Separating Ions With Matching Electron Counts

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

A particle detector checks a stream that may contain fluoride ions, neon atoms, sodium ions, or magnesium ions. Its first channel counts electrons. A second channel records which plate attracts each particle. Positive particles bend toward the negative plate, negative particles bend toward the positive plate, and neutral particles do not bend.

Particle	**Protons**	**Charge**
F^-	9	−1
Ne	10	0
Na^+	11	+1
Mg^{2+}	12	+2

1 Use the proton and charge records to show why the first channel cannot distinguish these four particles. [1]

Answer and work

The first channel records 10 electrons for unknown particle P. The second channel shows that P bends toward the negative plate.

2 Which particles still fit both records for P?

(1) F^- and Ne

(2) Ne and Na^+

(3) F^- and Mg^{2+}

(4) Na^+ and Mg^{2+}

The class adds a channel that measures electric force in the same field. In this model, a particle with charge magnitude 2 experiences twice the electric force of one with charge magnitude 1. A singly charged reference experiences one unit of force. Particle P experiences two units.

3 Identify P and explain how the new reading resolves the remaining possibilities. [1]

Answer and work

4 A second particle shows the same force magnitude, but its direction record is missing. Its electron count is still 10. Explain whether it can be identified from the listed candidates and whether that conclusion depends on the candidate list. [1]

Answer and work