

Worksheet for The Magnificent Puzzles of Raymond Smullyan

1. Puzzling Barbers

I **Arturo:** It's rumored that in a certain village in Italy, there lives a barber named Arturo. For any resident *besides Arturo*, Arturo shaves that resident just in case that resident does not shave Arturo. Could this rumor be true?

II **Roberto:** Arturo hears that in a neighboring village, there lives a barber named Roberto. For any resident *besides Roberto*, Roberto shaves that resident just in case that resident shaves Roberto. Could this rumor be true?

III **A reunion:** Could Roberto and Arturo ever live in the same village?

IV **The Barber's club:** In the capital, barbers belong to a club. Here is what we know about the club

- i If any member has shaved a member of the club, then every member of the club has shaved him.
- ii Four of the members are called Guido, Lorenzo, Petrucio, and Cesare.
- iii Guido has shaved Ceasare bald.

Has Petrucio shaved Lorenzo?

V **The exclusive Barber's club:** Some barbers belong to a more exclusive club. A barber is a member of this club if and only if he doesn't shave anybody who shaves him. A barber named Cardano once boasted that he had shaved every member of the club, and no one else. Could Cardano be telling the truth?

2. The Lady or the Tiger: Day One

In Frank Stockton's Story "The Lady or the Tiger?", prisoners must choose between two rooms, one of which contains a lady and one of which contains a tiger. If he chooses the former, he marries the lady. If he chooses the latter, he gets eaten by the tiger.

The king of a certain land had also read that story, and it gave him an idea. "Just the perfect way to try my prisoners!" he said one day to his minister. "Only, I won't leave it to chance. I'll have signs on the doors of the rooms, and in each case I'll tell prisoners certain facts about the signs. If the prison is clever and can reason logically, he'll save his life - and win a nice bride to boot!"

"Excellent idea!" said the minister

On the first day, there were three trials. In all three, the king explained to the prisoner that each of the two rooms contained either a lady or a tiger, but it could be that there were tigers in both rooms, or ladies in both rooms, or then again maybe one room contained a lady and the other room a tiger.

I **The first trial:** The king pointed to the signs on the doors of the rooms

In this room there is a lady,
and in the other room there
is a tiger

In one of these rooms there
is a lady, and in one of these
rooms there is a tiger

"Is it true, what the signs say?" asked the prisoner. "One of them is true," replied the king, "but the other one is false". If you were the prisoner, which door would you open?

II **The second trial:** And so, the first prisoner saved his life and made off with the lady. The signs on the doors were changed, and new occupants for the rooms were selected accordingly. This time the signs read as follows.

At least one of these rooms contains a lady

A tiger is in the other room

“Are the statements on the signs true?” asked the second prisoner. “They are either both true or both false,” replied the king. Which room should the prisoner pick?

III **The third trial:** In this trial, the king explained that, again, the signs were either both true or both false. Here are the signs.

Either a tiger is in this room, or a lady is in the other room

A lady is in the other room

Does the first room contain a lady or a tiger? What about the second room?

3. The Lady or the Tiger: Day Two

“The second day was a fiasco!” the king said to his minister. “All three prisoners solved their puzzles! Well, we have three trials coming up today, and I think I’ll make them a little tougher

“Excellent idea!” said the minister.

Well in each of the trials of the day, the king explained that in the lefthand room (Room I), if a lady is in it, then the sign on the door is true, but if a tiger is in it, then the sign is false. In the righthand room (Room II) the situation is the opposite: a lady in the room means the sign on the door is false, and a tiger in the room means the sign is true. Again, it is possible that both rooms contain ladies or both contain tigers, or that one room contains a lady and one room contains a tiger.

IV **The fourth trial:** After the king explained the rule to the prisoner, he pointed to two signs.

Both rooms contain ladies

Both rooms contain ladies

Which room should the prisoner pick?

V **The fifth trial:** The same rules apply, and here are the signs:

At least one of these rooms contains a lady

The other room contains a lady

Which room should the prisoner pick?

VI **The sixth trial:** The king was particularly fond of this puzzle, and the next one too. Here are the signs:

It makes no difference which room you pick

There is a lady in the other room

Which room should the prisoner pick?

VII **The seventh trial:** Here are the signs:

It does make a difference which room you pick

You are better off choosing the other room

Which room should the prisoner pick?

VIII **The eighth trial:** "There are no signs above the doors!" exclaimed the prisoner. "Quite true," replied the King, "The signs were just made and I haven't had time to put them up yet." "Then how do you expect me to choose?," demanded the prisoner. "Well here are the signs," the King replied.

This room contains a tiger.

Both rooms contain tigers.

"That's all well and good," said the prisoner anxiously, "but which sign goes on which door"? The king thought awhile. "Yes, well, it doesn't matter," he said. "You can solve this problem without that information." What is the solution?

4. The Island of Knights and Knaves

A certain island is inhabited by knights and knaves. Knights, being honorable fellows, always tell the truth. Knaves, on the other hand, always lie.

I **Cary and Grant:** You meet two inhabitants on the island: Cary, and Grant. Cary tells you that Grant is a knave. Grant says: "we are both knights". Can you determine the type of each islander?

II **Margaret and Thatcher:** You meet two inhabitants: Margaret, and Thatcher. Margaret says: "exactly one of us is a knight." Thatcher says that Margaret is a lying knave. Can you determine the type of each islander?

III **Alonzo and Church:** You meet two inhabitants, Alonzo and Church. Alonzo says “Church and I are not of the same type.” Church says “at least one of us is a knight”. Can you determine the type of each islander?

IV **Muggsy and Bogues:** You meet two inhabitants, Muggsy and Bogues. Muggsy says: “it’s false that Bogues is a knave.” Bogues says: “I could claim that Muggsy is a knave.”

5. The Search for Arthur York

Inspector Craig of Scotland Yard was called to the Island of Knights and Knaves to help find a criminal named Arthur York. What made the process difficult was that it was not known whether Arthur York was a knight or a Knave.

I **The first trial:** One suspect was arrested and brought to trial. Inspector Craig was the presiding judge. Here is a transcript of the trial:

Craig: What do you know about Arthur York?

Defendant: Arthur York once claimed that I was a knave.

Craig: Are you by any chance Arthur York?

Defendant: Yes.

Is the defendant Arthur York?

II **The second trial:** Another suspect was arrested and brought to trial. Here is a transcript of the trial:

Craig: The last suspect was a queer bird; he actually claimed to be Arthur York! Did *you* ever claim to be Arthur York?

Defendant: No.

Craig: Did you ever claim that you are *not* Arthur York?

Defendant: Most emphatically.

Craig's first guess was that the defendant was not Arthur York, but are there really sufficient grounds for acquitting him?

III **The third trial:** A third suspect was arrested and brought to trial. He brought with him his defense attorney, and the two made the following statements in court.

Attorney: My client is indeed a knave, but he is not Arthur York.

Defendant: My attorney always tells the truth!

Is there enough evidence to acquit or convict the defendant?

6. Some Facts about Knights and Knaves

I **Question 1:** Is it possible for any islander to claim that he is a knave?

II **Question 2:** Is it possible for any islander to claim that he and his brother are both knaves?

III **Question 3:** Suppose an islander A says of himself and his brother B : "at least one of us is a knave" What types are they?

IV **Question 4:** Suppose A says instead: "Exactly one of us is a knave." What can be deduced about A and B ?

V **Question 5:** Suppose A says instead: "My brother and I are both of the same type." What could be deduced about *A* and *B*?

VI **Question 6:** Suppose A says instead: "My brother and I are of different types." What could be deduced about *A* and *B*?