1. A satellite of mass m_s orbits a planet of mass m_p at an altitude equal to twice the radius (R) of the planet. What is the satellite's speed assuming a perfectly circular orbit?

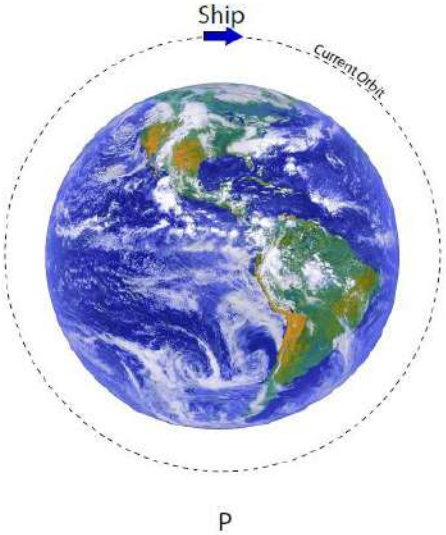
(A) $v = \sqrt{\frac{Gm_P}{R}}$

(B) $v = \sqrt{\frac{Gm_S}{R}}$

(C) $v = \sqrt{\frac{Gm_S}{2R}}$

(D) $v = \sqrt{\frac{Gm_P}{3R}}$

2. A spaceship in a circular orbit 400 km above the surface of the Earth wishes to manipulate its orbit to reach a point P on the opposite side of the Earth which is 1000 km above the Earth's surface. If the spaceship is at the position shown in the diagram and currently moving in a clockwise direction, in which direction should the ship accelerate in order to reach point P?



(A) toward the top of the page
(B) toward the right of the page
(C) toward the bottom of the page
(D) toward the left of the page

3. A rock is thrown horizontally from the top of a 100-meter-high vertical cliff on Planet Unicorn with a speed of 20 m/s. If the mass of Planet Unicorn is 10_{25} kg and the top of the cliff is approximately 4000 kilometers from the center of the planet, how far from the base of the cliff does the rock land?

(A) 0.022 m
(B) 0.044 m
(C) 43.8 m
(D) 90.1 m

4. Which of the following changes would increase the magnitude of the gravitational field intensity an object feels when near a planet? (Select two answers.)

(A) increase the mass of the object
(B) increase the mass of the planet
(C) decrease the spin rate of the planet
(D) decrease the separation distance between object and planet

5. Marty is an astronaut who is preparing to go on a mission in orbit around the Earth. For health reasons, his mass needs to be determined before take-off and while he is in orbit. The morning of the launch, Marty sits on one pan of a two-pan scale and 94 kg of mass is needed to balance him.

(a) State and explain whether the two-pan scale registered Marty's gravitational mass or inertial mass.

(b) After a few days in orbit Marty is again to determine his mass. Explain why the two-pan scale used before launch cannot be used to measure his mass while in orbit.

(c) To determine Marty's mass in orbit he is to sit in a chair of negligible mass that is attached to a wall by a spring that has a force constant, k. Consequently, the chair freely vibrates back and forth with a period, T when displaced sideways a distance, x. Explain how the spring-mounted chair can be used to determine Marty's mass, m. Give relevant measurements and equation(s).

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(d) If Marty has lost mass while in orbit, what specific change would occur when he sits in the chair and starts it oscillating?

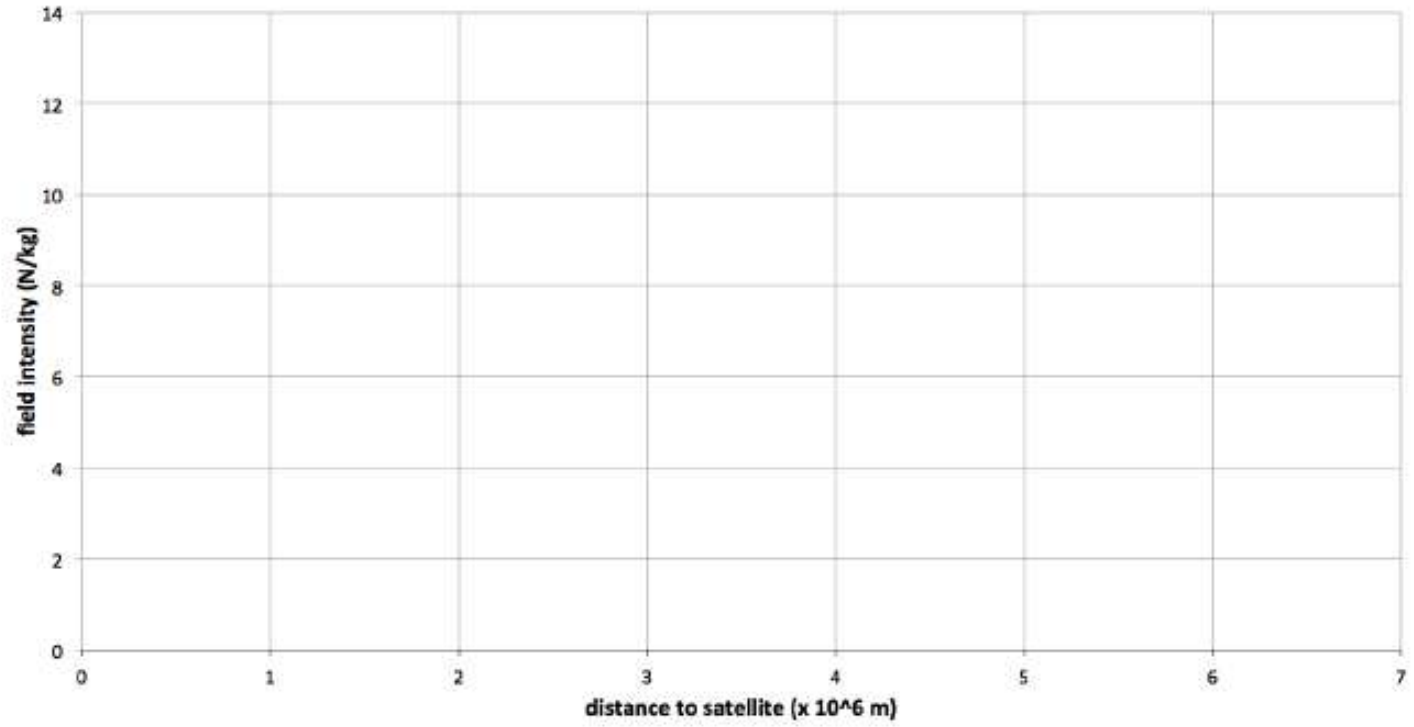
(e) Explain why this spring-mounted chair measures Marty's inertial mass.

6. A space probe is sent on a mission to map out the gravitational field intensity in the vicinity of a satellite of planet X. Some of the data collected is shown in the chart to the right:

distance to satellite ($\times 10^6$ m)	field intensity (N/kg)
2.0	13.3
2.5	8.4
3.0	5.9
3.5	4.5
4.0	3.3
6.0	1.5

(a) On the axes below, plot the gravitational field intensity, g, vs. the distance, R, to the satellite.

(b) Draw in the appropriate best fit line or curve.



(c) Using the best fit, what distance corresponds to a field intensity of 2.1 N/kg?

(d) In order to determine the mass of the satellite, a plot of field intensity vs. $1/R^2$ can be utilized. Fill in the appropriate values for $1/R^2$ in the chart to the right.

$1/R^2$ ($1/m^2$)	field intensity (N/kg)
	13.3
	8.4
	5.9
	4.5
	3.3
	1.5

(e) On the axes below plot gravitational field intensity, g, vs. $1/R^2$.

(f) Use the plot and best fit to determine the mass of the planet.