Name _____ Date _____

CONCEPTUAL Physics PRACTICE PAGE

Chapter 3 Linear Motion

Hang Time

Some athletes and dancers have great jumping ability. When leaping, they seem to momentarily "hang in the air" and defy gravity. The time that a jumper is airborne with feet off the ground is called *hang time*. Ask your friends to estimate the hang time of the great jumpers. They may say 2 or 3 seconds. But surprisingly, the hang time of the greatest jumpers is most always less than 1 second! A longer time is one of many illusions we have about nature.

To better understand this, find the answers to the following questions:

1. If you step off a table and it takes one-half second to reach the floor, what will be the speed when you meet the floor?

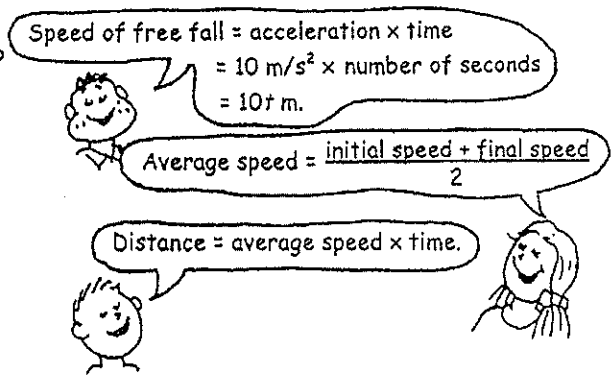
_____

2. What will be your average speed of fall?

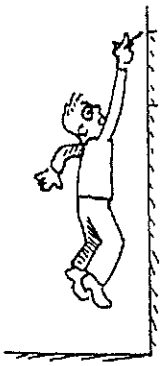
_____

3. What will be the distance of fall?

_____



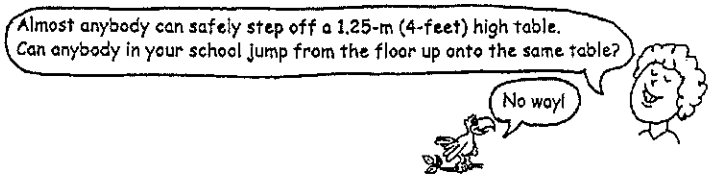
4. So how high is the surface of the table above the floor? _____

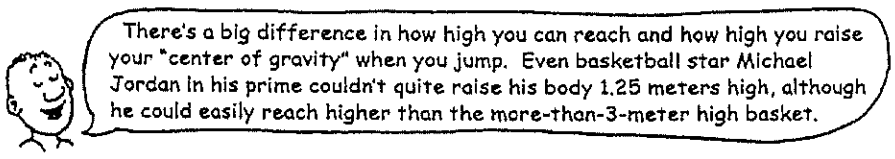


Jumping ability is best measured by a standing vertical jump. Stand facing a wall with feet flat on the floor and arms extended upward. Make a mark on the wall at the top of your reach. Then make your jump and at the peak make another mark. The distance between these two marks measures your vertical leap. If it's more than 0.6 meters (2 feet), you're exceptional.

5. What is your vertical jumping distance? _____

6. Calculate your personal hang time using the formula $d = 1/2\ gt^2$. (Remember that hang time is the time that you move upward + the time you return downward.)





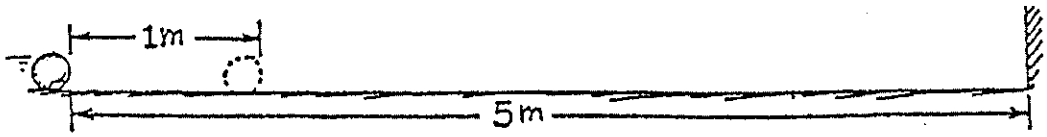
Here we're talking about vertical motion. How about running jumps? We'll see in Chapter 10 that the height of a jump depends only on the jumper's vertical speed at launch. While airborne, the jumper's horizontal speed remains constant while the vertical speed undergoes acceleration due to gravity. While airborne, no amount of leg or arm pumping or other bodily motions can change your hang time.

Hewitt Drew it!

Chapter 3 Linear Motion

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?

_____

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

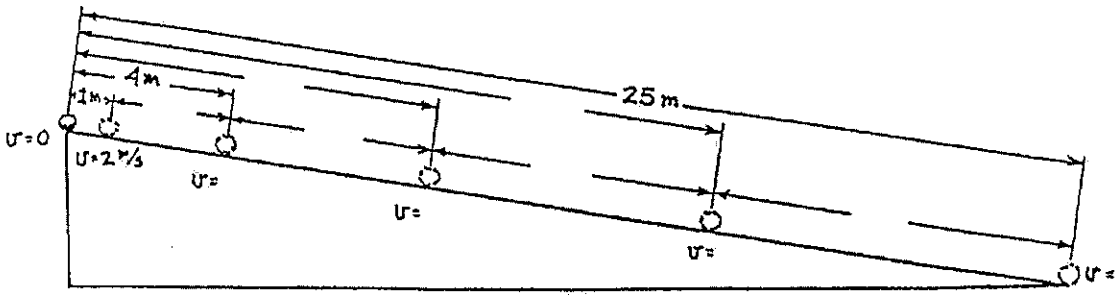
2. Table I shows data of sprinting speeds of some animals. Make whatever computations necessary to complete the table.

TABLE I

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

_____

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.

_____

Hewitt Drew It!