Exercise 6.2a
Energy

Name: ________________________

Date:_________________ Per:________

1. Convert 34.56 joules to calories

2. Convert 12300 calories to joules

3. Convert 180. Calories to joules

4. Convert 4.03 mJ to calories

5. Identify and define each variable in this equation.
   a. ΔE ______________________________
   b. q ______________________________
   c. w ______________________________

The formula for calculating change in internal energy is $\Delta E = q + w$.

6. Calculate ΔE for each of the following cases:
   a. $q = +51$ kJ, $w = -15$ kJ ______________________________
   b. $q = -65$ kJ, $w = -20.$ kJ ______________________________
   c. In which of these cases does the system do work on the surroundings?______________________

7. Calculate ΔE for each of the following:
   a. $q = +47$ kJ, $w = +88$ kJ ______________________________
   b. $q = +47$ kJ, $w = 0$ ______________________________
   c. In which of these cases do the surroundings do work on the system? ______________________

8. A gas absorbs 45 kJ of heat and does 29 kJ of work. Calculate ΔE. ________________________

9. What is a state function? Enthalpy and internal energy are state functions as a direct consequence of the first law of thermodynamics. Explain. ____
____
____
____

The formula for calculating work is $w = -P\Delta V$. Because the value for work is calculated by multiplying pressure by volume, the units for work would be '*atm•L*' (or some product of pressure and volume units). Obviously, this is not a standard unit of work, but a conversion to joules is possible: 101.325 J = 1atm•L.

10. The volume of an ideal gas is decreased from 5.0 L to 2400.0 mL at a constant pressure of 2.0 atm. Calculate the work associated with this process in 'atm•L'. Is working being done <u>on</u> the system or <u>by</u> the system?

11. If 2.30×10^{-2} atm•L of work are done on a 10.00 mL volume of gas at a constant pressure of 4.20 atm, what is the new volume of gas?

Answers: 1) 8.260 cal 2) 5.15×10^{4} J 3) 7.53×10^{5} J 4) 9.63×10^{-4} cal 6a) 36kJ b) -85kJ c) both 7a) 135 kJ b) 47 kJ c) a 8) 16 kJ 10) 5.2 atm•L, on 11) 4.52 mL 12) 375 J 13) -13.2 kJ 14) 11.0 L 15) q = 30.9 kJ, w = -12.4kJ, ΔE = 18.5 kJ 17a) 9.0×10^{2} J b) 26 J/mol•°C c) 1600 g 18) Al

Exercise 6.2a
Energy

Name: ________________________

Date:_________________ Per:_________

12. If the internal energy of a thermodynamic system is increased by 300. J while 75 J of expansion work is done, how much heat was transferred and in which direction, to or from the system?

13. A sample of an ideal gas at 15.0 atm and 10.0 L is allowed to expand against a constant external pressure of 2.00 atm at a constant temperature. Calculate the work in units of kJ for the gas expansion. (*Hint*: Boyle's law applies)

14. Consider a mixture of air and gasoline vapor in a cylinder with a piston. The original volume is 40 cm^3. 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?

15. A balloon filled with 39.1 moles of 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°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)

q =
w =
ΔE =

16. Are the following processes exothermic or endothermic?
    a. When solid KBr is dissolved in water, the solution gets colder. ____________________
    b. Natural gas (CH_4) is burned in a furnace. _________________
    c. When concentrated H_2SO_4 is added to water, the solution gets very hot. __________________
    d. Water is boiled in a teakettle. __________________

Answers: 1) 8.260 cal 2) 5.15 x 10^5 J 3) 7.35 x 10^5 J 4) 9.63 x 10^{-4} cal 6a) 36kJ b) -85kJ c) both 7a) 135 kJ b) 47 kJ c) a 8) 16 kJ 10) 5.2 atm•L, on 11) 4.52 mL 12) 375 J 13) -13.2 kJ 14) 11.0 L 15) q = 30.9 kJ, w = -12.4kJ, ΔE = 18.5 kJ 17a) 9.0 x 10^2 J b) 26 J/mol•°C c) 1600 g 18) Al

Exercise 6.2a
Energy

Name: ________________________

Date:_________________ Per:________

17. The specific heat capacity of silver is 0.24 J/°C·g.
    a. Calculate the energy required to raise the temperature of 150.0 g Ag from 273 K to 298 K.

    b. Calculate the energy required to raise the temperature of 1.0 mole of Ag by 1.0°C (called the *molar heat capacity* of silver).

    c. It takes 1.25 kJ of energy to heat a sample of pure silver from 12.0°C to 15.2°C. Calculate the mass of silver.

8. A 5.00 g sample of one of the substances listed in the table below was heated from 25.2°C to 55.1°C, requiring 133 J to do so. Which substance was it?

Substance	Specific Heat Capacity (J/°C·g)
$H_2O(l)$	4.18
$H_2O(s)$	2.03
Al(s)	0.89
Fe(s)	0.45
Hg(l)	0.14
C(s)	0.71

Answers: 1) 8.260 cal 2) 5.15×10^5 J 3) 7.35×10^5 J 4) 9.63×10^{-4} cal 6a) 36kJ b) -85kJ c) both 7a) 135 kJ b) 47 kJ c) a 8) 16 kJ 10) 5.2 atm•L, on 11) 4.52 mL 12) 375 J 13) -13.2 kJ 14) 11.0 L 15) q = 30.9 kJ, w = -12.4kJ, ΔE = 18.5 kJ 17a) 9.0×10^2 J b) 26 J/mol•°C c) 1600 g 18) Al