Correcting Two Isotope Counts in a Detector

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

A classroom detector models two boron isotopes with rounded masses of 10 u and 11 u. It reports the isotope correctly whenever it counts an atom, but it misses some atoms. Separate reference tests give the fraction of each isotope the detector counts. Treat the table fractions as exact in the model.

Isotope	Fraction counted	Recorded atoms from unknown
Boron-10	0.50	20
Boron-11	1.00	20

1 How many boron-10 atoms from the unknown reached the detector in the model?

(1) 10

(2) 20

(3) 30

(4) 40

2 Use the corrected counts to calculate the average atomic mass of the unknown to two decimal places. [1]

Answer and work

3 The recorded counts are 20 and 20, giving 10.50 u. Explain how the detector changes the relative counts and why the recorded mean is higher than the corrected mean. [1]

Answer and work

A new detector setting counts both isotopes with the same efficiency. Assume it counts some of each isotope present, but the efficiency may still be less than 1.00.

4 If the new setting counts half of each isotope, predict the two recorded counts for the original unknown. Explain whether their ratio is changed by detection. [1]

Answer and work