CHAPTER 0

Spontaneity

0.1 Which of the following processes are spontaneous: (a) An apple falls down a tree (b) Water flowing down a river (c) Water flowing up a river (d) A ball rolling downhill

0.2 Which of the following processes are spontaneous: (a) A ball rolling uphill (b) Sugar dissolving on coffe (c) Cacao powder dissolving in cold water (d) An iron pipe rusting

0.3 Which of the following processes are spontaneous: (a) Boiling of water at 100°C and 1atm (b) Boiling of water at 50°C and 1atm (c) Boiling of water at 100°C and 2atm

0.4 Which of the following processes are spontaneous: (a) Melting of ice at 0°C (b) Melting of ice at 10°C (c) A diamond becoming graphite

Entropy

0.5 A hot container submerged in water releases 100J of energy at 298K. Calculate the entropy change of the hot container.

0.6 An cup of milk cools down in a refrigerator at 15°C, releasing 20J. Calculate the change in entropy in the milk.

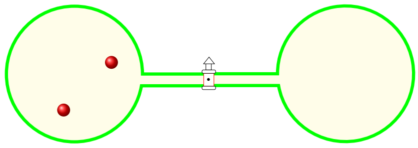
0.7 Calculate the entropy change in a gold nugget when it receives 50KJ at 100°C.

0.8 Calculate the entropy change in a gold nugget when it receives 50KJ at 100°C.

0.9 Calculate the entropy change when 200KJ of heat are being reversibly transferred from a hot reservoir at 300K into a cold reservoir at 200K.

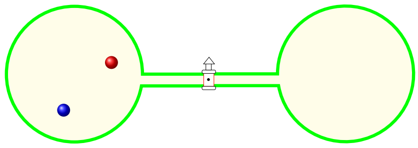
0.10 Calculate the entropy change when 40KJ of heat are being reversibly transferred from a cold reservoir at 100K into a cold reservoir at 400K.

0.11 Think about the possible arrangements of two identical molecules in a two-bulbed flask:



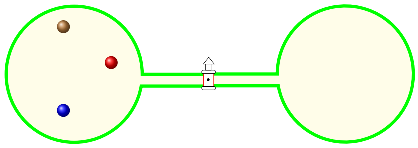
(a) How many arrangements are possible? (b) Which is the most likely arrangement? (c) Which is the probability of the most likely arrangement?

0.12 Think about the possible arrangements of two different molecules in a two-bulbed flask:



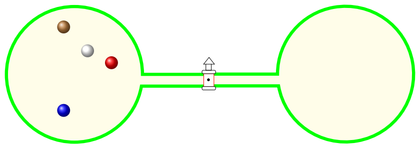
(a) How many arrangements are possible? (b) Which is the most likely arrangement? (c) Which is the probability of the most likely arrangement?

0.13 Think about the possible arrangements of three different molecules in a two-bulbed flask:



(a) How many arrangements are possible? (b) Which is the most likely arrangement? (c) Which is the probability of the most likely arrangement?

0.14 Think about the possible arrangements of four different molecules in a two-bulbed flask:



(a) How many arrangements are possible? (b) Which is the most likely arrangement? (c) Which is the probability of the most likely arrangement?

Standard molar entropies

0.15 Indicate which substance in the pair will have a larger molar entropy at the same conditions: (a) NO or CO (b) H_2O or D_2O (ps: D is a heavy isotope of hydrogen) (c) NaCl(s) or NaCl(aq)

0.16 Indicate which substance in the pair will have a larger molar entropy at the same conditions:

(a) I_2(s) or I_2(g) (b) CH_4(g) or CH_3Cl(g) (c) H_2(g) at 1atm or H_2(g) at 2atm

0.17 Indicate which substance in the pair will have a larger molar entropy at the same conditions:

(a) H_2(g) at 298K or H_2(g) at 400K (b) $C_($graphite) or $C_($diamond) (c) He(g) or Ar(g)

0.18 Indicate which substance in the pair will have a larger molar entropy at the same conditions:

(a) 2 moles H_2O(g) or 5 moles H_2O(g) (b) 5L H_2O (g) or 3L H_2O(g) (c) KCl(l) or KCl(aq)

Calculating entropy changes

0.19 A piece of metal with a heat capacity of 3 J/K is warmed up from 100°C to 300°C. Calculate the entropy change of the metal.

0.20 A piece of metal with a heat capacity of 5 J/K is cooled from 100°C to 50°C. Calculate the entropy change of the metal.

0.21 A 50-g piece of metal with a specific heat capacity of 0.5 J/g· K is warmed up from 300K to 400K. Calculate the entropy change of the metal.

0.22 A 4-g piece of metal with a specific heat capacity of 0.1 J/g· K is cooled from 300K to 200K. Calculate the entropy change of the metal.

0.23 Calculate the heat capacity of 3 moles of an ideal monoatomic gas measured at constant volume.

0.24 Calculate the heat capacity of 3 moles of an ideal monoatomic gas measured at constant pressure.

0.25 Calculate the heat capacity of 6 moles of an ideal diatomic gas measured at constant pressure.

0.26 Calculate the heat capacity of 9 moles of an ideal polyatomic gas measured at constant pressure.

Answers