

### Exercise 11. Waves at Sea

This exercise is designed to give students an appreciation for transfer of energy between the wind and water and the development of large waves at sea. These large waves become long-period swells and ultimately form the big surf that strikes distant shorelines. Students will be required to interpolate between values given in the tables to answer the questions on deep-water waves. We recommend that this exercise be followed by, or given in conjunction with, Exercise 12 (Waves in Shallow Water and Beach Erosion).

1. a. 13 knots, 24 km/hour.  
b. ~4.15 hours.  
c. The resulting wave heights would not be a problem to boaters, because they are very small (< 2 feet or 0.6 meters in height).  
d. In the winter, the resulting wave heights are much higher, approximately 4.1 meters (13.6 ft). Wave heights of this magnitude would obviously be more of a problem for boaters than wave heights of less than 0.6 meters (< 2 ft).
2. Maximum wind speed is 42.4 knots; resulting wave heights would be 9.9 meters or 32.3 feet.
3. a. During the winter, the largest waves striking California come from the northwest sector.  
b. In the summertime, the largest swells come from the south with a range of 10–16 seconds and 6.1–8.54 meters (20–28 ft).  
c. Waves of medium periods produce the largest waves.
4. a. Group velocity is one-half individual wave velocity or 50 kilometers/hour.  
b. These waves would take ~3 hours to travel 1,500 kilometers.  
c. Long waves contain the most energy and travel with the highest velocities.