

TSOKOS READING ACTIVITY

Section 2-11 (4 Points)

1. IB Assessment Statements for Topic 9.2, Gravitational Field, Potential and Energy
 - 9.2.7. Explain the concept of escape speed from a planet.
 - 9.2.8. Derive an expression for the escape speed of an object from the surface of a planet.
 - 9.2.9. Solve problems involving gravitational potential energy and gravitational potential.
2. Objectives for Tsokos Lesson 2-11, Motion in a Gravitational Field:
 - a. State the definitions of gravitational potential energy, $E_p = -G \frac{M_1 M_2}{r}$, and gravitational potential, $V = -G \frac{M}{r}$.
 - b. Understand that the work done as a mass m is moved across two points with gravitational potential difference ΔV is $W = m\Delta V$.
 - c. Understand the meaning of escape velocity and solve related problems using the equations for escape speed from a body of mass M and radius R , $v_{esc} = \sqrt{\frac{2GM}{R}}$.
 - d. Solve problems of orbital motion using the equation for orbital speed at a distance r from a body of mass M , $v = \sqrt{\frac{GM}{r}}$.
 - e. Understand the term weightlessness.
3. Read section 2-11 in your textbook.
4. Answer the following questions:
 - a. The work energy stored in the gravitational field of two masses is called the _____ of the two masses.
 - b. What is the equation for the gravitational potential energy of two masses? _____
 - c. Given a gravitational constant of $6.67 \times 10^{-11} \text{ N} \cdot \text{m}^2 / \text{kg}^2$, if you and the person next to you each have a mass of 70kg and you are sitting a third of a meter apart, what is the energy of attraction between you? _____
 - d. A satellite's total energy as it orbits is the _____
 - e. Give the long and 2 short equations of the total energy of a satellite. _____

- f. Estimate the total *force* on a 6,000-kg satellite in continuous orbit around the earth. _____
- g. What is the meaning of the term *gravitational potential, V*? _____

- h. What is an equation for the gravitational potential due to a single mass, M , at a distance r from the center of M ? _____
- i. What are the units for gravitational potential? _____
- j. If an object is to escape the gravitational pull of a large mass, the object's total energy must be _____

- k. Define escape velocity, V_{esc} . _____

- l. Give the equation for escape velocity. _____
- m. Is escape velocity dependent on the mass that is escaping? _____
- n. For an escape from planet earth (sounds like a B-movie title) where the acceleration due to gravity is _____, the escape velocity can be rewritten as _____
- o. What is the escape velocity *in m/s* required from just the earth's gravitational pull? _____
- p. What two laws are required for understanding orbital motion? _____

- q. What property of the law of gravitation allows for circular or elliptical orbits? _____

- r. Give an equation for a satellite's velocity given a distance r from the body it is orbiting. _____

- s. If the mass of a satellite is doubled, what is the change in its orbiting speed? _____

- t. Explain why a satellite moves to a lower orbit when it encounters frictional forces due to the atmosphere. _____

- u. Explain why (and how) this move to a lower orbit will cause the satellite to increase its velocity rather than decrease. _____

- v. How large is this component of the gravity force in relation to the frictional force? _____
- w. What is the name given to the curious fact that as satellites encounter friction due to the atmosphere that their speed actually increases? _____
- x. What is the formula for the period of a satellite or planet orbit? _____
- y. For elliptical orbits, r in the above equation should be replaced by the _____
- z. A surface consisting of points all equidistant from a mass center and thus all having the same gravitational potential is called an _____
- aa. What can you tell from the slope of a graph of the variation of the gravitational potential with distance? _____
- bb. Equipotential surfaces and gravitational field lines are _____ to each other (circle all applicable).
- A. normal
 - B. abnormal
 - C. perpendicular
 - D. parallel
 - E. morally opposed

Pay special attention to the concepts of gravitational field, potential, field lines, field strength, and equipotential surfaces. The same concepts apply to electricity and are nearly identical in application.

5. Answers may be typed or neatly printed. Drawings may be freehand, but try to make use of the 'Shapes' or 'Insert Clipart' functions of MS Word. If you submit this assignment electronically, the filename must be in the following format, "LastnameFirstinitialPerXReadActX-X".