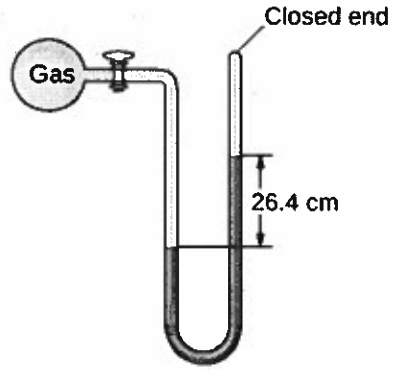
$\frac{v_1}{v_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}}$ $P_1V_1=P_2V_2$

Review of simple gas laws

Name: Answer key

1.00 atm = 760 mm Hg = 101.3 kPa **Show your work.** **Round to sig.figs.**

1. Calculate the pressure **(in kPa)** of the enclosed gases in the manometers below. Show your work below each manometer. (6)



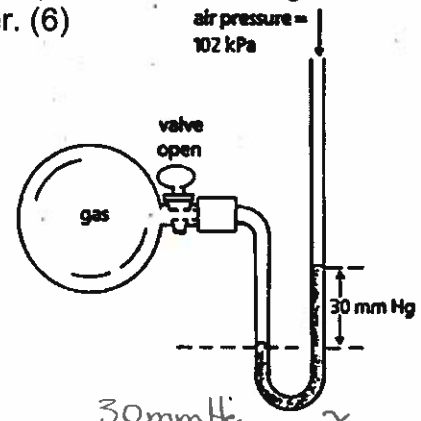
A) $P_{gas} = h = 26.4\text{cm}$

$\frac{x}{10}$

264 mm Hg

$\frac{264\text{mm Hg}}{760\text{mm Hg}} = \frac{x}{101.3\text{kPa}}$

$x = 35.2\text{kPa}$



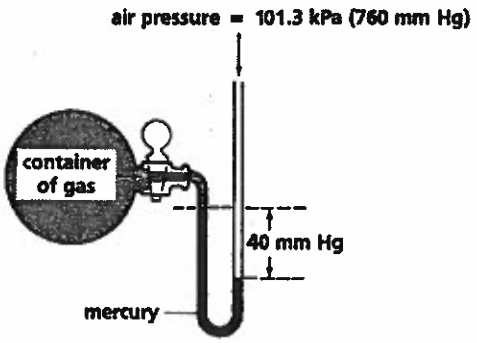
B) $\frac{30\text{mm Hg}}{760\text{mm Hg}} = \frac{x}{101.3\text{kPa}}$

$x = 4.0\text{ kPa}$

$P_{gas} = P_{atm} + h$

$= 102 + 4.0\text{ kPa}$

$P_{gas} = 106\text{ kPa}$



C) $\frac{40\text{ mm Hg}}{760\text{ mm Hg}} = \frac{x}{101.3\text{ kPa}}$

$x = 5.3\text{kPa}$

$P_{gas} = P_{atm} - h$

$= 101.3 - 5.3$

$P_{gas} = 96.0\text{ kPa}$

2. Calculate the ratio of the velocity of helium atoms to that of neon atoms at the same temperature. (State your answer as a sentence. _____ diffuses x-times faster/slower than _____) (2)

$\frac{V_{He}}{V_{Ne}} = \sqrt{\frac{M_{Ne}}{M_{He}}} = \sqrt{\frac{20.18}{4.00}} = 2.25$

Helium diffuses 2.25 times faster than neon.

3. Fluorine gas and an unknown gas (X) effuse through a hole pierced in the side of a container. What is the molar mass of the unknown gas with an effusion rate of 0.172 m/s and that of fluorine is 0.255 m/s? What is this gas? (closest value) (2)

$\frac{V_{F_2}}{V_X} = \frac{\sqrt{M_X}}{\sqrt{M_{F_2}}}$

$\frac{0.255}{0.172} = \frac{\sqrt{M_X}}{\sqrt{38.00}}$

$(\sqrt{M_X})^2 = (9.1391)^2$

$M_X = 83.523$

$M_X = 83.5$

KRYPTON

4. A gas with a volume of 4.0L at a pressure of 90 kPa is allowed to expand until the pressure drops to 20 kPa. What is the new volume? (2)

$P_1V_1 = P_2V_2$

$(90\text{ kPa})(4.0\text{L}) = (20\text{ kPa})(V_2)$

$V_2 = 18\text{L}$

18L

5. Consider a squirrel that was just sprayed by a skunk! Use the Kinetic Theory to explain how the pungent smell diffuses through the air. (2)

1) Molecules are infinitely small. They will travel over a considerable distance before colliding with another causing the smell to spread out.
2) Molecules are in constant motion, traveling in straight lines. They will continue to spread out.
3) Molecules are not attracted or repelled by each other (will not clump together)
4) Collisions between molecules are perfectly elastic, this permits the smell to continue to diffuse without loosing speed.

*Temperature statement doesn't apply here!

6. 5.0 liters of air at -36 °C is warmed to 89 °C. What is the new volume if the pressure remains constant?

$T_1 = -36 + 273 = 237K$

$T_2 = 89 + 273 = 362K$

$V_1 = 5L$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\frac{5.0L}{237K} = \frac{V_2}{362K}$

$V_2 = 7.6L$

7. A sample of a gas has a volume of 0.102 L at a temperature of 201 K. If the absolute temperature is doubled, what will be the new volume of the gas in mL?

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\frac{0.102L}{201K} = \frac{V_2}{402K}$

$V_2 = 0.204L = 204mL$

8. At a temperature of -33 °C, a sample of gas exerts a pressure of 53.3 kPa. At what temperature will the pressure reach 133 kPa?

$T_1 = -33 + 273 = 240K$

$P_1 = 53.3kPa$

$P_2 = 133kPa$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{53.3\,kPa}{240K} = \frac{133\,kPa}{T_2}$

$T_2 = 599$

599 − 273 = 326 °C

9. A gas confined in a rigid container exerts a pressure of 33.5 kPa at a temperature of 17 °C. What will be the pressure of the gas if it is cooled to a temperature of -23 °C?

$P_1 = 33.5kPa$

$T_1 = 17 + 273 = 290K$

$P_2 = ?$

$T_2 = -23 + 273 = 250K$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$\frac{33.5kPa}{290K} = \frac{P_2}{250K}$

$P_2 = 28.9kPa$