

Question 4: Paragraph**7 points**

(a) For indicating **one** of the following: **1 point**

- That the gravitational force would be smaller for a greater radius
- That the gravitational field strength would be smaller for a greater radius
- That the acceleration due to gravity would be smaller for a greater radius

For indicating **one** of the following: **1 point**

- The sphere travels the same vertical distance in both scenarios
- The amount of work done on the sphere is dependent on the magnitude of the gravitational force
- The change in gravitational potential energy is less on Planet X

Example Response

The mass is the same and the radius is larger, so the force of gravity is less. The work done depends on the force times distance. Because the distance is the same, the work is less.

Total for part (a) 2 points

(b)	For relating a larger planetary mass to a one of the following:	1 point
	• A larger weight of the sphere • A larger acceleration due to gravity g • A larger gravitational field strength	
	For indicating that the period is inversely related to one of the following:	1 point
	• The acceleration due to gravity g • The gravitational field strength	
	For indicating that the amount of stretch is dependent on one of the following:	1 point
	• The weight of the sphere • The acceleration due to gravity g • The gravitational field strength	
	For relating the length of the string to the period of the pendulum	1 point
	For a logical, relevant, and internally consistent argument that addresses the required argument or question asked, and follows the guidelines described in the published requirements for the paragraph-length response	1 point
Example Response		
$T = 2\pi\sqrt{\frac{\ell}{g}}$. On Planet Y the gravitational force on the sphere is larger than when on Earth. Therefore, the sphere will experience a larger acceleration due to gravity on Planet Y. Because “g” is in the denominator of the equation, a larger acceleration due to gravity leads to a potentially smaller period. However, the increased gravitational force exerted on the sphere by Planet Y could result in the string stretching. This could result in the length of the pendulum increasing. Because T increases with the length of the pendulum, a longer string could potentially lead to a larger period.		
	Total for part (b)	5 points
	Total for question 4	7 points