

# 2020 Moon to Mars Ice & Prospecting Challenge Scoring Matrix

Teams must collect at least 50 mL of water to be eligible for the 1<sup>st</sup> or 2<sup>nd</sup> overall prize



Team: \_\_\_\_\_

## Total Possible Points = 490

Water Extraction (Max 180 points) – 40% of overall score	Day 1 Hands-On / Hands-Off	Day 2 Hands-On / Hands-Off	“z”	Scoring Volume	Max Points	Actual Points
Number of points assigned for water collection	/	/			150	
Water Clarity					30	
Prospecting: Drilling Telemetry (Max 90 pts) – 20% of overall score			Max	Actual	Comments/Notes	
Identify the correct number of overburden layers and determine relative layer hardness			50			
Identify the thickness of each layer within an established margin of error (MOE)			40			
Technical Paper (Max 135 points) – 30% of overall score			Max	Actual	Comments/Notes	
Quality of Path-to-Flight description, including rationale behind various trades and critical modifications made to the system for extracting water from sub-surface ice on Mars <b>and</b> prospecting on the moon.			45			
Technical quality, feasibility, and innovation of design for use off-Earth			35			
Quality of integration video and summary description			30			
Quality of team’s production and testing approach			15			
Adherence to Technical Paper guidelines			10			
Poster Presentation (Max 45 points) – 10% of overall score			Max	Actual	Comments/Notes	
Discussion of the Earth system (How team got from here to the off-Earth system). <b>Note:</b> The Poster should be a summary of the technical paper with emphasis on modifications made for extracting water from sub-surface ice on Mars <b>and</b> prospecting on the moon.			25			
Technical Content, Style, Coherence			10			
Engagement with judges (all team members should participate) and quality of response to questions			10			

## Penalties

Penalty Points are deducted from a team’s total score	Max	Points Deducted	Comments/Notes
Exceeding the Volume Limit (10 points off total score for every 1 cm over the size limit of 1m x 1m x 2m)* *Penalties will be determined by rounding up or down to the nearest whole cm.	–		
Exceeding the Mass Limit (20 points off total score for every 1 kg of extra weight over the weight limit of 60 kg)** **Penalties will be determined by rounding up or down to the nearest whole kg.	–		
Exceeding 9A Current/Amperage limit by blowing a fuse (80 points off total score and disqualification for the top prize)	80		
Failure to provide a WOB data logger that can provide real-time data (60 points off total score and disqualification for the top prize)	60		
Misalignment between what was proposed in the Mid-Project Review and/or Technical Paper and the system brought to the competition (up to 200 points off total score at the discretion of the judges)	200		
Solid debris in collection bag (1 point per 10 grams)	–		# of grams: Day 1 _____ # of grams: Day 2 _____
Excessive dirt outside of the 12’ x 12’ tarp under team test station (up to 20 points off the total score at the discretion of the judges)	20		

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## Water Collection

Each team's water volume will be collected (separately for hands-off and hands-on periods) and measured at the end of each day. Silt that has settled to the bottom of the containers will also be measured at the end of the day and subtracted from the water volume measurements to give each team their total water volume for that day's hands-off and hands-on collections.

A team's Scoring Volume will be equal to their hands-on water volume PLUS five (5) times their hands-off water volume:

$$\text{Scoring Volume} = \text{Total Hands-On Water} + (5 \times \text{Hands-Off Water})$$

The highest total Scoring Volume collected over the 2-day period by any one team = "z":

The Scoring Volume will then be normalized to a 150-point scale so the team with the most Scoring Volume will receive 150 points for Water Collection and the other teams will receive points for Water Collection based on the following equation:

$$(\text{Team's Scoring Volume} / z * 150)$$

### Prospecting

#### Scoring for identifying the correct number of overburden layers and determining relative layer hardness

- Partial points will be awarded if teams can correctly identify some of the correct spots for the layer's sequence.
- For each layer greater than or less than the current number of layers, teams will lose 50/N points (*where N is the true number of layers*). Each layer will be compared with the correct layer sequencing to determine accuracy of the team's suggested order. An error term will be calculated based on how far off the team's remaining ordering is from the true ordering (based on the square of the difference between team's suggested ordering and the correct ordering), and remaining points will be scaled based on how large the error term is.

$$\text{Error} = \sum_{i=1}^N (\text{Correct Layer Order}_i - \text{Your Layer Order}_i)^2$$

$$\text{Points Deducted} = \frac{\text{Error}}{\text{Max Possible Error}} * \text{Remaining Points}$$

#### Scoring for identifying the thickness of each layer

- Partial points will be awarded for estimates slightly outside the MOE
- The suggested thickness of each layer will be compared to the actual thickness of that layer.
  - If the estimate is within the MOE for that layer, teams will receive 40/N points (*where N is the true number of layers*).
  - If the estimate is within 2 \* MOE for that layer, teams will receive 40/(2N) points (half-credit).
  - If the estimates is greater than 2 \* MOE for that layer, zero points will be given for estimating the thickness of that layer.
- This process will continue until the judges have checked all estimates against the true number of layers, regardless of whether the team estimated fewer or more layers (i.e., if there are 6 layers but a team only estimates thicknesses for 4, their estimate for the thicknesses of layers 5 and 6 will be treated as 0 cm, and no points will be awarded for estimating the thickness of unidentified layers).

### Water Clarity

**Scoring for water clarity (Max of 30 points):** Teams will be awarded up to 30 points based on the clarity of the water extracted. Turbidity tests will be conducted at the end of each day, with points being awarded to each team's sample with the best clarity over the 2-day period.

#### NTU (Nephelometric Turbidity Unit):

Measurement of Reflected Light from a Sample

Samples with an NTU < 1,000 will be calculated using a dilution

Turbidity (NTU)	Points
Less than 5 NTU (Minimum Standard for Waste Water)	30 points
5.1 – 50 NTU	25 Points
51 – 1,000 NTU	20 Points
1,001 – 5,000 NTU	15 Points
5,001 – 25,000 NTU	10 Points
25,001 – 50,000	5 Points
Greater than 50,000	0 Points

Water Extraction (max 180 pts)	_____
Prospecting (max 90 pts)	_____
Technical Paper (max 135 pts)	_____
Poster Presentation (max 45 pts)	_____
<b>Subtotal</b>	_____
<b>Subtract Total Penalty Points</b>	_____
<b>Final Score</b>	_____



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**Note:** In the event of a tie, total water volume collected may become the deciding factor (i.e., the team who collected the most water in the tie will emerge as the winner).