

## Question #1:

Part 1:  $T = \sum (P_i \times \frac{D}{S_i})$

*← Probability*

Rocky

$$0.50 \cdot \left( \frac{2 \text{ Km}}{2 \text{ Km/h}} \right) = 0.50 \text{ h}$$

Sandy

$$0.20 \cdot \left( \frac{2 \text{ Km}}{3 \text{ Km/h}} \right) \approx 0.13 \text{ h}$$

Smooth

$$0.30 \cdot \left( \frac{2 \text{ Km}}{5 \text{ Km/h}} \right) = 0.12 \text{ h}$$

$$\text{Route 1} = 0.50 + 0.13 + 0.12 = \boxed{0.75 \text{ h}}$$

## Route 2:

Rocky

$$0.40 \cdot \left( \frac{1.8 \text{ Km}}{2 \text{ Km/h}} \right) = 0.36 \text{ h}$$

Sandy

$$0.40 \cdot \left( \frac{1.8 \text{ Km}}{3 \text{ Km/h}} \right) = 0.24 \text{ h}$$

Smooth

$$0.20 \cdot \left( \frac{1.8 \text{ Km}}{5 \text{ Km/h}} \right) = 0.072 \text{ h}$$

$$\text{Route 2} = 0.36 + 0.24 + 0.072 = \boxed{0.672 \text{ hr}}$$

Route 3

Rocky

$$0.10 \cdot \left( \frac{3.1 \text{ Km}}{2 \text{ Km/h}} \right) = 0.155 \text{ h}$$

Sandy

$$0.50 \cdot \left( \frac{3.1 \text{ Km}}{3 \text{ Km/h}} \right) \approx 0.517 \text{ h}$$

Smooth

$$0.40 \times \left( \frac{3.1 \text{ Km}}{5 \text{ Km/h}} \right) \approx 0.248 \text{ h}$$

$$\text{Route 3} = 0.155 + 0.517 + 0.248 = \boxed{0.92 \text{ h}}$$

Route 2 has the lowest expected time of  
0.672 hr

$\therefore$  Mars Rover Should Pick  
Route 2 //

Part 2:

Add 45 min to Route 1 if walk is damaged

Add 1 hr if bridge is out

Route 1.

Expected time from before is 0.75 hr

Additional time  $0.30 \times 0.75$

Total expected time  $0.75 + (0.30 \times 0.75)$

The new estimation:

$$\begin{aligned} \text{Route 1} &= 0.75 + (0.30 \cdot 0.75) \\ &= 0.975 \text{ hr} \end{aligned}$$

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$$\text{Route 2} = 0.672 + (0.60 \cdot 1)$$

$$\begin{array}{l} \text{New} \\ \text{expected} \\ \text{time} \end{array} = 1.272 \text{ hr}$$

Route 3 time Remain same as above 0.92 hr

Now Route 1 has the 2nd lowest expected time of 0.975 hr however

Route 3 is now the fastest with an expected time of 0.920

$\therefore$  Mars Rover should Pick <sup>Route</sup> 3 //

## Part 3

let's calculate the time to traverse Route 3  
given that it is confirmed to be smooth.

$$T_{\text{smooth}} = \frac{3.1 \text{ km}}{5 \text{ km/h}} = 0.62 \text{ hr}$$

Best case scenario for Route 3  
since if the satellite info confirms  
that the terrain is smooth,  
the time to traverse Route 3 will be  
0.62 hr.

Without the satellite info.

$$T_{\text{Route 3}} = 0.92 \text{ hr}$$

Difference

$$\Delta T = 0.920 - 0.62 = 0.3 \text{ hr}$$

18 minutes or 0.3 hr is the value of satellite  
info

which implies that if satellite can give info  
in less than 18 min, it is good to wait  
and take Route 3, since it will still be faster

than the expected time without the information.  
However if confirm that terrain is not smooth we will  
now have 0.92 hr like our original calculation, eliminating  
the possibility of Best-case scenario.

→ also if the wait is more than 18 minutes then it is not  
worth the wait and the rover should proceed  
with the current estimated fastest route.

## ChatGPT 3.5 Reply for Question 1

Let's start by calculating the expected travel times for each route without considering any additional information. We'll then factor in the additional information to make our decision.

First, let's calculate the expected travel times for each route without considering the extra obstacles:

For Route 1:

50% chance of rocky terrain (2 km at 2 km/h) = 1 hour

30% chance of damaged crater wall (additional 45 minutes) = 0.5 hours

20% chance of sandy terrain (2 km at 3 km/h) =  $\frac{2}{3}$  hours

Total expected travel time for Route 1 =  $(0.5 * 0.7) + (0.5 * 1.5) = 0.35 + 0.75 = 1.1$  hours

For Route 2:

40% chance of rocky terrain (1.8 km at 2 km/h) = 0.9 hours

60% chance of damaged bridge (additional 1 hour) = 0.6 hours

20% chance of smooth terrain (1.8 km at 5 km/h) = 0.36 hours

Total expected travel time for Route 2 =  $(0.4 * 0.9) + (0.6 * 1.6) = 0.36 + 0.96 = 1.32$  hours

For Route 3:

10% chance of rocky terrain (3.1 km at 2 km/h) = 1.55 hours

50% chance of sandy terrain (3.1 km at 3 km/h) = 1.03 hours

40% chance of smooth terrain (3.1 km at 5 km/h) = 0.62 hours

Total expected travel time for Route 3 =  $(0.1 * 1.55) + (0.5 * 1.03) + (0.4 * 0.62) = 0.155 + 0.515 + 0.248 = 0.918$  hours

Now, let's consider the additional obstacles:

For Route 1:

30% chance of damaged crater wall (additional 45 minutes) = 0.5 hours

Total expected travel time for Route 1 with the crater obstacle =  $1.1 + 0.5 = 1.6$  hours

For Route 2:

60% chance of damaged bridge (additional 1 hour) = 0.6 hours

Total expected travel time for Route 2 with the bridge obstacle =  $1.32 + 0.6 = 1.92$  hours

For Route 3:

Suppose we can use a satellite to find out whether the terrain in Route 3 is smooth. The value of this information depends on how long we are willing to wait for it. If the difference in expected travel time between Route 3 and the other routes is significant, then waiting for the satellite information may be worthwhile.

In this case, Route 3 already has the lowest expected travel time (0.918 hours) among the three routes, so we should choose Route 3 without waiting for additional information from the satellite.

So, the final decision is to pick Route 3 without waiting for satellite information.

The above incorrectly calculates the expected times by not properly applying the probabilities to the additional obstacles and by not accurately assessing the expected time saved with the satellite information. It also made multiple small calculation errors.

I also tried putting the same answer in ChatGPT again and asked to point out the mistakes and this is what I got:

Here's a breakdown of the errors:

#### Misinterpretation of probabilities in Route 1 calculation:

- The calculation incorrectly combines the probability of terrain type with the probability of the crater wall being damaged. These are separate events. The expected time should be calculated by considering the terrain speed first, then adjusting for the probability of the crater delay.
- The probability of the crater wall being damaged is independent of the terrain type and should be added separately to the expected time.

#### Incorrect expected time calculation for Route 1:

- The correct calculation for Route 1 without the crater wall consideration was previously calculated as 0.75 hours. The probability of the crater wall being damaged should add  $0.30 * 0.75 = 0.225$  hours, not 0.5 hours.

#### Incorrect expected time calculation for Route 2:

- The calculation incorrectly assesses the additional time for the bridge being out. It appears to add the full hour regardless of the probability of the bridge being out.
- The correct calculation should add 60% of an hour ( $0.60 * 1 = 0.6$  hours) to the expected time without the bridge repair which was previously calculated as 0.672 hours, not 1.32 hours.

#### Incorrect calculation of expected travel times for Route 3:

- The probabilities for each terrain type seem to be ignored in the multiplication step, and the raw travel times are summed instead.
- The correct expected time for Route 3 without the satellite information is 0.920 hours as calculated previously.

#### Misinterpretation of the value of information from the satellite:

- The value of the satellite information is not about whether waiting for it is worthwhile based on the current lowest expected time. Instead, it's about how much the information could potentially improve the decision by confirming whether Route 3 is the best route. The satellite could confirm if Route 3 is smooth, thus ensuring a travel time of 0.62 hours, which would be faster than the expected times without the satellite information.
- The value of the information should be quantified as the expected time saved if Route 3 is confirmed to be smooth compared to the expected time without the satellite information.