# Girls' Moon Mission Sample Answer

**Sample Mission - Sightseeing with 3 space girls**

Forward Mission:

❖ Leave Earth for LEO on Launch Vehicle (6000kg) with 3 space girls (3 x 200kg) + a spacecraft (5000kg) + cameras (20kg) + Fuel for the rest of the trip (?? kg) → 11,620kg + Fuel for next steps

❖ Depart LEO to Lunar Surface with 3 space girls (600kg) + spacecraft (5000kg) + cameras (20kg) + Fuel for the rest of the trip (?? kg) → 5620kg + Fuel for next step

❖ Lunar Surface back to Earth Entry: bring back 3 space girls (600kg) + spacecraft (5000kg) + cameras (20kg) → 5620kg

Backward Calculation of Necessary Fuel:

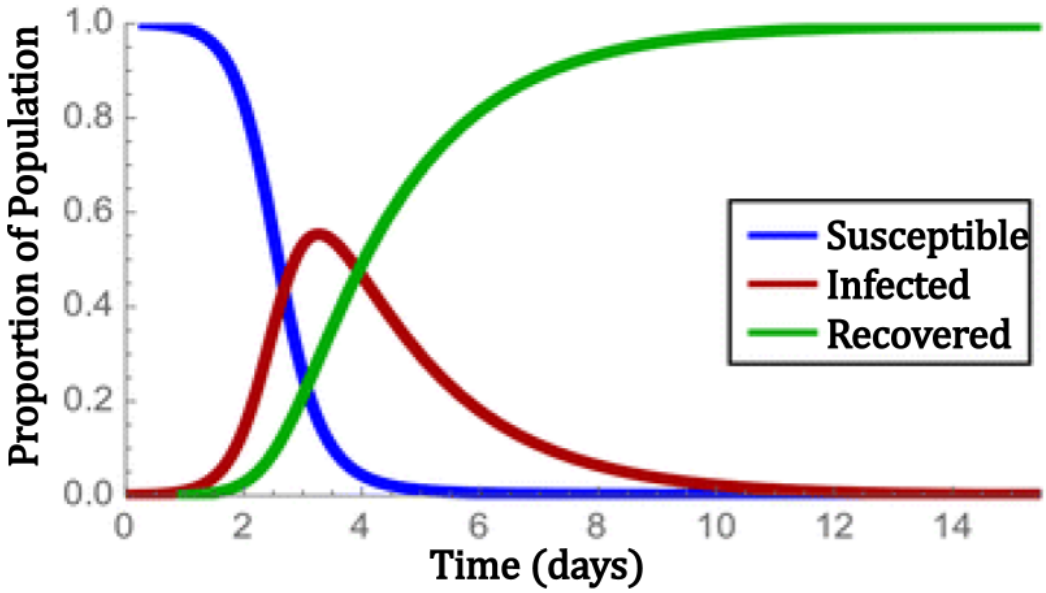
❖ To bring 5620kg back to Earth, need 5620 x 3 = 16860 kg of Fuel on Lunar Surface

❖ To have 5620 + 16860 = 22,480 kg on Lunar Surface, need 22480 x 7 = 157,360 kg of Fuel in LEO

❖ To get 11,620 + 157,360 = 168,980 kg in LEO, need to launch 168,980 x 14 = 2,365,720 kg =~ 5.22 million lbs of weight!

**Answers will vary based on choice of mission.**

# Infectious Disease Modeling Answer Key

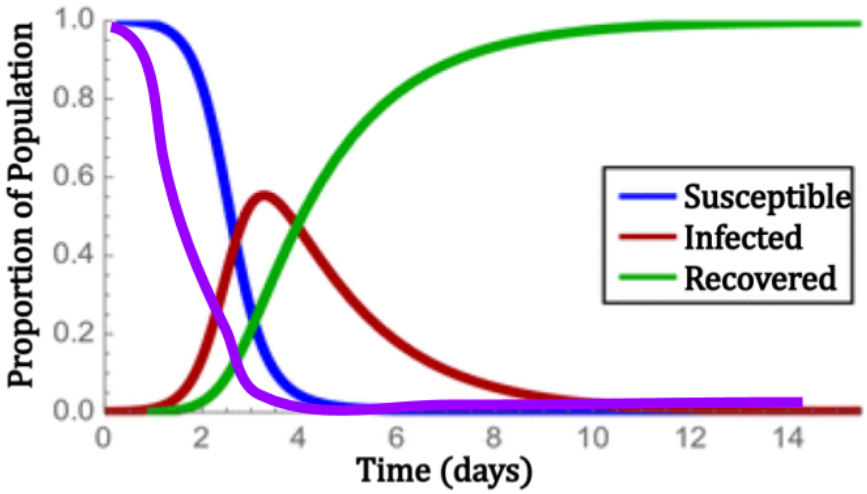



1. What proportion of the population is infected at the epidemic peak? How many people would that be assuming the DC population of around 700K?
About 55% of the population is infected at the epidemic peak. That would be around 700K*0.55=385K people in DC.

2. If this graph were to be applied to DC (population of around 700K) how many hospital beds would be needed to fully accommodate patients? (Hint: The CDC speculates that in average 1 in 5 people who are infected with COVID-19 develop difficulty in breathing and require hospital care.) Assuming that DC has 4623 hospital beds, would the health system be overwhelmed?

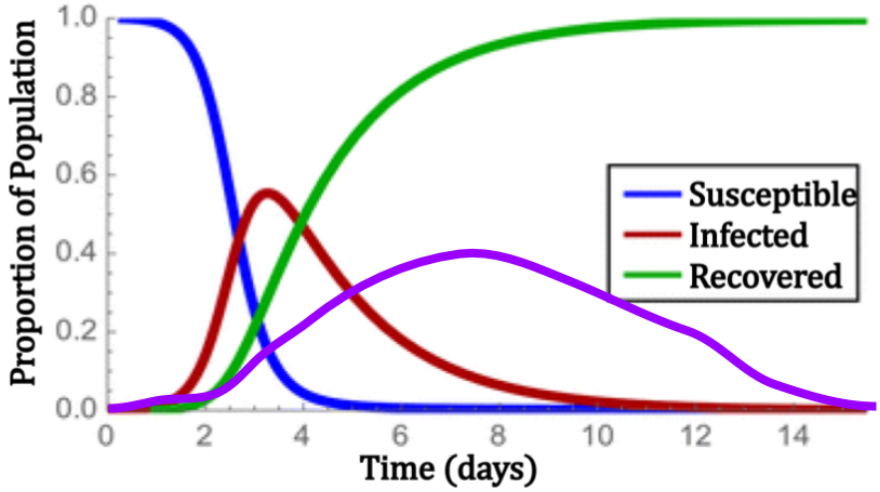
77,000 hospital beds will be needed. At the peak of the "infected" curve, 0.55 percent of DC's population has been infected. Thus, 700K*0.55*(⅕) beds will be required to fully accommodate patients. The health system will be overwhelmed since 77,000 is a much higher number than 4623.

3. If the disease was more infectious, how would the shape of the "susceptible" curve change?
If this disease were more infectious, the "susceptible" curve would decrease at a faster rate, as people would move to the "infected" category more quickly.




4. How would strict government-imposed social distancing change the shape of the “infected” curve?

Strict social distancing would result in flattening of the “infected “ curve. Cases would increase at a less rapid rate and the peak would be lower, ensuring that hospitals are better equipped to handle cases.

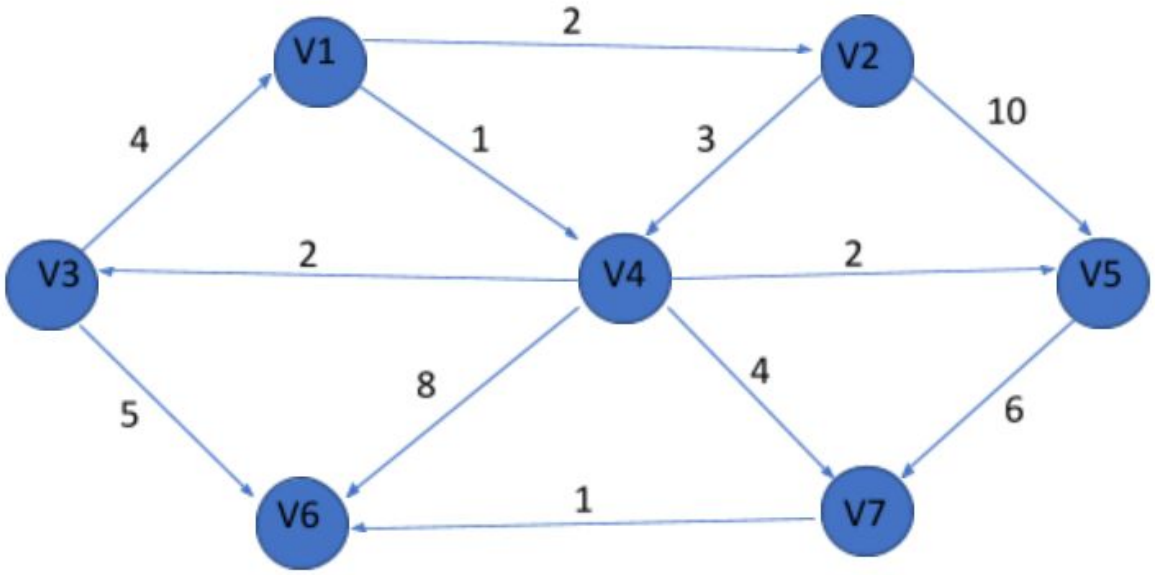



5. How do you think a vaccine will change the starting point of the “susceptible” curve? How would it affect the peak of the infected curve?

The “susceptible” curve will start at a much lower point because far fewer people would be prone to infection in the first place. The peak of the infected curve would represent a significantly lesser proportion of the population.

# Shortest Path! Answer Key

Below is a weighted and directed network graph with nodes and links. Each node is labeled with V# and each link is labeled with its weight/distance.




1. How many nodes/vertices are there in the network?

Seven nodes

2. How many links are in the network?

Twelve links

3. What is the shortest path from V3 to V5? (Note that the links are unidirectional.)

V3 -> V1 -> V4 -> V5

4. What is the shortest path from V1 to V6?

V1 -> V4 -> V7 -> V6

5. How do your answers to 3. and 4. change if all links become bidirectional (arrows on both ends)?

The answer to be 3. would be V3 -> V4 -> V5, and the answer to 4. would be VI-> V4 -> V7 -> V6

6. An algorithm is a procedure, or set of steps, to solve a math problem. Can you write a set of steps that could allow anyone to find the shortest distance

from any node to any other node? Write the steps so that somebody unfamiliar with the problem would be able to follow. Assume the original graph (not the bidirectional one we assumed in 5.

1) From the starting point, identify all the nodes you can go to.

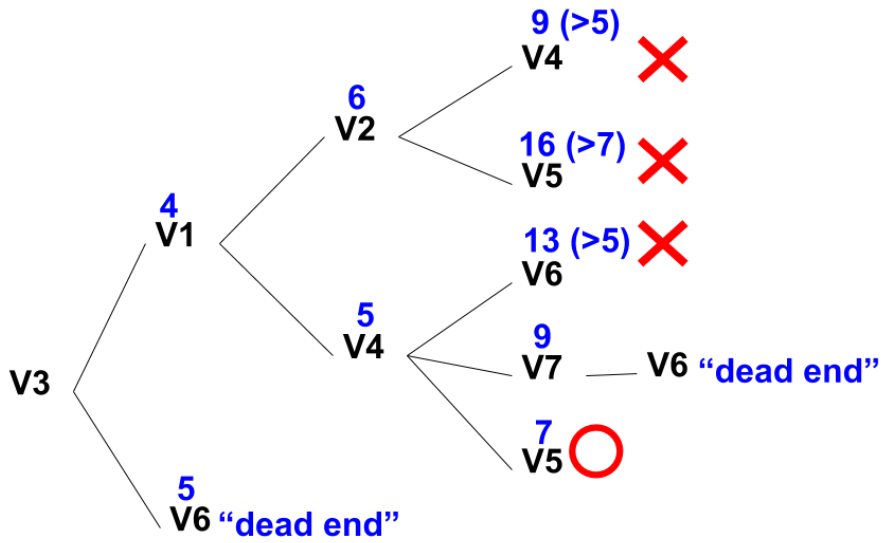
2) Write down the ending node and the weight of the links that lead to that node.

3) Keep repeating the previous steps for every node you can go to, adding on the weight for every link you go through.

4) If there are multiple paths that lead to a particular node, only keep the path that has the lowest weight.

5) Repeat until all routes reach the intended end node.

ex) V3 to V5 : V3 -> V1 -> V4 -> V5 (total weight: 7)




7. This is a hypothetical network. In real life, the numbers on the links, or "weights" could represent many different things. Think of at least two variables these link weights could represent during an evacuation scenario.

Higher link weights can mean that there are more obstacles in the way of the path of evacuation, such as the road having fewer lanes or the path going through a thick, uninhabited forest.

Lower link weights can indicate that the roads don't have much traffic or are already cleared for evacuation. Lower link weights can also mean that there is

public transportation such as buses that are readily available to evacuate a large number of people at the same time quickly and efficiently.

Links could represent time, amount of traffic, or level fire risk on each link.

# Brainstorming Bias Answer Key

ABC is a company that creates apps for tourists. They have designed an app that lets tourists automatically unlock their phone and takes a selfie by simply smiling with teeth.

Questions:

List the benefits that could come from using this feature.

- Tourists can easily take pictures while they are walking around without the hassle of pressing buttons to unlock the phone.
- Since many tourists smile with teeth when they take pictures, it would be very convenient to have the software to automatically detect the smile and take a picture.

List the harms that could come from using this feature.

- If the app doesn't come with facial recognition features, anyone will be able to unlock the phone and access the personal information and photos in the phone.
- The phone may unlock unbeknownst to the owner, and may be the target of security breach.
- If the app stores the selfies/photos in their server or the storage in the app, malicious hackers may obtain the photos.
- Tourists who want to take a different type of picture than smiling with their teeth will not be able to take advantage of this feature.

XYZ grocery story has just implemented a 6ft tall self checkout stand. It is a white pole, with a camera on the top. All customers have to do is look into the camera. It uses facial recognition to link to the customers' online account and charge them.

It's system was trained using images of people from all parts of the world.

Questions:

List the benefits that could come from using this feature.

- This method is a more efficient and faster way of checking out and there would be no need of employing any cashiers. Also in current situations

of a global pandemic, the technology will be helpful to deter the spread of COVID-19, since there will be less person-to-person contact.
- Patrons won't have to bring any cash or credit card to the store since the camera will automatically charge their online account.
- There will be a smaller risk of customers using fake money or bad checks since the payment will be authorized immediately online.

List the harms that could come from using this feature.

- Customers may not want to have their face and personal information linked and registered in the bank's or grocery store's database. Such customers will not be able to pay for their groceries conveniently.
- Other people could accidentally look into the camera and be charged for something that they don't want.
- It is possible that people may sneak past the camera to shoplift, although this can be deterred by making the camera detect all the people that go past the pole and alert an employee if a possibility of shoplifting is detected.
- If the electricity goes out or cameras malfunction, customers can't pay for the groceries.
- If there aren't a sufficient number of camera poles, the exit of the grocery store will be extremely crowded in peak hours and may invoke a safety hazard or quarrels between customers.
- People who use wheelchairs may be unable to access the camera from that height.

Automatic speech recognition (ASR) technology allows computers to translate spoken word into text. ASR can already be found in multiple aspects of our life, such as speech transcription apps, voice dialing, home appliance control, keyword search, and more.

Word Error Rate (WER) is a common metric of the performance of a speech recognition system and can be computed as the following.

$$WER = \frac{S+D+I}{N}$$

(S= # of substitutions, D= # of deletions, I= # of insertions, N= total # of words in initial speech)

Questions:

What does it mean that WER is higher? Does a good ASR software have a high or low WER?

- A good ASR has a low WER because less substitutions, deletions, and insertions indicate that the software replicates the spoken word more accurately to text.

A recent study discovered that the average WER of ASR softwares from major companies like Google, Apple, and Amazon is much higher for black people than white people. What does that indicate, and what would be a reason for that? How can we increase inclusivity in ASR?

- It indicates that the software makes more errors when transcribing black people's speech. The reason could be that there is insufficient audio data for black speakers with a particular accent. The database that the software is trained on may largely comprise of white speakers with a standard American accent. Bigger efforts to collect speech samples from various parts around the world and from people with different accents and mother tongues will be helpful.