Counting Products Along Two Decay Branches

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

A classroom simulation begins with 80 identical parent nuclei. For each parent that decays, the model records one stable daughter nucleus. There are two possible daughter types. The model's expected counts assign one quarter of decays to the alpha branch and three quarters to the beta branch.

Time	Parent nuclei	Alpha-branch daughters	Beta-branch daughters
Start	80	0	0
One half-life	40	10	30
Two half-lives	20	Hidden	Hidden

1 How many new beta-branch daughters are expected between the two measured half-life marks?

(1) 5

(2) 10

(3) 15

(4) 45

2 Calculate the two hidden daughter counts at the second half-life mark. Show how the earlier daughters enter the totals. [1]

Answer and work

A reader records 20 remaining parents and 45 beta-branch daughters at the second mark. The reader uses the beta-branch count as if it were the count of all decayed parents.

3 What starting count would the reader infer, and why would it differ from the simulation's actual starting count? [1]

Answer and work

4 A separate run also starts with 80 parents. Its overall parent half-life stays the same, but the simulation swaps the fractions assigned to the two branches. Predict all three counts after two half-lives. [1]

Answer and work