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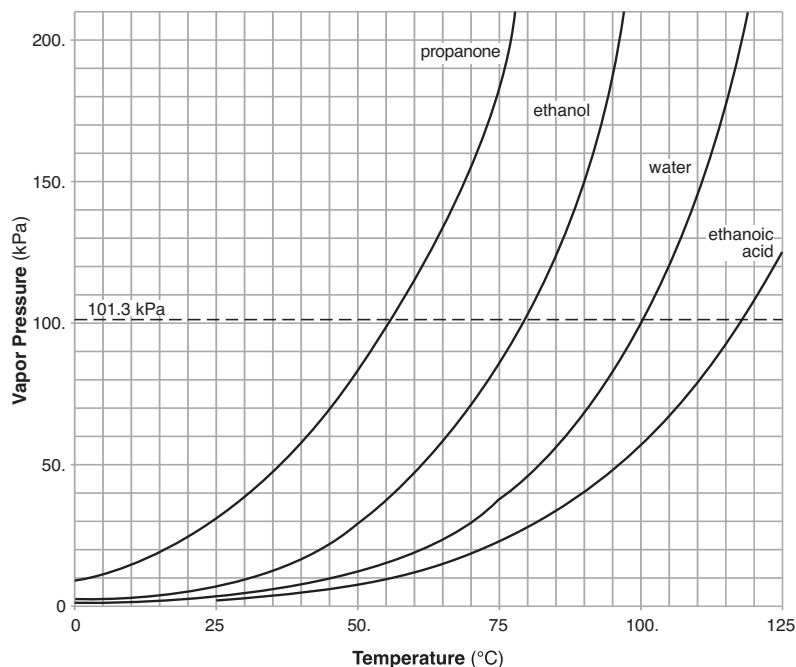
## Unit 4 - Topic 4

### Vapor Pressure

An open glass of water left standing around will eventually evaporate even without being heated. When water evaporates, it changes from a liquid to a gas (water vapor). Water vapor takes up more space than an equal mass of liquid water. As a result, in a closed container, the vapor that forms can exert a significant amount of pressure. This pressure is known as vapor pressure. Even in an open container, the vapor is confined by the air pressing down on it. Some of it collects at the surface and exerts pressure. Occasional high energy molecules at the water's surface escape. That is why the water eventually evaporates. But for a water molecule to expand and form vapor bubbles throughout the liquid as it does when it boils, the vapor has to exert as much pressure as the blanket of air confining it. As a liquid is heated, more of it turns into vapor and the vapor pressure increases. When the vapor pressure reaches atmospheric pressure, the liquid boils. Under great external pressure, the liquid boils at a higher temperature.

The graph below shows the vapor pressures of four common liquids as a function of temperature. Refer to the graph to answer the questions that follow.

- \_\_\_\_\_ Which of the substances has the lowest boiling point?
- \_\_\_\_\_ Which of the substances has a boiling point of  $100^{\circ}\text{C}$ ?
- \_\_\_\_\_ Which of the substances has the highest boiling point?
- \_\_\_\_\_ Which of the substances has the highest vapor pressure at  $40^{\circ}\text{C}$ ?
- \_\_\_\_\_ Which of the substances will boil at  $79^{\circ}\text{C}$ ?
- \_\_\_\_\_ At what temperature will ethanol boil when the atmospheric pressure is  $50\text{ kPa}$ ?
- \_\_\_\_\_ At what atmospheric pressure will propanone boil at  $20^{\circ}\text{C}$ ?
- \_\_\_\_\_ At what atmospheric pressure will water boil at  $90^{\circ}\text{C}$ ?
- \_\_\_\_\_ Which of the substances above has the lowest vapor pressure at  $70^{\circ}\text{C}$ ?
- \_\_\_\_\_ As the pressure decreases, the boiling point of water (a) increases, (b) decreases, or (c) remains the same?
- \_\_\_\_\_ What is the vapor pressure of water at  $60^{\circ}\text{C}$ ?



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**Table H of your Reference Tables shows the vapor pressures of four common liquids as a function of temperature. Refer to Table H to answer these questions.**

12. As temperature increases, vapor pressure \_\_\_\_\_. This is true for all liquids.

13. To determine the 'normal' boiling point, one would find where the vapor pressure curve intersects the pressure axis at \_\_\_\_\_ kPa. Why is this pressure value significant?

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14. Estimate the vapor pressure of ethanol at 70°C. \_\_\_\_\_ Do the same for propanone. \_\_\_\_\_

15. \_\_\_\_\_ Which liquid has the highest vapor pressure at any temperature?

16. \_\_\_\_\_ Which liquid has the weakest IMFs?

17. \_\_\_\_\_ Which liquid is the least volatile?

18. \_\_\_\_\_ What is the atmospheric pressure if ethanol is boiling at 65°C today?