Answer on the question #60227, Chemistry / General Chemistry

Question:
A student placed 25.421 g of metal in A coffee cup with exactly 50 g of water initial temperature of the metal was 99.5°C and the initial temperature of the water in the cup was 22.5°C if the final temp of the system with 31.8°C what is the specific heat of the metal

B) if the actual specific heat for the metal in question one was 1.35J/g c calculate the percentage error

Solution:
A) If we assume no energy losses, then the quantity of heat that water received and the quantity of heat that metal provided are the same:

$$Q_{water} = -Q_{metal}$$

The heat is linked to the change of the temperature of the body in the following way:

$$Q = cm(T_2 - T_1),$$

where c is the heat capacity, m is the mass and T_2 and T_1 are the final and the initial temperature, respectively.
So, for the former equation we can write:

$$c_{water}m_{water}\left(T_2 - T_{1,water}\right) = -c_{metal}m_{metal}\left(T_2 - T_{1,metal}\right)$$

The heat capacity of water is 1 cal/g °C, so we can rearrange the last equation:

$$c_{metal} = \frac{c_{water}m_{water}\left(T_2 - T_{1,water}\right)}{m_{metal}\left(-T_2 + T_{1,metal}\right)}$$

And finally,

$$c_{metal} = 0.27\frac{cal}{g\,°\text{C}}$$

B) To calculate this, we should convert the value in cal to J. As 1 cal is 4.184 J, it is very easy to see that 0.27 cal/g °C = 0.27·4.184 = 1.13 J/g °C
Then, the percentage eror is:

$$x = \frac{1.35 - 1.13}{1.35} \cdot 100\% = 16\%$$

Answer: A) 0.27 cal/g °C, or 1.13 J/g °C B) 16%