NAME _____ DATE _____

Scenario

Angela, Blake, and Carlos are studying the data table to the right, which shows the mass, orbital radius, and orbital period of four planets. They note that the orbital period increases but disagree about why this happens. Their arguments are as follows:

Planet	Mass [10^{24} kg]	Orbital Radius [10^{9} m]	Orbital Period [years]
Mercury	0.330	57.9	0.241
Venus	4.87	108.2	0.616
Earth	5.97	149.6	1.00
Neptune	102	4495.1	164

Angela: "It appears that the more mass a planet has, the longer its period is. This is because more massive objects are more difficult to move, so these objects move slower in their orbits.

Blake: "No, all the planets move at the same speed around the sun, but planets with greater orbital radius must make longer circumference orbits, causing their orbital periods to be greater."

Carlos: "It is the case that farther-radius planets must make farther-circumference orbits, but the farther planets also go slower because there is less gravitational force acting on them."

For this problem, consider one planet of mass m making a circular orbit of radius R around the sun (mass M). Let v represent the speed of the planet as it orbits the sun and T be the orbital period.

Create an Equation

PART A: Beginning with basic equations for gravitational and centripetal force and an equation that relates speed and period of circular motion, derive an expression for the orbital period of this planet in terms of R, M, v, and physical constants as necessary. Note that it may be helpful for Part B for you to number your steps so that they can be referred to later.

Step 1	
Step2	
Step 3	
Step 4	
Step 5	
Step 6	

Argumentation

PART B: Your work in Part A can be used to support or refute the arguments of the three students. For each student, explain which aspects of their reasoning is correct (if any) and incorrect (if any) and cite steps of work from Part A (not your final answer) and explain how that step supports or refutes each aspect.

i. *Angela*	ii. *Blake*	iii. *Carlos*