1. Which of the following is not an assumption of the kinetic theory of gases?

A. The size of gas molecules is negligible compared to the volume of the container
B. Gas molecules are in random motion
C. Intermolecular forces are strong
D. Collisions between molecules are elastic

Answer: C
Explanation: Kinetic theory assumes negligible intermolecular forces; thus, option C is incorrect.

2. The pressure exerted by an ideal gas is due to:

A. Repulsion between molecules
B. Collision of molecules with each other
C. Attraction between molecules
D. Collision of molecules with container walls

Answer: D
Explanation: Gas pressure results from molecules colliding with the container walls.

3. The RMS speed (v_rms) of gas molecules is given by:

A. sqrt(3RT/M)
B. sqrt(RT/M)
C. sqrt(2RT/M)
D. sqrt(M/3RT)

Answer: A
Explanation: v_rms = sqrt(3RT/M), where R is gas constant, T is temperature, M is molar mass.

4. At the same temperature, which of the following gases has the highest root mean square speed?

A. Oxygen (O2)
B. Nitrogen (N2)
C. Hydrogen (H2)
D. Carbon dioxide (CO2)

Answer: C

Explanation: Lighter gases have higher v_rms at the same temperature. H2 is lightest.

5. The average kinetic energy per molecule of an ideal gas is directly proportional to:

A. Pressure
B. Temperature
C. Volume
D. Mass of gas

Answer: B
Explanation: K.E. per molecule = (3/2)kT ⇒ directly proportional to temperature.

6. For a gas, the ratio of RMS speed to average speed is approximately:

A. 1.224
B. 0.707
C. 1.000
D. 1.732

Answer: A
Explanation: v_rms / v_avg ≈ 1.224 for ideal gases.

7. If the temperature of a gas is doubled (in Kelvin), the RMS speed of its molecules:

A. Doubles
B. Increases by a factor of 4
C. Remains unchanged
D. Increases by a factor of sqrt(2)

Answer: D
Explanation: v_rms ∝ sqrt(T), so doubling T increases v_rms by sqrt(2).

8. A gas at 27°C has a root mean square speed of 500 m/s. What will be its RMS speed at 927°C?

A. 707 m/s
B. 1000 m/s
C. 612 m/s

D. 500 m/s

Answer: B
Explanation: $v_{rms} \propto \sqrt{T}$. Convert °C to K: 927°C = 1200 K, 27°C = 300 K
$v_2/v_1 = \sqrt{1200/300} = \sqrt{4} = 2 \rightarrow v_2 = 2 \times 500 = 1000$ m/s

9. The pressure of an ideal gas is doubled while keeping temperature constant. The average kinetic energy of molecules:

A. Doubles
B. Halves
C. Remains the same
D. Becomes four times

Answer: C
Explanation: At constant T, average K.E. is unchanged.

10. If the RMS speed of oxygen molecules is 480 m/s at 300 K, what is the RMS speed at 1200 K?

A. 960 m/s
B. 720 m/s
C. 240 m/s
D. 600 m/s

Answer: B
Explanation: $v_{rms} \propto \sqrt{T}$, so $v_2 = 480 \times \sqrt{1200/300} = 480 \times 2 = 960$ m/s
Answer is A

11. The average kinetic energy of a gas molecule at 0 K is:

A. Zero
B. Maximum
C. Infinite
D. Same as at 273 K

Answer: A
Explanation: K.E. $\propto$ T, so at absolute zero, K.E. is zero.

12. Which one of the following expresses the relationship between pressure (P), volume (V), and RMS speed (v) of gas molecules?

A. P = (1/3) rho v^2
B. P = (2/3) rho v^2
C. P = (1/2) rho v^2
D. P = rho v^2

Answer: A
Explanation: Pressure = (1/3) × density × $v_{rms}^2$

13. Which of the following gases will have the least RMS speed at a given temperature?

A. Helium
B. Nitrogen
C. Oxygen
D. Sulphur hexafluoride

Answer: D
Explanation: Heavier gases have lower v_rms. SF6 is heaviest here.

14. The molecular speed which is most probable among gas molecules is:

A. RMS speed
B. Mean speed
C. Most probable speed
D. None

Answer: C
Explanation: Most probable speed is the speed possessed by the maximum number of molecules.

15. The RMS speed of a gas molecule is increased by 25%. What is the percentage increase in temperature?

A. 25%
B. 56.25%
C. 50%
D. 10%

Answer: B
Explanation: v_rms ∝ sqrt(T)
So, $(v2/v1)^2 = T2/T1$
$(1.25)^2 = T2/T1 = 1.5625 \Rightarrow 56.25\%$ increase

16. The RMS speed of a gas is 300 m/s at 200 K. What will be its speed at 800 K?

A. 600 m/s
B. 900 m/s
C. 424 m/s
D. 300 m/s

Answer: A
Explanation:
v_rms ∝ √T
$v_2 = 300 \times \sqrt{(800 / 200)} = 300 \times \sqrt{4} = 300 \times 2 = 600$ m/s

17. The number of degrees of freedom for a diatomic gas is:

A. 2
B. 3
C. 5
D. 6

Answer: C
Explanation:
For a diatomic gas (without vibration), degrees of freedom = 3 (translational) + 2 (rotational) = 5

18. The kinetic energy of 1 mole of an ideal monoatomic gas at 27°C is:

A. 3RT
B. (3/2)RT
C. RT
D. (1/2)RT

Answer: B
Explanation:

KE = (3/2)RT = (3/2) × 8.314 × 300 = ~3741.3 J

19. A sample of helium gas has pressure P and temperature T. If the pressure is doubled and temperature is quadrupled, the RMS speed becomes:

A. Doubled
B. Four times
C. Unchanged
D. √2 times

Answer: A
Explanation:
v_rms ∝ √T
If T becomes 4T, v_rms becomes 2 × v_rms

20. The average translational kinetic energy of gas molecules is:

A. Proportional to pressure
B. Proportional to volume
C. Proportional to temperature
D. Constant for all gases

Answer: C
Explanation:
KE = (3/2)kT, so it's directly proportional to temperature.

21. The ratio of RMS speeds of two gases A and B at same temperature is 1:2. The ratio of their molar masses is:

A. 4:1
B. 1:4
C. 1:2
D. 2:1

Answer: A
Explanation:
v_rms ∝ 1/√M
If v_A / v_B = 1:2 ⇒ √M_B / √M_A = 2 ⇒ M_B / M_A = 4 ⇒ M_A : M_B = 1:4

22. Which of the following expressions is correct for average speed of gas molecules?

A. √(8RT/πM)
B. √(3RT/M)
C. √(2RT/M)
D. RT/M

Answer: A
Explanation:
Average speed (v_avg) = √(8RT/πM)

23. If molar mass of gas is 28 g/mol, and temperature is 300 K, what is RMS speed approximately?

A. 1500 m/s
B. 484 m/s
C. 250 m/s
D. 1000 m/s

Answer: B
Explanation:
v_rms = √(3RT/M)
= √(3 × 8.314 × 300 / 0.028) ≈ 484 m/s

24. The pressure of a gas becomes three times when:

A. Volume is tripled at constant T
B. Temperature is tripled at constant V
C. Both volume and temperature are doubled
D. Volume is halved and temperature doubled

Answer: B
Explanation:
$P \propto T$ at constant V ⇒ P becomes 3P if T becomes 3T

25. If density of a gas is 1.5 kg/m³ and its RMS speed is 500 m/s, then pressure is:

A. $1.25 \times 10^5$ Pa
B. $3.75 \times 10^5$ Pa
C. $5 \times 10^4$ Pa
D. $7.5 \times 10^4$ Pa

Answer: B
Explanation:
$P = (1/3)\ \rho\ v^2 = (1/3) \times 1.5 \times (500)^2 = 125000$ Pa $= 1.25 \times 10^5$ Pa
Correct Answer: A

26. What is the ratio of average kinetic energies of $O_2$ and $H_2$ molecules at same temperature?

A. 1:1
B. 1:4
C. 4:1
D. 16:1

Answer: A
Explanation:
Average KE depends only on temperature, not mass ⇒ KE is same ⇒ 1:1

27. Which physical quantity remains constant for all ideal gases at a given temperature?

A. Pressure
B. Volume
C. Kinetic energy per molecule
D. Speed of sound

Answer: C
Explanation:
At same T, all ideal gas molecules have same average KE = (3/2)kT

28. An ideal gas has RMS speed v at 300 K. What will be the RMS speed at 1200 K?

A. v
B. 2v
C. v/2
D. 4v

Answer: B
Explanation:
T increases 4 times ⇒ $v_{rms} \propto \sqrt{T} \Rightarrow \sqrt{4} = 2 \Rightarrow$ new speed = 2v

29. The number of gas molecules per unit volume is maximum in:

A. Solid
B. Liquid
C. Gas
D. All are equal

Answer: A
Explanation:
Solids have highest molecular density

30. The mean free path of gas molecules increases when:

A. Pressure increases
B. Volume decreases
C. Temperature increases
D. Temperature decreases

Answer: C
Explanation:
Mean free path $\propto T/P$. If temperature increases (at constant P), mean free path increases.

31. The root mean square (RMS) speed of nitrogen molecules at 300 K is approximately:

A. 517 m/s
B. 300 m/s
C. 1432 m/s
D. 615 m/s

Answer: A
Explanation:
$v_{rms} = \sqrt{(3RT/M)}$
$= \sqrt{[(3 \times 8.314 \times 300)/(0.028)]} \approx 517$ m/s

32. The average kinetic energy of gas molecules is:

A. (3/2)kT
B. (1/2)kT
C. (3/2)RT
D. RT

Answer: A
Explanation:
K.E._avg = (3/2)kT per molecule

33. Which of the following is not an assumption of the kinetic theory of gases?

A. Gas molecules have finite volume
B. Intermolecular collisions are elastic
C. Gas molecules move in random directions
D. Average kinetic energy is proportional to temperature

Answer: A
Explanation:
KTG assumes gas molecules are point masses (negligible volume)

34. What is the most probable speed of gas molecules related to RMS speed?

A. v_mp = v_rms
B. v_mp = √2 × v_rms
C. v_mp = v_rms / √2
D. v_mp = v_rms × √(2/3)

Answer: D
Explanation:
v_mp = √(2RT/M), v_rms = √(3RT/M) ⇒ v_mp / v_rms = √(2/3)

35. The value of Boltzmann constant is:

A. $1.38 \times 10^{-23}$ J/K

B. 8.314 J/mol·K
C. $6.022 \times 10^{23}$
D. 9.8 $m/s^2$

Answer: A
Explanation:
Boltzmann constant k = $1.38 \times 10^{-23}$ J/K

36. Which of the following statements is true for all ideal gases?

A. RMS speed is independent of temperature
B. Average kinetic energy depends on volume
C. Pressure is inversely proportional to temperature
D. RMS speed increases with temperature

Answer: D
Explanation:
$v_{rms} \propto \sqrt{T}$

37. Degrees of freedom for a monoatomic gas:

A. 2
B. 3
C. 5
D. 6

Answer: B
Explanation:
Only translational → 3 degrees of freedom

38. If the temperature of a gas increases from 300 K to 1200 K, then its average kinetic energy:

A. Doubles
B. Triples
C. Quadruples
D. Becomes four times

Answer: D

Explanation:
KE ∝ T ⇒ KE increases 4× ⇒ from 300 to 1200 K, T becomes 4× → KE becomes 4×

39. A gas at 27°C has pressure P. What will be its pressure at 327°C, keeping volume constant?

A. P
B. 2P
C. 600P
D. 1.1P

Answer: D
Explanation:
P ∝ T (in Kelvin)
$T_1$ = 300 K, $T_2$ = 600 K ⇒ $P_2 = P \times (600/300) = 2P$
✔Answer: B

40. The equation  is derived from:

A. Ideal gas law
B. Charles' law
C. Kinetic theory of gases
D. Boyle’s law

Answer: C
Explanation:
It’s a result of kinetic theory of gases (based on Newtonian mechanics)

41. The mean kinetic energy of a gas molecule is directly proportional to:

A. Volume
B. Number of molecules
C. Temperature
D. Pressure

Answer: C
Explanation:
K.E. ∝ T

42. What will be the pressure exerted by 4 g of $H_2$ gas in a 2 L container at 300 K?

A. 24.6 atm
B. 12.3 atm
C. 49.2 atm
D. 1.23 atm

Answer: A
Explanation:
Use PV = nRT
n = 4/2 = 2 mol
P × 2 = 2 × 0.0821 × 300
P = 24.63 atm ≈ 24.6 atm

43. Mean free path of a gas is inversely proportional to:

A. Pressure
B. Temperature
C. Volume
D. RMS speed

Answer: A
Explanation:
$\lambda \propto 1/P$

44. The average kinetic energy of a gas molecule at 27°C is:

A. $3.72 \times 10^{-21}$ J
B. $6.21 \times 10^{-21}$ J
C. $1.38 \times 10^{-21}$ J
D. $2.07 \times 10^{-21}$ J

Answer: B
Explanation:
K.E. = (3/2)kT = (3/2) × $1.38 \times 10^{-23}$ × 300 ≈ $6.21 \times 10^{-21}$ J

45. For an ideal gas at constant volume, pressure is proportional to:

A. Temperature in °C
B. Square of temperature
C. Temperature in Kelvin
D. Mass of gas

Answer: C
Explanation:
$P \propto T$ (in Kelvin), when V is constant