# FAQs

1. **Predict the specific heat for a model food with the following composition: carbohydrate 40%, protein 20%, fat 10%, ash 5%, moisture 25%.**

**Solution:** $X_h = 0.4$; $X_p = 0.2$; $X_f = 0.1$; $X_a = 0.05$; $X_m = 0.25$

From Heldman and Singh (1981) proposed equation

$$c_p = 1.424X_h + 1.549X_p + 1.675X_f + 0.837X_a + 4.187X_W$$

$c_p$ = (1.424 x 0.4) + (1.549 x 0.2) + (1.675 x 0.1) + (0.837 x 0.05) + (4.187 x 0.25)

= 2.14 kJ/(kg $^o$C)

2. Estimate the thermal conductivity of meat pastry that contains 68.3% water.

**Solution:** . For meats and fish, temperature 0-60 $^o$C, water content 60-80%, wet basis, Sweat (1975) proposed the following equation:

$k$= 0.08 + 0.52$X_W$

Therefore, $k$ = 0.08 + (0.52 x 0.683) = 0.435 W/(m $^o$C)

3. One face of a stainless-steel plate 1 cm thick is maintained at 110 $^o$C, and the other face is at 90 $^o$C (Figure below). Assuming steady-state conditions, calculate the rate of heat transfer per unit area through the plate. The thermal conductivity of stainless steel is 17 W/(m $^o$C).

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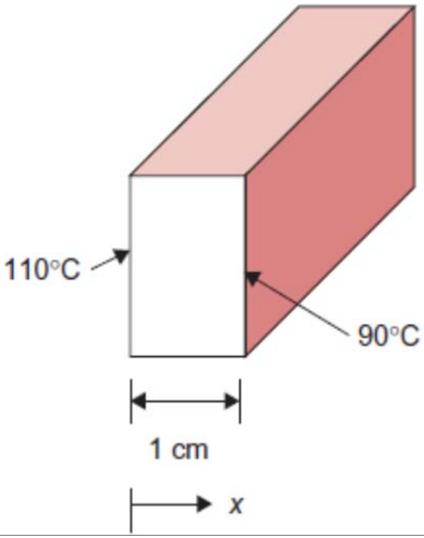
<tr>
<td>
</td>
<td>For steady-state heat transfer in rectangular coordinates we will use<br><br>$$q_x = -k\frac{AdT}{dx}$$<br>q = -(17) x (1) x (110-90) / (0 – 0.01)<br><br>q = 34,000 W<br><br>A positive sign is obtained for the heat transfer, indicating that heat always flows “downhill” from 110 $^{o}$C to 90 $^{o}$C</td>
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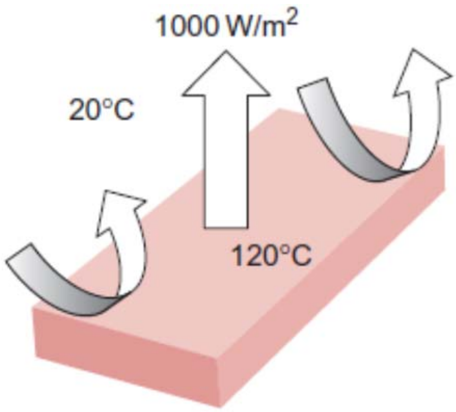
**4.** The rate of heat transfer per unit area from a metal plate is 1000 W/m$^2$.The surface temperature of the plate is 120 $^{o}$C, and ambient temperature is 20 $^{o}$C (Figure below). Estimate the convective heat transfer coefficient.

<table>
<tr>
<td>
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<td>Since the rate of heat transfer per unit area is known, we will estimate the convective heat transfer coefficient directly from Newton’s law of cooling<br><br>$$q = hA(T_S - T_\infty)$$<br>h = 1000/(120 – 20)<br>= 10 W/(m$^2$ $^{o}$C)</td>
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**5.** Calculate the rate of heat energy emitted by 100 $m^2$ of a polished iron surface (emissivity = 0.06) as shown in Figure below. The temperature of the surface is 37 $^oC$.

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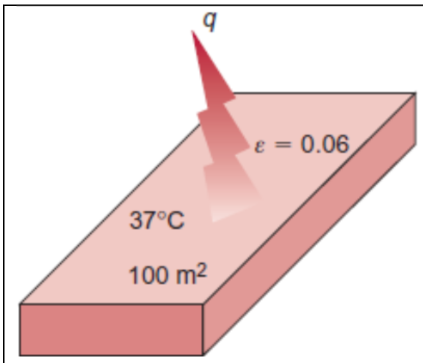
|---|---|
|  | Using Stefan-Boltzmann law,<br><br>$q = \sigma \varepsilon A T_A^4$<br><br>q = (5.669 x $10^{-8}$) x (0.06) x (100) x $(310)^4$<br>= 3141 W<br><br>Total energy emitted by the polished iron surface is 3141 W |