Name _____ Class _____ Date _____

Concept-Development Practice Page 4-1

Free Fall Speed

1. Aunt Minnie gives you $10 per second for 4 seconds. How much money do you have after 4 seconds? $40

2. A ball dropped from rest picks up speed at 10 m per second. After it falls for 4 seconds, how fast is it going? 40 m/s

3. You have $20, and Uncle Harry gives you $10 each second for 3 seconds. How much money do you have after 3 seconds? $50

4. A ball is thrown straight down with an initial speed of 20 m/s. After 3 seconds, how fast is it going? 50 m/s

5. You have $50 and you pay Aunt Minnie $10/second. When will your money run out? 5 s

6. You shoot an arrow straight up at 50 m/s. When will it run out of speed? 5 s

7. So what will be the arrow's speed 5 seconds after you shoot it? 0 m/s

8. What will its speed be 6 seconds after you shoot it? 7 seconds? 10 m/s; 20 m/s

Free Fall Distance

1. Speed is one thing; distance another. *Where* is the arrow you shoot up at 50 m/s when it runs out of speed? 125 m

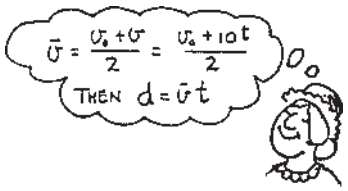
2. How high will the arrow be 7 seconds after being shot up at 50 m/s? 105 m

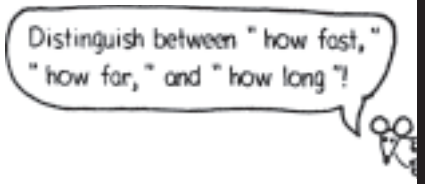
3. a. Aunt Minnie drops a penny into a wishing well and and it falls for 3 seconds before hitting the water. How fast is it going when it hits? 30 m/s

   b. What is the penny's average speed during its 3-second drop? 15 m/s

   c. How far down is the water surface? 45 m

4. Aunt Minnie didn't get her wish, so she goes to a deeper wishing well and throws a penny straight down into it at 10 m/s. How far does this penny go in 3 seconds? 75 m



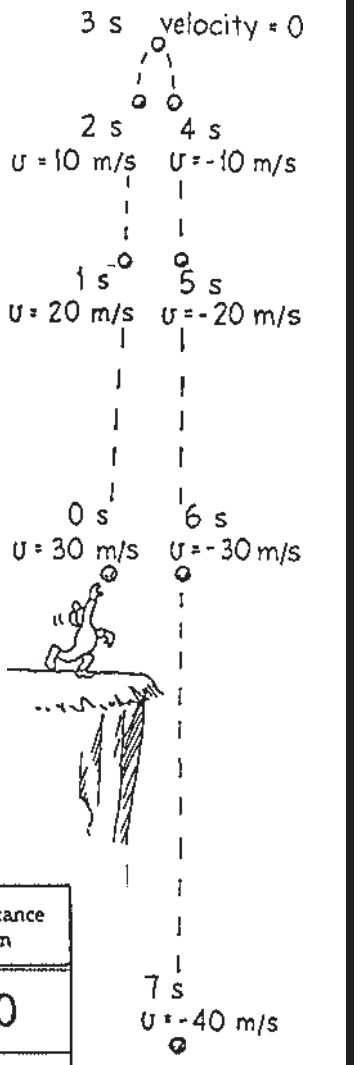


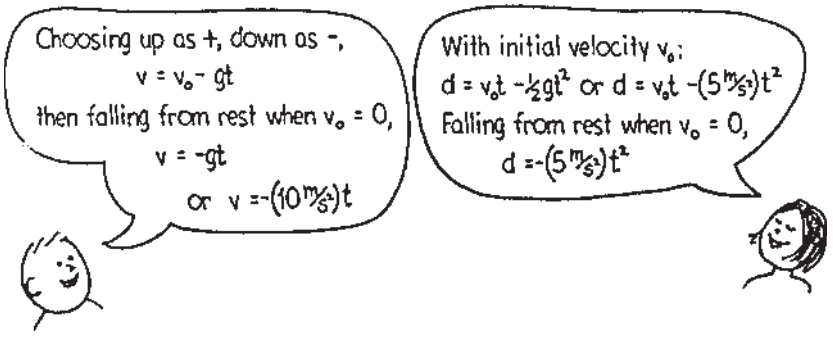
CONCEPTUAL PHYSICS

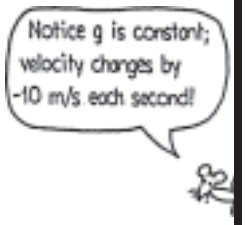
Straight Up and Down

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.







Time in seconds	1. Velocity m/s	1. Distance m	2. Velocity m/s	2. Distance m	3. Velocity m/s	3. Distance m
0	30	0	40	0		0
1	20	25	30	35		
2	10	40	20	60		
3	0	45	10	75		
4	-10	40	0	80		
5	-20	25	-10	75		
6	-30	0	-20	60		
7	-40	-35	-30	35		
8	-50	-80	-40	0		

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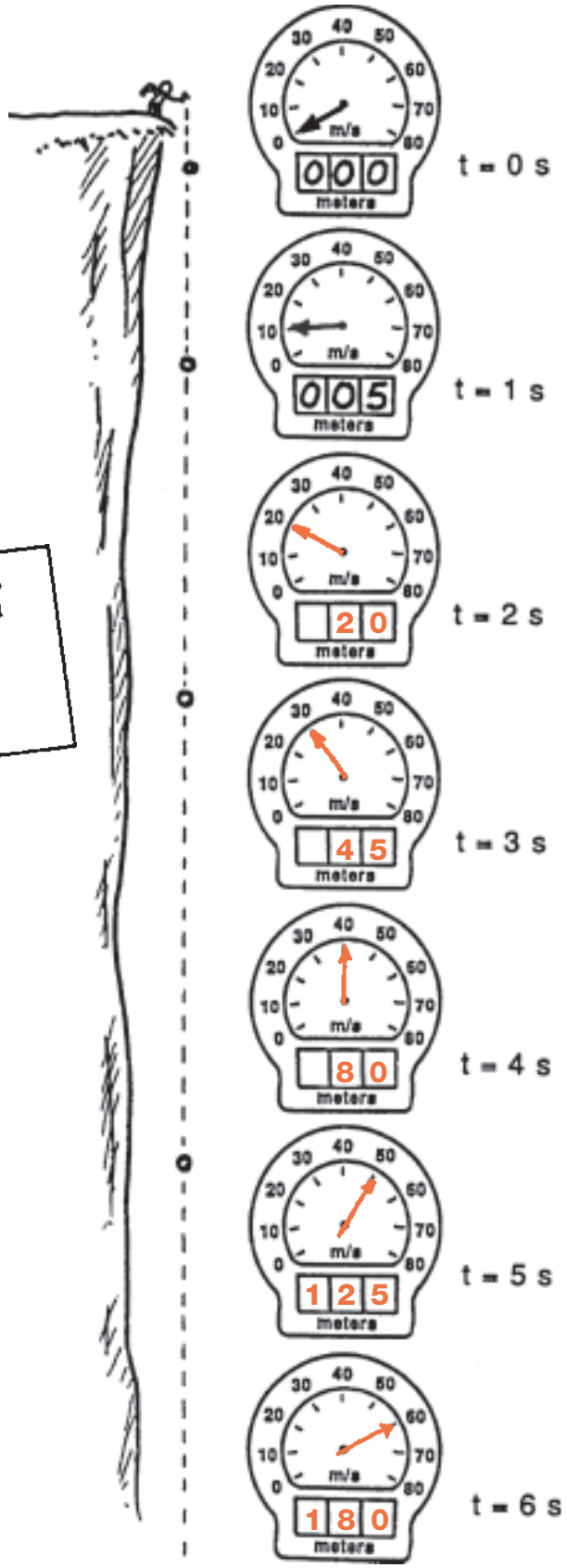
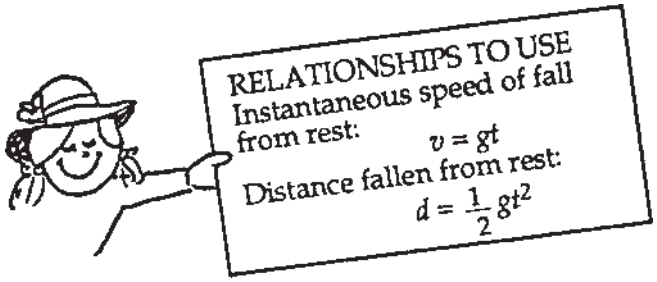
Free Fall

1. A rock dropped from the top of a cliff picks up speed as it falls. Pretend that a speedometer and odometer are attached to the rock to show readings of speed and distance at 1-second intervals. Both speed and distance are zero at time = zero (see sketch). Note that after falling 1 second, the speed reading is 10 m/s and the distance fallen is 5 m. The readings for succeeding seconds of fall are not shown and are left for you to complete. Draw the position of the speedometer pointer and write in the correct odometer reading for each time. Use $g = 10\ m/s^2$ and neglect air resistance.





a. The speedometer reading increased by the same amount, 10 m/s, each second. This increase in speed per second is called acceleration.

b. The distance fallen increases as the square of the time.

c. If it takes 7 seconds to reach the ground, then its speed at impact is 70 m/s, the total distance fallen is 245 m, and its acceleration of fall just before impact is 10 m/s^2.

CONCEPTUAL PHYSICS

Non-Accelerated Motion

1. The sketch shows a ball rolling at constant velocity along a level floor. The ball rolls from the first position shown to the second in 1 second. The two positions are 1 meter apart. Sketch the ball at successive 1-second intervals all the way to the wall (neglect resistance).

   a. Did you draw successive ball positions evenly spaced, farther apart, or closer together? Why?
   Evenly spaced — constant velocity means equal distances covered in equal times.

   b. The ball reaches the wall with a speed of 1 m/s and takes a time of 5 seconds.

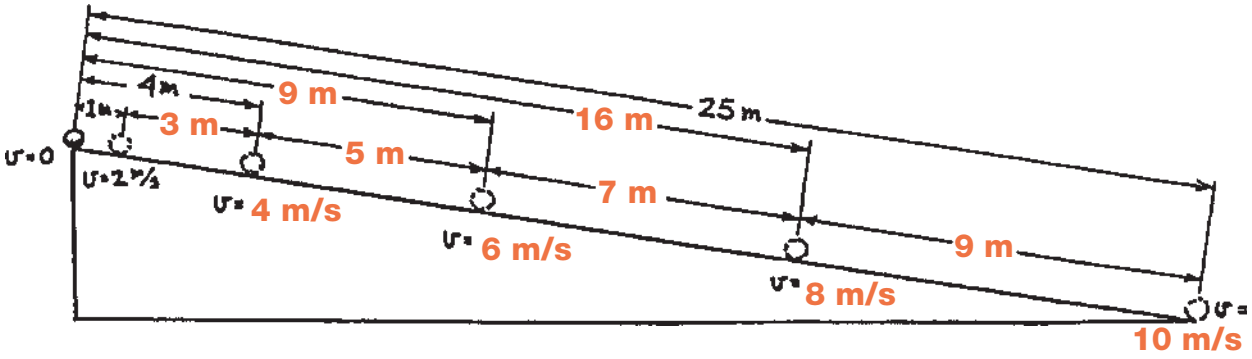
2. Table I shows data of sprinting speeds of some animals. Make whatever computations are necessary to complete the table.

Table I

ANIMAL	DISTANCE	TIME	SPEED
CHEETAH	75 m	3 s	25 m/s
GREYHOUND	160 m	10 s	16 m/s
GAZELLE	1 km	0.01 h	100 km/h
TURTLE	30 cm	30 s	1 cm/s

Accelerated Motion

3. An object starting from rest gains a speed $v = at$ when it undergoes uniform acceleration. The distance it covers is $d = 1/2\ at^2$. Uniform acceleration occurs for a ball rolling down an inclined plane. The plane below is tilted so a ball picks up a speed of 2 m/s each second; then its acceleration $a = 2$ m/s^2. The positions of the ball are shown for 1-second intervals. Complete the six blank spaces for distance covered, and the four blank spaces for speeds.



   a. Do you see that the total distance from the starting point increases as the square of the time? This was discovered by Galileo. If the incline were to continue, predict the ball's distance from the starting point for the next 3 seconds.
   Yes, distance increases as the square of time; 36 m, 49 m, 64 m

   b. Note the increase of distance between ball positions with time. Do you see an odd-integer pattern (also discovered by Galileo) for this increase? If the incline were to continue, predict the successive distances between ball positions for the next 3 seconds.
   Yes; 11 m, 13 m, 15 m