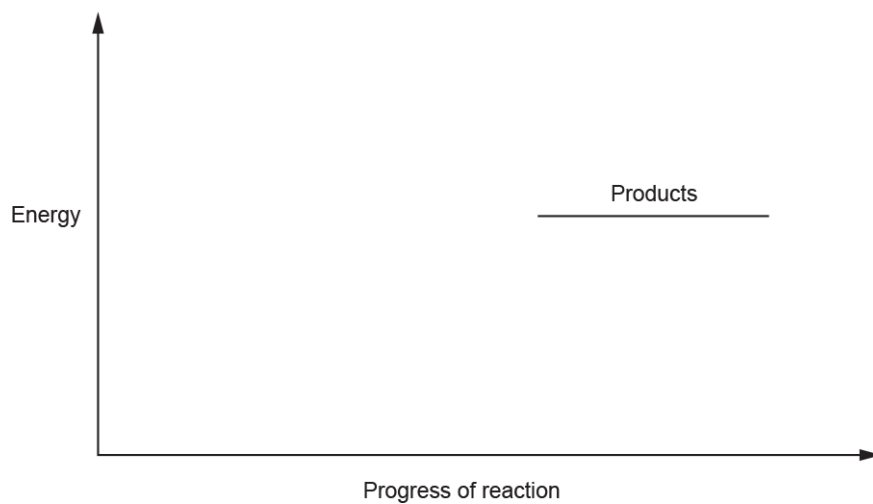
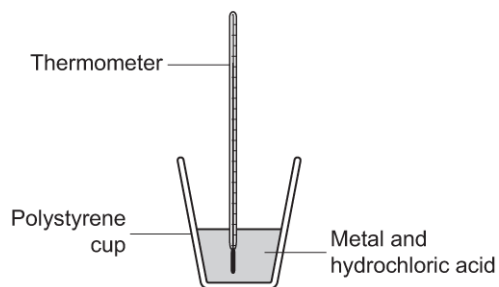


Fig. 19.2

[3]

3 (a). A student investigates the reaction of different metals with hydrochloric acid.



The student repeats the experiment with different metals.

She repeats the experiment three times for each metal.

She measures the temperature change in each experiment.

Look at her results.

Metal	Temperature change (°C)		
	Test 1	Test 2	Test 3
Magnesium	10.3	10.5	10.2
Zinc	8.6	8.7	7.6
Iron	5.2	4.9	5.1

i. One of the student's results is anomalous.

Put a **ring** around the anomalous result in the table.

[1]

ii. Suggest a reason why the result could be anomalous.

----- [1]

iii. Calculate the **mean** temperature change for **magnesium**.

Give your answer to **1** decimal place.

Mean temperature change = °C [2]

(b).

i. The student wants to improve her experiment to get more **accurate** results.

Suggest an improvement to her experiment, which will give more accurate results.

Give a reason for the improvement.

Improvement

Reason

[2]

ii. The student concludes that the more reactive the metal is, the higher the temperature rise.

Describe further tests the student can do to confirm her conclusion.

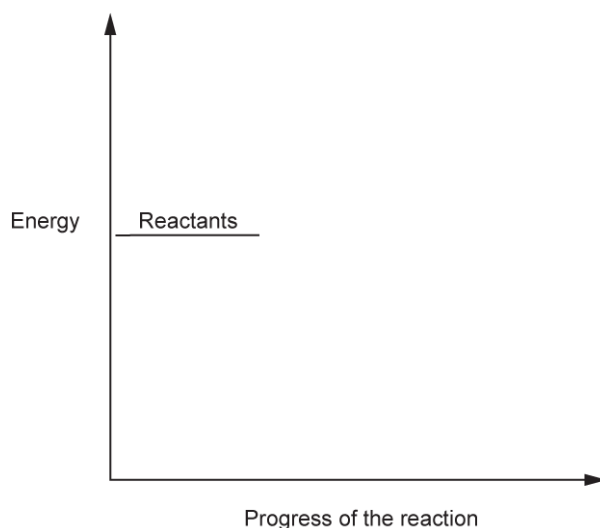
----- [2]

(c). A reaction profile shows the energy involved in a reaction.

Draw the reaction profile for the reaction between magnesium and hydrochloric acid.

Label the:

- products
- energy change
- activation energy.



[3]

(d).

- i. The student notices that the **temperature rises** when a metal is added to the acid.

What name is given to this type of reaction when the temperature rises?

----- [1]

- ii. The metal magnesium reacts with hydrochloric acid, HCl , to form magnesium chloride, MgCl_2 , and hydrogen.

Write a **balanced symbol** equation for this reaction.

----- [2]

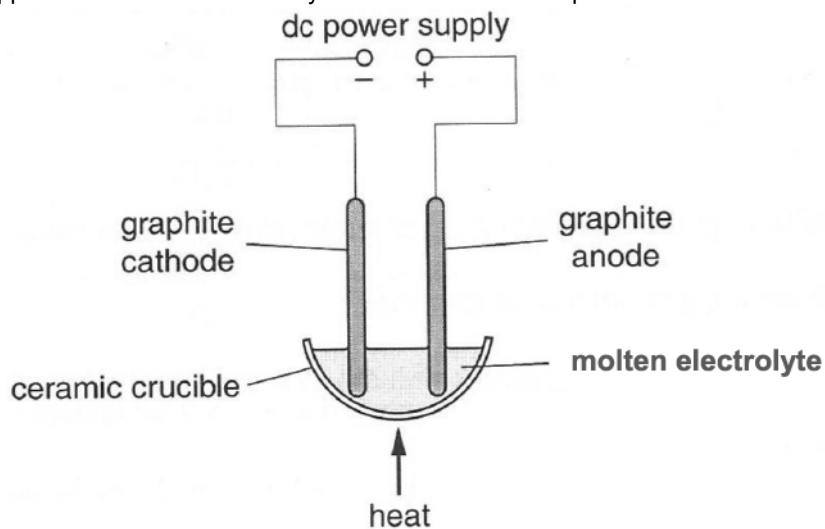
- iii. The experiment is repeated with aluminium and hydrochloric acid.

Write down the **name** of the **salt** produced in this reaction.

----- [1]

4. Look at the diagram.

It shows the apparatus used for the electrolysis of some molten compounds.



The table shows what is made at each electrode during the electrolysis of some molten compounds.

Molten electrolyte	Formula	Product at negative electrode (cathode)	Product at positive electrode (anode)
sodium chloride	NaCl	chlorine
lead bromide	PbBr ₂	lead

Complete the table.

[2]

5. When Phil adds water to calcium oxide, a vigorous exothermic reaction takes place forming calcium hydroxide.

Calcium hydroxide has the formula Ca(OH)₂.

Show that the relative formula mass, M_r , of calcium hydroxide is 74.1.

[2]

6.

- a. Nanoparticles are used as catalysts.

Describe a property of nanoparticles that make them useful as catalysts.

[2]

- b. David is synthesising a new titanium dioxide nanoparticle for use as a catalyst.

One TiO_2 nanoparticle has a mass of 5.0×10^{-3} mg.Calculate how many TiO_2 nanoparticles are in 80.0 mg of TiO_2 .

[2]

7. Hardeep adds magnesium metal to a sample of acid and to a sample of alkali.

He measures the pH of the acid and the alkali.

What results should Hardeep expect?

	Result for acid experiment	Result for alkali experiment
A	pH below 7 no reaction with magnesium	pH above 7 magnesium fizzes
B	pH below 7 magnesium fizzes	pH above 7 no reaction with magnesium
C	pH above 7 magnesium fizzes	pH above 7 no reaction with magnesium
D	pH above 7 no reaction with magnesium	pH below 7 magnesium fizzes

Your answer

[1]

END OF QUESTION PAPER