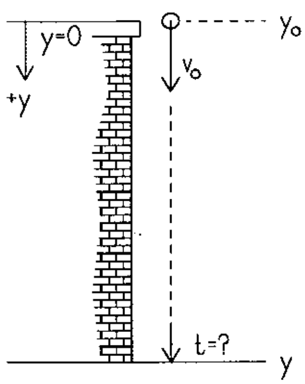
Skill Drill 13

This drill asks you to give further thought to some of the hints for the intelligent use of formulas outlined in the previous review.

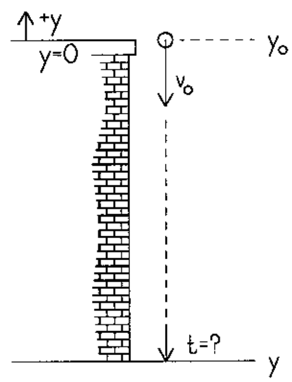
1. The following diagrams all apply to the problem of a freely falling ball used as an example in Review 13. In each case the choice of direction and origin of the coordinate axis is different. Otherwise the problem is identical to the example.

Give the values (with sign) of y_o, y (at base of building), v_o, and a which you would use in the quadratic expression given in the review to find the time the ball reaches the ground. (For numerical values, refer to the statement of the problem on the first page of Review 13.)

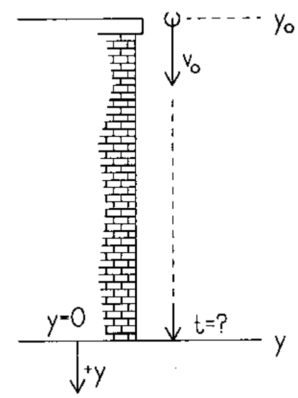
(a)



(b)



(c)



(a)

y_o = ________
y = ________
v_o = ________
a = ________.

(b)

y_o = ________
y = ________
v_o = ________
a = ________.

(c)

y_o = ________
y = ________
v_o = ________
a = ________.

2. Verify that the choice of y_o, y, v_o, and *a* appropriate to Figure (a) above yields the same value of time (t = 2.0 s) which was found in the example problem in Review 13. Recall that the equation to use is

$$y = \tfrac{1}{2}at^2 + v_o t + y_o \ .$$

3. The following is an assortment of equations which might be encountered in connection with problems in several areas of physics. Some of them are correct and some are erroneous. Apart from subscripts (and primes) all of the equations involve position (or length) *x*, speed *v*, acceleration *a*, and time *t*. By checking the dimensions of the terms in these expressions, determine which are possibly correct and which are surely incorrect. (Remember: trig functions are dimensionless.)

$x = \frac{1}{2} v_o / t$ OK___Not OK___

$t = \sqrt{\frac{2(x-x_o)}{a}}$ OK___Not OK___

$v_{av} = \frac{v_1 + v_2}{2t}$ OK___Not OK___

$x = \frac{v_o^2}{a_g} \sin 2\theta$ OK___Not OK___

$t_p = 2\pi \sqrt{\frac{a_g}{x_p}}$ OK___Not OK___

$\tan\theta = \frac{v^2}{a_g\, x_r}$ OK___Not OK___

$t_p = \frac{v - v_s}{x_w}$ OK___Not OK ___

$v_R = \frac{\acute{v} + v}{1 + \frac{\acute{v}v}{v_L^2}}$ OK___Not OK ___

$t_p = t_o \sqrt{\frac{1 - v/v_0}{1 + v/v_0}}$ OK___Not OK ___

4. This problem is a variation on the example problem discussed in Review 13:

At the same moment (t=0) that the ball is thrown downwards from the top of the 30 meter high building with a speed of 5.0 m/s, an elevator on the side of the building starts upwards at a *constant* speed of 5.0 m/s. How long afterwards (time *t*) do the ball and elevator pass by each other? This can be found by solving the following pair of simultaneous equations for t:

$$y = \tfrac{1}{2}at^2 + v_{oB}t + y_{oB} \qquad \textit{and} \qquad y = v_{oE}t + y_{oE}\ .$$

where subscripts B and E refer to the positions and speeds of the ball and elevator, respectively. y is the position at which ball and elevator pass each other.

Draw a diagram which illustrates this problem . Indicate on the drawing the origin and direction of the y-axis, as well as the values (with signs) of v_{oB}, y_{oB}, v_{oE}, and y_{oE}.