Distinguishing Excitation From Ionization

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

A classroom detector model starts with neutral atoms in their ground state. An atom can receive energy from at most one photon during the test. A photon of 3 model energy units can raise an electron to a higher level, but removing an electron from a ground-state atom requires at least 6 units. An electron collector counts only electrons that leave an atom.

Test	Photon energy (units per photon)	Number of photons arriving	Light emitted by sample	Electrons collected
P	3	14	Yes	0
Q	7	6	No	6

1 Which record directly shows that some atoms lost electrons?

(1) The photons in P have energy of 3 units.

(2) P emits light.

(3) Q gives six electrons at the collector.

(4) Q has fewer incoming photons.

2 Calculate the total energy arriving in each test. Explain why the tests can give different electron counts even at those totals. [1]

Answer and work

3 Explain how P can emit light while the collector receives no electrons. [1]

Answer and work

A new run doubles the number of arriving photons in P. Their energy is still 3 units each. Each atom still receives energy from at most one photon.

4 Predict whether doubling the number of these photons will make the collector count electrons. Use the threshold in the model. [1]

Answer and work