

1. (i) If your heart is beating at 76.0 beats per minute, what is the frequency of your heart's oscillations in hertz? (ii) What is the oscillating period of your heart when the frequency increases by a factor of 1.3? (iii) A sewing machine needle moves in simple harmonic motion with a frequency of 2.5 Hz and an amplitude of 1.27 cm; how long does it take the tip of the needle to move from the highest point to the lowest point in its travel? (iv) How long does it take the needle tip to travel a total distance of 11.43 cm?
  
2. Astronaut Harry has landed on Pluto and conducts an experiment to determine the acceleration due to gravity on the dwarf planet. He uses a simple pendulum that is 0.640 m long and measures 10 complete oscillations in 63.8 s. What is the acceleration of gravity on Pluto?
  
3. If you drop a stone into a mineshaft that is 122.5 m deep, how soon after you drop the stone do you hear it hit the bottom of the shaft? The temperature in the mineshaft is  $10^{\circ}\text{C}$ .
  
4. Two submarines are underwater and approaching each other head-on as shown in Fig. 1. Sub *A* has a speed of 10 knots and sub *B* has a speed of 30 knots. Commander Harry on Sub *A* is pinging on *B* with an active sonar frequency of 10 kHz. The speed of sound underwater is 2,912 knots, that is roughly 4.3 times as fast as in air. (i) What frequency will receive Sally on submarine *B* from Harry's sonar? (ii) What is the frequency of the echo Harry receives from Sally's submarine?
  
5. The security alarm on a parked car goes off and produces a frequency of 960 Hz. The speed of sound is 343 m/s. As you drive toward this parked car, pass it, and drive away, you observe the frequency to change by 95 Hz. At what speed are you driving?

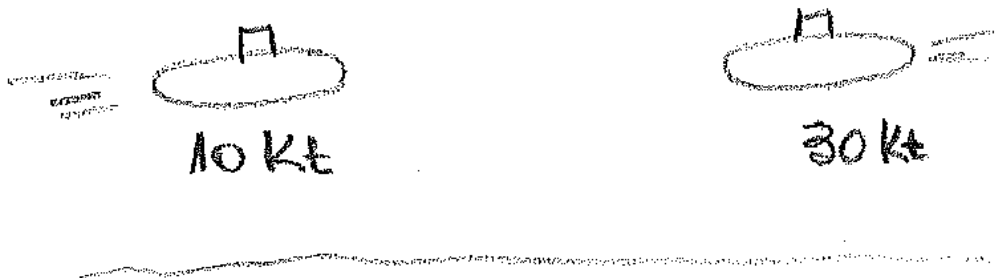


Figure 1: The situation in question 4.