Chemistry CP
Energy Calculation Worksheet #4

Name: Key

You may need the following information to answer the questions:

Specific heat of water= 4.184 J/g°C **Specific heat of steam= 1.84 J/g°C**

Specific heat of ice= 2.09 J/g°C

Heat of fusion of water= 6.02 kJ/18 grams **Heat of vaporization of water= 40.6 kJ/18 grams**

1. A 345 gram sample of water at -35°C is heated until it becomes steam with a temperature of 100.0°C. How many joules of energy were used? ① $Q = 2.09 \times 345 \times 35 = 25{,}236.75\text{J}$ ② $345\text{g} \mid \frac{6.02\text{kJ}}{18\text{g}} = 115.38333\text{kJ} \mid \frac{1000\text{J}}{1\text{kJ}} = 115383.33\text{J}$ ③ $Q = 4.184 \times 345 \times 100 = 144348\text{J}$ ④ $345\text{g} \mid \frac{40.6\text{kJ}}{18\text{g}} = 778.166667\text{kJ} \mid \frac{1000\text{J}}{1\text{kJ}} = 778166.67\text{J}$

Ans: 1063134.75J (1,100,000J)

2. A 405 gram sample of ice at -8°C is heated until the temperature reaches 29°C. How many joules of energy were needed to make this change? ① $Q = 2.09 \times 405 \times 8 = 6771.6\text{J}$ ② $405\text{g} \mid \frac{6.02\text{kJ}}{18\text{g}} = 135.45\text{kJ} \mid \frac{1000\text{J}}{1\text{kJ}} = 135450\text{J}$ ③ $Q = 4.184 \times 405 \times 29 = 49141.08\text{J}$

Answer: 191362.68J (200000J)

3. A 12 oz can of soda weighs 450 grams. Soda is mostly water. How many joules of energy are released when a can of soda is cooled from 25°C (room temperature) to- 4°C (freezer temp)?

① $Q = 4.184 \times 450 \times 25 = 47070\text{J}$ ② $450\text{g} \mid \frac{6.02\text{kJ}}{18\text{g}} = 150.5\text{kJ} \mid \frac{1000\text{J}}{1\text{kJ}} = 150500\text{J}$ ③ $Q = 2.09 \times 450 \times 4 = 3762\text{J}$

Answer 201332J (200000J)

4. How many kilojoules of energy are required to heat 25 grams of water from 0.0°C to 100.0°C?

① $Q = 4.184 \times 25 \times 100 = 10460\text{J} \mid \frac{1\text{kJ}}{1000\text{J}} = 10.460\text{kJ}$ (10 kJ)

5. How many joules of energy are required to melt 270. grams of ice?

① $270\text{g} \mid \frac{6.02\text{kJ}}{18\text{g}} = 90.3\text{kJ} \mid \frac{1000\text{J}}{1\text{kJ}} = 90300\text{J}$

6. How many kilojoules of energy are required to boil 1150 grams of water into steam?

① $1150\text{g} \mid \frac{40.6\text{kJ}}{18\text{g}} = 2593.889\text{kJ}$ (2590 kJ)

7. A 125 gram sample of ice at -40.0°C is heated until it changes to steam at 105°C. How much total energy (in joules) has been added to the system? ① $Q = 2.09 \times 125 \times 40 = 10450\text{J}$ ② $125\text{g} \mid \frac{6.02\text{kJ}}{18\text{g}} = 41.805556\text{kJ} \mid \frac{1000\text{J}}{1\text{kJ}} = 41805.56\text{J}$ ③ $Q = 4.184 \times 125 \times 100 = 52300\text{J}$ ④ $125\text{g} \mid \frac{40.6\text{kJ}}{18\text{g}} = 281.9444\text{kJ} \mid \frac{1000\text{J}}{1\text{kJ}} = 281944.44\text{J}$ ⑤ $Q = 1.84 \times 125 \times 5 = 1150\text{J}$

Answer: 387650.00 (388000J)

8. How many joules of energy are given off when 130. grams of water are cooled from 75°C to -5°C?

① $Q = 4.184 \times 130 \times 75 = 40794\text{J}$ ② $130\text{g} \mid \frac{6.02\text{kJ}}{18\text{g}} = 43.477778\text{kJ} \mid \frac{1000\text{J}}{1\text{kJ}} = 43477.78\text{J}$ ③ $Q = 2.09 \times 130 \times 5 = 1358.5\text{J}$

Answer = 85630.28J

9. How many kilojoules of energy are given off when 340 grams of water are cooled from 100°C to -35°C? ① $Q = 4.184 \times 340 \times 100 = 142256\text{J} \mid \frac{1\text{kJ}}{1000\text{J}} = 142.256\text{kJ}$ ② $340\text{g} \mid \frac{6.02\text{kJ}}{18\text{g}} = 113.7111\text{kJ}$ ③ $Q = 2.09 \times 340 \times 35 = 24871\text{J} \mid \frac{1\text{kJ}}{1000\text{J}} = 24.871\text{kJ}$

Answer = 280.8381kJ = (300 kJ) (90000J)

10. How many joules of energy are required to heat 360 grams of frozen juice (mostly water) from -15°C to 100°C?

① $Q = 2.09 \times 360 \times 15 = 11286\text{J}$ ② $360\text{g} \mid \frac{6.02\text{kJ}}{18\text{g}} = 120.4\text{kJ} \mid \frac{1000\text{J}}{1\text{kJ}} = 120400\text{J}$ ③ $Q = 4.184 \times 360 \times 100 = 150624\text{J}$

Answer = 282310J (300000J)