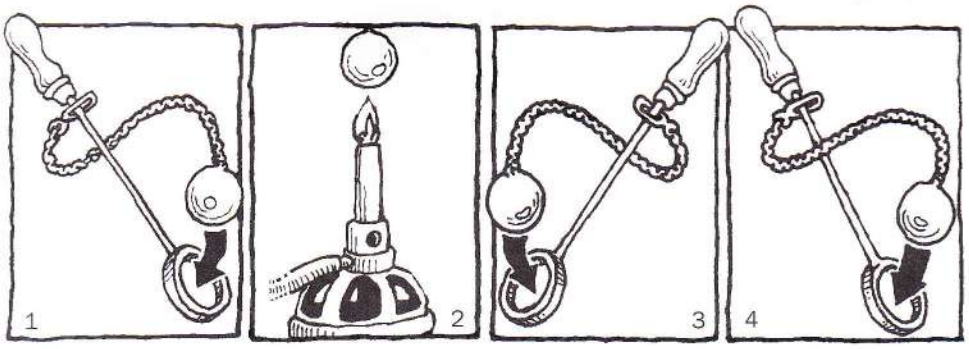
Name: _____

Class: _____ Date: _____

Student Sheet 5
Engineering for Expansion
Homework for Lesson 5

1. A student performed the following experiment. Look at the pictures and predict what will happen in frames 3 and 4. Write your answer below the picture.



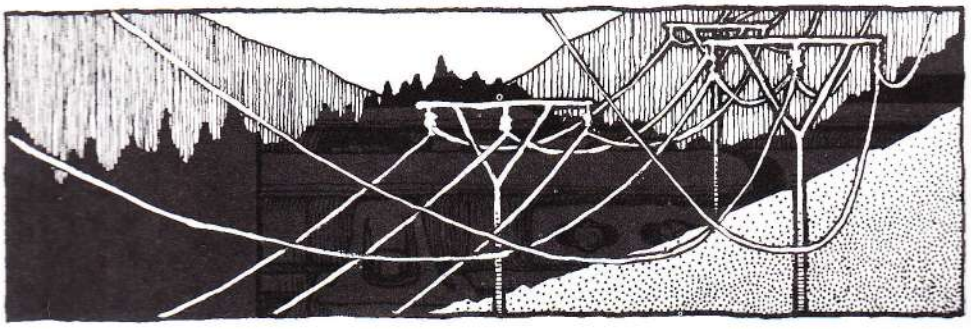
1. The cold ball just passes through the ring.

2. The ball is heated with a Bunsen burner.

3. What will happen when the student tries to pass the hot ball through the ring?

4. What will happen if the student tries to pass the ball through the ring after it has been allowed to cool?

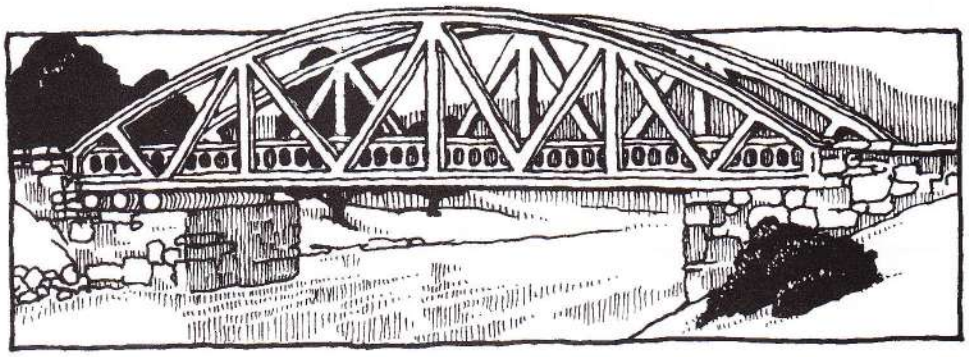
2. Expansion and contraction cause problems for engineers. Look at the examples and answer each question in terms of expansion (or contraction).



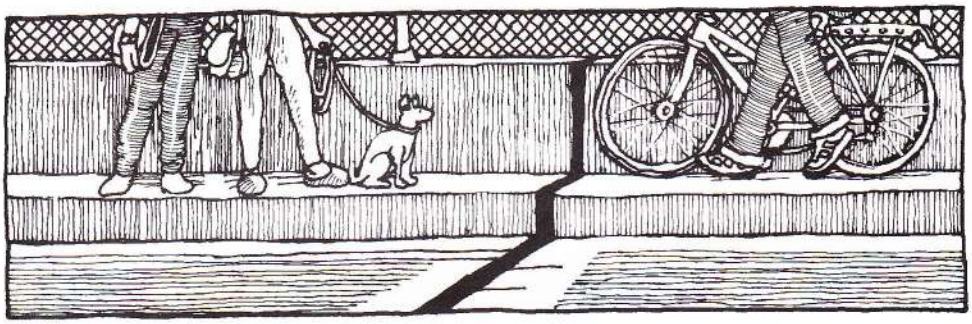
Why do engineers put up power lines so that they are slack in hot weather?

(continued)

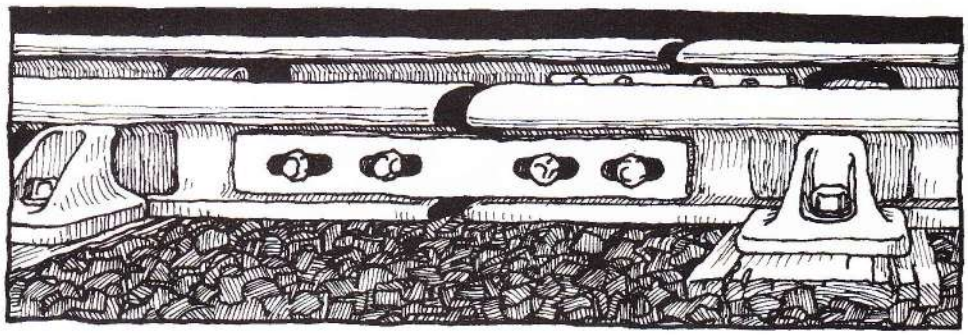
Student Sheet 5 (continued)



Why is this bridge supported at one end by rollers?



What is the purpose of the gap in the road on this bridge?



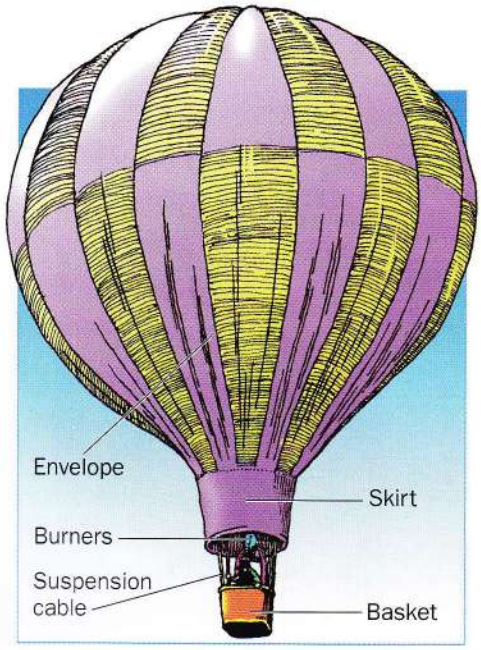
Why are the bolts that hold these steel rails together in oval holes? Why are there gaps between adjoining rails?

(continued)

Hot air! That's what you will find inside a hot air balloon. But why does hot air help a balloon rise? Hot air balloons rely on the fact that the density of air decreases as it gets hotter. A gas burner, mounted above a balloon's basket, is used to heat the air inside the balloon. As the air heats, it increases in volume, or expands. You already know that density is equal to mass divided by volume. So what happens if the volume of the air inside a balloon increases while the mass of the air stays the same? The density of the air in the balloon decreases. When the average density of the balloon (including the burner, basket, and passengers) becomes less than the density of the surrounding air, the balloon begins to rise. It floats in the air.

The balloonist can alter the height of the balloon by switching the burner on and off. If the burner is turned off, the air inside the balloon cools. As the air cools, its volume decreases, it becomes denser, and the balloon goes down. The balloonist can also let some of the hot air out of the top of the balloon to make the balloon go down. If the burner is turned on, the air in the balloon becomes hotter. The air takes up more volume, becomes less dense, and the balloon rises.

The first free flight of a hot air balloon was in 1783, when the Montgolfier brothers sent a sheep, a duck, and a rooster into the air in a balloon made from linen. A few weeks later, in the first manned free flight, two Frenchmen, using burning straw as a heat source, piloted a Montgolfier balloon about 5 miles across Paris.



The hot air balloon rises because its average density is less than the surrounding air.

COURTESY OF SAN DIEGO AEROSPACE MUSEUM

This is a scale model of the balloon used for the first manned balloon flight. The balloon reached a height of almost 1000 meters and stayed aloft for 25 minutes.

Today, most hot air balloons are made from ripstop nylon and use propane gas burners instead of straw. The average hot air balloon is as tall as a seven-story building, is about 20 meters across at the widest part, and is big enough to carry four adults. Hot air balloons can be built in many shapes. □

QUESTION

How does a balloon pilot use density to control the altitude of a balloon?