85. The mass of hot air is $M_{\text{hot}} = nM$ by Eq. 20-3, where the number of moles contained within the envelope is

$$n = \frac{pV}{RT} = \frac{(1.01 \times 10^5)(2.18 \times 10^3)}{(8.31)T} = \frac{2.65 \times 10^7}{T}$$

with SI units understood. The magnitude of the gravitational force acting on the balloon is

$$F_g = (M_{\text{envelope}} + M_{\text{basket}} + M_{\text{hot}})\, g = \left(249 + M \frac{2.65 \times 10^7}{T}\right)(9.8)$$

with SI units, again, understood (which implies $M = 0.028$). The problem requires that the buoyant force (equal to the weight of the displaced air of density $\rho = 1.21\,\text{kg/m}^3$) is equal to 2700 N plus the magnitude of the gravitational force. Therefore,

$$\rho V g = 2700 + \left(249 + (0.028)\frac{2.65 \times 10^7}{T}\right)(9.8) \qquad \text{where } V = 2.18 \times 10^3\ .$$

Solving this for the temperature, we obtain

$$T = \frac{(0.028)(2.65 \times 10^7)}{\frac{(1.21)(2.18\times10^3)(9.8)-2700}{9.8} - 249} = 351 \text{ K}$$

which is equivalent to 78°.