 Total: 40

Homework 5.1

(2) **E.1** It will sink. Its average density is larger than that of helium.

(2) **E.2** The density, not the weight, of an object determines if it sinks or floats. If the density of the object is less than the density of the surrounding fluid, it will float.

(2) **E.3** As water enters the car, the car's average density will increase. At some point the average density of the car will become larger than the density of water and then it will sink.

(2) **E.4** Cold air has lower density than warm air. Thus, the cold air will stay in the bins, while the warm air stays on top of it.

(2) **E.6** The helium balloon has less mass (and thus less inertia) than the air it displaces. As the car stops, the mass (inertia) of the air keeps it moving forward toward the front of the car, while the balloon will move toward the back.

(2) **E.7** One kilogram of gasoline takes up more space than 1 kg of water. (Gasoline has a smaller density than water)

(2) **E.8** Oil has a smaller density than vinegar. Thus, the vinegar will settle to the bottom and the oil will float on top of the vinegar.

(2) **E.12** The air pressure is less at higher altitudes than at lower altitudes. When opening the bottle at high altitudes, and then sealing the bottle will trap the low pressure inside the bottle. At low altitudes, the higher pressure on the outside of the bottle and the low pressure at the inside of the bottle result in a pressure imbalance that dents the bottle.

(2) **E.13** Air pressure holds the dimple down when the jar has a vacuum inside, but the pressure difference vanishes when the jar is opened. (The vacuum inside is created by heating the jar, then putting the lid on and letting the jar cool down).

(2) **E.15** Cooling the air in the container reduced its pressure. The resulting pressure imbalance across the lid pushes the lid inward.

(2) **E.16** The lowest possible temperature is – 273.15K. All thermal motion ceases at that temperature.

(2) **E.18** The air in the bubbles heats up, thus increasing the pressure inside the air bubbles. This makes the bubbles (and marshmallow) expand.

E.1. $P = \rho_{particle} \cdot k_B \cdot T$

(2) $= 2.687 \cdot 10^{25} \frac{part.}{m^3} \cdot 1.381 \cdot 10^{-23} \frac{J}{K} \cdot 273.15\,K$

$P = 101,360\,Pa$

E.2 $F = P \cdot A$

(2) $= 101,360\,Pa \cdot 0.2\,m \cdot 0.39\,m$

$\approx 7900\,N$

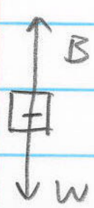
(need to measure area of book)

E.3 P at $300\,K \approx 101,000\,Pa$

(2) According to the ideal gas law, the pressure @ 900K will be 3x as high.

$\rightarrow P_{900K} = 303,000\,Pa$

E.6 Net force $= -$ weight $+$ buoyant force



(2) $= -m_{log} \cdot g + m_{H_2O} \cdot g$

$= -8\,kg \cdot 9.8 \frac{m}{s^2} + 10\,kg \cdot 9.8 \frac{m}{s^2}$

Net force $= 19.6\,N$

E.7 When it floats $\rightarrow$ buoyant force $=$ weight of boat

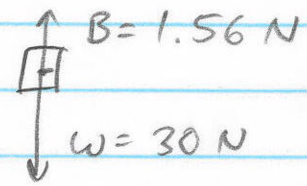
$\rightarrow$ buoyant force $= 1200\,N$

(2) $\rightarrow m_{H_2O} \cdot g = 1200\,N$

$m_{H_2O} = 122.4\,kg$ (or $0.1224\,m^3$)

E. 8 Weight of displaced water is 19x less than weight of gold

2 $\rightarrow \text{Weight}_{H_2O} = \underline{\underline{1.56\ N}}$



E. 9 (see 8.)

2 $F = W - B$

$= 30\ N - 1.56\ N$

$= \underline{\underline{28.44\ N}}$