Identifying the Fill in a Model Sign Tube

Base your answers on the information provided and your knowledge of chemistry. Use the 2025 Chemistry Reference Tables as needed.

A museum class compares two sealed model sign tubes. Both contain a single element. The tubes have the same volume, pressure, and temperature, so the model assigns them equal numbers of atoms. The technician subtracts the mass of the empty tubes to find the masses of the gas alone.

Tube	**Gas mass (g)**	**Electrons in occupied shells of one neutral atom**
P	0.40	2, 8
Q	0.80	2, 8, 8

1 Which elements fit P and Q, respectively? Use the periodic table.

(1) Helium and neon

(2) Neon and argon

(3) Sodium and chlorine

(4) Neon and krypton

2 Explain why Q can contain approximately twice as much gas mass even though the atom counts match. [1]

Answer and work

3 A student argues that the tubes contain elements in different groups because the atoms have different numbers of occupied shells. Use the electron arrangements to explain why both elements belong in the same group. [1]

Answer and work

During a test of the sign tubes, a detector records a positive ion with 17 electrons. The test model can remove one electron from a single gas atom without changing its nucleus. A student compares the reading with the electron count of a neutral chlorine atom.

4 Which tube can produce this ion? Use the model to explain why the electron count does not identify it as chlorine. [1]

Answer and work