CHM 130: Chapter 11 Homework Answer Key - errors corrected

1. Check all of the following that are **properties of gases**:
   b) indefinite shape
   d) can diffuse uniformly within same container
   e) can expand
   f) can compress
   g) have very low densities, about 1000 times less dense than water

2. Standard temperature and pressure (STP) are defined as _____.
   c) 273 K and 760 torr

   Explanation: Standard temperature = 0°C (273 K); Standard pressure = 1 atm (760 torr)

3. The pressure of a gas decreases when either the number of collisions increases or the energy of collisions increases. True or False?

   Explanation: False, the pressure of a gas will **increase** when the number of collisions increase or when the energy of the collisions increase.

4. Which of the following statements is correct?
   b) Atmospheric pressure decreases as altitude increases.

   Explanation: Atmospheric pressure decreases as altitude increases. At higher altitudes, there are fewer air molecules, so the pressure is lower. Because air is made up mostly of nitrogen and oxygen, there's less oxygen at higher altitudes, so one may feel out of breath more easily in the mountains.

5. Convert 35 psi to units of atmospheres (atm).

$$35 \text{ psi} \times \frac{1 \text{ atm}}{14.7 \text{ psi}} = \mathbf{2.4 \text{ atm}}$$

6. Convert 745 torr to units of mmHg.

$$745 \text{ torr} \times \frac{1 \text{ mm Hg}}{1 \text{ torr}} = \mathbf{745 \text{ mmHg}}$$

7. Convert 725 mmHg to atm.

$$725 \text{ mm Hg} \times \frac{1 \text{ atm}}{760 \text{ mm Hg}} = \mathbf{0.954 \text{ atm}}$$

8. Check all of the statements below referring to the pressure exerted by gas molecules in a container that are **true**:
   c) Increasing the volume of the container decreases the pressure.
   d) Decreasing the volume of the container increases the pressure.
   f) The volume of the container and the pressure of the gas are **indirectly (or inversely)** related.

   Explanation: Increasing the volume of the container results in fewer collisions between the gas molecules and the container's surface and thus, lower gas pressure. Thus, the volume of the container and the pressure of the gas are **inversely** related.

9. Check all of the statements below referring to the pressure exerted by gas molecules in a container that are **true**:
   a) Increasing the temperature increases the pressure.
   b) Decreasing the temperature decreases the pressure.
   e) The temperature and the pressure of the gas are **directly** related.

Explanation: Increasing the temperature results in more collisions between the gas molecules and the container's surface and thus, higher gas pressure. So the temperature and the pressure of a gas are **directly** related.

10. Check all of the statements below referring to the pressure exerted by gas molecules in a container that are **true**:
    a) Increasing the number of gas molecules increases the pressure.
    b) Decreasing the number of gas molecules decreases the pressure.
    e) The number of gas molecules and the pressure of the gas are **directly** related.

    Explanation: Increasing the number of gas molecules results in more collisions between the gas molecules and the container's surface and thus, higher gas pressure. So the number of gas molecules and the pressure of the gas are **directly** related.

11. A 25.0 L sample of air at a pressure 1.00 atm is compressed to 12.5 L. What is the new pressure of the sample?

P_1 = 1.00 atm	V_1 = 25.0 L
P_2 = ?	V_2 = 12.5 L

$$P_2 = \frac{P_1V_1}{V_2} = \frac{(1.00\text{ atm})(25.0\text{ L})}{12.5\text{ L}} = \mathbf{2.00\ atm}$$

- Because P and V are inversely related, if V is cut in half then P will double.

12. A 10.0 mL sample of nitrogen gas at 250.0 torr is expanded until the new pressure is 125.0 torr. Calculate the new volume of the sample.

P_1 = 250.0 torr	V_1 = 10.0 mL
P_2 =125.0 torr	V_2 = ?

$$V_2 = \frac{P_1V_1}{P_2} = \frac{(250.0\text{ torr})(10.0\text{ mL})}{125.0\text{ torr}} = \mathbf{20.0\ mL}$$

- Because P and V are inversely related, if V is cut in half then P will double.

13. A 25.0 mL sample of oxygen gas at -98.0 °C is heated to 77.0 °C. Calculate the new volume of the sample in mL.

V_1 = 25.0 mL	T_1 = -98.0 °C + 273 = 175 K
V_2 =?	T_2 = 77.0 °C + 273 = 350 K

$$V_2 = \frac{V_1T_2}{T_1} = \frac{(25.0\text{ mL})(350\text{ K})}{175\text{ K}} = \mathbf{50.0\ mL}$$

- Because V and T are directly related, doubling the temperature causes V to double.

14. A 20.0 L sample of helium is cooled from 250.0 K to 125.0 K. What is the new volume of the helium sample?

V_1 = 20.0 L	T_1 = 250.0 K
V_2 = ?	T_2 = 125.0 K

$$V_2 = \frac{V_1 T_2}{T_1} = \frac{(20.0\text{ L})(125.0\text{ K})}{250.0\text{ K}} = \mathbf{10.0\ L}$$

- Because V and T are directly related, if T is cut in half then V is also cut in half.

15. A sample of argon gas at 275 K and 0.950 atm is heated to 375 K. What is the new pressure for the gas?

P_1 = 0.950 atm	T_1 = 275 K
P_2 = ?	T_2 = 375 K

$$P_2 = \frac{P_1 T_2}{T_1} = \frac{(0.950\text{ atm})(375\text{ K})}{275\text{ K}} = \mathbf{1.30\ atm}$$

- T ↑, so P ↑

16. A sample of gas at 25°C and 1.25 atm is heated to 182°C . Calculate the new pressure for the gas.

P_1 = 1.25 atm	T_1 = 25°C = 298 K
P_2 = ?	T_2 = 182°C = 455 K

$$P_2 = \frac{P_1 T_2}{T_1} = \frac{(1.25\text{ atm})(455\text{ K})}{298\text{ K}} = \mathbf{1.91\ atm}$$

- T ↑, so P ↑

17. A 5.00 L sample of helium at 955 torr was cooled from 675 K to 225 K and compressed to a new volume of 2.50 L. Calculate the new pressure for the helium sample.

P_1 = 955 torr	V_1 = 5.00 L	T_1 = 675 K
P_2 = ?	V_2 = 2.50 L	T_2 = 225 K

$$P_2 = \frac{P_1 V_1 T_2}{T_1 V_2} = \frac{(955\text{ torr})(5.00\text{ L})(225\text{ K})}{(675\text{ K})(2.50\text{ L})} = \mathbf{637\ torr}$$

18. A 25.0 L sample of gas has a pressure of 2.50 atm at 20.0°C. Calculate the volume of the gas at STP.

- Remember that at STP , T= 273 K and P = 1 atm

P_1 = 2.50 atm	V_1 = 25.0 L	T_1 = 20.0 °C + 273 = 293 K
P_2 = 1 atm (P at STP)	V_2 =?	T_2 = 273 K (T at STP)

$$V_2 = \frac{P_1 V_1 T_2}{T_1 P_2} = \frac{(2.50\text{ atm})(25.0\text{ L})(273\text{ K})}{(293\text{ K})(1\text{ atm})} = \mathbf{58.2\ L}$$

19. Gas molecules are not attracted to one another. True or False?

Explanation: It is true because gas molecules feel very little attraction towards other gas molecules so gas molecules don't "stick together" like liquids and solids.

20. If the temperature of a sample of gas is **decreased**, the average kinetic energy of the gas will _____.

a) Decrease

Explanation: If the temperature is decreased, the gas particles move more slowly and thus will have less kinetic energy.