GRAVITATION UNIT H. W. AP PHYSICS C

Problems

Question 1.

To launch a spaceship from the earth, an escape velocity of v_{escape} is necessary. For that same spaceship to launch from Saturn, with a radius approximately 10 times that of the Earth, and a mass approximately 100 times that of the Earth, what escape velocity is required?

a. $\frac{\sqrt{10}}{v_{escape}}$

b. $\sqrt{10}\ v_{escape}$

c. $10\ v_{escape}$

d. $\frac{v_{escape}}{10}$

e. $1000\ v_{escape}$

Question 2.

At the surface of a planet with radius R, a mass experiences a gravitational acceleration g. At a height of $3R$ above the surface of the planet, the gravitational acceleration is:

a. $\frac{g}{3}$

b. $3g$

c. $\frac{g}{9}$

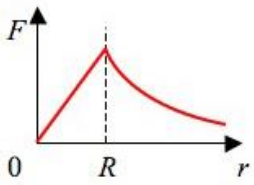
d. $9g$

e. $\frac{g}{16}$

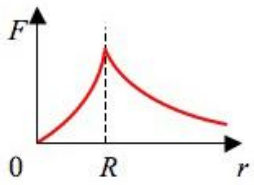
Question 3.

A large, massive, satellite is hollow, with all of its mass m located at a radius R from its center, as shown above. Which graph best represents the Force of gravity experienced by an astronaut at a distance r from the center of the satellite, where r goes from 0 to ∞?

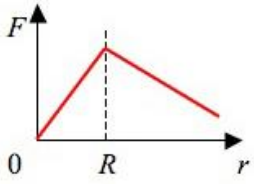
a.



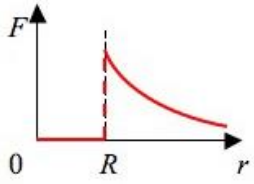
b.



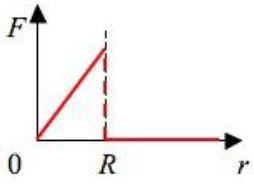
c.



d.



e.



Question 4.

A satellite of mass m is in a circular orbit about the earth (mass = M) at a height h above the surface, where $h = r$, the radius of the earth. What velocity should this satellite have in order to maintain its orbit?

a. $v = \sqrt{\frac{GM}{r}}$

b. $v = \frac{GM}{2r}$

c. $v = \sqrt{\frac{GM}{2r}}$

d. $v = \sqrt{\frac{GMm}{2r}}$

e. $v = \frac{\sqrt{GM}}{2r}$

Two stars, each of mass M, form a binary system. The stars orbit about a point a distance R from the center of each star, as shown in the diagram above. The stars themselves each have radius r.

Question 5. What is the force each star exerts on the other?

(A) $G\dfrac{M^2}{(2r+2R)^2}$

(B) $G\dfrac{M^2}{(R+r)^2}$

(C) $G\dfrac{M^2}{R^2}$

(D) $G\dfrac{M^2}{4R^2}$

(E) $G\dfrac{M^2}{2R^2}$

Question 6. In terms of each star's tangential speed v, what is the centripetal acceleration of each star?

(A) $\dfrac{v^2}{2R}$

(B) $\dfrac{v^2}{(r+R)}$

(C) $\dfrac{v^2}{2(r+R)}$

(D) $\dfrac{v^2}{2r}$

(E) $\dfrac{v^2}{R}$

Question 7. A Space Shuttle orbits Earth 300 km above the surface. Why can't the Shuttle orbit 10 km above Earth?

(A) The Space Shuttle cannot go fast enough to maintain such an orbit.
(B) Kepler's laws forbid an orbit so close to the surface of the Earth.
(C) Because *r* appears in the denominator of Newton's law of gravitation, the force of gravity is much larger closer to the Earth; this force is too strong to allow such an orbit.
(D) The closer orbit would likely crash into a large mountain such as Everest because of its elliptical nature.
(E) Much of the Shuttle's kinetic energy would be dissipated as heat in the atmosphere, degrading the orbit.

Question 8. The orbital speed of a satellite orbiting the earth in a circular orbit at the height of 400 km above the surface of the earth is v_o. If the same satellite is at a distance of 800 km above the surface of the earth and the radius of the earth is 6400 m, the orbital speed of the satellite would be

(A) $2v_o$
(B) v_o
(C) $0.97v_o$
(D) $0.71v_o$
(E) $0.5v_o$