

## 2.7 Free Fall

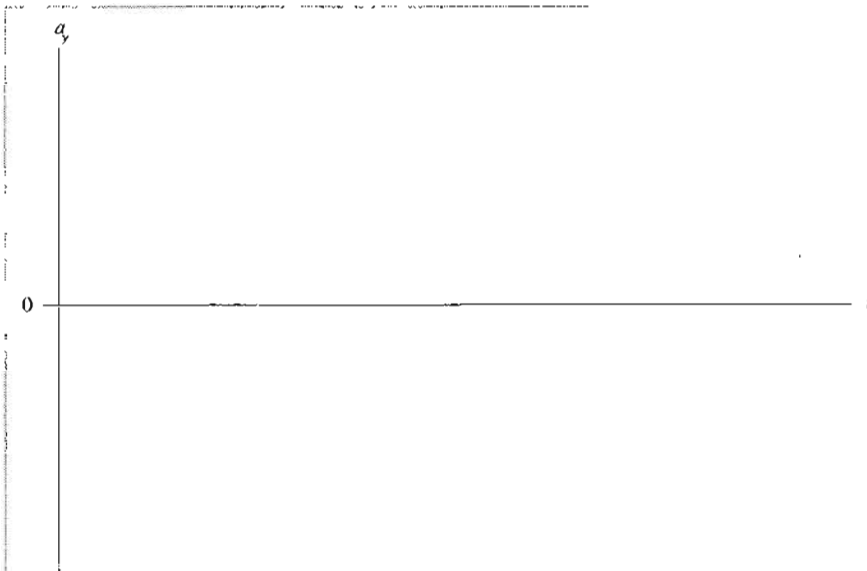
22. A ball is thrown straight up into the air. At each of the following instants, is the ball's acceleration  $g$ ,  $-g$ ,  $0$ ,  $< g$ , or  $> g$ ?

a. Just after leaving your hand? .....

b. At the very top (maximum height)? .....

c. Just before hitting the ground? .....

23. A ball is thrown straight up into the air. It reaches height  $h$ , then falls back down to the ground. On the axes below, graph the ball's acceleration from an instant after it leaves the thrower's hand until an instant before it hits the ground. Indicate on your graph the times during which the ball is moving upwards, at its peak, and moving downwards.



24. On a single graph, using the axes below, graph

a. the acceleration of a rock dropped from a bridge into the river below, and

b. the acceleration of a rock thrown (not dropped) from a bridge into the river below.

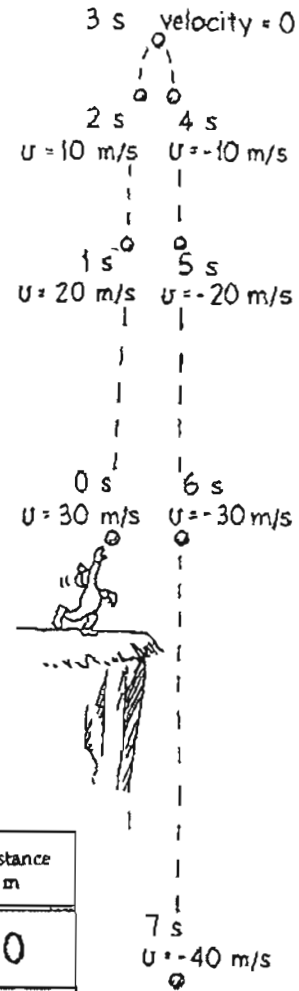
Be sure to label your graphs.



## Straight Up and Down

The sketch is similar to Figure 4.9 in the textbook. Assume negligible air resistance and  $g = 10 \text{ m/s}^2$ .

- Table 1 shows the velocity data of the figure for  $t = 0$  to  $t = 8$  seconds. Complete the table. Distances traveled are from the starting point (the *displacements*).
- Table 2 is for a greater initial velocity. Complete it.
- Table 3 doesn't specify an initial velocity. Choose your own and complete the table accordingly.



Choosing up as +, down as -,  
 $v = v_0 - gt$   
 then falling from rest when  $v_0 = 0$ ,  
 $v = -gt$   
 or  $v = -(10 \text{ m/s}^2)t$

With initial velocity  $v_0$ ;  
 $d = v_0 t - \frac{1}{2}gt^2$  or  $d = v_0 t - (5 \text{ m/s}^2)t^2$   
 Falling from rest when  $v_0 = 0$ ,  
 $d = -(5 \text{ m/s}^2)t^2$

Time in seconds	1.		2.		3.	
	Velocity m/s	Distance m	Velocity m/s	Distance m	Velocity m/s	Distance m
0	30	0	40	0		0
1	20					
2	10					
3	0					
4	-10					
5	-20					
6	-30					
7	-40					
8	-50					

Notice  $g$  is constant; velocity changes by  $-10 \text{ m/s}$  each second!

## CONCEPTUAL PHYSICS