

“Ultimate” Brain Teaser?

[Restatement of the Problem, Answer on the next page.](#)

As you might have guessed from knowing me, or watching the monthly Trivia question, puns, brain-teasers, logic problems, and trivia (especially about non-trivial things) are a source of amusement here. It seems to be time for me to share with you what I have long thought to be one of the best brain-teaser puzzles that I have ever run across. I got to know this one in the 1970's while hitch-hiking through Europe. It was rumored to have been on an entrance exam for Oxford or Cambridge in the '60s. I have no way of knowing if there is any truth at all to this, but truth never stands in the way of a good story. (See what I mean about non-trivial current events?)

I have heard a variety of “backstories” setting up the actual problem. Most go something like this: You are being held captive by an evil {replace with your favorite pariah} who intends to do you in, but for his (her?) own amusement, will give you one chance to save yourself. Before you are twelve pills that look exactly alike. In fact, eleven of them are – deadly poison with no known antidote. However, one pill, although exactly the same for all discernable purposes, weighs a slight bit different, either being a bit heavier or a bit lighter, you do not know which. There is an antidote for this poison, but a different antidote if the “different” pill is heavier than the other eleven, and another antidote if the “different” pill is in fact lighter than the other pills.

You are given a very simple balance scale, one with a tray on each side. You are allowed three, and only three uses of the scale after which you must take one of the twelve pills and your choice of the “heavy” antidote or the “light” antidote.

There is at least one answer that would allow absolute certainty in your pill-taking, but to my knowledge, only one.

The rumor about the entrance exam also provided that you had to turn in all work products, even (and perhaps, especially) the “wrong turn” or “dead-end” attempts to see how your mind was working.

The answer I know is rather involved and would be too long for the Newsletter, but I will be posting it on our Website PhillipsandBlow.com by the end of September 2020 for your use. I hope you get as much pleasure out of wracking your brain for hours, and then knowing the answer, as I have had over the years. Good Luck!

Answer to the “Pill Problem”

Knowing that the balance scale will only tell you which side is lighter or heavier than the other side, you have to think in terms of each pill relative to each other pill.

Most people immediately say to put six pills on one side and six on the other. But alas, you know the outcome even before you do it – one side must go down while the other side must go up. As you do not know whether this is because the “different” pill is lighter, making the side it is on go up, or if it is heavier, making the other side go up. Consequently, you will have used one-third of your uses of the scale with absolutely no additional information.

You could weigh two pills, one on each side until the scale balanced even, then you would know you had “known good” pills which could be weighed against other pills in succession until one “unknown” pill either went up (because it was lighter) or went down (because it was heavier). With unlimited weighings, this would work, but the evil entity holding you captive will only allow three discrete uses of the scale, then “down the hatch” with the pill of your choice.

1st Weighing

After a series of attempts using different numbers of pills being weighed against the same number of the other side, you come to dead ends (almost always using too many weighings), until you happen on using the first weighing to put four pills on one side, four on the other, and four on the side for later use.

When you do this, there are two possible outcomes (actually three, but two are absolute ‘mirror-images’ of each other and, for logic purposes, can be considered the same.)

OUTCOME A – The sides balance. This means that all eight pills are now known to be the same while the “different” pill is one of the four on the side.

If this is the case, take three of the four pills from the “unknown” group, and weigh them against three of the “Known Good” pills keeping the other one on the side.

2nd weighing

Again, two possible outcomes:

1) they balance. If this is the case, the remaining pill from the “unknown” group is the “different” pill.

Use the **3rd and last weighing** to weigh this “different” pill against any one of the other 11 pills. If it goes up, then the “different” pill is lighter, or conversely, it goes down, it is because it is heavier.

2) They do not balance. You now know this group of three contains the “different” pill and you now know whether the “different” pill is lighter (causing

that side to go up relative to the “known good” pills) or heavier (causing that side to go down relative to the “known good” pills).

For the **3rd Weighing**, take 2 of the group of three containing the “different” pill and weigh against each other.

If they balance, it is the remaining 3rd pill that is the “different” pill and you know whether this “different” pill is either heavier (which caused its side to do down in the 2nd weighing), or it is lighter (which caused its side to go up in the 2nd weighing).

If they do not balance, you know from the 2nd weighing, that the “different” pill is either lighter or heavier. If it is heavier, the side that goes down is the “different” and heavier pill. Conversely, if you know from the 2nd weighing that the “different” pill is lighter, the side that goes up is the “different” pill

OUTCOME B – The sides do not balance. This means that the four pills on the side while the “different” pill is one of the eight.

If they did not balance, then one side went up while the other side went down. You do not know if this is because the “different” pill is lighter or heavier, but you do know that the four pills on the side are “good”.

Now comes the tricky part of the logic. You need be able to identify individually each possible suspect pill. You can do this relatively easily by putting the eight pills into two piles on a sheet of paper with an label or identifier next to each one (as you can’t write directly on the pills).

Whichever side went down will arbitrarily called HEAVY (technically it should be called “Potentially Heavy”, but that is more exacting than is necessary) while the side that went down is referred to as LIGHT (meaning Potentially Light). Each individual pill in each group will then be numbered 1 to 4. You will now have 8 individually identified pills:

H1 H2 H3 H4 and L1 L2 L3 L4

2nd weighing

Place the six of the eight pills on the scale as follows:

H1 H2		H3 H4	L3 and L4 on the side
L1		L2	

Two possibilities:

1) They balance. This would mean that one of the (Potentially) Light pills on the side is the “different” pill. **3rd weighing:** Just weigh one against the other, the one that goes up is the “different” pill and it is lighter. There would be a similar result if you did the “mirror-image” of the scale arrangement.

2) They do not balance. You now know that the two pills on the side (plus the four on the side from the first weighing) are not the “different” pill.

In not balancing, one side will necessarily go down and the other go up. If the H1/H2/L1 side goes down, it is either because H1 or H2 is “heavier” or L2 (from the side that went up) is actually light. You still do not yet know which one is the “different” pill or if it is heavier or lighter.

This you find out in the **3rd weighing** where you weight H1 against H2. If they balance, the “different” pill is L2 and it is lighter. If they do not balance, whichever one went down is the “different” pill which is heavy.

All other combinations and results are but mirror-images of these and if you follow the same logic, you will be able to clearly identify which pill is “different” and whether.

To know if you truly understand this, ask the riddle to someone who is likely to understand it. Then try to lay out the logic explained above to get the right answer. Good Luck.