

## The 12-Ball Problem – Solution



We want to get maximum information with each weighing so here's the plan:

Each weighing is going to tell us something about the balls on the scale.

If they balance then we know they all are of Normal weight.

If they don't balance then those on one side are potentially Light and those on the other side are potentially Heavy.

So, after a weighing, we will mark on the balls with a magic marker one of the following:

N = Known to be of Normal weight.

H = Could be Heavy but we don't know for sure i.e. it's either Heavy or of Normal weight.

L = Could be Light but we don't know for sure i.e. it's either Light or of Normal weight.

X = We don't know anything about this ball just yet.

By the third weighing we need to have at most three unknown balls. They could be HHL, HLL, HHH or LLL and it will be easy to find the odd ball with one more weighing. So here we go!

For the first weighing we're going to put four balls on either side. Either they will balance or they won't.

## Situation #1: First Weighing - They Balance

1.1 If they balance then all 8 of them are of Normal weight and we just have four balls to sort out. That leaves us with NNNN, NNNN, XXXX.

1.2 Second Weighing - Weigh NX (left side) against XX (right side). This leaves one ball not yet weighed.



If they balance then the last ball is the odd ball. Just weight it against a Normal ball and we're done.

If they don't balance then we can mark the last ball as Normal and mark the other three appropriately. If the left side went up then we are left with LHH. If the right side went up we are left with HLL.

1.3 Third Weighing - Weigh NN (left side) against HL (right side) with one unknown ball left off.



If they balance then the last ball is marked correctly. If the right side goes up then the L ball is marked correctly. If the right side goes down then the H ball is marked correctly.

## Situation #2: First Weighing - They Don't Balance

2.1 If they don't balance at least we know the four balls that were left off are of Normal weight. So we are left with HHHH, LLLL, NNNN

2.2 Second Weighing - Weigh HLNN (left side) against HHLL (right side) with HLNN left off.



If they balance then we have NNNN, NNNN, HLNN. Just balance one of the unknown balls against a Normal one and you are done.

If the left side went down then the odd ball is either the Heavy ball on left or one of two Light balls on right so we are left with HLL. The third weighing can be the same as 1.3.

If the right side went down then the odd ball is one of two Heavy balls on right side or the Light ball on left side so we are left with LHH. The third weighing can be the same as 1.3.