Tutorial Foundations Week 6

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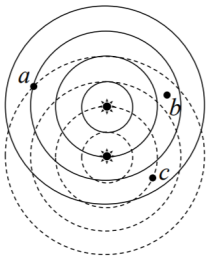
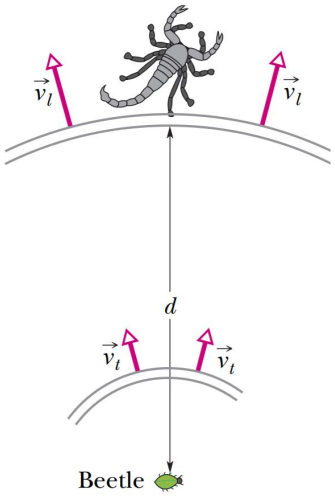
1. How does the energy of a kangaroo hopping at high speed transform during it's motion?
2. The figure (below) shows the circular waves emitted by two in-phase sources, at one instant in time. Are points a¸b, and c points of maximum constructive interference or perfect destructive interference?



•4 A sand scorpion can detect the motion of a nearby beetle (its prey) by the waves the motion sends along the sand surface (Fig. 16-29). The waves are of two types: transverse waves traveling at $v_t = 50$ m/s and longitudinal waves traveling at $v_l = 150$ m/s. If a sudden motion sends out such waves, a scorpion can tell the distance of the beetle from the difference Δt in the arrival times of the waves at its leg nearest the beetle. If $\Delta t = 4.0$ ms, what is the beetle's distance?



••36 *Party hearing.* As the number of people in the JCR increases, you must raise your voice for a listener to hear you against the *background noise* of the other freshers . However, once you reach the level of yelling, the only way you can be heard is if you move closer to your listener, into the listener's "personal space." ;) Model the situation by replacing you with an isotropic point source of fixed power P and replacing your listener with a point that absorbs part of your sound waves. These points are initially separated by $r_i = 1.20$ m. If the background noise increases by $\Delta\beta = 5$ dB, the sound level at your listener must also increase. What separation r_f is then required?

Ocean waves of wavelength 100 m have a period of 8 s. A motorboat heads into the waves at 9 m/s.

1. What is the wave speed relative to (i) the land; (ii) the boat?
2. With what frequency do wave crests hit the front of the boat? Note that the frequency change is known as a Doppler shift, which you may be familiar with as the change in pitch of a sound from a rapidly moving object, e.g. the sound of a racing car passing you.

•2 *A human wave.* During sporting events within large, densely packed stadiums, spectators will send a wave (or pulse) around the stadium (Fig. 16-28). As the wave reaches a group of spectators, they stand with a cheer and then sit. At any instant, the width w of the wave is the distance from the leading edge (people are just about to stand) to the trailing edge (people have just sat down). Suppose a human wave travels a distance of 853 seats around a stadium in 39 s, with spectators requiring about 1.8 s to respond to the wave's passage by standing and then sitting. What are (a) the wave speed v (in seats per second) and (b) width w (in number of seats)?

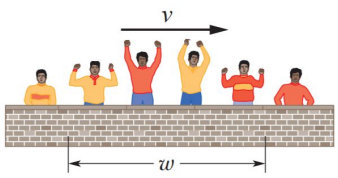


Fig. 16-28 Problem 2.