## I. Operational definitions

Two identical empty plastic bottles were outside on a hot afternoon. They were initially uncapped. At about three o'clock, a physicist tightly capped one of the bottles, bottle A.

By midnight, the weather had turned very cold. When the physicist observed the bottles at midnight, she found that the sides of bottle A were caved in, but bottle B was the same shape it had been in the afternoon.

Bottles at 3 P.M.   Bottles at midnight
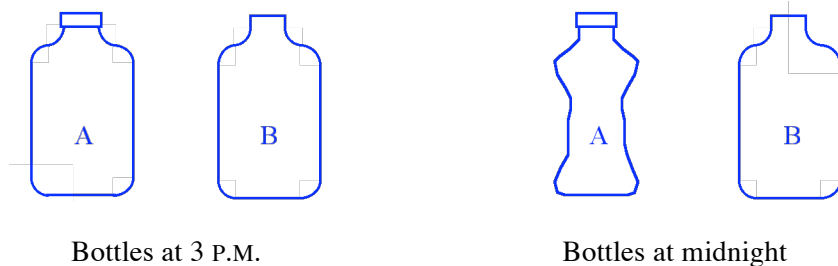
Based on the information given, answer the following questions. Explain your reasoning.

A. Did the mass of air inside bottle A *increase, decrease,* or *remain the same* from 3 P.M. to midnight? Explain.

B. Did the volume of air inside bottle A *increase, decrease,* or *remain the same* from 3 P.M. to midnight? Explain.

C. Did the volume of air inside bottle B *increase, decrease,* or *remain the same* from 3 P.M. to midnight? Explain

D. Did the mass of air inside bottle B increase, decrease, or remain the same from 3 P.M. to midnight? Explain.

II. Other proportions

A. There are 28 g of salt dissolved in 400 ml of water. Consider the quantity 0.07 = 28/400.

1. Give the name of the quantity if there is one. (Again, no penalty if you don't know it.)

2. What is the interpretation of .07 g in this context? (Again, an interpretation often begins with "It is the number of…" and is not the same thing as the name; no credit for giving the name here.)

3. Use the interpretation to find the amount of salt dissolved in 19 ml of the same solution.

B. You can get 28 oz of spicy pretzels for $4.40, or you can get 16 oz of regular pretzels for $2.30.

1. Which is a better deal? Explain your reasoning.

2. How much would 16 oz of the spicy pretzels cost, assuming the same price per ounce?

C. In the United States the efficiency of a car is specified by how many miles per gallon it gets (MPG). In Europe, a car's efficiency is denoted by how many liters it consumes per 100 kilometers of travel (LPK). Which of the following is true of an efficient car? Choose the right one and explain your reasoning below.

a. It has a high MPG and a high LPK.

b. It has a high MPG and a low LPK.

c. It has a low MPG and a low LPK.

d. It has a low MPG and a high LPK.

e. Its MPG is equal to its LPK.