Name: _____

Class: _____

Due Date: _____

Physics Topic 25 – Gas Laws

Answer the following questions. The solutions to this worksheet can be found on the YouTube channel Go Physics Go.

1. C: Define and give the units for each variable for *pressure* $P = \frac{F}{A}$. Is it a scalar or vector? Do not confuse pressure P with power P or momentum $\vec{p}$ or density ρ!

2. E: The surface area of an average human male foot is approximately $651\ \text{cm}^2$. Determine the pressure on each foot of a 75.0 kg man standing on both feet.

3. C: Define *Avogadro's constant* N_A.

4. C: Define and give the units for each variable for a *mole* $n = N/N_\text{A}$.

5. E: Determine the number of molecules in 3.25 moles of O_2.

6. E: Determine the number of moles of 1.47×10^{26} particles.

7. E: Consider H_2O.
   a. What is the molar mass of H_2O?
   b. How many moles are in 50.0 grams of H_2O?
   c. How many grams are in 18.0 moles of H_2O?

8. E: Consider CO_2.
   a. What is the molar mass of CO_2?
   b. How many moles are in 26.0 grams of CO_2?
   c. How many grams are in 32 moles of CO_2?

9. E: Consider CH_4.

   a. What is the molar mass of CH_4?

   b. How many moles are in 46.0 grams of CH_4?

   c. How many grams are in 146 moles of CH_4?

10. C: Define and give the units of *atomic mass unit u.*

11. C: State some characteristics of an *ideal gas.*

12. C: What are some differences between an *ideal gas* and a *real gas*?

13.C: Define and draw a graph showing *Boyle's Law.*

14.C: Define and draw a graph showing *Charles' Law.*

15.C: Define and draw a graph showing *Gay-Lussac's Law.*

16.C: Take *Boyle's Law*, *Charles' Law*, and *Gay-Lussac's Law* to obtain a general equation for an ideal gas.

17.C: Define and give the units of each variable for the *Ideal Gas Law* $PV = nRT$.

18.C: Define and give the units of each variable for the *Ideal Gas Law* $PV = Nk_{\mathrm{B}}T$.

19. E: What is the number of moles of an ideal gas in $80.0\ \text{cm}^3$ at room temperature of 20.0°C and a pressure of 1.00×10^5 Pa?

20. E: What is the volume of 22.0 moles of an ideal gas when it fills a cylinder at a temperature of 40.0°C and a pressure of 1.01×10^5 Pa?

21. E: What is the temperature of 0.255 moles of an ideal gas when it fills a volume of $225\ \text{cm}^3$ at a pressure of 1.01×10^5 Pa?

22. E: Three moles of an ideal gas originally occupies a volume of $120.\ \text{cm}^3$ with a pressure of 1.01×10^5 Pa at a temperature of 23.0°C. What will be its new volume if its pressure is held constant and its temperature increases to 35.0°C?

23. E: Five moles of an ideal gas originally occupies a volume of $160.\ \text{cm}^3$ with a pressure of 1.01×10^5 Pa at a temperature of 23.0°C. What will be its new pressure if its volume is held constant and its temperature increases to 75.0°C?

24. E: Two moles of an ideal gas originally occupies a volume of $346.\ \text{cm}^3$ with a pressure of 1.01×10^5 Pa at a temperature of 30.0°C. What will be its new pressure if its volume increases to $362.\ \text{cm}^3$ and its temperature is held constant?

25. A sphere with a volume V contains 30.0 mg of an ideal gas with a pressure P. An additional mass of the gas is added to the sphere while the temperature is kept constant. The pressure of the sphere increases to $4P$ while the volume of the sphere increases to $3V$. Calculate the amount of gas added to the sphere.

26. C: Define and give the units for each variable for the equation for the kinetic theory of an ideal gas $P = \frac{1}{3}\rho v^2$.

27. E: The density of air on Earth is approximately $1.29\ \frac{\text{kg}}{\text{m}^3}$ at a pressure of 1.01×10^5 Pa. Assume the air is an ideal gas. Determine the average speed of the air.

28. E: The density of air on Mars is approximately $0.200\ \frac{\text{kg}}{\text{m}^3}$ at a pressure of 610 Pa. Assume the air is an ideal gas. Determine the average speed of the air.

29. C: Define and give the units for each variable for the equation for the internal energy of an ideal monatomic gas $U = \frac{3}{2}nRT = \frac{3}{2}Nk_{\text{B}}T$.

30. E: Determine the internal energy of 7.42 moles of an ideal gas at a temperature of 32.0°C.

31. E: Determine the internal energy of 2.84×10^{24} particles of an ideal gas at a temperature of 27.0°C.

32.E: Use the equation $\overline{E_{\mathrm{K}}} = \frac{3}{2} k_{\mathrm{B}} T$ to determine the average kinetic energy and speed of O_2 at a room temperature of 20.0°C. Assume O_2 is an ideal gas.

33.E: Use the equation $\overline{E_{\mathrm{K}}} = \frac{3}{2} k_{\mathrm{B}} T$ to determine the average kinetic energy and speed of $\mathrm{CO_2}$ at a temperature of 23.0°C. Assume $\mathrm{CO_2}$ is an ideal gas.