Solutions

Solute →

Solvent →

Concentrated solution → in order to make a concentrated solution, one must add more solute to the solution

Dilute solution → in order to make a dilute solution, one must add more solvent to the solution

Saturated → a solution where no further solute can be dissolved in a solution

Supersaturated → when additional solute is added to a saturated solution it becomes supersaturated and the solute will not dissolve in the solution

Solubility

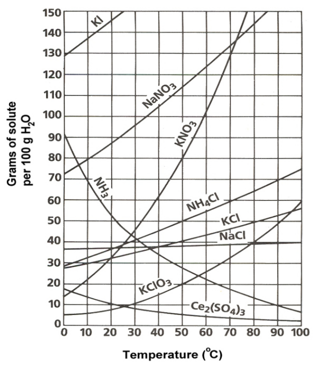
The ability of a given substance to dissolve in a solvent

Ex.

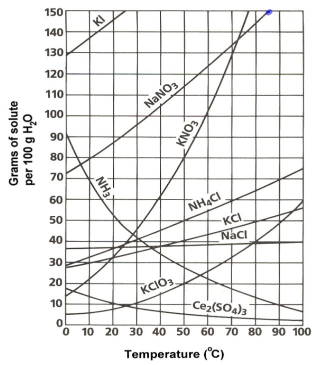
benzoic acid and salt in COLD water

Solubility curves

A graph that shows how much solute can be dissolved in a solution at different temperatures



on the line
→ saturated
Above the line
→ supersaturated
below the line
→ unsaturated



What is the solubility of KNO_3 at 50ºC
a. 60 g/100g H_2O
b. 80 g/100g H_2O
c. 34 g/100g H_2O
d. 130 g/100g H_2O

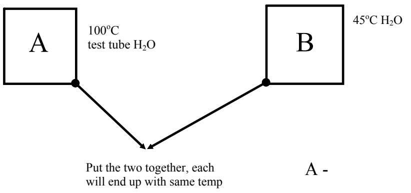
At what temp. is 80 g/100g H_2O of $NaNO_3$ soluble
a. 10 ºC
b. 20 ºC
c. 30 ºC
d. 40 ºC

As temperature increases, what can you say about the solubility of NH_3?

At what temperature are $KClO_3$ and $Ce(SO_4)_3$ soluble at a level of 10 g/100 g H_2O?
a. 20 ºC
b. 25 ºC
c. 5 ºC
d. 15 ºC

If I were to put 90 g / 100 g H_2O of $NaNO_3$ in a beaker at 10 ºC, what kind of solution would I have?
a. saturated
b. supersaturated
c. dilute

Heat



A -

B -

Heat → energy exchanged between two objects due to a difference in temperature or the object going through a phase change

Symbol =

Units =

1 cal = 4.184 J

Calorie vs calorie

1 Calorie of food = 1000 calories of heat energy

Ex.

A potato has an average energy value of 686,000 J. What is that value expressed in Calories?

Measuring Heat energy changes

To measure heat energy change one must use a calorimeter

** Not all substances heat up at the same rate**

* Must take the type of material into consideration when measuring heat energy

Specific Heat

* the heat energy required to raise the temperature of 1 g of a substance 1°C

Symbol = C_p

Unit = J/g°C

Cp for H_2O = 4.184 J/g°C

Cp for Al = 0.896 J/g°C

Calculating Heat Energy

$q = m\,Cp\,\Delta T$

q = Heat ⟶ J or cal

m = mass ⟶ g

Cp = Specific heat ⟶ J/g °C

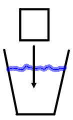
ΔT = change in Temperature ⟶ °C

↳ change $(T_{final} - T_{initial})$

Heat Problems

1) How much heat is transferred to the air when a 4110 g piece of lead cools from 660.0 °C to 25.0 °C? C_p = .1276 J/g °C

2) Trying to determine the specific heat of a substance
- allows us to determine what the material is made of



m = 122 g
T_i = 100 °C
T_f = 42.5 °C

Cp = ???

lose heat

m = 100 g H_2O
T_i = 21.2 °C
Cp = 4.184 J/g °C
T_f = 42.5 °C

gains heat

− HEAT LOSS = HEAT GAINED
Block = water

HEAT LOSS + HEAT GAINED = 0

$-q_{Block} = q_{water}$

$-mCp\Delta T = mCp\Delta T$

$-(122\,g)(C_p)(42.5°C - 100.°C) = (100.\,g)(4.184\,J/g°C)(42.5 - 21.2°C)$

$\frac{7015\,(C_p)}{7015} = \frac{8911.92\,J}{7015\,g°C}$

$C_p = 1.27\,J/g°C$

A hamburger contains 1,340,000 Joules of energy and a container of french fries contains 799, 000 Joules of energy. Calculate how many Calories are in this meal.

$2139000\,J \times \frac{1\,cal}{4.184\,J} \times \frac{1\,Cal}{1000\,cal}$

511.2 Cal

How much heat energy is lost if a 60 g sample of Aluminum is cooled from 45 °C to 23° C. C_p of Aluminum is 0.897 J/g °C

$q = mC_p\Delta T$

q = ?
m = 60 g
C_p = 0.897 J/g°C
T_f = 23 °C
T_i = 45 °C

$q = (60\,g)(0.897\,J/g°C)(23 - 45°C)$

q = −1184.04 J

q = −1000 J

Calculate the mass of water if the amount of heat energy gained is 750 J. The specific heat of water is 4.184 J/g °C. The temperature went from 22° C to 53° C

q = 750 J
m = ?
C_p = 4.184 J/g°C
T_f = 53 °C
T_i = 22 °C

$\frac{q}{C_p\Delta T} = \frac{m\,C_p\Delta T}{C_p\Delta T}$

$m = \frac{q}{C_p\,\Delta T}$

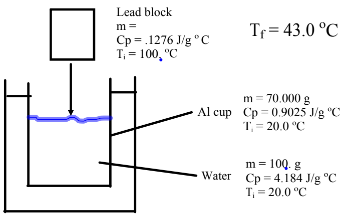
$m = \frac{750\,J}{(4.184\,J/g°C)(53°C - 22°C)}$

m = 5.78

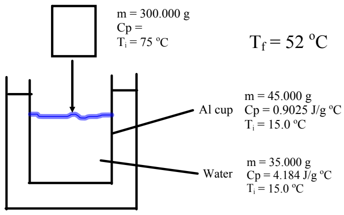
m = 5.8 g

− HEAT LOSS = HEAT GAINED

HEAT LOSS + HEAT GAINED = 0



Solve for m?



Solve for C_p of the unknown block ?

-Heat loss = heat gain

Block = water + Al cup

$q_{Block} = q_{water} + q_{Al}$

$mC_p\Delta T = mC_p\Delta T + mC_p\Delta T$

If 3500 J of energy were added to a 28.2 g sample of iron at 20 °C, what is the final temp of the iron in Kelvin. Refer to page 513 in text for the specific heat of iron

You need 70.2 J to raise the temp of 34.0 g of ammonia from 23°C to 24°C. Calculate the specific heat of ammonia

Do problems 16 and 17 on page 548

Specific Heat Lab

1. Setup a hot plate and begin to boil some water in a 250 ml beaker
2. Find the mass of the unknown metal
3. Find the mass of the water (around 75-100 g (75-100 ml))
   - put the styrofoam cup on the scale and 0 the scale
   - pour between 75 and 100 ml of water in the cup and record the mass of the water
4. Find the initial temp of the water
5. Once the water is boiling, put your metal in the boiling water. Keep the metal in the water for AT LEAST 7 MIN.
6. Quickly place the unknown in the cup with the water. Cover the cup with the empty styrofoam cup (THE ONE WITH THE HOLE IN IT)
7. Do not let any heat escape from the system
8. Gently swirl the water in the cup once or twice
9. Place the temperature probe in the hole in the top of the cup. Find the final temperature of the system with the temperature probe. The final temperature of the system should be recorded when the temperature stops rising DO NOT TOUCH THE UNKNOWN WITH THE TEMP. PROBE

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