Name Answer Key

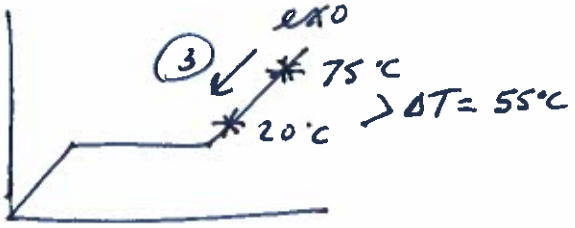
Date _____ Pd ___

Unit 3 Hd 5 – Quantitative Energy Problems (Chem)

For each of the problems sketch a warming or cooling curve (Graph) to help you decide which equation(s) to use to solve the problem. Keep a reasonable number of sig figs in your answers.

1. A cup of coffee (140 g) cools from 75.0°C down to comfortable room temperature 20.0°C. How much energy does it release to the surroundings?

→ like water



(3) $(m)(C_p)(\Delta T) = Q$

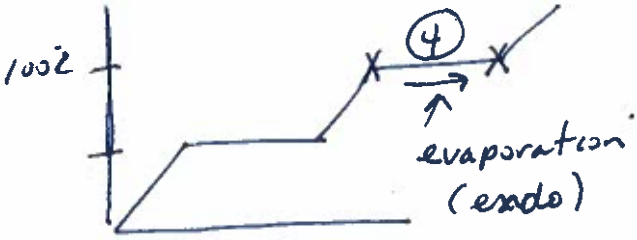
$(140\,g)\left(4.18\,\frac{J}{g\cdot°C}\right)(55°C) =$

32,186 J

2. Suppose during volleyball practice, you lost 2.0 lbs of water due to sweating. If all of this water evaporated, how much energy did the water absorb from your body? Express your answer in kJ.

1 lb = 454 g → metric sheet

$2.0\,lb\left(\frac{454\,g}{1\,lb}\right) = 908\,g$

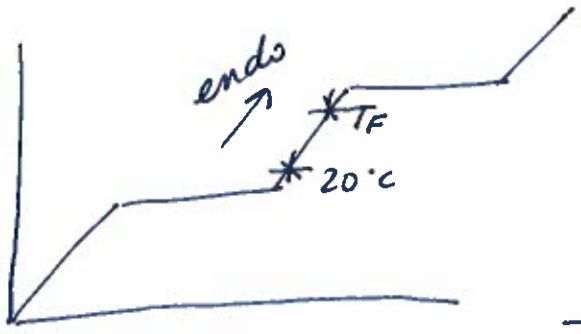


(4) $(m)(\Delta H_v) = Q$

$(908\,g)\left(2260\,\frac{J}{g}\right) = 2052080\,J\left(\frac{1\,kJ}{1000\,J}\right)$

$= 2052\,kJ$

3. Suppose that during the Icy Hot lab that 65.5 kJ of energy were transferred to 450 g of water at 20°C. What would have been the final temperature of the water?



Find ΔT

$65.5\,kJ\left(\frac{1000\,J}{1\,kJ}\right) = 65,500\,J$

$\Delta T = \frac{Q}{(m)(C_p)} = \frac{65,500\,J}{(450\,g)\left(4.18\,\frac{J}{g\cdot°C}\right)} = 34.8°C$

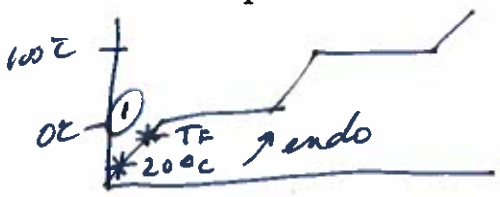
T goes up, so add

$T_I + \Delta T = T_F$

$20°C + 34.8°C =$ **54.8°C**

4. The heat capacity of solid iron is 0.447 J/g°C. If the same quantity of energy as in #3 were transferred to a 450 g chunk of iron at 20.0°C, what would be the final temperature?

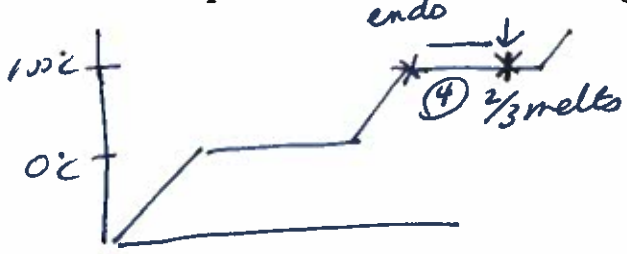
Find ΔT $\quad Q = 65{,}500\ J$



$$\Delta T = \frac{Q}{(m)(C_p)} = \frac{65{,}500\ J}{(450g)\left(.447\frac{J}{g\cdot°C}\right)} = 326°C$$ (goes up)

$$20°C + 326°C = \boxed{346°C}$$

5. Suppose a bag full of ice (450. g) at 0.0 °C sits on the counter and begins to melt to liquid water. How much energy must be absorbed by the ice if 2/3 of it melted?



$\frac{2}{3} = .667$ so $450g(.667) = 301g$ melts

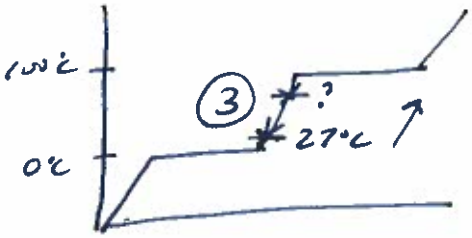
$$Q = (m)(\Delta H_f)$$

$$(301g)\left(334\frac{J}{g}\right) = \boxed{101{,}534\ J}$$

6. A serving of Cheez-Its releases 130 kcal (1 kcal = 4.18 kJ) when digested by your body. If this same amount of energy were transferred to 2.5 kg of water at 27°C, what would the final temperature be? Find ΔT

Extra credit type problem

$$130\,kcal\left(\frac{4.18\,kJ}{1\,kcal}\right)\left(\frac{1000\,J}{1\,kJ}\right) = 543{,}400\ J$$



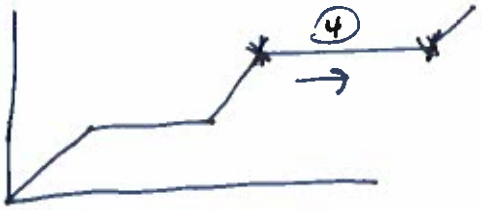
$$\Delta T = \frac{Q}{(m)(C_p)} = \frac{543{,}400\ J}{(2500g)\left(4.18\frac{J}{g\cdot°C}\right)} = 52°C$$

T goes up so add

$$T_I + 52°C = T_F$$

$$27°C + 52°C = \boxed{79°C}$$

7. If this same quantity of energy were transferred to 2.5 kg of water at its boiling pt, what fraction of the water would be vaporized?



Find mass

$$m = \frac{Q}{\Delta H_v} = \frac{543{,}400\ J}{2260\frac{J}{g}} = 240g\ \text{boiled}$$

$$\frac{240g\ \text{Boiled}}{2500g\ \text{total}} \approx \frac{1}{10} \text{ or } \approx 10\%$$