Name: _____ Date: _____

1. In order that a single process be both isothermal and isobaric:

A) one must use an ideal gas
B) such a process is impossible
C) a change of phase is essential
D) one may use any real gas such as N_2
E) one must use a solid

2. The pressure of an ideal gas is doubled during a process in which the energy given up as heat by the gas equals the work done on the gas. As a result, the volume is:

A) doubled
B) halved
C) unchanged
D) need more information to answer
E) nonsense; the process is impossible

3. A gas is confined to a cylindrical container of radius 1 cm and length 1 m. The pressure exerted on an end face, compared with the pressure exerted on the long curved face, is:

A) smaller because its area is smaller
B) smaller because most molecules cannot traverse the length of the cylinder without undergoing collisions
C) larger because the face is flat
D) larger because the molecules have a greater distance in which to accelerate before they strike the face
E) none of these

4. The speeds of 25 molecules are distributed as follows: 5 in the range from 2 to 3 m/s, 10 in the range from 3 to 4 m/s, 5 in the range from 4 to 5 m/s, 3 in the range from 5 to 6 m/s, 1 in the range from 6 to 7 m/s, and 1 in the range from 7 to 8 m/s. Their average speed is about:

A) 2 m/s
B) 3 m/s
C) 4 m/s
D) 5 m/s
E) 6 m/s

5. Two ideal gases, each consisting of N monatomic molecules, are in thermal equilibrium with each other and equilibrium is maintained as the temperature is increased. A molecule of the first gas has mass m and a molecule of the second has mass $4m$. The ratio of the changes in the internal energies $\Delta E_{4m}/\Delta E_m$ is:

A) 1/4
B) 1/2
C) 1
D) 2
E) 4

6. The mean free path of molecules in a gas is proportional to:

A) the molecular cross-sectional area
B) the reciprocal of the molecular cross-sectional area
C) the root-mean-square molecular speed
D) the square of the average molecular speed
E) the molar mass

7. The "Principle of Equipartition of Energy" states that the internal energy of a gas is shared equally:

A) among the molecules
B) between kinetic and potential energy
C) among the relevant degrees of freedom
D) between translational and vibrational kinetic energy
E) between temperature and pressure

8. An automobile tire is pumped up to a gauge pressure of 2.0×10^5 Pa when the temperature is 27º C. What is its gauge pressure after the car has been running on a hot day so that the tire temperature is 77º C? Assume that the volume remains fixed and take atmospheric pressure to be 1.013×10^5 Pa.

A) 1.6×10^5 Pa
B) 2.6×10^5 Pa
C) 3.6×10^5 Pa
D) 5.9×10^5 Pa
E) 7.9×10^5 Pa

9. An ideal gas of N monatomic molecules is in thermal equilibrium with an ideal gas of the same number of diatomic molecules and equilibrium is maintained as the temperature is increased. The ratio of the changes in the internal energies $\Delta E_{\text{dia}}/\Delta E_{\text{mon}}$ is:

A) 1/2
B) 3/5
C) 1
D) 5/3
E) 2

10. The number of degrees of freedom of a triatomic molecule is:

A) 1
B) 3
C) 6
D) 8
E) 9

11. A real gas is changed slowly from state 1 to state 2. During this process no work is done on or by the gas. This process must be:

A) isothermal
B) adiabatic
C) isovolumic
D) isobaric
E) a closed cycle with state 1 coinciding with state 2

12. The ratio of the specific heat of an ideal gas at constant volume to its specific heat at constant pressure is:

A) R
B) $1/R$
C) dependent on the temperature
D) dependent on the pressure
E) different for monatomic, diatomic, and polyatomic gases

13. The temperature of a gas is most closely related to:

A) the kinetic energy of translation of its molecules
B) its total molecular kinetic energy
C) the sizes of its molecules
D) the potential energy of its molecules
E) the total energy of its molecules

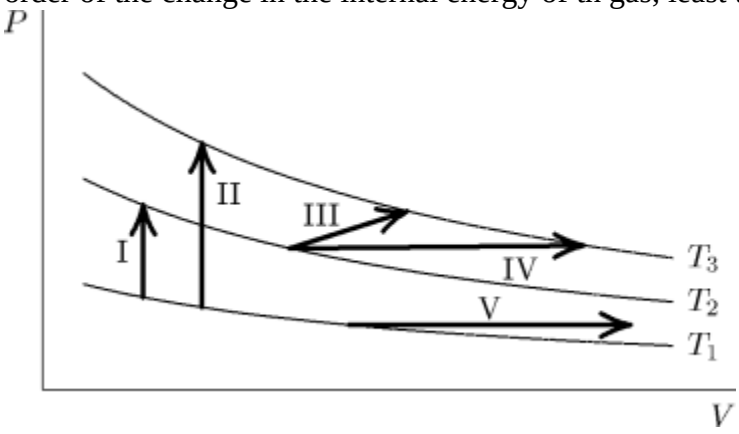
14. It is known that 28 g of a certain ideal gas occupy 22.4 liters at standard conditions (0^o C, 1 atm). The volume occupied by 42 g of this gas at standard conditions is:

A) 14.9 liters
B) 22.4 liters
C) 33.6 liters
D) 42 liters
E) more data are needed

15. During a slow adiabatic expansion of a gas:

A) the pressure remains constant
B) energy is added as heat
C) work is done on the gas
D) no energy enters or leaves as heat
E) the temperature is constant

16. The diagram shows three isotherms for an ideal gas, with $T_3 - T_2$ the same as $T_2 - T_1$. It also shows five thermodynamic processes carried out on the gas. Rank the processes in order of the change in the internal energy of th gas, least to greatest.



A) I, II, III, IV, V
B) V, then I, III, and IV tied, then II
C) V, I, then III and IV tied, then II
D) IV, V, III, I, II
E) II, I, then III, IV, and V tied

17. An ideal gas has molar specific heat C_p at constant pressure. When the temperature of n moles is increased by ΔT the increase in the internal energy is:

A) $nC_p\,\Delta T$
B) $n(C_p + R)\,\Delta T$
C) $n(C_p - R)\,\Delta T$
D) $n(2C_p + R)\,\Delta T$
E) $n(2C_p - R)\,\Delta T$

18. When work W is done on an ideal gas of diatomic molecules in thermal isolation the increase in the total translational kinetic energy of the molecules is:

A) 0
B) $2W/3$
C) $2W/5$
D) $3W/5$
E) W

19. A system consists of N gas molecules each of mass m. Their rms speed is v^{rms}. Their total translational kinetic energy is:

A) $(1/2)m(Nv^{rms})^2$
B) $(1/2)N(mv^{rms})^2$
C) $(1/2)m(v^{rms})^2$
D) $(1/2)N(mv^{rms})^2$
E) $N[(1/2)mv^{rms}]^2$

20. The temperature of n moles of an ideal monatomic gas is increased by ΔT at constant pressure. The thermal energy Q absorbed, change ΔE_{int} in internal energy, and work W done by the environment are given by:

A) $Q = (5/2)nR\,\Delta T$, $\Delta E_{int} = 0$, $W = -nR\,\Delta T$
B) $Q = (3/2)nR\,\Delta T$, $\Delta E_{int} = (5/2)nR\,\Delta T$, $W = -(3/2)nR\,\Delta T$
C) $Q = (5/2)nR\,\Delta T$, $\Delta E_{int} = (5/2)nR\,\Delta T$, $W = 0$
D) $Q = (3/2)nR\,\Delta T$, $\Delta E_{int} = 0$, $W = -nR\,\Delta T$
E) $Q = (5/2)nR\,\Delta T$, $\Delta E_{int} = (3/2)nR\,\Delta T$, $W = -nR\,\Delta T$

21. The mean free path of air molecules near the surface of Earth is about:

A) 10^{-9} m
B) 10^{-7} m
C) 10^{-5} m
D) 10^{-3} m
E) 10^{-1} m

22. Over 1 cycle of a cyclic process in which a system does net work on its environment:

A) the change in the pressure of the system cannot be zero
B) the change in the volume of the system cannot be zero
C) the change in the temperature of the system cannot be zero
D) the change in the internal energy of the system cannot be zero
E) none of the above

23. The pressure of an ideal gas is doubled in an isothermal process. The root-mean-square speed of the molecules:

A) does not change
B) increases by a factor of $\sqrt{2}$
C) decreases by a factor of $1/\sqrt{2}$
D) increases by a factor of 2
E) decreases by a factor of 1/2

24. Two identical rooms in a house are connected by an open doorway. The temperatures in the two rooms are maintained at different values. Which room contains more air?

A) the room with higher temperature
B) the room with lower temperature
C) the room with higher pressure
D) neither because both have the same pressure
E) neither because both have the same volume

25. When work W is done on an ideal gas of N diatomic molecules in thermal isolation the temperature increases by:

A) $W/2Nk$
B) $W/3Nk$
C) $2W/3Nk$
D) $2W/5Nk$
E) W/Nk

Answer Key

1. C
2. B
3. E
4. C
5. C
6. B
7. C
8. A
9. D
10. E
11. C
12. E
13. A
14. C
15. D
16. B
17. C
18. D
19. D
20. E
21. B
22. E
23. A
24. B
25. D