

### Passage III

Solids, liquids, and gases usually expand when heated. Three experiments were conducted by scientists to study the expansion of different substances.

#### Experiment 1

The apparatus shown in Diagram 1 was used to measure the linear expansion of wires of the same length made from different metals. In each trial, a wire was connected to a voltage source, run through a series of pulleys, then attached to a weight. The temperature of the wire was varied by changing the amount of voltage applied. The amount of expansion is directly proportional to the rotation of the final pulley. The results are shown in Figure 1.

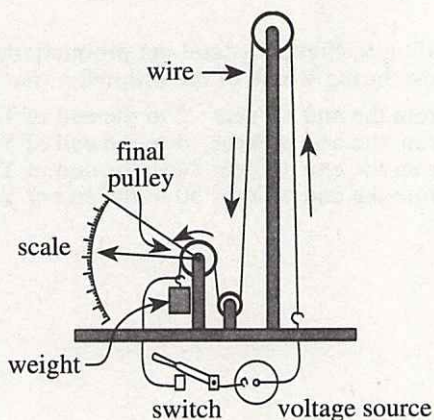


Diagram 1

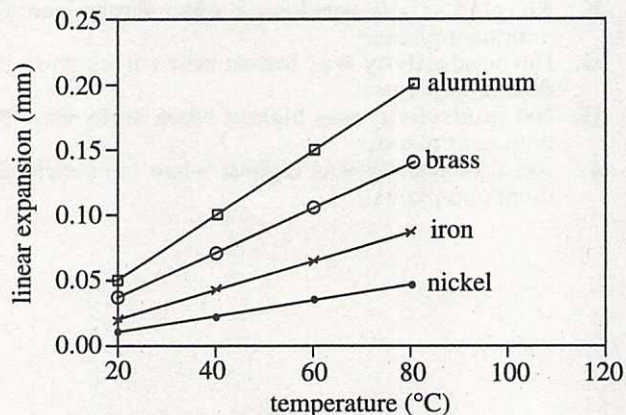


Figure 1

#### Experiment 2

A sample of liquid was placed in a stoppered test tube fitted with a graduated capillary tube and the test tube was then placed in a temperature-controlled water bath (Diagram 2). The rise of the liquid in the capillary tube was then measured at different temperatures. The results for 3 liquids are shown in Figure 2.

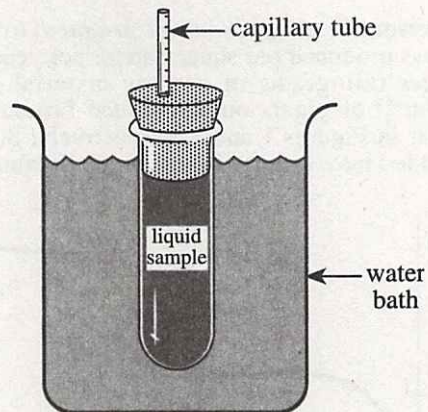


Diagram 2

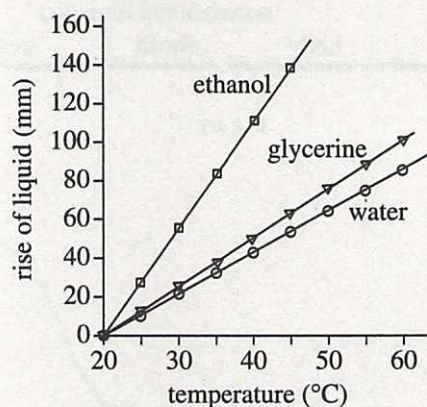


Figure 2

#### Experiment 3

A 20 mL sample of a gas in a gas syringe at room temperature (20°C) was placed in a temperature-controlled water bath (Diagram 3). Changes in gas volume as the temperature increased were measured for 3 gases. The results are shown in Figure 3.

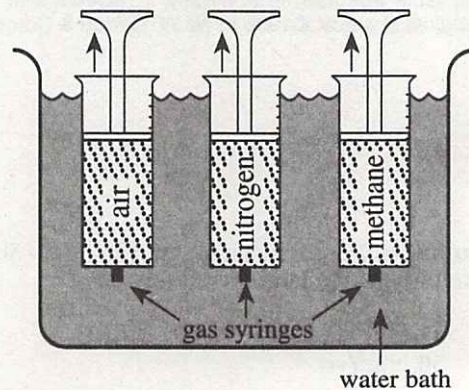


Diagram 3

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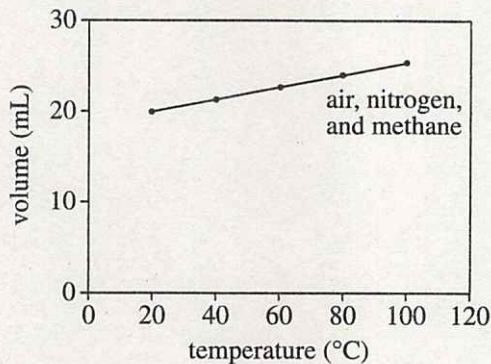


Figure 3

12. In Experiment 2, at which of the following temperatures did all of the liquids tested have the same volume?

F. 20°C  
 G. 30°C  
 H. 40°C  
 J. 50°C

13. A scientist has hypothesized that as the temperature of a gas is increased at constant pressure, the volume of the gas will also increase. Do the results of Experiment 3 support his hypothesis?

A. Yes; the volume of all of the gases tested in Experiment 3 increased as temperature increased.  
 B. Yes; although air decreased in volume when the temperature increased, nitrogen and methane volumes both increased.  
 C. No; the volume of all of the gases tested in Experiment 3 decreased as temperature increased.  
 D. No; although air increased in volume when the temperature increased, nitrogen and methane volumes both decreased.

14. Based on the results of Experiment 1, if an engineer needs a wire most resistant to stretching when it is placed under tension and heat, which of the following wires should she choose?

F. Aluminum  
 G. Brass  
 H. Iron  
 J. Nickel

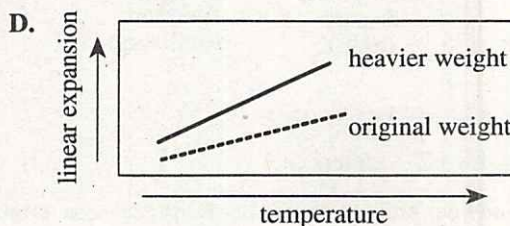
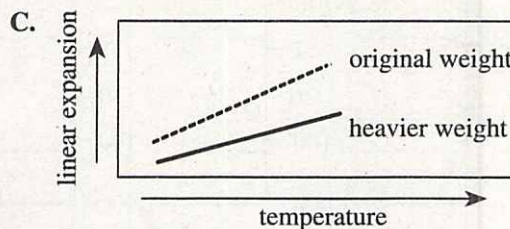
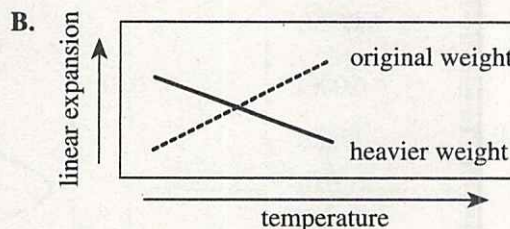
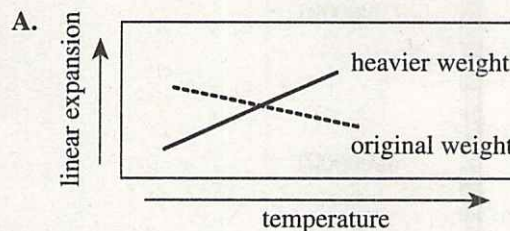
15. Based on the results of Experiment 3, if a balloon was filled with air at room temperature and placed on the surface of a heated water bath, as the temperature of the water increased, the volume of the balloon would:

A. increase only.  
 B. decrease only.  
 C. decrease, then increase.  
 D. remain the same.

16. The scientists tested a copper wire of the same initial length as the wires tested in Experiment 1. At 80°C, the linear expansion of the wire was 0.12 mm. Based on the results of Experiment 1, which of the following correctly lists 5 wires by their length in the apparatus at 80°C from *shortest to longest*?

F. Aluminum, brass, copper, iron, nickel  
 G. Aluminum, copper, brass, iron, nickel  
 H. Nickel, iron, copper, brass, aluminum  
 J. Nickel, iron, brass, copper, aluminum

17. If Experiment 1 had been repeated using a heavier weight attached to the brass wire, which of the following figures best shows the comparison between the results of using the heavier weight and the original weight on the brass wire?



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