(40)

Description	Name of phase change	exo or endothermic?
(a) Br_2 vapor → Br_2 liquid	condensation	exothermic
(b) I_2 crystals disappear from an evaporating dish in fume hood (they must have gone straight from solid to gas!)	sublimation	endothermic
(c) rubbing alcohol in an open container slowly disappears (must be liquid → gas)	evaporation ↑ ("vaporization" would also work, but evaporation is more specific. Not boiling though)	endothermic
d) Molten lava from volcano turns to solid rock (Liquid → solid)	freezing	exothermic

(43) Cooling Drinking water by letting part of it evaporate from canvas bags or ~~pour~~ porous clay pots:

How many grams of water can be cooled from 35°C to 20°C by the evaporation of 60 g of water?

ΔH_{vap} of H_2O in this temp range is 2.4 kJ/g
specific heat of H_2O is 4.18 J/g-K (or 4.184 J/g-K?)

$(60\text{ g } H_2O)(2.4\text{ kJ/g}) = 144\text{ kJ}$ required to evaporate the 60 grams of water.
most of this energy will come out of the rest of the water in the pot/bag.

$q = mc\Delta T$

$$m = \frac{q}{c\Delta T} = \frac{144\text{ kJ}\left(\frac{1000\text{ J}}{1\text{ kJ}}\right)}{(4.18\text{ J/g·K})(15\text{ K})} = 2296.7\text{ g} \rightarrow \boxed{2300\text{ g}}$$

or 2000 g if 60 g has the 1 SF...

↑

$|\Delta T| = 35°C - 20°C = 15°C$ or 15 K

(45) Ethanol (C_2H_5OH) mp = −114 °C bp = 78°C

ΔH_{fusion} = 5.02 kJ/mole C_{solid} = 0.97 J/g·K

ΔH_{vap} = 38.56 kJ/mole C_{liquid} = 2.3 J/g·K

(a) How much heat to convert 42.0 g ethanol at 35°C to vapor at 78°C?

At 35°C, the ethanol will be a liquid.

(1) heat liquid from 35°C up to 78°C, which is the boiling pt temp

$q = mC\Delta T = 42.0g(2.3 \frac{J}{gK})(78°C - 35°C) = 4153.8\ J$

2 SF hundreds place

↑ or $\frac{2.3\ J}{g\ °C}$

(2) vaporize the ethanol to a gas at 78°C

$q = m\,\Delta H_{vap}$ or $q = n\,\Delta H_{vap}$ } Depends on whether ΔHvap is given per gram or per mole.. in our case it is given in kJ per mole.

$q = (42.0g)\left(\frac{1\ mole}{46.0688g}\right)\left(\frac{38.56\ kJ}{mole}\right)\left(\frac{1000\ J}{1\ kJ}\right) = 35154.38\ J$

3 SF hundreds place

Total: 4153.8 J + 35154.38 J = 39308 J → (a) **39300 J or 39.3 kJ**

(b) How much heat req'd to convert the same amt from −155°C to vapor @ 78°C?

At −155°C, the ethanol will be a solid.

(1) heat solid ethanol from −155°C up to its melting point of −114 °C

$q = mC\Delta T = (42.0g)(.97 \frac{J}{gK})(-114°C - {}^{-}155°C) = 1670.34\ J$

(2) Melt the solid at −114 °C (solid at −114°C → Liquid at 114°C)

$q = n\,\Delta H_{fusion} = (42.0g)\left(\frac{1\ mole}{46.0688g}\right)\left(5.02 \frac{kJ}{mol}\right)\left(\frac{10^3 J}{kJ}\right) = 4576.63\ J$

(3) heat the liquid from −114°C to 78°C

$q = mC\Delta T = (42.0g)\left(2.3 \frac{J}{g \cdot K}\right)(78°C - {}^{-}114°C) = 18547.2\ J$

(4) Vaporize the liquid at 78°C

$q = n\,\Delta H_{vap}$ = 35154.38 J (calculated in part (a))

Total: 1670.34 J + 4576.63 J + 18547.2 J + 35154.38 J = 59948.55

59.94855 kJ → **60. kJ**