Phase diagram of ethylene glycol - water.
## Typical Physical Properties of Coolant Compounds

<table>
<thead>
<tr>
<th>Property</th>
<th>Water</th>
<th>Methyl Alcohol</th>
<th>Ethylene Glycol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific gravity 20/20°C</td>
<td>1.00</td>
<td>0.7924</td>
<td>1.1155</td>
</tr>
<tr>
<td>Specific heat, 25°C cal/(g) (°C)</td>
<td>0.99765</td>
<td>0.600 (20°C)</td>
<td>0.574</td>
</tr>
<tr>
<td>Freezing point, °C pure</td>
<td>0</td>
<td>-97.7</td>
<td>-13.3</td>
</tr>
<tr>
<td>Freezing point, 50% water solution (°C pure)</td>
<td>. . . .</td>
<td>-44.5</td>
<td>-36.6</td>
</tr>
<tr>
<td>Boiling point, °C</td>
<td>100</td>
<td>64.5</td>
<td>197.3</td>
</tr>
<tr>
<td>Vapor pressure, 20°C mm Hg</td>
<td>17.535</td>
<td>96.1</td>
<td>0.12</td>
</tr>
<tr>
<td>Flash point, open-cup °C</td>
<td>. . . .</td>
<td>15.6</td>
<td>115.6</td>
</tr>
<tr>
<td>Viscosity, 20°C, cP</td>
<td>1.01</td>
<td>0.59</td>
<td>20.9</td>
</tr>
</tbody>
</table>
Phase Diagram of Et glycol - water
**Diagram Description**

- **Liquidus**: $l \rightarrow l + s$
- **Solidus**: $s = l + s$
- **Solvus**: $s = s_1 + s_2$
- **Eutectic**: $l \rightarrow s_1 + s_2$

**Graph Details**

- **Temperature, °C**: On the y-axis.
- **Temperature, °F**: On the x-axis.
- **Composition**:
  - % NaCl
  - % H₂O

**Key Points**

- **Ice + brine**: At $-21^\circ C$.
- **23.3% NaCl**: Indicated by a line.
- **Salt + brine**: Above 23.3% NaCl.

**Legend**

- Red line: Liquidus
- Black line: Solidus
- Purple line: Solvus
- Green line: Eutectic
Comparative Phase Diagram for KCl, NaCl, and CaCl$_2$
50 wt% Sn - 50 wt % Pb

Primary Pb-rich α

Sn-rich β

Pb-rich α

cut, polish, etch

Nicole Barbe Ponsardin  
(1777-1866)

- 1798 married François Clicquot  
- widowed at age 27 & took control of the winery  
  bold, imaginative management  
  ① marketing champagne to all the great  
  courts of Europe: *mythmaking*  
  ② bought land in the best vineyards  
  ③ fought fiercely against counterfeiting  
  ④ established strict quality control procedures  
  ⑤ produced the first *rosé champagne*  
  ⑥ oversaw invention of new technology:  
     *remuage* (riddling)
Problem:

champagne is cloudy -- how to clarify without losing the sparkle?

a little chemistry....

\[
\begin{align*}
sugar + yeast & \rightarrow alcohol + CO_2 \\
\text{grape juice} & \quad \text{grape skin}
\end{align*}
\]

byproducts include sundry insolubles, sedimentary & suspended

removal treatments

mechanical

chemical

(siphon)

(coagulants)

won't work for champagne!

\( \text{at small } r, r^2 > r^3 \)
Invention of Mme. Clicquot

1. invert bottle in order to collect sediment at the top

2. to assist with 1 angle the bottle at 45°, turn periodically (remuage/riddling)*

3. to contain the lees freeze a plug of ice in bottle neck at time of disgorgement

* motorized riddling: Gyropalette/VLM
3.091 final exam

Tuesday, 15 December, 9:00 a.m. – 12:00 noon
Johnson Athletic Center

» 3 hours but not 3× work of monthly test
» intensive coverage since T3
» extensive coverage of everything
» aid sheet permitted, 8½" × 11"
» bring Periodic Table, Table of Constants, calculator, and a pen
» no headphones, no audio
3.091 final exam

- comparable difficulty to monthly tests
- read the entire exam
- show your work & justify your conclusions
- solve algebraically
- remain confident
- academic honesty
3.091 final exam

- overall grade based on many factors, including trends
- claim exam papers starting January 4
- no time limit for appeals  security measures
some personal observations
That’s all, Folks!

Happy Holidays