\textbf{NOT TO SCALE}
<table>
<thead>
<tr>
<th></th>
<th>m.p. (K)</th>
<th>b.p. (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>oxygen</td>
<td>55</td>
<td>90</td>
</tr>
<tr>
<td>argon</td>
<td>84</td>
<td>87</td>
</tr>
<tr>
<td>nitrogen</td>
<td>63</td>
<td>77</td>
</tr>
</tbody>
</table>

- liquid \( \text{N}_2 \)  
- liquid \( \text{O}_2 \)  
- \( \text{H}_2\text{O} \) ice  
- \( \text{Ar} \) ice
polymorphs: different atomic arrangements at constant composition

1 atm = 101325 Pa = 0.1 MPa = 14.7 psi = 1 bar

1 GPa = 10,000 atm
CARBON DIOXIDE (CO₂)
ZIRCONIA (ZrO₂)
allotropes of sulfur

allotropes: forms of an element differing in bonding and molecular structure, e.g., \( O_2 \) and \( O_3 \) are allotropes of oxygen
polymorphs of sulfur

$\alpha = \beta$ at 95.5°C

rhombic

monoclinic
\[ \beta = \lambda \text{ at } 119^\circ\text{C} \]

\[ \lambda = \mu \text{ at } 160^\circ\text{C} \]

forming plastic sulfur
decaffeinating coffee

- use a process called *solvent extraction*
- historically the solvent was CH$_2$Cl$_2$
- today, green beans soaked in CO$_2$ at 90°C and $\approx$200 atm.
- caffeine conc. drops from the normal 1-3% to $\approx$0.02%
- reduce $T$ & $P$ to exceed $K_{sp}$
  - caffeine precipitates out of solution
- recycle the CO$_2$