Unit 7 - Week 5

Assignment 5

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2020-10-21, 23:59 IST.

1) The absolute entropy of 1 mol of He at room temperature (300K) and atmospheric pressure using Sackur-Tetrode equation is ___________J/K. *1 point*

- 238
- 200
- 352
- 126

No, the answer is incorrect.
Score: 0
Accepted Answers:
126

2) Consider a container divided into two chambers, one chamber of volume V_1 having N_1 molecules of a monatomic ideal gas at temperature T and pressure P, and the other chamber of volume V_2 having N_2 molecules of a *same* monatomic gas at the *same* temperature and pressure. If the partition between the two chambers is now removed, what is the overall change in the entropy? *1 point*

(a) $\Delta S = N_1 k_B \ln\left(\frac{V_1+V_2}{N_1+N_2}\right) + N_2 k_B \ln\left(\frac{V_1+V_2}{N_1+N_2}\right)$

(b) $\Delta S = N_1 k_B \ln\left(\frac{N_1}{V_1}\right) + N_2 k_B \ln\left(\frac{N_2}{V_2}\right)$

(c) 0

(d) $\Delta S = N_1 k_B \ln\left(\frac{V_1+V_2}{V_1}\right) + N_2 k_B \ln\left(\frac{V_1+V_2}{V_2}\right)$

- (a)
- (b)
- (c)
- (d)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(c)

3) The vibrational partition function for a molecule with fundamental frequency ν is given by *1 point*

(a) $\exp\left(-\frac{h\nu}{k_B T}\right)$

(b) $\left[1+\exp\left(-\frac{h\nu}{k_B T}\right)\right]^{-1}$

(c) $\exp\left(-\frac{h\nu}{k_B T}\right)\left[1-\exp\left(-\frac{h\nu}{k_B T}\right)\right]^{-1}$

(d) $\exp\left(-\frac{h\nu}{2k_B T}\right)\left[1-\exp\left(-\frac{h\nu}{k_B T}\right)\right]^{-1}$

- (a)
- (b)
- (c)
- (d)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(d)

4) The length of the bond in an oxygen molecule is R =1.2074Å and the atomic mass of oxygen is 16 g/mol. The rotational temperature and the rotational partition function of oxygen molecule at 300 K will be respectively *1 point*

- 2.08 K and 72
- 2.08 K and 144
- 4.16 K and 72
- 4.16 K and 144

No, the answer is incorrect.
Score: 0
Accepted Answers:
2.08 K and 72

5) A classical gas of molecules, each of mass m, is in thermal equilibrium at temperature T. The velocity components of the molecules along the Cartesian coordinates are v_x, v_y and v_z. The mean value of $(v_x+v_y)^2$ is *1 point*

(a) $\frac{3k_B T}{2m}$

(b) $\frac{2k_B T}{m}$

(c) $\frac{k_B T}{2m}$

(d) $\frac{k_B T}{m}$

- (a)
- (b)
- (c)
- (d)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(b)

6) Consider N non-interacting, distinguishable particles in a two-level system at temperature T. The energies of the levels are 0 and ε, where ε > 0. In the high temperature limit $(k_B T > \varepsilon)$ what is the population of particles in the level with energy ε? *1 point*

(a) $\frac{1}{2}N$

(b) $\frac{1}{4}N$

(c) N

(d) $\frac{3}{4}N$

- (a)
- (b)
- (c)
- (d)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)

7) A system of N non-interacting classical point particles is constrained to move on the two dimensional surface of a sphere. The internal energy of the system is *1 point*

(a) $Nk_B T$

(b) $\frac{3}{2}Nk_B T$

(c) $\frac{1}{2}Nk_B T$

(d) $\frac{5}{2}Nk_B T$

- (a)
- (b)
- (c)
- (d)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(a)

8) Gibb's paradox arises due to *1 point*

- omittance of quantum nature of the particles.
- indistinguishability of classical particles.
- absence of inter-particle interactions.
- distinguishability of classical particles.

No, the answer is incorrect.
Score: 0
Accepted Answers:
distinguishability of classical particles.

9) For an ideal gas with molar mass M, the molar translational entropy at a given temperature is proportional to *1 point*

- $M^{1/2}$
- $M^{3/2}$
- ln (M)
- e^M

No, the answer is incorrect.
Score: 0
Accepted Answers:
ln (M)

10) The molecular partition function of a system is given by, $q(T) = \left(\frac{k_B T}{hc}\right)^{\frac{3}{2}}\left(\frac{8\pi^3 m k_B T}{h^2}\right)^{\frac{3}{2}}$, where the symbols have their usual meanings. The heat capacity at constant volume for this system is *1 point*

(a) 3R/2

(b) 6R

(c) 9R/2

(d) 3R

- (a)
- (b)
- (c)
- (d)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(d)