Materials in Motion

Predict how temperature and pressure affect new materials

P.7.5B.1 "Make predictions about the effect of temperature and pressure on the relative motion of atoms and molecules (speed, expansion, and condensation) relative to recent breakthroughs in polymer and materials science (e.g...."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline temperature changes, circle pressure changes, and draw an arrow from each change to its effect on particles or materials.

What Happens Inside New Materials?

1. Imagine a clear, self-healing protective film on a tablet screen. The film is made of long polymer molecules that can reconnect across a small scratch. When the film warms, its molecules move and bend more rapidly, so loose ends may meet and form new links more easily. Gentle pressure can push the scratched edges together, giving the molecules more chances to reconnect. Pressure does not automatically make molecules move faster if the temperature stays the same. Heating may also make the film expand slightly, so makers must test how well it fits.

2. Porous concrete has many connected spaces that let rainwater drain through a sidewalk. In warm weather, water molecules in those spaces move faster, and liquid water can evaporate into water vapor. When moist air in a pore cools enough, its water molecules slow down and may gather as liquid droplets. This change from gas to liquid is condensation. If liquid water later freezes, it expands and can damage the concrete. Designers study these changes to help the material survive shifts in weather.

3. Engineers are also testing flexible circuits with silicone layers that bend around rigid silicon chips. A tiny sealed air pocket inside a device can affect the circuit above it. If the pocket warms while it can stretch, its gas particles move faster and spread farther apart, so the pocket expands. If the pocket is squeezed at a steady temperature, the particles crowd closer and hit the walls more often, but their average speed need not increase. On a cool surface, water vapor in moist air may condense, possibly interfering with electronics.

2 ANSWER WITH EVIDENCE

Use the passage

1. A repaired protective film cools after being warmed. Predict how its molecules move and how its size may change.

2. Someone gently presses the edges of a scratch together without warming the film. Predict how this could affect repair and molecular speed.

3. Moist air is trapped in the pores of a concrete sidewalk. Predict what may happen during a cold night and what could happen if the resulting water freezes.

4. A sealed, stretchy air pocket beneath a flexible circuit is warmed, then squeezed while held at a steady temperature. Predict how the pocket and its gas particles change at each step.

3 YOUR TURN

Your own words

A polymer cover protects a flexible sensor that has a sealed air pocket beneath it. The cover sits in warm, humid air, then cools while a clip squeezes the pocket. In four sentences, predict changes in motion, spacing, size, and possible condensation, then explain one possible effect on the sensor.

ANSWER KEY

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GRADE 7 · P.7.5B.1

PART 1 · READ AND MARK

Underline temperature changes, circle pressure changes, and draw an arrow from each change to its effect on particles or materials. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A repaired protective film cools after being warmed. Predict how its molecules move and how its size may change.	**Its molecules move more slowly, and the film may shrink slightly.**
2	Someone gently presses the edges of a scratch together without warming the film. Predict how this could affect repair and molecular speed.	**The edges may reconnect more easily because their molecules are closer. Pressure alone need not increase molecular speed.**
3	Moist air is trapped in the pores of a concrete sidewalk. Predict what may happen during a cold night and what could happen if the resulting water freezes.	**Water vapor may condense into liquid droplets. If that water freezes, it expands and may damage the concrete.**
4	A sealed, stretchy air pocket beneath a flexible circuit is warmed, then squeezed while held at a steady temperature. Predict how the pocket and its gas particles change at each step.	**Warming makes the gas particles move faster and the pocket expand. Squeezing crowds the particles closer and increases wall collisions, but need not increase their average speed.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

As the cover cools, its polymer molecules move more slowly, and the cover may shrink slightly. The clip crowds the pocket's gas particles together, but squeezing alone need not increase their average speed. Water vapor from the humid air may condense on the cover if it gets cold enough. The smaller pocket and shrinking cover could change how the cover presses against the sensor.

Accept predictions that distinguish pressure changing particle spacing from temperature changing average particle speed. Condensation is possible when moist air cools enough, not guaranteed whenever it cools.