Test Your fiziks concepts!

Topic: Statistical Mechanics

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

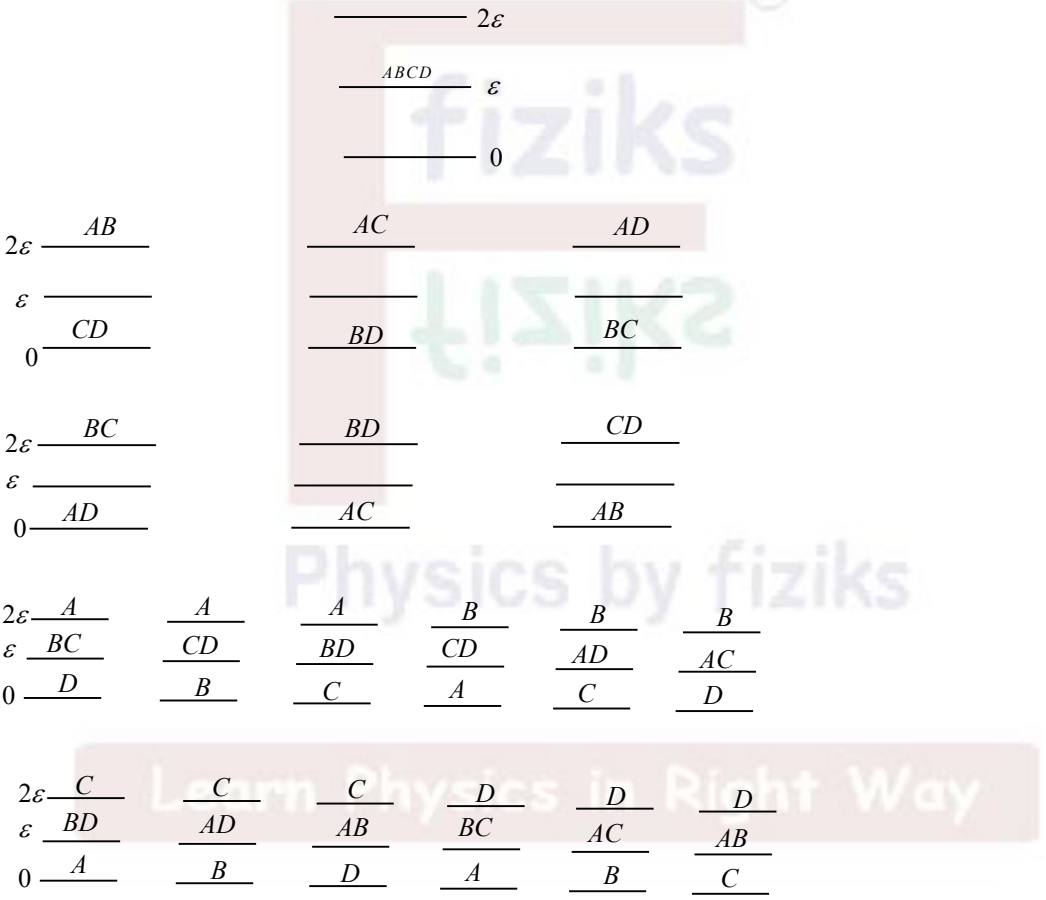
Q. Four distinguishable particles fill up energy levels $0, \in, 2\in$. The number of available microstates for the total energy $4\in$ is

(a) 20 (b) 24

(c) 11 (d) 19

Ans.: (d)

Solution:



$\therefore$ Total number of microstates so that total energy of a system of 4 distinguishable particle is 4ε is $\Omega = 19$.

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Topic: Mechanics

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

Q. For a particle moving in a central potential, which one of the following statements is correct?

(a) The motion is restricted to a plane due to the conservation of angular momentum

(b) The motion is restricted to a plane due to the conservation of energy only

(c) The motion is restricted to a plane due to the conservation of linear momentum

(d) The motion is not restricted to a plane

Ans.: (a)

Solution.: For central force problem angular momentum $\vec{J}$ is conserved and $\vec{r}.\vec{J}=0$ which ensure that motion of particle is confined in plane

Note:

For detailed solutions, visit the *Free Download* section at www.physicsbyfiziks.com

Test Your fiziks concepts!

Topic: Thermodynamics

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

Q. A copper rod of 88 cm and an aluminium rod of unknown length have their increase in length independent of increase in temperature. The length of aluminium rod is:

$\left(\alpha_{\text{Cu}} = 1.7\times10^{-5}\,\text{K}^{-1} \text{ and } \alpha_{Al} = 2.2\times10^{-5}\,\text{K}^{-1}\right)$

(a) 6.8 cm (b) 113.9 cm (c) 88 cm (d) 68 cm

Ans.: (d)

Solution.: Increase in length of a metallic rod $= L\alpha\Delta T$

As the increase in length is independent of temperature

$\therefore\ L\alpha = \text{constant} \quad \Rightarrow \alpha_{Cu}L_{Cu} = \alpha_{Al}L_{Al}$

$1.7\times10^{-5}\times88\,cm = 2.2\times10^{-5}\times L_{Al} \Rightarrow L_{Al} = \dfrac{1.7\times88}{2.2} = 68\ cm$

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Topic: Statistical Mechanics

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

Q. System A consists of 3 identical non-interacting bosons. System B consists of 2 identical non-interacting bosons. They both have identical energy spectra - three non-degenerate energy levels $0, \in, 2\in$. The particles of A and B are distributed in various energy levels in such a way that the total energy of the combined system is 4ϵ. The average energy of the system A in units of $\in$ is

(a) 2.2 (b) 2.3 (c) 2.1 (d) 2.4

Ans.: (b)

Solution.:

Note: $\Omega_A = \dfrac{(n_i + g_i - 1)!}{n_i!(g_i - 1)!} = \dfrac{(3+3-1)!}{3!(3-1)!} = 10$; $\Omega_B = \dfrac{(2+3-1)!}{2!(3-1)!} = 6$

0	ε	2ε	E_A		0	ε	2ε	E_B
AAA	-	-	0		BB	-	-	0
AA	A	-	ε		B	B	-	ε
AA	-	A	2ε		B	-	B	2ε
A	AA	-	2ε		-	BB	-	2ε
A	A	A	3ε		-	B	B	3ε
A	-	AA	4ε		-	-	BB	4ε
-	AAA	-	3ε					
-	AA	A	4ε					
-	A	AA	5ε					
-	-	AAA	6ε					

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0	ε	2ε	$E_{Total}=4\varepsilon$	E_A	E_B
AAA	–	BB	4ε	0	4ε
AAB	–	AB	4ε	2ε	2ε
ABB	–	AA	4ε	4ε	0
BB	AA	A	4ε	4ε	0
AB	AB	A	4ε	3ε	ε
AB	AA	B	4ε	2ε	2ε
AA	AB	B	4ε	ε	3ε
AA	BB	A	4ε	2ε	2ε
B	AAAB	–	4ε	3ε	ε
A	AABB	–	4ε	2ε	2ε

For system A, $E_{\text{A Total}}=23\varepsilon$; $\langle E_A\rangle=\dfrac{23\varepsilon}{10}=2.3\varepsilon$

For system B, $E_{\text{A Total}}=17\varepsilon$; $\langle E_B\rangle=\dfrac{17\varepsilon}{10}=1.7\varepsilon$

$\langle E\rangle=\langle E_A\rangle+\langle E_B\rangle=2.3\varepsilon+1.7\varepsilon=4\varepsilon$

$\therefore$ Average energy of system A is 2.3ε . So (b) is correct.

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Topic: Mechanics

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

Q. A planet is in a highly eccentric orbit about a star. The distance of its closest approach is 300 times smaller than its farthest distance from the star. If the corresponding speeds are v_c and v_f, then v_c / v_f is

(a) $\frac{1}{300}$ (b) $\frac{1}{\sqrt{300}}$ (c) $\sqrt{300}$ (d) 300

Ans.: (d)

Solution.: Using conservation of angular momentum

$$mv_c r_c = mv_f r_f \Rightarrow \frac{v_c}{v_f} = \frac{r_f}{r_c} = \frac{300 r_c}{r_c} = 300$$

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Topic: Thermodynamics

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

Q. The value of coefficient of volume expansion of glycerin is $5\times10^{-4}/K$. The fractional change in the density of glycerin for a rise of 40°C in its temperature, is:

(a) 0.010 (b) 0.015 (c) 0.020 (d) 0.025

Ans.: (c)

Solution.: We know that, for volumetric expansion: $V = V_0(1+\gamma\Delta T)$

$$\because \text{Volume}(\text{V}) = \frac{\text{Mass}(\text{M})}{\text{Density}(\text{d})} \;;\; \frac{M}{d} = \frac{M}{d_0}(1+\gamma\Delta T)$$

$$\Rightarrow d = d_0(1-\gamma\Delta T) \Rightarrow d = d_0 - d_0\gamma\Delta T \;\Rightarrow \frac{d_0 - d}{d_0} = \gamma\Delta T$$

$$\text{Fractional change in density} = \frac{\Delta d}{d_0} = 5\times10^{-4}\times40 = 0.020$$