

Scales (On Steroids)

Solution

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September 7, 2026

Nine stones: one is heavier

Weigh three stones against three others. If they balance, the heavy stone is among the three left aside. If they do not, it is among the three on the heavier side.

Now weigh one of those three against another. The heavier one is the answer; if they balance, the unweighed one is the answer. Two weighings suffice.

Twelve stones: one is heavier or lighter

Label the stones 1 through 12. First weigh 1, 2, 3, 4 against 5, 6, 7, 8.

Case 1: they balance. Stones 1–8 are normal. Weigh 9, 10, 11 against 1, 2, 3.

If this second weighing balances, stone 12 is different. Weigh it against stone 1 to learn whether it is heavier or lighter.

If the second weighing does not balance, the different stone is among 9, 10, 11, and you already know whether it is heavy or light. Weigh 9 against 10. A balance identifies 11; otherwise the side consistent with the known heavy/light direction identifies 9 or 10.

Case 2: the first weighing does not balance. Rename the four stones on its *heavier* pan A, B, C, D , and those on its *lighter* pan E, F, G, H . Let I be stone 9, which is now known to be normal.

The only possibilities are: one of A, B, C, D is heavy, or one of E, F, G, H is light. For the second weighing, put

$$A, B, E \text{ against } C, F, I.$$

Use the following table for the third and final weighing. “Left” and “right” always refer to the order printed in the relevant weighing.

Second result	Third weighing	Interpretation of the third result
Left heavier	A against B	Left heavier: A heavy. Right heavier: B heavy. Balance: F light.
Right heavier	C against I	Left heavier: C heavy. Balance: E light. (Right heavier cannot occur.)
Balance	G against H	Left lighter: G light. Right lighter: H light. Balance: D heavy.

Why three weighings are necessary. There are 24 possibilities: each of 12 stones could be heavy or light. Two weighings have at most $3^2 = 9$ outcome sequences, which cannot distinguish 24 possibilities. The procedure above distinguishes all of them in three.

History and sources: [companion history PDF](#).