Name _____
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Simple Harmonic Motion Problem Set

1. A child on a swing has a mass of 34 kg and the swing's length is 3 m. What is the period?

2. A second kid hops on the swing with the child above and they swing together. If the second kid has twice the mass of the first, what is their combined period?

3. A wrecking ball swings freely from the end of the boom of a crane. If the ball's frequency is 0.167 Hz, what is the length of the cable suspending the ball?

4. What length must a pendulum be to allow 20 cycles of a 165 gram mass in 15 seconds?

5. The concentration of extra mass in certain spots beneath the Earth's surface will change the normal value of g. Called g anomalies (gravity abnormalities), they exist in many places, especially the west end of the U.P. Testing to find these can be done by setting up a small portable pendulum, measuring T, and calculating g. If the bob's length is 0.08 m and it takes 11.06 seconds for one cycle, calculate the value of g there.

6. If a mass-spring system is taken to the Moon, will the period of the system change? How about the period of a pendulum taken to the Moon? Explain.

7. What mass on a spring with a spring constant of 100 N/m will oscillate with a period of 2.0 s?

8. A 0.50 kg mass oscillates in simple harmonic motion on a spring with a spring constant of 200 N/m. What are (a) the period and (b) the frequency of the oscillation?

9. If the spring constant in a mass-spring system is tripled, the new period is

   a. 3 b. $\sqrt{3}$ c. $\frac{1}{\sqrt{3}}$ times the old period. (Choose one).

   Why?

   If the initial period is 2.0 s and the spring constant is halved, what is the new period?

10. The largest ruby in the world may be found in New York. This ruby is 109 mm long, 91 mm wide, and 58 mm thick, making its volume about 575 cm^3. (By comparison, the world's largest diamond, the Star of Africa, has a volume of just over 30 cm^3.)
    a. If the ruby is attached to a vertically hanging spring with a spring constant of 2.00×10^2 N/m so that the spring is stretched 15.8 cm what is the gravitational force pulling the spring?

    b. What is the mass of the jewel?

11. Rising 348 m above the ground, La Gran Piedra in Cuba is the tallest rock on Earth. Suppose an elastic band 2.00×10^2 m long hangs vertically off the top of La Gran Piedra. If the band's spring constant is 25.0 N/m, how large must a mass be if, when it is attached to the band, it causes the band to stretch all the way to the ground?

12. Ganymede, the largest of Jupiter's moons, is also the largest satellite in the solar system. Find the acceleration of gravity on Ganymede if a simple pendulum with a length of 1.00m has a period of 10.5 s.

13. The hummingbird makes a humming sound with its wings, which beat with a frequency of 90.0 Hz. Suppose a mass is attached to a spring with a spring constant of 2.50×10^{2} N/m. How large is the mass if its oscillation frequency is 3.00×10^{-2} times that of a hummingbird's wings?

14. A double coconut can grow for 10years and have a mass of 20.0 kg. If a 20.0 kg double coconut oscillates on a spring 42.7 times each minute, what is the spring constant of the spring?

15. A spring stretches by 25.0 cm when a 0.500 kg mass is suspended from its end.
    a. Determine the spring constant.

    b. How much elastic potential energy is stored in the spring when it is stretched this far?

16. On a planet where the gravitational acceleration is five times *g* on Earth, a pendulum swings back and forth with a period 1.22 s. What is the length of the pendulum?

17. Find the period of a pendulum that is 1.2 m long.

18. A pendulum has a period of 1.2 s. How long is it?

19. A pendulum has a frequency of 1.2 Hz. Find the period and the length of this pendulum.

20. You are stranded on an island and need to make a clock. How would you build a pendulum that has a period of 1.0 second and another a period of 1.0 minute?

21. While on the island you discover the tallest tree. To determine its height you suspend a rope from the top and tie yourself on at the bottom. You push off and return to the starting point 7.0 seconds later. How tall is the tree?

22. You discover a spring and want to know its properties. You hang it from a tree and measure the length of the spring to be 1.0 m. You suspend 15 kg from the spring and it stretches to a new length of 1.4 m. Find the spring constant for this spring.

23. You then pull the mass from problem #22 a bit further and release. Find the period and frequency of oscillation for the spring in problem #22.

24. A spring with a spring constant of 650 N/m has a rest length of 1.7 m. When a mass is suspended from it and then set into simple harmonic motion the mass oscillates at a frequency of 1.4 Hz. Find the mass of the object.

25. If the mass in problem #24 is now at rest while suspended from the spring, what is the length of the spring?

26. You wish to build a clock with a spring that has a spring constant of 23 N/m. How much mass will you need to make this clock have a frequency of 1.0 Hz?

27. Your boss at work needs a way to accurately measure 5.0 seconds. Clocks are out of the question and all you have is a 1.0 kg bucket with 15 kilograms of sand, a 2 m long piece of rope and a spring with a spring constant of 22 N/m. How would you suggest building this measuring equipment and what are its specifications?

28. The bowling balls used for a Newton's Cradle had cables that were 23 feet (7.0 m) long. If a person released it toward you and you were at the other end of the swing, how much time would you have to get out of the way?