IB Chemistry HL - R1.1

Measuring enthalpy changes

Exercises + Practice questions

Official answers appended at the end

Exercise

Q3. When a sample of $NH_4SCN(s)$ is mixed with $Ba(OH)_2.8H_2O(s)$ in a glass beaker, the mixture changes to a liquid and the temperature drops sufficiently to freeze the beaker to the table. Which statement is true about the reaction?

A The process is endothermic and ΔH is negative.

B The process is endothermic and ΔH is positive.

C The process is exothermic and ΔH is negative.

D The process is exothermic and ΔH is positive.

Q4. Which one of the following statements is true of all exothermic reactions?

A They produce gases.

B They give out heat.

C They occur quickly.

D They involve combustion.

Q5. Which is the best explanation of why the temperature of the liquid decreases when it evaporates?

A The number of liquid molecules is decreasing.

B The mean kinetic energy of the liquid molecules is decreasing.

C The pressure above the liquid surface is increasing.

D The rate of evaporation is increasing.

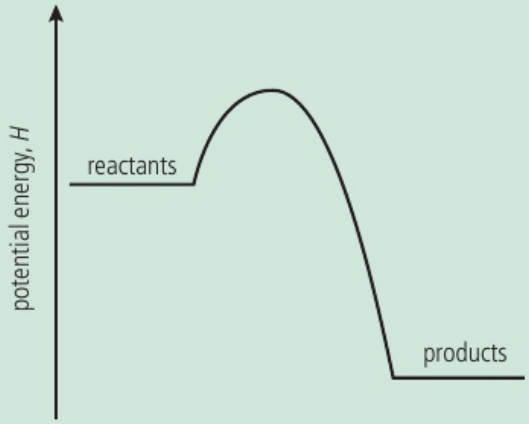
Q6. Two objects made of different masses of aluminium have the same temperature.

Which is the best description of the relative average kinetic energy and total energies of the aluminium atoms in the different objects?

	Average kinetic energy of the atoms	**Total energy of the atoms**
A	greater in object of larger mass	same
B	less in object of larger mass	same
C	same	greater in object of larger mass
D	same	less in object of larger mass

Exercise

Q7. Which statement is consistent with the potential energy profile shown?



A Heat is produced during the reaction and the products are more stable than the reactants.

B Heat is taken in during the reaction and the products are more stable than the reactants.

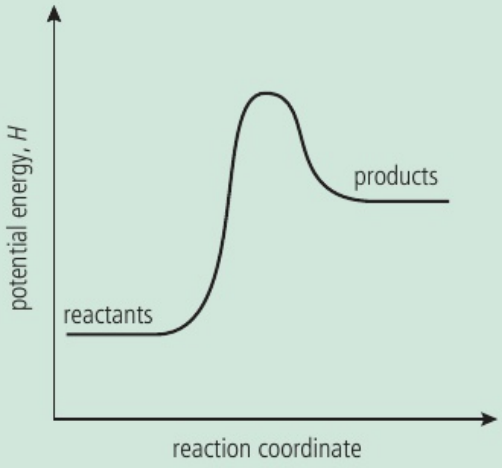
C Heat is produced during the reaction and the reactants are more stable than the products.

D Heat is taken in during the reaction and the reactants are more stable than the products.

Q8. Identify the endothermic reaction.

	Enthalpy	Direction of heat transfer
A	$H_{reactants} < H_{products}$	system → surroundings
B	$H_{reactants} < H_{products}$	surroundings → system
C	$H_{reactants} > H_{products}$	system → surroundings
D	$H_{reactants} > H_{products}$	surroundings → system

Q9. The potential energy profile of a reaction is shown.



What can be deduced about the nature of the reaction and the relative stability of the reactants and products?

	Nature of reaction	Most stable
A	endothermic	reactants
B	endothermic	products
C	exothermic	reactants
D	exothermic	products

Exercise

Q10. If 500 J of heat is added to 100.0 g samples of each of the substances below, which will have the largest temperature increase?

	Substance	Specific heat capacity / $J\,g^{-1}\,K^{-1}$
A	gold	0.129
B	silver	0.237
C	copper	0.385
D	water	4.18

Q11. Calculate the amount of heat needed to increase the temperature of a 5.0 g sample of copper from 27 °C to 29 °C. (Specific heat capacity of Cu is $0.385\,J\,g^{-1}\,°C^{-1}$)

A 0.770 J **B** 1.50 J **C** 3.00 J **D** 3.85 J

Q12. Consider the specific heat capacity of the following metals.

Metal	Specific heat capacity / $J\,g^{-1}\,K^{-1}$
Al	0.897
Be	1.82
Cd	0.231
Cr	0.449

1 kg samples of the metals at room temperature are heated by the same electrical heater for 10 minutes.

Identify the metal which has the highest final temperature.

A Al **B** Be **C** Cd **D** Cr

Q13. In an experiment to determine the enthalpy of combustion of an alcohol, the mass of a burner plus its contents, and the temperature of a known mass of water in a calorimeter are measured before and after the experiment. What are the expected results?

	Mass of burner and contents	Reading on thermometer
A	decreases	increases
B	decreases	stays the same
C	increases	increases
D	increases	stays the same

Q14. The experimental arrangement in Figure 9 is used to determine the enthalpy of combustion of an alcohol.

Which of the following would lead to an experimental result which is **less** exothermic than the literature value?

I. Heat loss from the sides of the copper calorimeter.

II. Evaporation of alcohol during the experiment.

III. The thermometer touches the bottom of the calorimeter.

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

Q15. A copper calorimeter was used to determine the enthalpy of combustion of butan-1-ol. The experimental value obtained was $-2100 \pm 200\,kJ\,mol^{-1}$, and the data booklet value is $-2676\,kJ\,mol^{-1}$.

Which of the following accounts for the difference between the two values?

I. random measurement errors

II. incomplete combustion

III. heat loss to the surroundings

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

Q16. The thermochemical equation for the combustion of propane is:

$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l) \quad \Delta H^{\ominus} = -2219\,kJ\,mol^{-1}$

Identify the true statements.

I. If 1.00 g of propane is burnt completely, 2219 kJ of energy are produced.

II. The reactants have more potential energy than the products.

III. The reaction is exothermic.

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

Q17. An experiment is carried out to determine the enthalpy of combustion of methanol. A known mass of tap water is heated by burning a sample of methanol.

The following data were collected.

Mass of water m_{water}	Temperature change of the tap water ΔT
Initial mass of methanol $m_{initial}$	Final mass of methanol m_{final}

(a) Which formula can be used to calculate an experimental value for the enthalpy change of combustion of methanol?

A $m_{water} \times 4.18 \times \Delta T$

B $\dfrac{m_{water} \times 4.18 \times \Delta T \times 32.05}{(m_{initial} - m_{final})}$

C $(m_{initial} - m_{final}) \times 4.18 \times \Delta T$

D $\dfrac{m_{water} \times 4.18 \times \Delta T \times (m_{initial} - m_{final})}{32.05}$

(b) Identify the assumptions made in using the formula in part **(a)**.

I. The density of tap water is $1.0\,g\,cm^{-3}$.

II. All the energy from the combustion heats the beaker of water.

III. The specific heat capacity of the beaker is negligible.

A I and II only **B** I and III only

C II and III only **D** I, II and III