NAME ______________________________ DATE ______________

Scenario

The mass of Mars is 1/10 times that of Earth; the diameter of Mars is 1/2 that of Earth.

Quantitative Analysis

PART A: Derive the equation for gravitational, g, due to a planet.

PART B: Let g be the gravitational field strength on Earth's surface. Derive an expression for the gravitational field on the surface of Mars without plugging in a value for the mass or radius of Mars. Your answer should be a number multiplied by g. For each line of the derivation, explain what was done mathematically (i.e., annotate your derivation).

Argumentation

PART C: A rock is dropped 2.0 meters above the surface of Mars. Does this rock take a longer or a shorter time to fall than a rock dropped 2.0 m above the surface of Earth? Justify your answer without using equations.

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PART D: On the internet, a student finds the following equation for the time an object will take to fall to the ground from a height h, depending on the mass and radius of the planet the object is on: $t = \sqrt{\dfrac{2hG}{MR^2}}$

Regardless of whether this equation is correct, does it agree with your qualitative reasoning in Part C? In other words, does this equation for t have the expected dependence as reasoned in Part C?

_________ Yes _________ No

Briefly explain your reasoning without deriving an equation for t.

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PART E: Another student deriving an equation for the time it takes for an object to fall from height h makes a mistake and comes up with: $t = \sqrt{\dfrac{R^2}{2GMh}}$. Without deriving the correct equation, how can you tell that this equation is not plausible—in other words, that it does not make physical sense? Briefly explain your reasoning.

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