Test Your fiziks concepts!

Topic: Statistical Mechanics

(For CSIR NET-JRF, GATE, JEST and TIFR Aspirants)

Q. A monatomic crystalline solid comprises of N atoms, out of which n atoms are in interstitial positions. If the available interstitial sites are N', then number of possible microstates is

(a) $\dfrac{(N'+n)!}{n!N!}$

(b) $\dfrac{N!}{n!(N+n)!}\dfrac{N'!}{n!(N'+n)!}$

(c) $\dfrac{N!}{n!(N'-n)!}$

(d) $\dfrac{N!}{n!(N-n)!}\dfrac{N'!}{n!(N'-n)!}$

Ans.: (d)

Solution.: Total number of atoms $=N$, Total number of interstitial sites $=N'$

atoms at interstitial positions $=n$

The number of ways to choose which n atoms (out of N) moves to interstitial sites

$$=\frac{N!}{n!(N-n)!}$$

The number of ways to place these n atoms into the N' interstitial sites

$$=\frac{N'!}{n!(N'-n)!}$$

Thus, total number of possible microstates is $=\dfrac{N!}{n!(N-n)!}\dfrac{N'!}{n!(N'-n)!}$

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Topic: Mechanics

(For IIT-JAM, JEST, TIFR and CUET Aspirants)

Q. Two planets P_1 and P_2 having masses M_1 and M_2 revolve around the Sun in elliptical orbits, with time periods T_1 and T_2 respectively. The minimum and maximum distances of planet P_1 from the Sun are R and $3R$ respectively, whereas for planet P_2 these are $2R$ and $4R$, respectively, where R is a constant. Assuming M_1 and M_2 are much smaller than the mass of the Sun, the magnitude of $\frac{T_2}{T_1}$ is

(a) $\frac{2}{3}\sqrt{\frac{2M_1}{3M_2}}$ (b) $\frac{3}{2}\sqrt{\frac{3M_2}{2M_1}}$ (c) $\frac{3}{2}\sqrt{\frac{3}{2}}$ (d) $\frac{2}{3}\sqrt{\frac{2}{3}}$

Ans.: (c)

Solution.: For $P_1:,\ 2a_1 = 4R \Rightarrow a_1 = 2R;$ For $P_2: 2a_2 = 6R \Rightarrow a_2 = 3R$

$$\because T^2 \propto a^3 \Rightarrow \frac{T_2}{T_1} = \left(\frac{a_2}{a_1}\right)^{3/2} = \left(\frac{3R}{2R}\right)^{3/2} = \left(\frac{3}{2}\right)^{3/2} = \frac{3}{2}\sqrt{\frac{3}{2}}$$

option (c) is correct.

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Test Your fiziks concepts!

Topic: Thermodynamics

(For PGT: KVS, NVS, DSSSB, State Education Boards, etc.)

Q. A Centigrade and a Fahrenheit thermometer are dipped in boiling water. The water temperature is lowered until the Fahrenheit thermometer registers 140°F. What is the fall in temperature as registered by the centigrade thermometer?

(a) 80°C (b) 60°C (c) 40°C (d) 30°C

Ans.: (c)

Solution.: Using $\frac{F-32}{180}=\frac{C}{100}$, $\Rightarrow \frac{140-32}{180}=\frac{C}{100}\Rightarrow C=60°C$

As the temperature of boiling water = 100°C

fall in temperature = 100 – 60 = 40°C