

Example : Planet Z

A 1500-kg satellite orbits Planet Z at an altitude equal to 3x Planet Z's radius.

$$\begin{aligned} \text{Planet Z} \\ M &= 7.4 \times 10^{23} \text{ kg} \\ R &= 8.3 \times 10^6 \text{ m} \end{aligned}$$

1. What is the force of attraction between the satellite and Planet Z?
2. What is the satellite's orbital speed?
3. What is the satellite's orbital period?
4. What is the satellite's kinetic energy?
5. What is the satellite's gravitational potential energy?
6. What is the satellite's total energy in orbit?
7. What is the satellite's gravitational energy on the surface of Planet Z?
8. In order to launch the satellite into its orbit, how much kinetic energy does the satellite need on the surface of Planet Z?

Two baseballs are thrown straight up on the surface of Planet Z.

9. If the first baseball escapes Planet Z's pull completely, what is the minimum speed at which it was thrown?
10. What is the maximum height reached by the second baseball if it is thrown at a speed of 2500 m/s?

Use the data below to answer the following questions:

Planet H (hollow sphere)

Mass =  $2.43 \times 10^{24}$  kg

Radius =  $7.25 \times 10^6$  m

Period of Rotation = 27.3 hrs

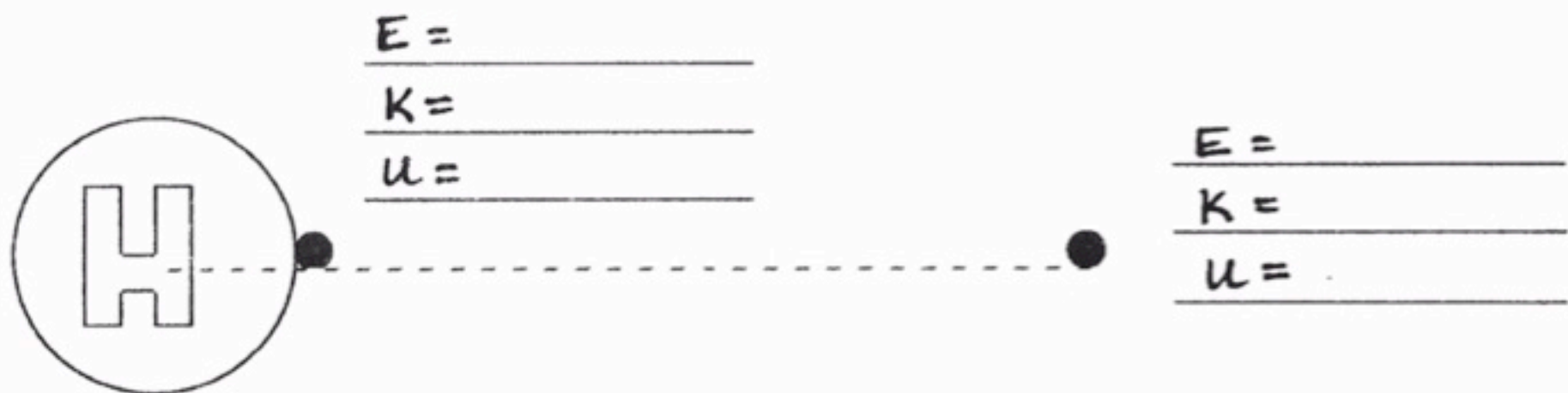
Planet S (solid sphere)

Mass =  $4.58 \times 10^{26}$  kg

Radius =  $8.62 \times 10^7$  m

Period of Rotation = 31.4 hrs

1. A little boy (mass = 42 kg) digging in his backyard on Planet H makes a startling discovery. What is his weight on the surface of his planet? What is his weight below the surface?
2. Intrigued by the fact that their planet is hollow, residents of Planet H send a 1200-kg satellite into orbit to study the planet from a fixed point above the surface of the planet. What is the satellite's orbital radius? What is the satellite's orbital speed?
3. Fill in the missing energy values for the H-synchronous satellite when it is launched and when it is in orbit.



4. Meanwhile, on distant Planet S – oh wait, you want to know just how distant it is? See if you can figure it out. The force of attraction between the two planets is 0.500 N. What is the center-to-center separation of the planets?
5. As I was saying, over on Planet S, a little girl tosses a 2.2-kg ball up with a speed of 9.4 m/s. How many seconds later does she catch it?
6. On a later toss, the girl misses the ball and it falls into a tunnel that passes through the center of the planet. (Didn't her parents warn her about playing near open tunnel holes?) What is the acceleration of the ball when it has fallen  $3.26 \times 10^7$  m?