19.4 (a) For copper, C_v at 20 K may be approximated by Equation 19.2, since this temperature is significantly below the Debye temperature (340 K). The value of C_v at 20 K is given, and thus, we may compute the constant A as

$$A = \frac{C_v}{T^3} = \frac{0.38 \text{ J/mol-K}}{(20 \text{ K})^3} = 4.75 \times 10^{-5} \text{ J/mol-K}^4$$

Therefore, at 40 K

$$C_v = AT^3 = \left(4.75 \times 10^{-5} \text{ J/mol-K}^4\right)(40 \text{ K})^3 = 3.04 \text{ J/mol-K}$$

and

$$c_v = (3.04 \text{ J/mol-K})(1 \text{ mol}/63.55 \text{ g})(1000 \text{ g/kg}) = 47.8 \text{ J/kg-K}$$

(b) Since 400 K is above the Debye temperature, a good approximation for C_v is

$$C_v = 3R$$

$$= (3)(8.31 \text{ J/mol-K}) = 24.9 \text{ J/mol-K}$$

And, converting this to specific heat

$$c_v = (24.9 \text{ J/mol-K})(1 \text{ mol}/63.55 \text{ g})(1000 \text{ g/kg}) = 392 \text{ J/kg-K}$$