

Solutions

2.1 B Velocity directions cancel, while speed is nonnegative and its equilibrium mean is positive.

Compare the rejected options: Mean velocity and mean speed are both zero; The most probable speed is zero; All particles have the rms speed; Speed density has no units. Use the stated model and conditions.

2.2 C Excited total weight $3e^{(-\ln 3)}=1$ equals ground weight 1; $Z=2$.

Compare the rejected options: $1/4$; $1/3$; $3/4$; 1. Use the stated model and conditions.

2.3 5. $a=N/(3v_0)=60/12=5$ particles per unit speed.

2.4 False. Only an interval has nonzero probability; a single point has zero measure.

3.1 All three characteristic speeds scale as $\sqrt{T/m}$, so heavier/light speed ratio is $1/2$. Mean translational energy is $3k_B T/2$ for either gas in the classical regime. Random velocity directions cancel in $\langle \mathbf{v} \rangle$, but $\langle v^2 \rangle$ is positive. Award speed ratios, regime, energy equality and vector distinction.