1. A neurologist holds a ruler of 1 m vertically with 0-m below his fingers, while his patient suspected of having partial brain damage waits with her fingers poised at 50-cm mark on the ruler. The ruler will be dropped unexpectedly and the patient will try to catch it as quickly as possible. If the ruler is caught at 90-cm, what is the reaction time of his patient? Do this test with your friend to check your own reaction time (and whether you have brain damage or not!).

2. A string is tied with weights at regular increasing heights above ground. We drop the string and listen to the sound as each weight strikes a board at the bottom. What type of time interval will be heard for each hit?

3. Setting a new world record in a 100-m race, Maggie and Judy cross the finish line in a dead heat, both taking 10.2 s. Accelerating uniformly, Maggie took 2.00 s and Judy 3.00 s to attain maximum speed, which they maintained for the rest of the race. (a) What was the acceleration of each sprinter? (b) What were their respective maximum speeds? (c) Which sprinter was ahead at the 6.00-s mark, and by how much?

4. A rock is dropped from rest into a well. (a) The sound of the splash is heard 2.40 s after the rock is released from rest. How far below the top of the well is the surface of the water? The speed of sound in air (at the ambient temperature) is 336 m/s. (b) What If? If the travel time for the sound is neglected, what percentage error is introduced when the depth of the well is calculated?

5. Three displacements are \( A = 200 \text{ m, due south}; \) \( B = 250 \text{ m, due west}; \) \( C = 150 \text{ m, } 30.0^\circ \text{ east of north.} \) Construct a separate diagram for each of the following possible ways of adding these vectors:

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R_1 = A + B + C; \quad R_2 = B + C + A; \quad R_3 = C + B + A.
\]
6. A man pushing a mop across a floor causes it to undergo two displacements. The first has a magnitude of 150 cm and makes an angle of 120° with the positive x axis. The resultant displacement has a magnitude of 140 cm and is directed at an angle of 35.0° to the positive x axis. Find the magnitude and direction of the second displacement.

7. The instantaneous position of an object is specified by its position vector \( \mathbf{r} \), leading from a fixed origin to the location of the point object. Suppose that for a certain object the position vector is a function of time, given by \( \mathbf{r} = 4\hat{i} + 3\hat{j} - 2t\hat{k} \), where \( r \) is in meters and \( t \) is in seconds. Evaluate \( d\mathbf{r}/dt \). What does it represent about the object?

8. Long John Silver, a pirate, has buried his treasure on an island with five trees, located at the following points: (30.0 m, −20.0 m), (60.0 m, 80.0 m), (−10.0 m, −10.0 m), (40.0 m, −30.0 m), and (−70.0 m, 60.0 m), all measured relative to some origin, as in Figure. His ship’s log instructs you to start at tree A and move toward tree B, but to cover only one-half the distance between A and B. Then move toward tree C, covering one-third the distance between your current location and C. Next move toward D, covering one-fourth the distance between where you are and D. Finally move towards E, covering one-fifth the distance between you and E, stop, and dig. (a) Assume that you have correctly determined the order in which the pirate labeled the trees as A, B, C, D, and E, as shown in the figure. What are the coordinates of the point where his treasure is buried? (b) What if you do not really know the way the pirate labeled the trees? Rearrange the order of the trees [for instance, B(30 m, −20 m), A(60 m, 80 m), E(−10 m, −10 m), C(40 m, −30 m), and D(−70 m, 60 m)] and repeat the calculation to show that the answer does not depend on the order in which the trees are labeled.