Question: Which of the changes to an ideal gas sample will result in an increase in non ideal behavior of the gas?

I. decreasing volume
II. decreasing temperature
III. increasing pressure

A. I
B. II
C. III
D. II and III
E. I, II, and III

Concepts: To answer this question we need to understand the key concepts of Kinetic Molecular Theory (KMT) to know what makes a gas "ideal."

Connections:

What is given? We are given three different changes to gas conditions.

What do I want to know? We want to know which of the changes will increase the non ideality of a gas sample.

The key to this question is KMT. Recall two key tenets of KMT: intermolecular forces (IMF) and molecular volume are negligible and can be ignored. When a gas is behaving ideally these two assumptions will be true. When these two properties become important considerations gases will no longer behave ideally and another relationship (such as the Van der Waals equation) must be used.

If we want to maximize the ideal behavior of a gas sample, we want to make it so that the volume of the molecules and the applicability of IMFs become negligible. We can do this in two ways: increase the volume of the sample (decrease pressure) and increase the temperature.

Increasing the volume (or decreasing pressure) separates gas molecules minimizing intermolecular forces. If molecules are not near each other they cannot interact. This also maximizes the amount of empty space between molecules making their volumes negligible. Increasing temperature increases the speed of the molecules. In order for IMFs to occur molecules must be close enough to each other to interact. Increasing the speeds of molecules ensures that molecules will be moving too fast for this interaction to occur.

Be sure you understand everything above before moving on to the solution below.

Solution:

I is correct: Decreasing volume increases P and therefore increases the possibility for nonideal behavior. (Molecules are closer together, increasing the effect of intermolecular interactions. Also the Volume that the gas occupies becomes non negligible as volume decreases.)

Gases behave ideally at high temperature (KE >>> IM forces) so as T increases, expect gas behavior to be more ideal Likewise, when you decrease the temperature you approach non ideal gas behavior. **Therefore II is correct**.

Gases behave ideally at low pressure so as P decreases, expect gas behavior to be more ideal: And as you increase pressure you approach non ideal gas behavior. **Therefore III is correct**.