

Holt Physics

Problem 7G**CENTRIPETAL ACCELERATION****PROBLEM**

Calculate the orbital radius of the Earth, if its tangential speed is 29.7 km/s and the centripetal acceleration acting on Earth is $5.9 \times 10^{-3} \text{ m/s}^2$.

SOLUTION

Given: $v_t = 29.7 \text{ km/s}$ $a_c = 5.9 \times 10^{-3} \text{ m/s}^2$

Unknown: $r = ?$

Use the centripetal acceleration equation written in terms of tangential speed.

Rearrange the equation to solve for r .

$$a_c = \frac{v_t^2}{r}$$

$$r = \frac{v_t^2}{a_c} = \frac{(29.7 \times 10^3 \text{ m/s})^2}{5.9 \times 10^{-3} \text{ m/s}^2} = 1.5 \times 10^{11} \text{ m} = 1.5 \times 10^8 \text{ km}$$

ADDITIONAL PRACTICE

- The largest salami in the world, made in Norway, was more than 20 m long. If a hungry mouse ran around the salami's circumference with a tangential speed of 0.17 m/s, the centripetal acceleration of the mouse was 0.29 m/s^2 . What was the radius of the salami?
- The largest steerable single-dish radio telescope is located at the branch of the Max Planck Institute in Bonn, Germany. Suppose this telescope rotates about its axis with the same angular speed as Earth. The centripetal acceleration of the points at the edge of the telescope is $2.65 \times 10^{-7} \text{ m/s}^2$. What is the radius of the telescope dish?
- In 1994, Susan Williams of California blew a bubble-gum bubble with a diameter of 58.4 cm. If this bubble were rigid and the centripetal acceleration of the equatorial points of the bubble were $8.50 \times 10^{-2} \text{ m/s}^2$, what would the tangential speed of those points be?
- An ostrich lays the largest bird egg. A typical diameter for an ostrich egg at its widest part is 12 cm. Suppose an egg of this size rolls down a slope so that the centripetal acceleration of the shell at its widest part is 0.28 m/s^2 . What is the tangential speed of that part of the shell?
- A waterwheel built in Hamah, Syria, rotates continuously. The wheel's radius is 20.0 m. If the wheel rotates once in 16.0 s, what is the magnitude of the centripetal acceleration of the wheel's edge?
- In 1995, Cathy Marsal of France cycled 47.112 km in 1.000 hour. Calculate the magnitude of the centripetal acceleration of Marsal with respect to Earth's center. Neglect Earth's rotation, and use $6.37 \times 10^3 \text{ km}$ as Earth's radius.