19.5 For aluminum, we want to compute the Debye temperature, θ_D , given the expression for A in Equation 19.2 and the heat capacity at 15 K. First of all, let us determine the magnitude of A, as

$$A = \frac{C_v}{T^3}$$

$$= \frac{(4.60 \text{ J/mol}-\text{K})(1 \text{ kg}/1000 \text{ g})(26.98 \text{ g/mol})}{(15 \text{ K})^3}$$

$$= 3.68 \times 10^{-5} \text{ J/mol} - \text{K}^4$$

As stipulated in the problem statement

$$A = \frac{12\pi^4 R}{5\theta_{\rm D}^3}$$

Or, solving for θ_{D}

$$\theta_{\rm D} = \left(\frac{12\,\pi^4 R}{5A}\right)^{1/3}$$

$$= \left[\frac{(12)(\pi)^4 (8.31 \text{ J/mol} - \text{K})}{(5)(3.68 \text{ x } 10^{-5} \text{ J/mol} - \text{K}^4)}\right]^{1/3} = 375 \text{ K}$$

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$$\theta_{\rm D} = \left(\frac{12\,\pi^4 R}{5A}\right)^{1/3}$$