

measuring enthalpy changes [15 marks]

1. [Maximum mark: 1]

What is the enthalpy change, in kJ mol^{-1} , when 107 g of solid ammonium chloride, NH_4Cl , are added to water to form 50.0 cm^3 of solution, producing a maximum decrease of 28°C ?

$M_r \text{NH}_4\text{Cl} = 53.5$

Specific heat capacity of water = $4.18 \text{ J g}^{-1} \text{ K}^{-1}$

A. $\Delta H = \frac{-50.0 \times 4.18 \times (28 + 273)}{2 \times 1000}$

B. $\Delta H = \frac{-50.0 \times 4.18 \times 28}{2 \times 1000}$

C. $\Delta H = \frac{50.0 \times 4.18 \times (28 + 273)}{2 \times 1000}$

D. $\Delta H = \frac{50.0 \times 4.18 \times 28}{2 \times 1000}$

[1]

2. [Maximum mark: 1]

How much heat energy, in J, does a 2.00 g block of copper metal at 65.0°C lose when it is dropped into 100.0 cm^3 of water and cools to 15.0°C ?

The specific heat capacity of copper is $0.385 \text{ J g}^{-1} \text{ K}^{-1}$ and the specific heat capacity of water is $4.18 \text{ J g}^{-1} \text{ K}^{-1}$.

A. $2.00 \times 0.385 \times (65.0 - 15.0)$

B. $2.00 \times 0.385 \times (65.0 - 15.0 + 273)$

C. $100.0 \times 4.18 \times (65.0 - 15.0)$

D. $100.0 \times 4.18 \times (65.0 - 15.0 + 273)$

[1]

3. [Maximum mark: 1]

Which statement about a chemical reaction involving covalent molecules is correct?

A. More energy is given out if the products are in the gaseous rather than the liquid state.

B. If the products have stronger bonds than the reactants the reaction is exothermic.

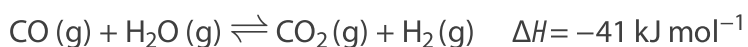
C. Enthalpy change of reaction is the sum of the bond enthalpies of the products minus the sum of the bond enthalpies of the reactants.

D. Forming bonds absorbs the activation energy.

[1]

4. [Maximum mark: 10]

The water-gas shift reaction is another way to manufacture hydrogen.



(a.i) State the oxidation state of carbon in carbon monoxide and carbon dioxide.

carbon monoxide:
carbon dioxide:

[1]

(a.ii) Identify the oxidising and reducing agents, and the species oxidised and reduced, in the forward reaction.

	CO(g)	H ₂ O(g)
oxidising or reducing agent?		
species oxidised or reduced?		

[2]

(b.i) Draw the Lewis structure of carbon dioxide.

[1]

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(b.ii) Annotate the Lewis structure in (b)(i) to show the polarity of the bonds by adding the symbols $\delta+$ and $\delta-$ as appropriate.

[1]

(b.iii) Explain the molecular geometry and polarity of the carbon dioxide molecule.

[2]

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(b.iv) Outline why the increase in carbon dioxide concentration in the atmosphere is of international concern.

[2]

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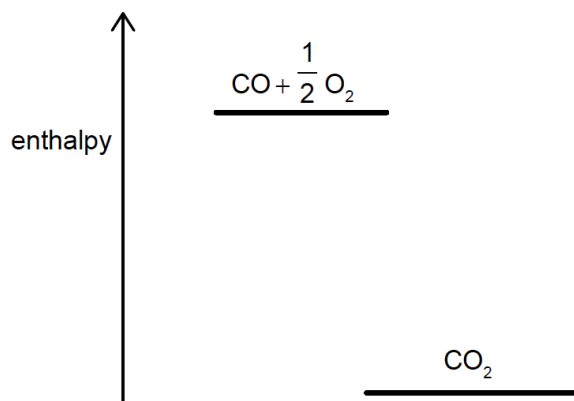
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- (b.v) Explain, referring to the enthalpy profile shown, whether carbon monoxide is more or less stable than carbon dioxide.



[1]

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5. [Maximum mark: 1]
Which reactions release heat?

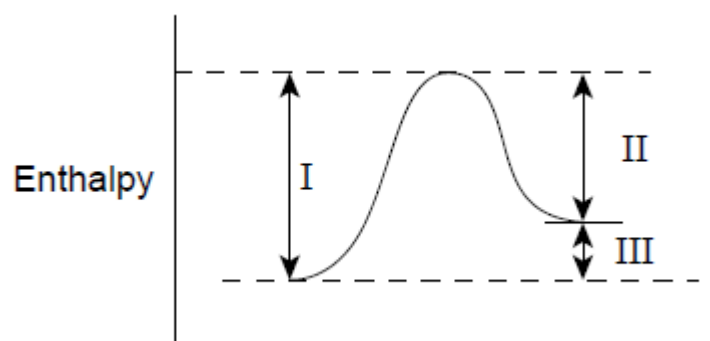
- I. $\text{C(s)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)}$
II. $\text{Na}^+\text{(g)} + \text{e}^- \rightarrow \text{Na(g)}$
III. $\text{NH}_3\text{(g)} \rightarrow \text{NH}_3\text{(l)}$

- A. I and II only
B. I and III only
C. II and III only
D. I, II and III

[1]

6. [Maximum mark: 1]

Which expression represents the calculation of ΔH ?



- A. I – II
- B. II – I
- C. I – III
- D. II – III

[1]