$q = \Delta H_{fus} \times mol$

Thermochemical Calculations

Name:_____ Block:_____ Date:_____

Specific Heat for ice= 2.09 J/g°C Specific heat for water vapor= 1.75 J/g°C

1. **How much heat is required to completely melt 45.0g of ice?**

$45\,g \left| \frac{1\,mol}{18\,g} \right| \frac{6.01\,kJ}{1\,mol} = 15.0\,kJ$

$45\,g \left| \frac{1\,mol}{18} \right.$

OR $(2.5\,mol\,H_2O) * 6.01\,kJ/mol = q = 15.0\,kJ$

2. **How much heat is required to boil 35.0g of ammonia?** (ΔH_{fus}= 5.64 kJ/mol ; ΔH_{vap}= 23.4 kJ/mol)

$35.0\,g\,NH_3 \left| \frac{1\,mol}{17\,g} \right| \frac{23.4\,kJ}{1\,mol} = 48.2\,kJ$

OR

$35.0\,g \left| \frac{1\,mol}{17\,g} \right. = 2.06\,mol$ $(2.06\,mol) * \frac{23.4\,kJ}{mol} = 48.2\,kJ$

3. **How much heat is released when 45.0g of water cools from 80.0°C to 25.0°C?**

$45.0\,g \left| \frac{1\,mol}{18\,g} \right.$

$45.0\,g * 4.18\,J/g°C * 55.0°C = 10{,}300\,J$

$10.3\,kJ$

4. **How much heat is required to heat 25.0g of ice (solid water) from -20.0°C to 35.0°C?** *(HINT: you need to use specific heat AND heat of fusion)*

$-20° \rightarrow 0°C$; melt @ $0°C$; $0°C \rightarrow 35°C$

Convert units!

$25\,g \cdot 2.09\,J/g°C \cdot 20°C = 1045\,J / 1000$

$\frac{25\,g}{18\,g} \left| \frac{1\,mol}{1\,mol} \right| \frac{6.01\,kJ}{} = 8.35\,kJ$ $= 13\,kJ$

$25\,g \cdot 4.18\,J/g°C \cdot 35 = 3657\,J / 1000$

5. **How much energy is released when you cool down water vapor from 185°C to water at 67°C?**

$20.0\,g$

$18°C *$

$20.0\,g \cdot 1.75 \cdot 85 = 2975\,J$

$\frac{200\,g}{18\,g} \left| \frac{1\,mol}{} \right. \cdot 40.7\,kJ = 45.2\,kJ$ $= 50.9\,kJ$

$20.0\,g \cdot 4.18 \cdot 33 = 2759$

extra info

6. **If 11.0kJ of energy are released when 800.0g of oxygen gas is frozen at -219°C, what is the ΔH_{fus} for O_2?**

$800.0\,g \left| \frac{1\,mol}{32\,g} \right. = 25\,mol$

$\frac{11kJ}{25\,mol} = \boxed{.44\frac{kJ}{mol}}$

~~7.~~ **How much energy, in kilocalories, is needed to boil 30.0g of methanol at 64.7°C? (ΔH_{vap}=35.5 kJ/mol)**

$4.18kJ = 1kcal$

$30.0\,g \left| \frac{1\,mol}{32\,g} \right| \frac{35.5kJ}{1\,mol} \left| \frac{1kcal}{4.18kJ} \right. = 7.96\,kcal$

or Calories

8. **If it takes 13.5 kJ to boil 30.0g of hydrogen gas, what is the ΔH_{vap} of H_2?**

$30.0g\,H_2 \left| \frac{1\,mol}{2g} \right. = 15\,mol$

$\frac{13.5kJ}{15\,mol} = .9\,kJ/mol$

9. **How much energy would be required to heat solid ice from -25.0°C to water vapor at 150.0°C?**

-25°C → melt@0°C 0-100° boil@100 15.0g then 100-150°C 47kJ/mol

heating ice → $q = (15.0g)\left(2.09\,J/g°C\right)(25°C) = 784.5J = .784kJ$

$15g \left| \frac{1mol}{18g\,H_2O} \right. = .83\,mol$

melting → $q = (.83\,mol)(6.01kJ/mol) = 5.01kJ$

heating liquid → $q = (15.0g)(4.18J/g°C)(100°C) = 6270J = 6.270kJ$

boiling → $q = (.83\,mol)(40.7kJ/mol) = 33.9kJ$

heating gas → $q = (15.0g)(1.75J/g°C)(50°C) = 1313J = 1.313kJ$

$= 47.3kJ$