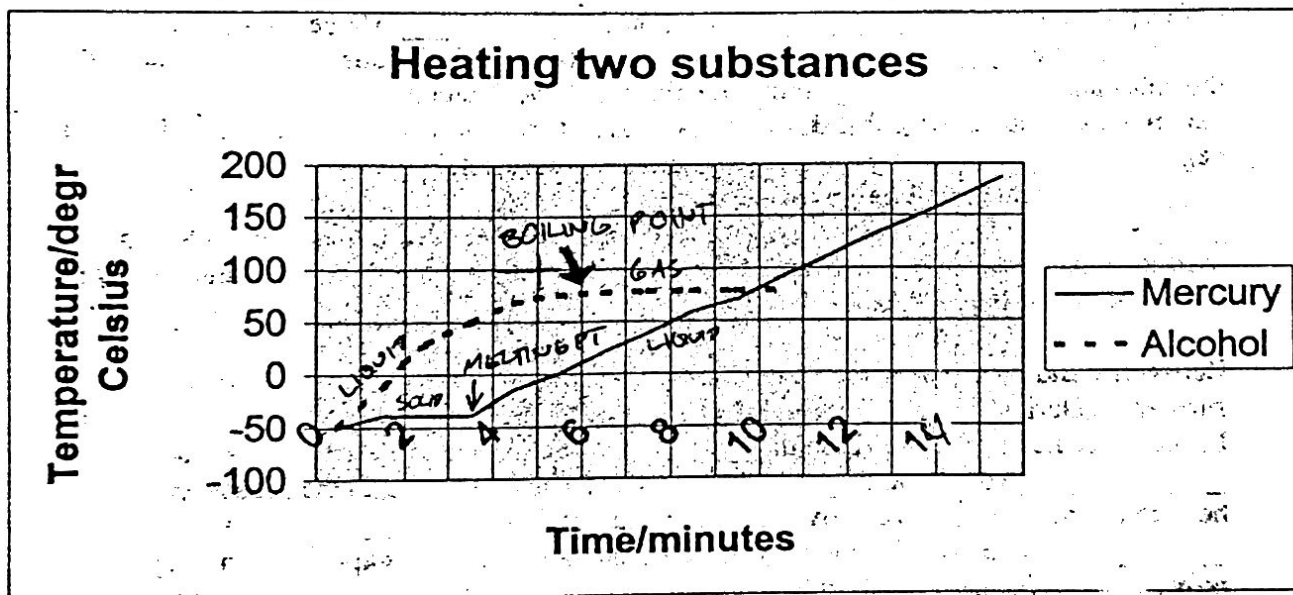


* SOLUTIONS *

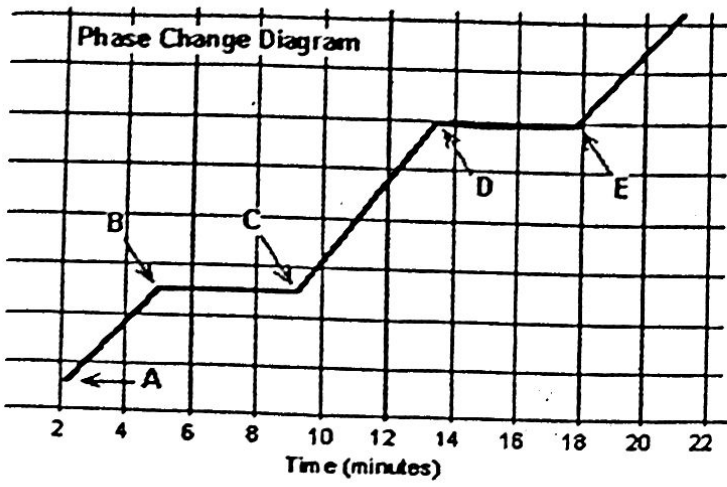
CHANGES OF STATE

- Say whether each statement is TRUE or FALSE: If it is false re-write it so it is correct.
 - Changes of state are chemical changes **FALSE - ARE PHYSICAL CHANGES**
 - Freezing is not a change of state **FALSE - IS A CHANGE OF STATE (L → S)**
 - The temperature does not change during a change of state **TRUE**
 - When a gas turns into a liquid the process is called evaporation **FALSE - PROCESS IS CONDENSATION**
 - A liquid can be heated only up to its boiling point **TRUE (after that, its no longer liquid!)**
- The graph below shows equal masses of two substances being heated in the same way. Both mercury and alcohol are liquids at room temperature.



Using the graph answer the following questions:

- Estimate the boiling point of alcohol. **APPROX. 75°C**
- Estimate the melting point of mercury. **APPROX -40°C**
- How many minutes did it take for the alcohol to reach its boiling point? **6 MINUTES**
- Which liquid has the highest boiling point? **MERCURY (≈ 357°C - OFF THE CHART)**
- Which liquid has the lowest melting point? **ALCOHOL (-89°C - OFF THE CHART)**
- Suggest why the line for alcohol stops after 10 minutes. **ALCOHOL HADN'T FINISHED BOILING - UPWARD LINE WOULD MEAN IT'S NOW A GAS**
- Which liquid is changing state between 2 and 4 minutes? Name the change. **MERCURY - MELTING**



The graph was drawn from data collected as a substance was heated at constant rate. Use the graph to answer the following questions.

At point A, the beginning of observations, the substance exists in a solid state. Material in this phase has definite volume and definite shape. With each passing minute, heat/E is added to the substance. This causes the molecules of the substance to move more rapidly which we detect by a temperature rise in the substance. At point B, the temperature of the substance is 50 °C. The solid begins to MELT. At point C, the substance is completely melted or in the liquid state. Material in this phase has definite volume and indefinite shape. The energy put to the substance between minutes 5 and 9 was used to convert the substance from a solid to a liquid. This heat energy is called the latent heat of fusion.

Between 9 and 13 minutes, the added energy increases the temperature of the substance. During the time from point D to point E, the liquid is vaporizing. By point E, the substance is completely in the gaseous phase. Material in this phase has indefinite volume and indefinite shape. The energy put to the substance between minutes 13 and 18 converted the substance from a liquid to a gaseous state. This heat energy is called the latent heat of vaporization. Beyond point E, the substance is still in the gaseous phase, but the molecules are moving faster as indicated by the increasing temperature.

Which of these three substances was likely used in this phase change experiment?

Substance	Melting point	Boiling point
Bolognium	20 °C	100 °C
Unobtanium	40 °C (-0°C)	140 °C (+20°C)
Foosium	70 °C	140 °C

BONUS: For water, the value for the latent heat of vaporization is 6.8 times greater than the latent heat of fusion. Imagine we were adding heat at a constant rate to a block of ice in a beaker on a hot plate, and it took 4 minutes for the ice to melt completely. How long would it take, after the water started boiling, for the beaker to be completely empty (the liquid water totally converted to water vapor)?

LATENT HEAT VAPORIZATION = 6.8x GREATER, SO SHOULD TAKE
 6.8x LESS TIME TO BOIL THAN MELT,
 SO $\frac{4 \text{ MIN}}{6.8} = 0.59 \text{ MINUTES} = 35.3 \text{ SECONDS}$