# INSIGHT PUZZLE COLLECTION

Volume 1

Volume

NSIGH<sup>7</sup>



21 Challenging Insight Puzzles that *Faired* ruled technical interviews in the 80's and 90's at companies like Amazon, Microsoft and Apple!





### Insight Puzzle Collection

Volume 1

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#### What is an insight puzzle?

This is a special type of logic puzzle that uses a *simple premise* but requires both logic and an insight, or a unique perspective, in order to solve it. These are different from the more conventional logic puzzles that can often be solved through direct reasoning and calculation.

We've chosen to focus this book on challenging insight problems because we believe they are uniquely fun and rewarding for the problem solver. These problems also help us think differently about a situation, and come up with creative solutions.

We hope you enjoy this carefully curated collection of puzzles!

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### PROBLEMS

#### **PROBLEM:** VILLAGE BARBER SHOPS

In the village of Asmar there are two barbershops. The Western shop is clean and quiet, and is run by a barber with the best haircut in town. The Eastern shop is loud and messy and is run by a disheveled barber. The Eastern shop rarely receives any customers.

Only the barbers of Asmar are permitted to cut hair, as it is a dangerous process, and no barber may cut their own hair. You are in need of a haircut.

Which barbershop should you visit?





Hint on page 66 Solution on page 90

#### **PROBLEM:** GOLD BARS

You hire a worker to till your land for seven days. At the end of each day you must pay him a piece of gold. You have a bar of gold with six notches in it, where you may cut it.

Making only two cuts, how can you ensure that at the end of each day you can pay him 1/7<sup>th</sup> of the gold bar?



Difficulty level 2

Hint on page 62 Solution on page 86

#### **PROBLEM:** PANDORA'S BOX

You are presented with three chests: one gold, one silver, and one copper. One of these chests contains hope, while the others contain misery.

You must open one of the chests. Each chest is labelled with the following hints, but only one of these hints is true.

Silver	<i>Hope</i> is in this chest.
Bronze	Misery is in this chest.
Gold	Hope is not in the gold chest.

Which chest do you open?







Difficulty level 2

8

Hint on page 65 Solution on page 89

#### **PROBLEM:** MEASURING CUPS

You are given two measuring cups that measure 3 and 5 cups each. Using only these cups but an infinite amount of water, can you measure out exactly 4 cups?





Difficulty level 3

Hint on page 67 Solution on page 91

#### **PROBLEM:** LOADED COIN

How can you get a fair coin toss if someone hands you a coin that is weighted to come up heads more often than tails?

Hint on page 63 Solution on page 87 Ξ

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Difficulty level 3

#### **PROBLEM:** THREE BARRELS

The following three baskets are labelled incorrectly and contain either *apples, pears,* or a combination of *apples and pears*.

Can you figure out the correct label for each basket?

You may not look into any basket, but you may reach into a single basket and pull out the first fruit that you touch.



Difficulty level 4

Hint on page 49 Solution on page 73

#### **PROBLEM:** CANNIBAL CROSSING

Three missionaries and three cannibals wish to cross a river using a small self-navigating ferry boat. Although the ferry appears to be spacious, it can only carry a maximum of two people at a time. As a result, the ferry must be shuttled back and forth across the river multiple times until everyone has crossed.

For everyone's safety, you must never allow the cannibals to outnumber the missionaries on either side of the river (including those in the boat).

16

In what order should the people cross?



Hint on page 64 Solution on page 88

#### **PROBLEM:** BURNING ROPES

You are given two ropes of equal length, and one match. Each rope takes 30 minutes to burn, but you do not know their burn rate — for example, a rope may burn slowly at first, but then speed up or slow down over time.

Using these ropes and the match, can you accurately measure 45 minutes of time?



Hint on page 50 Solution on page 74

#### **PROBLEM:** THREE LIGHT BULBS

There are three identical incandescent light bulbs in a room. Outside the room are three light switches. Each switch controls one bulb (turning it on or off).

You cannot see the bulbs or any of their light from where the switches are located, and the door must be closed when you flip a switch. You may turn the switches on or off as many times as you like, but may only enter the room once to examine the bulbs.

How will you figure out which switch corresponds to which bulb?



Hint on page 53 Solution on page 77

#### **PROBLEM:** CROSSING A PIRATE

You are standing on one side of a river, and a merchant is standing on the other side. You wish to pay him for a product but you're separated by the river. The only way to pay him is to use a small ferry boat that glides back and forth across the river. The boat cannot hold any passengers, but has a small chest on it, into which you can place money and the merchant can place the product.

Unfortunately there is a pirate that patrols the river. If the boat is sent across with anything of value inside the chest, the pirate will attempt to seize it.

To prevent this, you and the merchant each have a lock and matching key. The chest is lockable using chains and both of your locks.

How do you conduct the exchange?



#### **PROBLEM:** SACKS OF GRAIN

You are a farmer standing by the side of the road with a merchant. You have a half-empty sack of grain that you wish to exchange with the merchant for his half-full sack of grain. The problem is, you have no other equipment to make the transfer — you each have a sack of grain with a rope tie.

How do you make the exchange such that you each retain your sack and ties, and no grain spills or mixes?



Hint on page 60 Solution on page 84

#### **PROBLEM:** COUNTERFEIT COINS

You have ten bags of coins. One bag contains fake coins while the others are authentic. Counterfeit coins weigh 1.1 grams and authentic coins weigh 1.0 grams.

You have a scale but it can only be used one time. Can you figure out which bag contains the fake coins?



Hint on page 68 Solution on page 92

#### **PROBLEM:** BURNING ROPES REDUX

You are given two ropes of equal length, and one match. Each rope takes 60 minutes to burn, but you do not know their burn rate — for example, a rope may burn slowly at first, but then speed up or slow down over time.

Using these ropes and the match, can you accurately measure 45 minutes of time?



#### **PROBLEM:** FOUR MEN ON THE MOUNT

Four companions are about to be executed, but they can all be saved if one of them can correctly guess the color of his own hat.

If anyone utters anything other than the correct color of his hat, they will all be executed. They know there are two black and two white hats, but no one can see their own hat.

Each man can only see the colors of the hats of the men in front of them, but one man is secluded behind a stone wall.

Do the men survive?



Hint on page 48 Solution on page 72

#### **PROBLEM:** THREE DOORS

You are on a game show and are presented with three doors. You are told that behind one of the doors is a million dollars worth in gold, behind the other two is nothing.

You select a door (any one), but rather than opening the door you chose, the host opens one of the other doors to reveal that there is nothing behind it. Now you are asked if you'd like to stick with your original selection or change your answer to the remaining closed door.

What do you do? Why?



Hint on page 54

Solution on page 78

#### **PROBLEM:** BRIDGE CROSSING

Four travelers are standing on one side of a large rickety bridge one night. All four must cross the bridge, but only two may cross at a time.

Each person walks at a different pace, which determines how long it will take them to cross. When two people cross together, their time equals that of the slowest person. Since they only have one flashlight, one person must run the flashlight back to the initial side so that more people may cross. Thus only one or two people may cross at a time, no more.

Each person has the following time:

Person:	Α	В	С	D
Time:	10 minutes	5 minutes	2 minutes	1 minute

What is the arrangement of travel such that all four people cross the bridge in 17 minutes or less?



Hint on page 52 Solution on page 76

#### **PROBLEM: VILLAGE THIEVERY**

In the village of Asmar there are 100 married couples. Each of these individuals never speaks to anyone other than their spouse. Once a year the men leave to visit a neighboring town for work, and they return the following morning.

If a man commits a theft during the night, all of the women in the village will sense it, except for his wife.

On the following morning a red flag will be raised in the center of town for all to see if one or more husband committed a theft the night before. The flag will then be raised each morning until all thieves are exposed.

Once a wife realizes her husband's guilt, she will publicly divorce him the following morning after the flag is raised.

If 15 men commit theft one night, how many days will the flag be raised?



#### **PROBLEM:** THREE WISE MONKS

A king wishes to select the wisest man in his court to be his advisor. He has narrowed the list down to three – you plus two others, and wishes to hold a contest to see who is the wisest.

You are all blindfolded and a hat is placed atop your heads. The blindfolds are removed and you are unable to see the color of your own hat, but can see the colors of the other two hats. You are told that each person's hat is either black or white, and that there must be at least one white hat in play.

To win the contest you must shout the color of your own hat, though you are unable to see it. You cannot make any other noise.

In front of you are two men, each wearing a white hat. After a little while you correctly shout the color of your hat. What color do you shout?



Hint on page 59 Solution on page 83

#### PROBLEM: STRANDED ON AN ISLAND

You are marooned on a desert island. You have sufficient food and water, but also have a medical condition. There is a single palm tree on the island and a large school of *man-eating* salmon in the water.

You have two vials of medicine, labeled A and B. Every day at noon you must take one tablet from A and one from B. Should you ever fail to take the correct dosage at noon, you will die immediately.

You know that you will be rescued in exactly 28 days, and fortunately have 28 doses of each kind of medicine.

On the 14<sup>th</sup> day as you were pouring your daily dosage onto the sand, the light reflected off a carnivorous salmon fin and distracted you. When you looked down you noticed three doses lying in the sand. Both types of medicine are identical in appearance.

What do you do?



Difficulty level 7

Hint on page 51 Solution on page 75

#### **PROBLEM:** POISONED WINE

You are holding a party in 24 hours and have 1000 bottles of wine to serve the guests. You have just been informed that one bottle has been poisoned with an odorless and tasteless poison. Upon ingestion, the poison will kill a person after 10 hours but before 20 hours. You have 100 sommeliers willing to test the bottles of wine.

Given that the party is in 24 hours, and you must wait up to 20 hours to know if a sommelier is poisoned, you will only have one shot at testing the wine.

Will you be able to fully test the wine before serving it to your guests? If so, what is the minimum number of sommeliers that will be needed for the testing?



Hint on page 57 Solution on page 81

#### **PROBLEM:** THE TWO KNIGHTS

You stand before two knights, each one guarding a door. One door leads to certain death, and the other leads to life. You must figure out which door to take by asking only one question, and you may choose who to ask.

The problem is that one knight always tells the truth, while the other one always lies. You don't know which is which.

What single question can you ask to figure out the correct door?





Hint on page 58 Solution on page 82

### HINTS

#### HINT: FOUR MEN ON THE MOUNT

#### HINT: THREE BARRELS

Silence is golden.

Everything is mislabelled.

#### HINT: BURNING ROPES

#### HINT: STRANDED ON AN ISLAND

Think twice.

Balance is key.

#### HINT: BRIDGE CROSSING

#### HINT: THREE LIGHT BULBS

Opposites attract.

Properties of light.

#### HINT: THREE DOORS

#### HINT: BURNING ROPES REDUX

Bet against the house.

Think twice, then again.

#### HINT: VILLAGE THIEVERY

#### HINT: POISONED WINE

It all starts with one.

Use binary logic.

#### HINT: THE TWO KNIGHTS

#### HINT: THREE WISE MONKS

Ask one to speak for the other.

What must everyone see?

#### HINT: SACKS OF GRAIN

#### HINT: CROSSING A PIRATE

Think inside the box.

Use multiple trips.

#### HINT: GOLD BARS

#### HINT: THE LOADED COIN

Pay the equivalent value.

Couple the odds.

#### HINT: CANNIBAL CROSSING

#### HINT: PANDORA'S BOX

Use multiple trips.

Which boxes must be false?

#### HINT: VILLAGE BARBER SHOPS

#### HINT: MEASURING CUPS

Who cuts the barber's hair?

Reduce to one.

#### **HINT: COUNTERFEIT COINS**

Disperse the fakes.

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## SOLUTIONS

#### SOLUTION: FOUR MEN ON THE MOUNT

#### SOLUTION: THREE BARRELS

The man on the first step, with the black hat, correctly guesses the color of his hat. The man on the top step with the white hat is unable to figure out the color of his hat, so he remains quiet.

The silence helps the man on the first step (black hat) realize that the man behind him must see two different color hats, so his hat must be the opposite color of whatever color he sees in front of him.

Pick a fruit out of the barrel labelled apples and pears. We know that every barrel is labelled incorrectly, so if we pick an apple, then this barrel must contain only apples, and if we pick a pear then it must contain only pears.

With this barrel labelled correctly, we can reassign the two remaining labels using the knowledge that their existing assignments must be incorrect, and one *must* contain both *apples and pears*.

#### SOLUTION: BURNING ROPES

We know that each rope takes 30 minutes to burn, so if we light one rope at both ends it will take 15 minutes to burn.

We wait until this first rope is almost completely burned, and then we use it to light the second rope. Once this rope is fully burned, a full 45 minutes will have passed.

#### SOLUTION: STRANDED ON AN ISLAND

You figure out which vial has fewer tablets and take one from the opposite vial and place it on the sand next to the others. Now that you've balanced them out (so you have two A's and two B's on the sand) you line them up and break each of them in half.

You take half of each tablet today, and the other half tomorrow.

Alternatively, you could grind the four tablets up and take half of the mixture.

#### SOLUTION: BRIDGE CROSSING

All four may cross in 17 minutes. The key is to always make sure that you have a fast person available to walk the flashlight back to the beginning side.

Send 1 and 2 over, send 2 back	4 minutes total
Send 10 and 5 over, send 1 back	15 minutes total
Send 1 and 2 over.	17 minutes total

#### SOLUTION: THREE LIGHT BULBS

Turn on two of the bulbs and wait half an hour. Then turn one of those two switches back to the off position. Go into the room. The light that is on corresponds to the switch that is still in the on position.

The bulb that is off but very warm corresponds to the switch that was left on for a while and then turned off. The remaining bulb that is off and cold is the switch that was never activated.

#### SOLUTION: THREE DOORS

#### SOLUTION: BURNING ROPES REDUX

You should change your door, because your odds will increase to 66%.

Imagine that you have chosen a door (any door, it doesn't matter which) and have decided to stick with your original answer. In 1 of the 3 scenarios, you would win, but in the other 2 you would lose.

Next imagine that you had decided to change your selection. In 1 of the 3 scenarios you would lose, but in 2 of the 3 scenarios you would win (or 66% of the time).

If you always change your choice, then you will effectively be betting the odds that your initial choice was wrong. We can do this because the host will always open a losing door. We know that each rope takes 60 minutes to burn, so if we light one rope at both ends it will take 30 minutes to burn. At the same time, we light the second rope at *one* end.

We wait until this first rope is completely burned, and then we light the unlit end of the second rope. Once the second rope is fully burned, a full 45 minutes will have passed.

#### SOLUTION: POISONED WINE

All husbands will be exposed after 16 days.

If one husband commits a theft, his wife will realize this when the red flag is first raised, because she will be unaware of any other thievery. She will then divorce her husband on the second morning after the cheating.

If two husbands are criminals, both of their wives will do nothing the first morning, as they will each be aware of one guilty husband. On the second morning both wives will be surprised to realize that no husband was divorced, and can infer that there must be at least two guilty husbands. Both wives will then divorce their husbands on the third morning.

From this example we can see that if 15 husbands commit theft, they will all be divorced on the 16th morning.

You will be able to correctly determine which bottle has been poisoned, and you will use only 10 sommeliers to do it. To see why, let's examine a simpler case:

If we have two bottles of wine, and only one is poisoned, we can test them using a single sommelier. He will drink one bottle, and if he survives then we know which bottle was poisoned.

Using similar logic if we have four bottles of wine we can test them using *two* sommeliers: No one will taste the first bottle, only the first sommelier will taste the second bottle, only the *second* sommelier will taste the third, and both will taste the fourth. We will know which bottle was poisoned based on whether one, both, or neither sommelier dies.

We can see that with n sommeliers we can test  $2^n$  bottles of wine. Since  $2^{10}$  is 1024, we can test all 1000 bottles using 10 sommeliers.

#### SOLUTION: THE TWO KNIGHTS

You ask either one: "If I were to ask the other knight which door leads to life, what would he say?"

If you're speaking to the honest knight, he knows that the other knight would lie, and would identify the door of death, so being honest, he would respond with the door of death.

If you're speaking to the dishonest knight, he knows that the other knight would tell the truth, and would identify the door of life. However, being dishonest himself, he would lie and respond with the door of death.

So regardless of which knight you ask, you must choose the opposite door that the knight identifies, as it will lead to life.

#### SOLUTION: THREE WISE MONKS

You must be wearing a white hat, so you shout white and win. Since you know at least one of the hat colors that each of the other two men see, you can infer from the fact that both remain silent that your hat must be white.

If you had a black hat on, then the game would be trivial for either of the other two men (who would realize that if their hat was black, then the third person would automatically know the color of their own hat).

#### SOLUTION: SACKS OF GRAIN

#### SOLUTION: CROSSING A PIRATE

You tie the rope around your sack at the halfway mark, such that all of your grain is below the tie. You then turn the remaining portion of your bag inside out to form a bowl. You pour the merchant's grain into the bowl and then hang the merchant's sack beneath yours. You reach into the sack to untie the rope and your grain falls into the merchant's bag. You place money in the chest and apply your lock. The boat goes to the merchant, who promptly adds his lock. The boat comes back to you, and you remove your lock. You then send the boat back to the merchant who is able to remove his lock and retrieve the money. You perform the same operation in reverse to receive the product.

#### SOLUTION: GOLD BARS

Pay the farmer using the following schedule:

- Day 1: Cut off a 1 piece and pay the farmer with it.
- *Day 2*: Ask for the 1 piece back, cut off a two piece and pay the farmer with it.
- Day 3: Pay the farmer using the 1 piece.
- *Day 4*: Pay the farmer using your remaining solid 4 piece segment of gold and ask for the 1 and 2 gold pieces back.
- Day 5: Pay one additional gold piece.
- Day 6: Ask for the 1 piece back, and pay the 2 piece.

Day 7: Pay the final day using the 1 piece.

#### SOLUTION: THE LOADED COIN

Bind the outcomes of two coin tosses together by treating an outcome (tails + heads) as tails, (heads + tails) as heads, and reflip when you get any other combination.

#### SOLUTION: CANNIBAL CROSSING

The following order will allow everyone to cross the river safely:

- 1. One cannibal and one missionary cross.
- 2. One missionary returns.
- 3. Two cannibals cross.
- 4. One cannibal returns.
- 5. Two missionaries cross.
- 6. One missionary and one cannibal return.
- 7. Two missionaries cross.
- 8. One cannibal returns.
- 9. Two cannibals cross.
- 10. One cannibal returns.
- 11. The last two cannibals cross.

#### SOLUTION: PANDORA'S BOX

The only hint that must be true is the Copper hint. Following this hint means that Hope must be in the Silver box.

#### SOLUTION: VILLAGE BARBER SHOPS

Since only barbers may cut hair, and the process is difficult, we can assume that each barber must cut the *other* barber's hair.

The Western barber has the nicest hair in town, so we should visit the Eastern barber who cuts it.

#### SOLUTION: MEASURING CUPS

Pour 3 cups of water into the small pitcher, filling it up. Now pour this water into the larger pitcher. Then pour 3 cups of water into the smaller pitcher again. Again, pour this water into the larger pitcher until the larger pitcher is full. This leaves us with 1 cup of water in the small pitcher.

Dump out the water from the larger pitcher. Pour the 1 cup of water in the small pitcher into the larger pitcher. Then fill up the small pitcher again and pour the 3 cups of water into the larger pitcher. This leaves us with 4 cups of water in the larger pitcher.

#### SOLUTION: COUNTERFEIT COINS

Take one coin from bag 1, two coins from bag 2, three coins from bag 3, and so forth.

Weigh these coins on the scale and record the result. If the fractional part of the total weight is 0.1, then the first bag must contain the fake coins. If the fractional part is 0.2, then the second bag is fake, and so forth.

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