Ch. 2 Problems: 5, 8, 9, 39, 41, 55, 63, 67, 71, 75, 83, 85, 91, 93, 99, 109, 111, 115, 119, 121, 123, 125

Ch. 5 Problems: 9, 10, 25, 27, 29, 33, 37, 39, 41, 43, 45, 47, 51, 53, 57, 61, 65, 69, 71, 75, 77, 81, 83, 87, 89, 93, 95, 97, 101, 105, 107

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Chapter 2

Problem 121

A car has a mileage rating of 38 mi per gallon of gasoline. How many miles can the car travel on 76.5 L of gasoline?

Problem 123

Consider these observations on two blocks of different unknown metals:

Block name	Volume
Block A	125 cm^3
Block B	145 cm

If block A has a greater mass than block B, what can be said of the relative densities of the two metals? (Assume that both blocks are solid.)

2.2.1 Solution

Block A has a greater mass and a smaller volume. As such, since $\rho = \frac{V}{m}$, it has a greater density.

Problem 125

You measure the masses and volumes of two cylinders. The mass of cylinder 1 is 1.35 times the mass of cylinder 2. The volume of cylinder 1 is 0.792 the volume of cylinder 1. If the density of cylinder 1 is 3.85 g/cm^3, what is the density of cylinder 2?

2.3.1 Solution

$$m_1 = 1.35 m_2 \tag{2.1}$$

$$V_1 = 0.792 V_2 \tag{2.2}$$

$$\rho_1 = \frac{m_1}{V_1} = \frac{1.35 m_2}{0.792 V_2} = \frac{1.35}{0.792}\rho_2 \tag{2.3}$$

$$\rho_2 = \frac{0.792}{1.35}\rho_1 = \frac{0.792}{1.35} * 3.85\mathrm{g/cm}^3 = \boxed{2.26\mathrm{g/cm}^3} \tag{2.4}$$

Chapter 3

Problem 114

A portable electric water heater transfers 255 watts (W) of power to 5.5L of water, where 1 W = 1 J/s. How much time (in minutes) does it take for the water heater to heat the 5.5 L of water from 25°C to 42°C? (Assume that water has a density of 1.0 g/mL.)

3.1.1 Solution

We should use an appropriate equation. The appropriate equation for this is the equation $q = mC\Delta T$, which allows us to find the amount of energy necessary for the temperature change. We know that the temperature change is $\Delta T = T_f - T_i = 42°\text{C} - 25°\text{C} = 17°\text{C}$. We know that the specific heat of water is 4.184J/g°C. We know the volume of water is $5.5\text{L} = 5500\text{mL} * 1\text{g/mL} = 5500\text{g}$.

$$\begin{aligned} q &= mC\Delta T \\ &= (5500\text{g})(4.184\text{J/g°C})(17°\text{C}) \\ &= (93500\text{g °C})(4.184\text{J/g°C}) \\ &= 391204\text{J} \end{aligned}$$

Now that we have the energy used, we need to find how long the water heater takes to generate that amount of energy.

$$\frac{391204\text{J}}{255\text{J/s}} = 1534.1\bar{3}\text{s} = 25.56\bar{8}\text{min} \approx \boxed{26\text{min}}$$

Problem 115

What temperature on the Celsius scale is equal to twice its value when expressed on the Fahrenheit scale?

3.2.1 Solution

The conversion between Fahrenheit and Celsius is $T_F = \frac{9}{5}T_C + 32$.

$$T_F = \frac{9}{5}T_C + 32$$

For the proposed to hold, the Fahrenheit value must be equal to the Celsius value.

$$T_C = \frac{9}{5}T_C + 32$$

We can subtract $\frac{9}{5}T_C$ from each side.

$$-\frac{4}{5}T_F = 32$$

We now can divide both sides by $-\frac{4}{5}$.

$$T_F = -40$$

THs means that the temperature that is the same is $\boxed{-40^\circ\text{C}}$.

Problem 116

What temperature on the Celsius scale is equal to twice its value when expressed on the Fahrenheit scale?

3.3.1 Solution

The conversion between Fahrenheit and Celsius is $T_F = \frac{9}{5}T_C + 32$.

$$T_F = \frac{9}{5}T_C + 32$$

In this instance, $2T_F = T_C$.

$$T_F = \frac{18}{5}T_F + 32$$

We can subtract $\frac{18}{5}T_C$ from both sides.

$$-\frac{13}{5}T_F = 32$$

We can lastly multiply both sides by 5.

$$T_F = -12.3078$$

Multiplying this by two, we get the temperature in Celsius.

$$T_C = -24.6154$$

Thus the answer is $\boxed{-24.6154^\circ\text{C}}$.

Chapter 5

Problem 9

What is the difference between a molecular element and an atomic element? List the elements that occur as diatomic molecules.

5.1.1 Solution

An atomic element contains a single copy of the element as a core building block/molecule. A molecular element contains multiple of the same element in each of its molecules. The following are the diatomic molecules: $H_2, N_2, O_2, F_2, Cl_2, Br_2, I_2$. The element names are hydrogen, nitrogen, oxygen, fluorine, chlorine, bromine, and iodine. They are generalized as $\mathcal{D}_2$.

Problem 107

Carbon has two naturally occurring isotopes: carbon-12 (mass = 12.00 amu) and carbon-13 (mass = 13.00 amu). Chlorine also has two naturally occurring isotopes: chlorine-35 (mass = 34.97 amu) and chlorine-37 (mass = 36.97 amu). How many CCl_4 molecules of different masses can exist? Determine the mass (in amu) of each of them.

5.2.1 Solution

There are ten.

Number	C-12	C-13	Cl-35	Cl-37	Mass (amu)
1	1	0	4	0	151.88
2	0	1	4	0	152.88
3	1	0	3	1	153.88
4	0	1	3	1	154.88
5	1	0	2	2	155.88
6	0	1	2	2	156.88
7	1	0	1	3	157.88
8	0	1	1	3	158.88
9	1	0	0	4	159.88
10	0	1	0	4	160.88