Algebra and Kinematics

1. Solve each equation for the indicated variable. Simplify your results.

   (a) Solve for ϕ: $\beta + 2\phi = 180 - (2\beta + \phi)$

   (b) Solve for C_1: $^1/C_s = {}^1/C_1 + {}^1/C_2$.

   (c) Solve for t: $x_1 + v_1 t = x_2 + \frac{1}{2} a_2 t^2$.

      i) Find a value for t if $x_1 = 2$ m, $x_2 = 5$ m, $v_1 = 8$ m/s, and $a_2 = 6$ m/s^2.

2. Solve each system of equations for the indicated variables. Simplify your results.

   (a) Solve for R_1 and R_2:   (1) $3R_1 - 2R_2 = 1.5$ (2) $5R_1 + 4R_2 = 8$

   (b) Solve for a and T: (1) $T - mg = ma$ (2) $Mg \sin\phi - T = Ma$.

   (c) Solve for a, T_1, and T_2:   (1) $F - T_1 = m_1 a$ (2) $T_1 - T_2 = m_2 a$

                                          (3) $T_2 = m_3 a$

3. An athlete swims the length of a 50.0-m pool in 20.0 s and makes the return trip in 22.0 s. Determine her average speed and average velocity in
   (a) the first half of the swim,
   (b) the second half of the swim, and
   (c) the round trip.

4. An electron in a cathode ray tube of a TV set enters a region where it accelerates uniformly from a speed of 3.0×10^6 m/s to a speed of 5.0×10^6 m/s in a distance of 2.0 cm.
   (a) How long is the electron in the region where it accelerates?
   (b) What is the acceleration of the electron in this region?

5. A particle travels in the positive x direction for 10.0 s at a constant speed of 50.0 m/s. It then accelerates uniformly to a speed of 80.0 m/s in the next 5.00 s. Find
   (a) the average acceleration of the particle in the first 10.0 s,
   (b) its average acceleration in the interval t = 10.0 s to t = 15.0 s,
   (c) the total displacement of the particle between t = 0 and t = 15.0 s, and
   (d) its average speed in the interval t = 0 s to t = 15.0 s.

6. A ranger in a national park is driving along at 35 mi/h when a deer jumps into the road 215 feet ahead of the vehicle. After a reaction time, t, the ranger applies the brakes to produce an acceleration of -9.00 ft/s^2. What is the maximum reaction time allowed if she is to avoid hitting the deer?

7. A young woman named Susan Speedy buys a super-deluxe sports car that can accelerate at a rate of 16 ft/s^2. She decides to test the car by dragging with another speedster, Ken Kool. Both start from rest, but experienced Ken leaves 1 s before Susan. If Ken moves with a constant acceleration of 12 ft/s^2 and Susan maintains an acceleration of 16 ft/s^2, find
   (a) the time it takes Susan to overtake Ken,
   (b) the distance she travels before she catches him, and
   (c) the velocities of both cars at the instant she overtakes him.

8. On a trip, you drive 375 mi north, then 245 mi at 30.0° east of north, then 85 mi at 20.0° south of east.
    (a) What is your total displacement?
    (b) If your average speed was 55.0 mi/hr, how long did the trip take you?
    (c) What was your average velocity?

9. A car is travelling at 80.0 km/h east at 9:00 am. The same car is travelling at 50.0 km/h west at 10:00 am.
    (a) Determine the change in velocity of the car from 9:00 am to 10:00 am. Draw a vector diagram showing the velocities at 9:00 am and 10:00 am and the change in velocity. Define the variables you use to name the vectors.
    (b) What is the average acceleration of the car between 9:00 am and 10:00 am?
    (c) The same car is travelling at 40.0 km/h south at 11:00 am. What is the change in velocity of the car (magnitude and direction) from 9:00 am to 11:00 am? Again, draw a vector diagram showing the velocities at 9:00 am and 11:00 am and the change in velocity.