

1 Hydrogen peroxide is a chemical that decomposes to produce oxygen and water.

The structural formulae of the chemicals involved are:

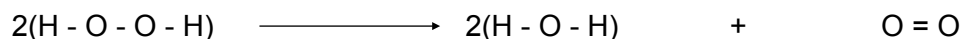


Table 1

BOND	BOND ENERGY (kJ)
O = O	498
O - O	146
H - O	464

1 (a) (i) Use the structural formulae above and information from Table 1 to calculate the energy required to break the bonds in the reactant.

$$4 \times 464 = 1856 \text{ [1 mark]}$$

$$2 \times 146 = 292 \text{ [1 mark]}$$

$$\text{total} = 2148 \text{ kJ [2 marks]}$$

You are often given full marks for writing just the correct answer, but you must show your working in case you make a mistake. Easy to make a mistake under exam conditions.

[2 marks]

1 (a) (ii) Calculate the energy released when new bonds are formed in the products.

$$(\text{H}-\text{O}) = 4 \times 464 = 1856 \text{ [1 mark]}$$

$$(\text{O}=\text{O}) = 498 \text{ [1 mark]}$$

$$\text{Total} = 2354 \text{ kJ [2 marks]}$$

[2 marks]

1 (a) (iii) Is the reaction endothermic or exothermic?

exothermic [1 mark]

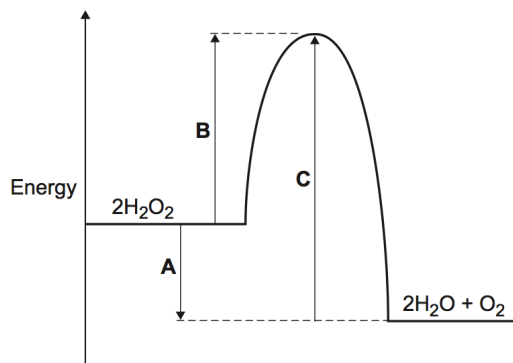
Explain why.

exothermic because (more) heat is given out (than put in) or ΔH is negative /answer to (ii) is negative. [1 mark]

ΔH is not specifically something you have to learn but it's relevant and your teacher may have taught you that.

[2 marks]

- 1 (b) The energy level diagram for the decomposition of hydrogen peroxide into water and oxygen is shown below.



- 1 (b) (i) Which letter represent activation energy?

[1 mark]

B [1 mark]

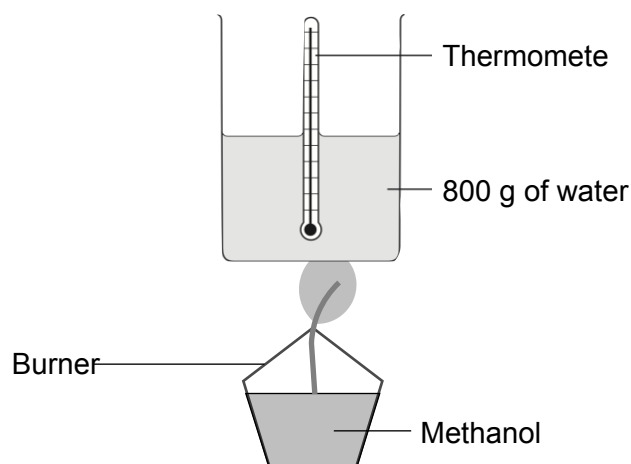
- 1 (b) (ii) Explain, in terms of energy, how a catalyst can make the reaction happen more quickly.

[2 marks]

lowers activation energy or needs less energy to start reaction
or less energetic route [1 mark]

(Total 9 marks)

- 2 A student did an investigation to measure the amount of energy released when methanol is burned. Some data from the investigation is given below.



Mass of water = 800 g, Start temperature of water = 20 °C, Final temperature of water = 64 °C

The energy released can be calculated using the following equation: $Q = m \times 4.2 \times \Delta T$

Where: Q = energy released (J) m = mass of water (g) ΔT = temperature change (°C)

2 (a) Use the student's results to calculate the energy released in joules (J).

[2 marks]

$$800 \times 4.2 \times 44 \text{ [1 mark]}$$

$$\text{Energy released} = 147,840 \text{ [2 marks] J}$$

2 (a) (i) In a second experiment the student measured the energy released by burning 10 g of methanol.

The energy released during the experiment was 150 000J. This is not the answer to part 2(a)

Relative formula mass (Mr) of methanol = 32.

Using this information, calculate the energy in kJ released when 1 mole of propane burns.

[2 marks]

$$32/10 = 3.2$$

$$3.2 \times 150\,000$$

Most students get these kind of questions wrong, so important that you know how to do it.

$$\text{Energy released} = 480 \text{ [2 marks] kJ}$$

(Total 4 marks)

3 Hydrogen can be used as an alternative to petrol for car engines.

Write the word equation that describes the combustion of hydrogen in air.

[2 marks]

Hydrogen + oxygen [1 mark] \longrightarrow water [1 mark]

3 (a) Suggest one advantage and one disadvantage of using hydrogen as a fuel for car engines.

[2 marks]

Advantage less or no pollution or no named pollutant given off (e.g. carbon dioxide, sulfur dioxide, nitrogen oxides, soot) [1 mark]

Disadvantage hard to store, is a gas, can cause explosions, needs high pressure containers [1 mark]

(Total 4 marks)