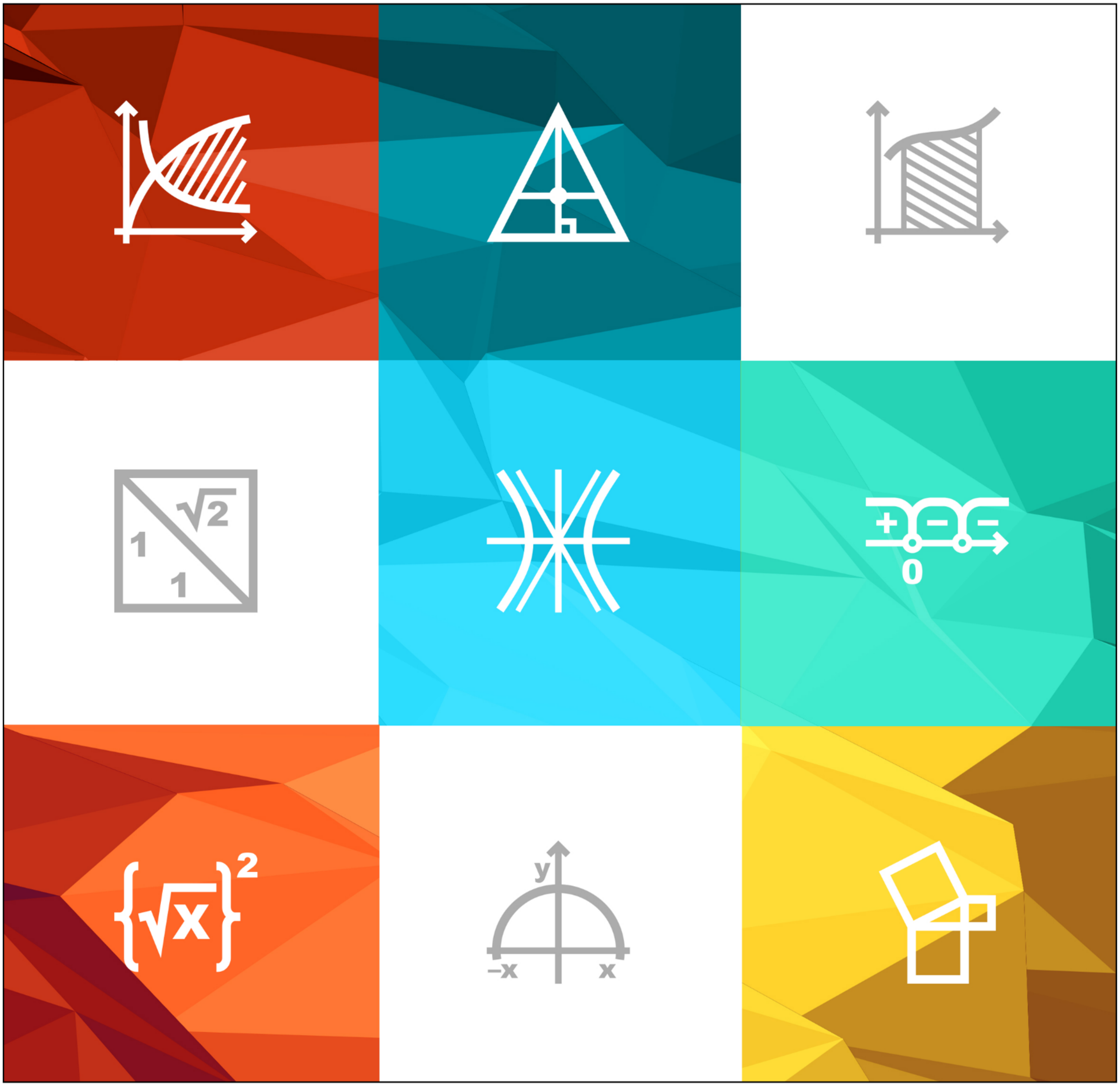
proprep

Workbook



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Thermochemistry

Heat

Questions

1) Calculate the amount of heat, in kJ, required:

a. To raise the temperature of 267 kg of iron by 16.8 °C.
The specific heat capacity of iron = 0.449 $\frac{J}{g°C}$.

b. To lower the temperature of 5.85 L of water from 45 °C to 31 °C.
The specific heat capacity of water = 4.18 $\frac{J}{g°C}$.

2) A 289 g piece of aluminum is removed from an oven and placed into 525 g water,
in an insulated container. The temperature of the water increases from,
25 °C to 64 °C. What is the original temperature of the aluminum?

The specific heat capacity of water = 4.18 $\frac{J}{g°C}$.

The specific heat capacity of aluminum is 0.903 $\frac{J}{g°C}$.

3) A 850 g piece of copper at 58 °C is added to 500 mL of water maintained at 35 °C,
in an insulated container. What will be the final temperature,
of the Cu-H2O mixture?

The specific heat capacity of water = 4.18 $\frac{J}{g°C}$.

The specific heat capacity of copper = 0.385 $\frac{J}{g°C}$.

4) A 128.5 g sample of magnesium at 127.9 °C is added to 236 g of water at 25 °C, in an insulated vessel. The final temperature = 37.1 °C.

The specific heat capacity of water = 4.18 $\frac{J}{g°C}$.

What is the molar heat capacity of magnesium?

5) 125.4 kJ, in the form of heat, is transferred to a 2L sample of water (d = 1 $\frac{g}{mL}$), at 25 °C. The final temperature of the water is 40 °C.

What is the heat capacity of water in $\frac{J}{K}$?

Answer Key

1) a. 2014 kJ

b. -342.34 kJ

2) 392 °C

3) 38 °C

4) 24.87 $\frac{J}{mol°C}$

5) $8.36 \cdot 10^3 \frac{J}{K}$

Enthalpy

1) How much heat, in kJ, is associated with the decomposition of 367 g of $MgCO_3$?

$$MgCO_3(s) \rightarrow MgO(s) + CO_2(g) \qquad \Delta H^\circ = 118 \text{ kJ}$$

2) How much heat, in kJ, is associated with the complete combustion of:

a. $33.2L\ C_3H_8(g)$ at STP?

b. $15.4L\ C_3H_8(g)$ at 35.2 °C and 624 mmHg?

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l) \qquad \Delta H^\circ = -2219.9 \text{ kJ}$$

3) $C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l) \qquad \Delta H^\circ = -2877 \text{ kJ}$

a. What mass of butane, $C_4H_{10}(g)$, must be burned to liberate $3.45 \cdot 10^5\ KJ$, of heat?

b. What volume of water, in liters, could be heated from 20 °C to 45 °C, if the $3.45 \cdot 10^5\ KJ$ of heat are transferred to water?

4) 0.5 g of NH_4Cl are added to 22 g water in a Styrofoam coffee cup.
The water temperature decreases from 26 °C to 24.5 °C.
Calculate the heat of solution of NH_4Cl (in kJ per mole of NH_4Cl).
Assume that the specific heat capacity of dilute NH_4Cl (aq) is the same, as that of water.

5) What mass of KOH needs to be dissolved in 73 g of water in order to raise, the water temperature by 2.5 °C?
The heat of solution of potassium hydroxide is -57.61 $\frac{\text{kJ}}{\text{mol}}$.

6) What mass of ice can be melted with the same amount of heat required to raise,
the temperature of 5.4 mol $H_2O(l)$ by 23 °C?

$$\Delta H^\circ_{\text{fusion}} = 6.01\frac{\text{kJ}}{\text{mol}}\ H_2O(s)$$

Answer Key

1) a. 513.3 kJ

2) a. – 3,285.45 kJ

b. – 844,094.78 kJ

3) a. 6,972.15 g

b. 3301.44 L

4) $\Delta H_{sol} = 14.7\frac{\text{kJ}}{\text{mol}}$

5) $m_{KOH} = 0.75g$

6) $m_{ice} = 27.53g$