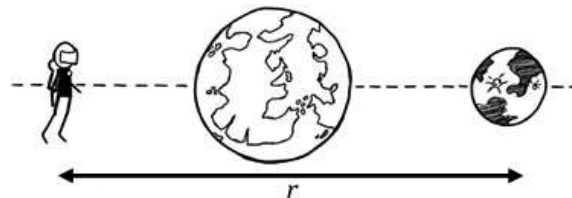NAME _____ DATE _____

Scenario

An astronaut is lost in space near an alien planet and its orbiting moon, shown at right (not to scale). At a particular instant, the moon is directly opposite the astronaut on the far side of the planet, in line with the center of the planet, and at a distance r *from the astronaut.*

Using Representations

PART A: Mark an "X" on the diagram shown to indicate the location where the astronaut could move so that she would feel no net gravitational force.

Argumentation

PART B: If the planet was not between the astronaut and moon, but the distance r was the same, would the gravitational force on the astronaut by the moon increase, decrease, or stay the same?

_____ Increase _____ Decrease _____ Stay the Same

Justify your answer.

_____

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PART C: The astronaut's jetpack is powered by an arc reactor that can supply nearly limitless energy to the suit's thrusters. The astronaut wishes to escape this planet-moon system and travel to other parts of this solar system, away from any other significant gravitational effects of other planets or moons. Consider the energy required to escape from the configuration shown above. If the astronaut was instead standing on the moon, would it require more, less, or the same amount of energy to escape the system?

_____ More energy _____ Less energy _____ Same amount of energy

Justify your answer. Equations may be a part of your explanation, but equations alone are insufficient.

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PART D: The astronaut is able to travel a very far distance x away from the planet-moon system at a constant velocity, needing a total amount of energy E to do so.

i. Explain why the jetpack must do work on the astronaut to maintain a constant velocity.

_____

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ii. Sketch a graph of the force exerted by the jetpack vs. x to keep the astronaut at a constant velocity as she moves away from the planet-moon system. Identify the feature of the graph that could be used to determine the energy used by the jetpack to move the astronaut in this manner.

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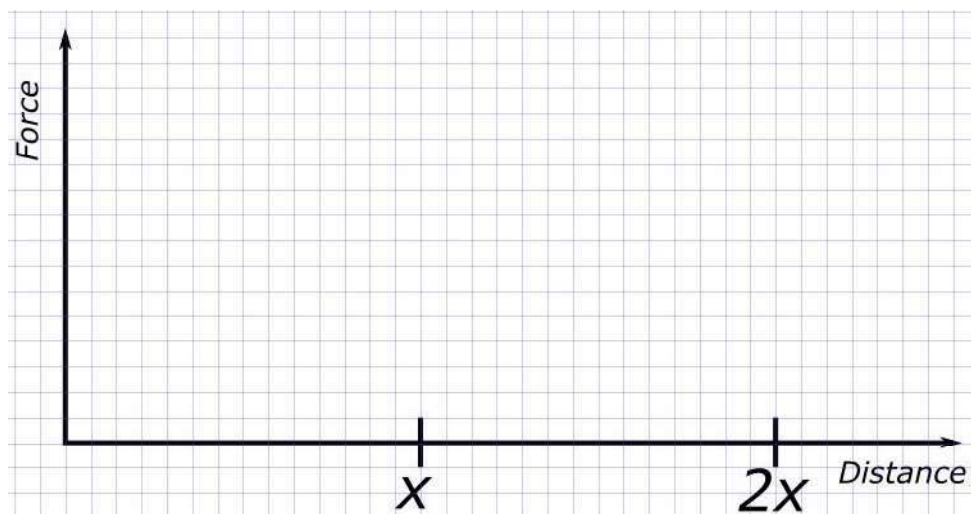
iii. Describe the power required from the jetpack as the astronaut travels away from the planet-moon system.

_____ More power as distance increases   _____ Same power regardless of distance   _____ Less power as distance increases

Justify your choice.

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