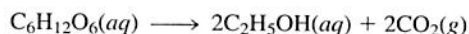


Heat and Work

21. Calculate ΔE for each of the following cases.
- $q = +51 \text{ kJ}$, $w = -15 \text{ kJ}$
 - $q = +100. \text{ kJ}$, $w = -65 \text{ kJ}$
 - $q = -65 \text{ kJ}$, $w = -20. \text{ kJ}$
 - In which of these cases does the system do work on the surroundings?
22. Calculate ΔE for each of the following.
- $q = -47 \text{ kJ}$, $w = +88 \text{ kJ}$
 - $q = +82 \text{ kJ}$, $w = +47 \text{ kJ}$
 - $q = +47 \text{ kJ}$, $w = 0$
 - In which of these cases do the surroundings do work on the system?
23. A gas absorbs 45 kJ of heat and does 29 kJ of work. Calculate ΔE .
24. A system releases 125 kJ of heat while 104 kJ of work is done on it. Calculate ΔE .
25. The volume of an ideal gas is decreased from 5.0 L to 5.0 mL at a constant pressure of 2.0 atm. Calculate the work associated with this process.
26. Consider a mixture of air and gasoline vapor in a cylinder with a piston. The original volume is 40. cm³. If the combustion of this mixture releases 950. J of energy, to what volume will the gases expand against a constant pressure of 650. torr if all the energy of combustion is converted into work to push back the piston?
27. A balloon filled with 39.1 mol helium has a volume of 876 L at 0.0°C and 1.00 atm pressure. The temperature of the balloon is increased to 38.0°C as it expands to a volume of 998 L, the pressure remaining constant. Calculate q , w , and ΔE for the helium in the balloon. (The molar heat capacity for helium gas is 20.8 J/°C · mol.)
28. One mole of H₂O(g) at 1.00 atm and 100.°C occupies a volume of 30.6 L. When one mole of H₂O(g) is condensed to one mole of H₂O(l) at 1.00 atm and 100.°C, 40.66 kJ of heat is released. If the density of H₂O(l) at this temperature and pressure is 0.996 g/cm³, calculate ΔE for the condensation of one mole of water at 1.00 atm and 100.°C.

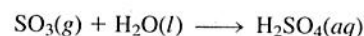
Properties of Enthalpy

29. The equation for the fermentation of glucose to alcohol and carbon dioxide is



The enthalpy change for the reaction is -67 kJ . Is the reaction exothermic or endothermic? Is energy, in the form of heat, absorbed or evolved as the reaction occurs?

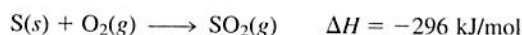
30. The reaction



is the last step in the commercial production of sulfuric acid. The enthalpy change for this reaction is -227 kJ . In designing a sulfuric acid plant, is it necessary to provide for heating or cooling of the reaction mixture? Explain.

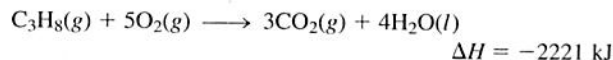
31. Are the following processes exothermic or endothermic?
- When solid KBr is dissolved in water, the solution gets colder.
 - Natural gas (CH₄) is burned in a furnace.
 - When concentrated H₂SO₄ is added to water, the solution gets very hot.
 - Water is boiled in a teakettle.
32. Are the following processes exothermic or endothermic?
- the combustion of gasoline in a car engine
 - water condensing on a cold pipe
 - $\text{CO}_2(\text{s}) \longrightarrow \text{CO}_2(\text{g})$
 - $\text{F}_2(\text{g}) \longrightarrow 2\text{F}(\text{g})$

33. For the reaction



- How much heat is evolved when 275 g sulfur is burned in excess O₂?
 - How much heat is evolved when 25 mol sulfur is burned in excess O₂?
 - How much heat is evolved when 150. g sulfur dioxide is produced?
34. The overall reaction in commercial heat packs can be represented as
- $$4\text{Fe}(\text{s}) + 3\text{O}_2(\text{g}) \longrightarrow 2\text{Fe}_2\text{O}_3(\text{s}) \quad \Delta H = -1652 \text{ kJ}$$
- How much heat is released when 4.00 mol iron is reacted with excess O₂?
 - How much heat is released when 1.00 mol Fe₂O₃ is produced?
 - How much heat is released when 1.00 g iron is reacted with excess O₂?
 - How much heat is released when 10.0 g Fe and 2.00 g O₂ are reacted?

35. Consider the combustion of propane:



Assume that all the heat in Sample Exercise 6.3 comes from the combustion of propane. What mass of propane must be burned to furnish this amount of energy assuming the heat transfer process is 60.% efficient?