Question 1a: Our Mars rover has been out collecting samples, and it needs to return to the charging station as quickly as possible.

Route 1:

Sandy terrain: 20% x 2 km / 3 km/h = 0.4 hours

Smooth terrain: 30% x 2 km / 5 km/h = 0.36 hours

Rocky terrain: 50% x 2 km / 2 km/h = 1 hour

Expected time for Route 1 = (0.4 + 0.36 + 1) hours = 1.76 hours

Route 2:

Sandy terrain: 40% x 1.8 km / 3 km/h = 0.24 hours

Smooth terrain: 20% x 1.8 km / 5 km/h = 0.072 hours

Rocky terrain: 40% x 1.8 km / 2 km/h = 0.36 hours

Expected time for Route 2 = 0.24 + 0.072 + 0.36 = 0.672 hours

Route 3:

Sandy terrain: 50% x 3.1 km / 3 km/h = 1.55 hours

Smooth terrain: 40% x 3.1 km / 5 km/h = 0.248 hours

Rocky terrain: 10% x 3.1 km / 2 km/h = 0.155 hours

Expected time for Route 3 = 1.55 + 0.248 + 0.155 = 1.953 hours

based on these calculations, Route 2 has the shortest expected time of 0.672 hours

1b: Crater addition

Expected time for Route 1 = (0.4 + 0.36 + 1) hours + (30% x 0.75 hours) = 1.76 hours + 0.225 hours = 1.985 hours

Expected time for Route 2 = (0.24 + 0.072 + 0.36) hours + (60% x 1 hour) = 0.672 hours + 0.6 hours = 1.272 hours

(Route 3 remains the same): Expected time for Route 3 = 1.953 hours

Route 2 is still the quickest option with an expected time of 1.272 hours.

1c: Satellite

The value of obtaining information about the terrain in Route 3 (smooth or not) from a satellite depends on the trade-off between the potential time savings and the delay in waiting for the information.

If it is smooth the route estimate will be estimated at…

Smooth terrain: 40% x 3.1 km / 5 km/h = 0.248 hours

Compared to the expected time

Expected time for Route 3 = 1.55 + 0.248 + 0.155 = 1.953 hours

Since waiting for the satellite information is expected to result in a significant reduction in travel time, it might be worth the delay. Saving 1.705 hours time. If the wait were to exceed this time, it may be best to continue without that information.

1d: ChatGPT

ChatGPT gave similar results but did the math slightly differently. When it came to hypotheticals like the satellite, it considered other unknown factors like the rover's energy constraints, mission goals, etc.