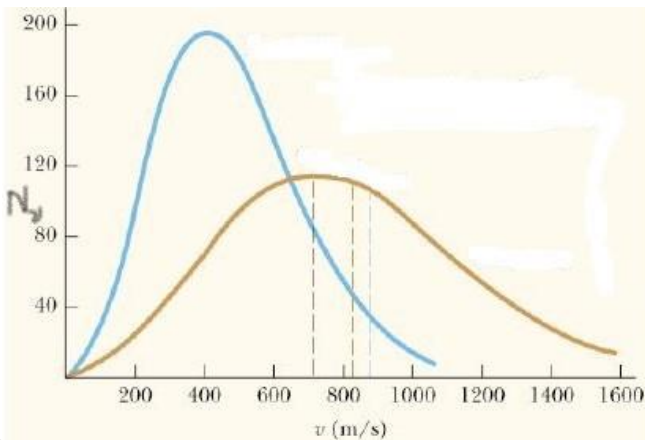Test -2

1

Consider the plot of the Maxwell-Boltzmann distribution of molecular speeds in a sample of gas. On the y-axis we have Nv(v) and on the x-axis we have v. What does the area under the curve represent?

Total energy of the particles

Unity as the total probability is one

Total number of particles   A

Total number of particles per unit mass

Number of particles times the speed

2. Mean free path of the molecules of a gas depends on the average kinetic energy E_{avg} as:

$(E_{avg})^2$

$\sqrt{E_{avg}}$

$1/(E_{avg})$

E_{avg} A

is independent of E_{avg}

3. One third of the energy added to a heat engine as heat is removed to the engine's surroundings as heat. The engine may be run as a heat pump. What is the coefficient of performance (COP) of a heat pump?

3

2

4/3

4

3/2   A

4. For two gases, A and B, that follow the Maxwell-Boltzmann distribution law, the velocity distribution curves have got the peaks at the same speed. Which one of the statements is true?

The molecules of the two gases have the same mass

The two gases have the same temperature

The RMS energies of the two gases are the same   A

The temperature of the two gases are the same

The total number of particles of the two gas samples have the same number of particles.

5. Consider a monatomic ideal gas. The ratio of the mean free path to the average separation between the gas molecules is dependent on absolute temperature T as:

$T^{(1/2)}$

$T^{(-1/2)}$

$T^{(-2/3)}$

$T^{(2/3)}$ A

$T^{(1/3)}$

6. A heat engine that in each cycle does positive work W, and is efficient enough to loose only W/3 energy as heat at temperature T_L. It can operate with an input of heat at temperature $T\_H=2T\_L$. In each cycle it takes in heat equal to 2W/3. It violates :

First law of thermodynamics

Second law of thermodynamics

Carnot's theorem

Both the first and the second laws of thermodynamics

Carnot's theorem and the first law of thermodynamics   A

7. How does decreasing the ratio m/T affect the Maxwell Boltzmann probability density function?

It makes the curve taller while keeping the peak at the same position

It lowers the curve while keeping the peak at the same position

It shifts the peak of the curve toward higher speed keeping the height constant   A

It shifts the peak of the curve toward higher speed and makes the peak taller

It shifts the peak of the curve toward higher speed and makes the peak smaller

8. The mean free path of an ideal gas is l at certain temperature and pressure. The pressure is increased by 25% while the temperature is decreased by 50%. The mean free path is changed to l'. The ratio of l' to l i.e. l'/l is equal to:

0.2

2.0

0.4   A

1.0

1/sqrt(2)

9. An ideal gas is heated isochorically from temperature T_i to temperature T_f. The pressure changes from P_i to P_f. The change of entropy of the ideal gas is:

$\Delta S = nR \ln(P_f/P_i)$

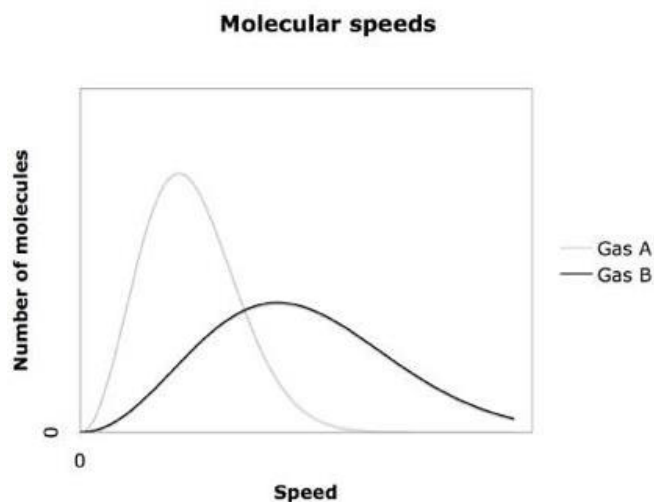$\Delta S = n\,C_P \ln(T_f/T_i)$

$\Delta S = n\,C_V \ln(T_f/T_i)$ A

$\Delta S = nR \ln(T_f/T_i)$

$\Delta S = n\,C_P \ln(P_f/P_i)$

10. Two monatomic gases are observed to have the following distributions for the speeds of their molecules. On the y-axis we have the number of particles having a particular speed v. Which of the following can be deduced with absolute certainty by looking at the plot?

Molecular speeds

Gas A has lower temperature than gas B

Gas A has more number of particles than gas B

Gas A and gas B both have the same number of particles.

The molecules in gas A are heavier than those in gas B.

Average speed of the molecules of gas B is greater than average speed of gas A molecules   A

11. A gas is kept inside a piston-cylinder system with a weight of 1 Newton placed on the piston. The temperature of the gas is increased four fold while the weight is tripled. The ratio of the new mean collisional frequency f' to that of the old mean collisional frequency f i.e. (f'/f) is:

3/4

3/2   A

4/3

2/3

sqrt(3)/2

12. An ideal gas is in a volume V1 at pressure P1. It undergoes adiabatic free expansion into twice its original volume i.e. V2=2V1. The ratio of the rms energy of the gas at the initial state to the mean energy of the final state of the gas molecules is:

sqrt(3 pi /8)

ln(3)

sqrt(5/3)   A

1/sqrt(2)

sqrt(20/3)

13. A sample of hydrogen gas is at the temperature 1006.85 degree Celsius while another sample of oxygen gas is at -193.15 degree Celsius. The peaks of the corresponding Maxwell-Boltzmann distribution is separated by how much speed interval?

0 m/s   A

40 m/s

80 m/s

5 m/s

4 m/s

14. The mean free path of a gas does not depend on which of the following:

Pressure of the gas

Absolute temperature of the gas

mass of the gas molecules   A

diameter of the gas molecules

number density of the gas molecules

15. What type of thermodynamic function entropy is?

an intensive function

a path function

a convex function of internal energy

a concave function of temperature

a state function   A