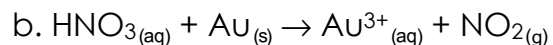
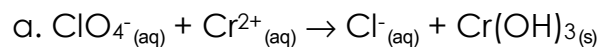


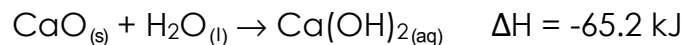
1. Permanganate ion reacts with strong acids in an oxidation-reduction reaction to produce Manganese(II) ions and oxygen gas. Write the **balanced net ionic equation** for this reaction. Using the table given, calculate the **molar enthalpy change** for this reaction. How many **grams of Calcium Permanganate** are needed to have 25.00 kJ of heat transferred?

Substance	$\Delta H_f^\circ$ (kJ mol <sup>-1</sup> )
H <sup>+</sup> <sub>(g)</sub>	1536.3
H <sup>+</sup> <sub>(aq)</sub>	0.00
H <sub>2</sub> O <sub>(g)</sub>	-241.8
H <sub>2</sub> O <sub>(l)</sub>	-285.840
Ca(MnO <sub>4</sub> ) <sub>2(s)</sub>	-1112
MnO <sub>4</sub> <sup>-</sup> <sub>(aq)</sub>	-518.4
Mn <sup>2+</sup> <sub>(aq)</sub>	-219
CO <sub>2(g)</sub>	-393.5
CO <sub>(g)</sub>	-110.5
CH <sub>4(g)</sub>	-74.87

2. **Balance** the following reactions. Give the **molecular equation** when possible.



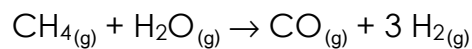
3. Given the following thermochemical equation,



How many **grams of calcium oxide** are needed to generate enough energy to increase the temperature of 5.00 g of aluminum ( $s = 0.903 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$ ) from 231.4 K to 299.5 K?

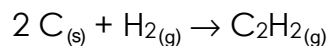
4. Helium gas is found to effuse 6.55 times faster than an unknown gas. Calculate the **molar mass** of the unknown gas. What is the **rms speed** of the unknown gas at standard temperature?

5. Hydrogen, H<sub>2</sub>, is prepared by *steam reforming*, in which hydrocarbons are reacted with steam. For CH<sub>4</sub>,

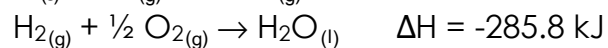
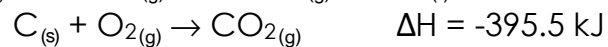
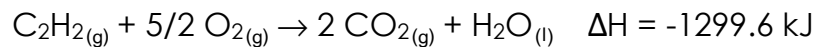


Calculate the **enthalpy change  $\Delta H^\circ$**  for this reaction, using standard enthalpies of formation.

6. Calculate  $\Delta H$  for the reaction



given the following thermochemical equations



7. An 18.6-mL volume of hydrochloric acid reacts completely with a solid sample of  $\text{MgCO}_3$ . The reaction is



The volume of  $\text{CO}_2$  formed is 159 mL at  $23^\circ\text{C}$  and 731 mmHg. What is the **molarity of the HCl** solution?