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IB Chemistry: SL

5.1 Energetics

CHEMISTRY

SL

5.1 Energetics

Question Paper

Course	DP IB Chemistry
Section	5. Energetics / Thermochemistry
Topic	5.1 Energetics
Difficulty	Hard

Time allowed: 20

Score: /10

Percentage: /100

Question 1

A student obtained the following experimental results for the enthalpy of combustion of cyclohexane (C_6H_{12}).

Mass of water / g	50.00
Initial temperature of the water / °C	19.60
Initial mass of spirit burner and cyclohexane / g	186.79
Final mass of spirit burner and cyclohexane / g	186.29

The student determined from this experiment that the enthalpy of combustion of cyclohexane is –1216 kJ mol^{-1}

The specific heat capacity of water = 4.18 J $g^{-1}K^{-1}$
The relative molecular mass (M) of cyclohexane = 84.18

Which calculation will correctly determine the final temperature of the water in this experiment?

A. $19.60 + \dfrac{608}{50.00 \times 4.18 \times 84.18}$

B. $19.60 + \dfrac{60800}{50.00 \times 4.18 \times 84.18}$

C. $19.60 + \dfrac{1216 \times 84.18}{25.00 \times 4.18}$

D. $19.60 + \dfrac{1216000 \times 84.18}{25.00 \times 4.18}$

[1 mark]

Question 2

In a calorimetric experiment 2.50 g of a fuel is burnt in oxygen. 30 % of the energy released during the combustion is absorbed by 500 g of water, the temperature of which rises from 25 °C to 68 °C.

The specific heat capacity of water is 4.2 J g K .
What is the total energy released per gram of fuel burnt?

A. $\frac{500 \times 4.2 \times (68 - 25)}{2.5}$

B. $\frac{500 \times 4.2 \times (273 + (68 - 25)) \times 100}{30 \times 2.5}$

C. $\frac{500 \times 4.2 \times (68 - 25) \times 100}{30 \times 2.5}$

D. $\frac{500 \times 4.2 \times (68 - 25) \times 100}{30}$

[1 mark]

Question 3

The reaction of hydrochloric acid with sodium hydroxide produced an overall temperature increase of 24.4 K.

Given the following data, how much thermal energy was evolved during this reaction?

Initial temperature of 25.0 cm^3 hydrochloric acid = 17.6°C

Initial temperature of 25.0 cm^3 sodium hydroxide = 18.5°C

The specific heat capacity of water is 4.18 J $g^{-1}K^{-1}$.

A. (25.0 x 4.18 x 6.8) + (25.0 x 4.18 x 5.9)

B. $\frac{25.0 \times 4.18 \times 6.8) + (25.0 \times 4.18 \times 5.9)}{2}$

C. 50.0 x 4.18 x $\left(\frac{6.8 + 5.9}{2}\right)$

D. (50.0 x 4.18 x 6.8) + (50.0 x 4.18 x 5.9)

[1 mark]

Question 4

The heat produced by the combustion of magnesium is used to heat some water.
Which values are needed to calculate the energy transferred during the reaction?

I. The mass of magnesium
II. The mass of the water
III. The temperature change of the water

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

[1 mark]

Question 5

The temperature rise when 0.1 MJ of heat energy is absorbed by 2.5 kg of solid aluminium is 44.4 °C.
What is the specific heat capacity of aluminium, in J $g^{-1}K^{-1}$?

A. $\frac{100000}{2.5 \times 44.4}$

B. $\frac{100000}{2500 \times 44.4}$

C. $\frac{0.1}{2.5 \times 44.4}$

D. $\frac{0.1}{2500 \times 44.4}$

[1 mark]

Question 6

An iron cube, with a mass of 0.5 kg, increases in temperature by 12.7 K when heated.

The specific heat capacity of iron is 0.448 J $K^{-1}g^{-1}$.

What is the enthalpy change, in kJ mol , for heating the iron cube?

A. 0.448 x 12.7 x 55.85

B. $\frac{0.448 \times 12.7 \times 500^2}{1000 \times 55.85}$

C. $\frac{0.448 \times 12.7 \times 55.85}{1000 \times 55.85}$

D. $-\frac{0.448 \times 12.7 \times 55.85}{1000}$

[1 mark]

Question 7

When completing experiments to measure enthalpy change for exothermic processes, which of the following is **not** a reason for the experimental data to be lower than the expected value?

A. Heat loss through convection
B. Water vapour released as a product
C. An inadequate supply of oxygen during combustion
D. Heat transfer to the system

[1 mark]

Question 8

Heptathiepane, S_7, can undergo complete combustion to form sulfur dioxide.

$$S_7(s) + 7O_2(g) \rightarrow 7SO_2(g)$$

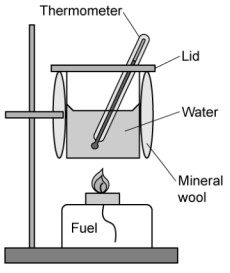
Which enthalpy changes can be used to describe this reaction?

	ΔH_p^0	ΔH_c^0	ΔH_r
A	✓	X	✓
B	X	✓	✓
C	X	✓	X
D	X	X	✓

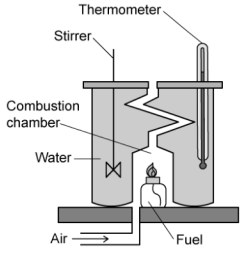
[1 mark]

Question 9

The diagrams below show a simple calorimeter that is commonly used in the school laboratory and the more accurate chamber calorimeter.



Simple calorimeter



Chamber calorimeter

Which of the following statements correctly explain why the chamber calorimeter is more accurate?

I. There is less heat loss
II. There is more complete combustion
III. There is less fuel lost

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

[1 mark]

Question 10

Which of the following assumptions are correct when completing the calorimetry experiment and subsequent calculations for the neutralisation of 25.0 cm^3 sulfuric acid by 25.0 cm^3 barium hydroxide?

I. That both solutions have the same initial temperature
II. The value of m in $q = mc\Delta T$ is 50 g
III. Heat is lost to the surroundings

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

[1 mark]