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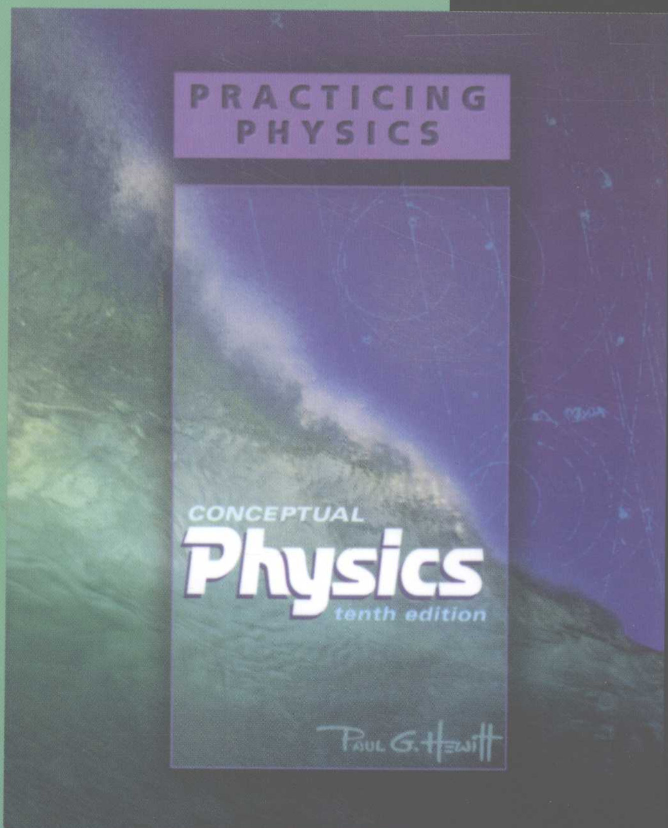
Paul G. Hewitt

概念物理（第10版）
习题集



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概念物理（第10版）
习题集

Practicing Physics: Conceptual Physics (Tenth Edition)

Paul G. Hewitt

清华大学出版社
北京

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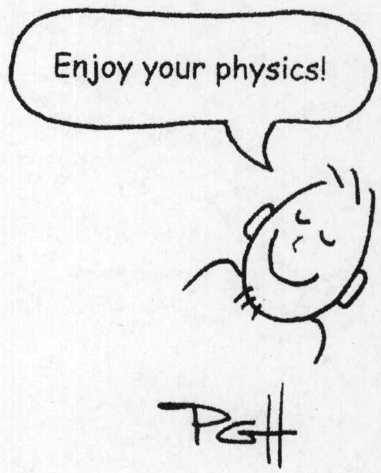
Welcome
to the CONCEPTUAL PHYSICS PRACTICE BOOK

These practice pages supplement *Conceptual Physics, Tenth Edition.* Their purpose is as the name implies—practice—not testing. You'll find it is easier to learn physics by *doing* it—by practicing. AFTER you've worked through a page, check your responses with the reduced pages with answers beginning on page 131.

Pages 193 to 290 show answers to the odd-numbered exercises and solutions to the problems in the textbook.



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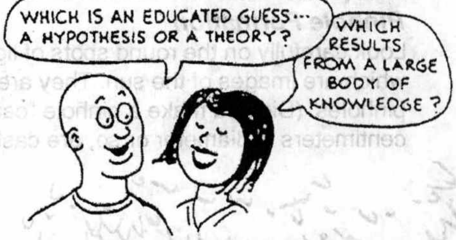
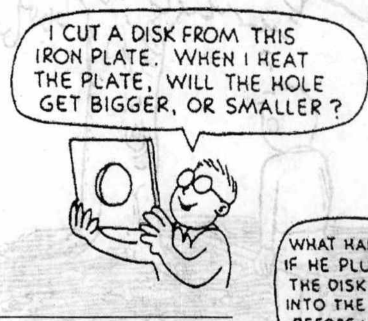
Making Hypotheses



The word science comes from Latin, meaning "to know." The word *hypothesis* comes from Greek, "under an idea." A hypothesis (an educated guess) often leads to new knowledge and may help to establish a theory.

Examples:

1. It is well known that objects generally expand when heated. An iron plate gets slightly bigger, for example, when placed in an oven. But what of a hole in the middle of the plate? One friend may say the size of the hole will increase, and another may say it will decrease.



   a. What is your hypothesis about hole size, and if you are wrong, is there a test for finding out?

   b. There are often several ways to test a hypothesis. For example, you can perform a physical experiment and witness the results yourself, or you can use the library or internet to find the reported results of other investigators. Which of these two methods do you favor, and why?

2. Before the time of the printing press, books were hand-copied by scribes, many of whom were monks in monasteries. There is the story of the scribe who was frustrated to find a smudge on an important page he was copying. The smudge blotted out part of the sentence that reported the number of teeth in the head of a donkey. The scribe was very upset and didn't know what to do. He consulted with other scribes to see if any of their books stated the number of teeth in the head of a donkey. After many hours of fruitless searching through the library, it was agreed that the best thing to do was to send a messenger by donkey to the next monastery and continue the search there. What would be your advice?

Making Distinctions

Many people don't seem to see the difference between a thing and the abuse of the thing. For example, a city council that bans skateboarding may not distinguish between skateboarding and reckless skateboarding. A person who advocates that a particular technology be banned may not distinguish between that technology and the abuses of that technology. There's a difference between a thing and the abuse of the thing.

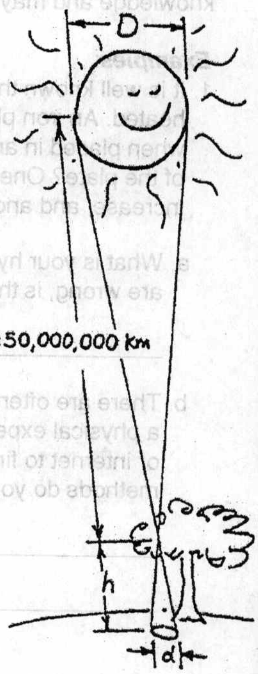
On a separate sheet of paper, list other examples where use and abuse are often not distinguished. Compare your list with others in your class.

Hewitt Drew it!

Chapter 1 About Science

Pinhole Formation

Look carefully on the round spots of light on the shady ground beneath trees. These are *sunballs*, which are images of the sun. They are cast by openings between leaves in the trees that act as pinholes. (Did you make a pinhole "camera" back in middle school?) Large sunballs, several centimeters in diameter or so, are cast by openings that are relatively high above the ground, while small ones are produced by closer "pinholes." The interesting point is that the ratio of the diameter of the sunball to its distance from the pinhole is the same ratio of the Sun's diameter to its distance from the pinhole. We know the Sun is approximately 150,000,000 km from the pinhole, so careful measurements of of the ratio of diameter/distance for a sunball leads you to the diameter of the Sun. That's what this page is about. Instead of measuring sunballs under the shade of trees on a sunny day, make your own easier-to-measure sunball.



1. Poke a small hole in a piece of card. Perhaps an index card will do, and poke the hole with a sharp pencil or pen. Hold the card in the sunlight and note the circular image that is cast. This is an image of the Sun. Note that its size doesn't depend on the size of the hole in the card, but only on its distance. The image is a circle when cast on a surface perpendicular to the rays—otherwise it's "stretched out" as an ellipse.

2. Try holes of various shapes; say a square hole, or a triangular hole. What is the shape of the image when its distance from the card is large compared with the size of the hole? Does the shape of the pinhole make a difference?

____

____

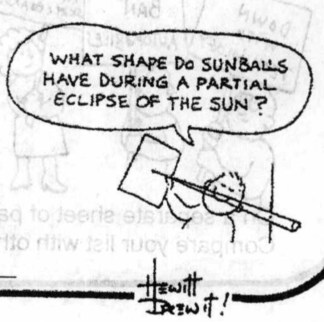
3. Measure the diameter of a small coin. Then place the coin on a viewing area that is perpendicular to the Sun's rays. Position the card so the image of the sunball exactly covers the coin. Carefully measure the distance between the coin and the small hole in the card. Complete the following:

$$\frac{\text{Diameter of sunball}}{\text{Distance of pinhole}} = \underline{\hspace{3cm}}$$

With this ratio, estimate the diameter of the Sun. Show your work on a separate piece of paper.

4. If you did this on a day when the Sun is partially eclipsed, what shape of image would you expect to see?

____

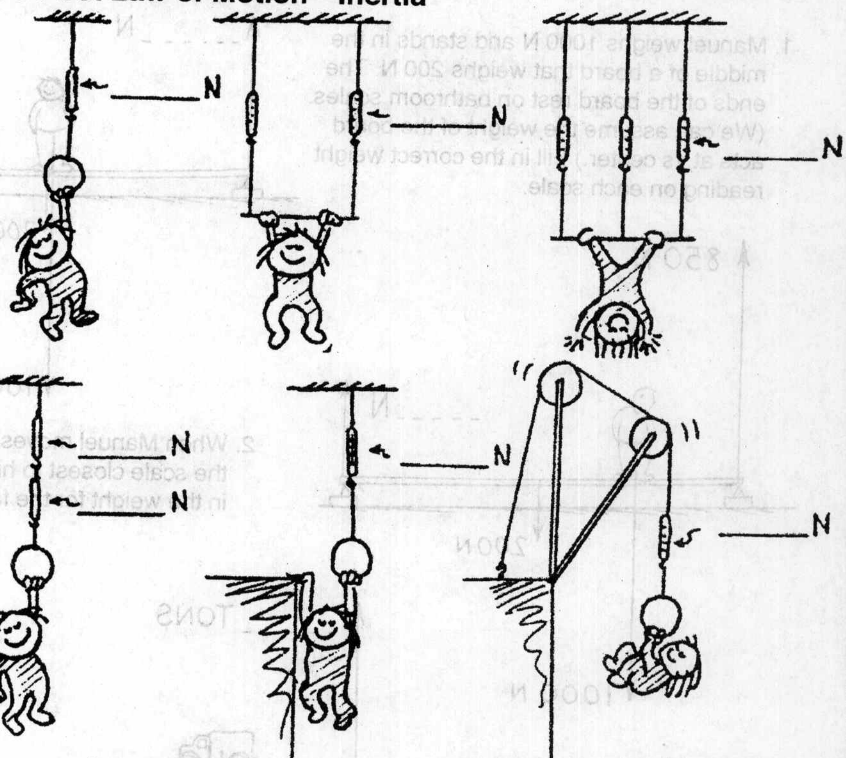


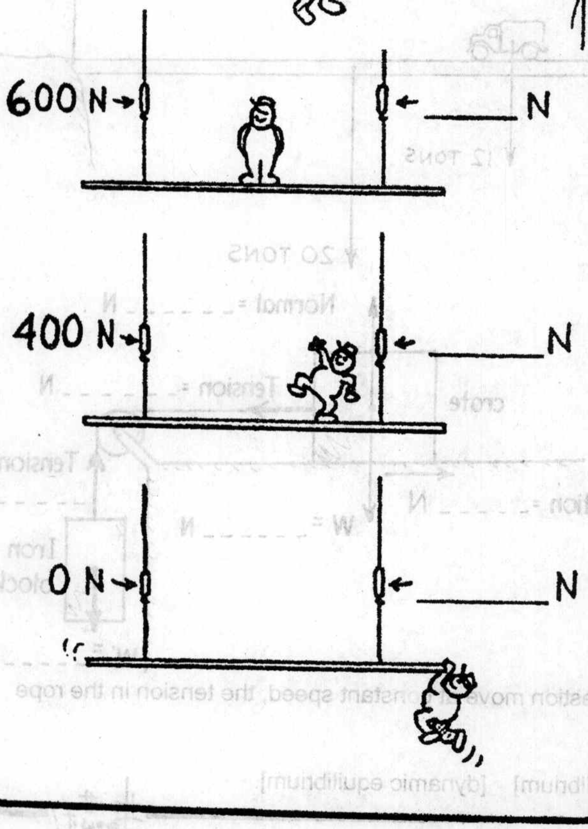
Name ____ Date ______________

Chapter 2 Newton's First Law of Motion—Inertia

Static Equilibrium

1. Little Nellie Newton wishes to be a gymnast and hangs from a variety of positions as shown. Since she is not accelerating, the net force on her is zero. That is, $\Sigma F = 0$. This means the upward pull of the rope(s) equals the downward pull of gravity. She weighs 300 N. Show the scale reading(s) for each case.





2. When Burl the painter stands in the exact middle of his staging, the left scale reads 600 N. Fill in the reading on the right scale. The total weight of Burl and staging must be

_______ N.

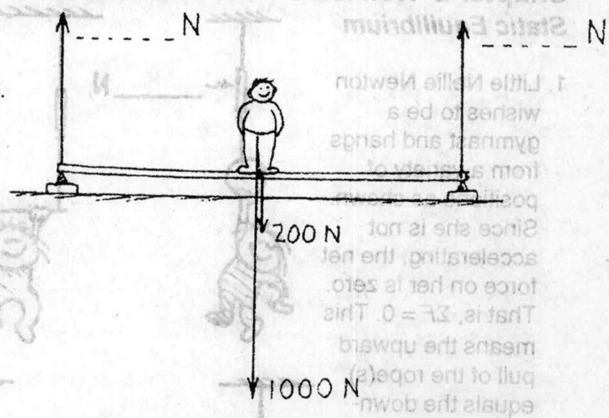
3. Burl stands farther from the left. Fill in the reading on the right scale.

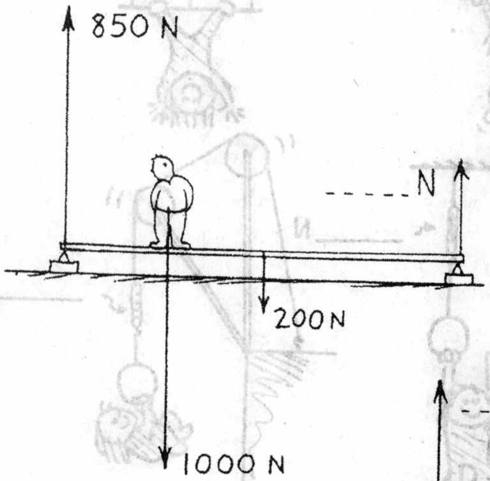
4. In a silly mood, Burl dangles from the right end. Fill in the reading on right scale.

Chapter 2 Newton's First Law of Motion—Inertia

The Equilibrium Rule: $\Sigma F = 0$

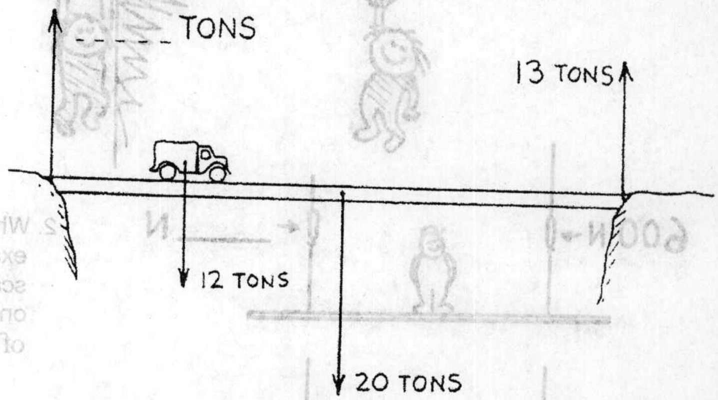
1. Manuel weighs 1000 N and stands in the middle of a board that weighs 200 N. The ends of the board rest on bathroom scales. (We can assume the weight of the board acts at its center.) Fill in the correct weight reading on each scale.



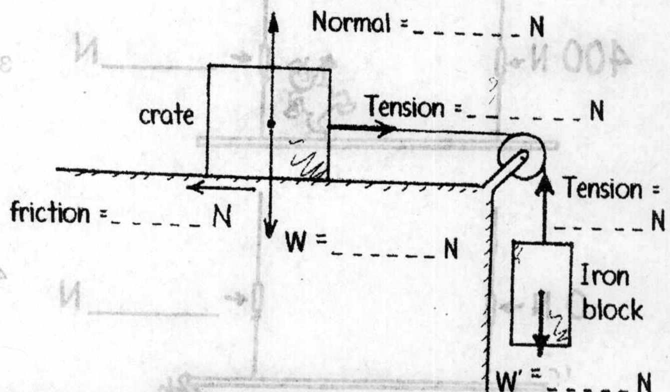


2. When Manuel moves to the left as shown, the scale closest to him reads 850 N. Fill in the weight for the far scale.

3. A 12-ton truck is one-quarter the way across a bridge that weighs 20 tons. A 13-ton force supports the right side of the bridge as shown. How much support force is on the left side?



4. A 1000-N crate resting on a surface is connected to a 500-N block through a frictionless pulley as shown. Friction between the crate and surface is enough to keep the system at rest. The arrows show the forces that act on the crate and the block. Fill in the magnitude of each force.



5. If the crate and block in the preceding question move at constant speed, the tension in the rope

[is the same] [increases] [decreases].

The sliding system is then in [static equilibrium] [dynamic equilibrium].

Hewitt Drew it!

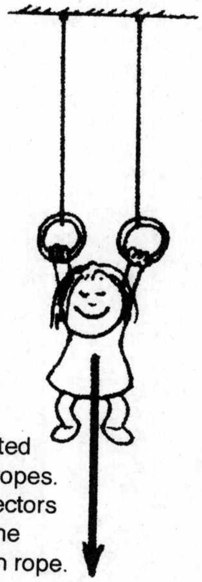
Name ______________________________ Date ____________

CONCEPTUAL Physics PRACTICE PAGE

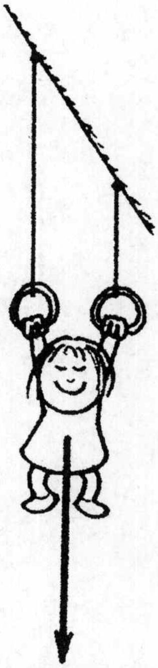
Chapter 2 Newton's First Law of Motion—Inertia

Vectors and Equilibrium

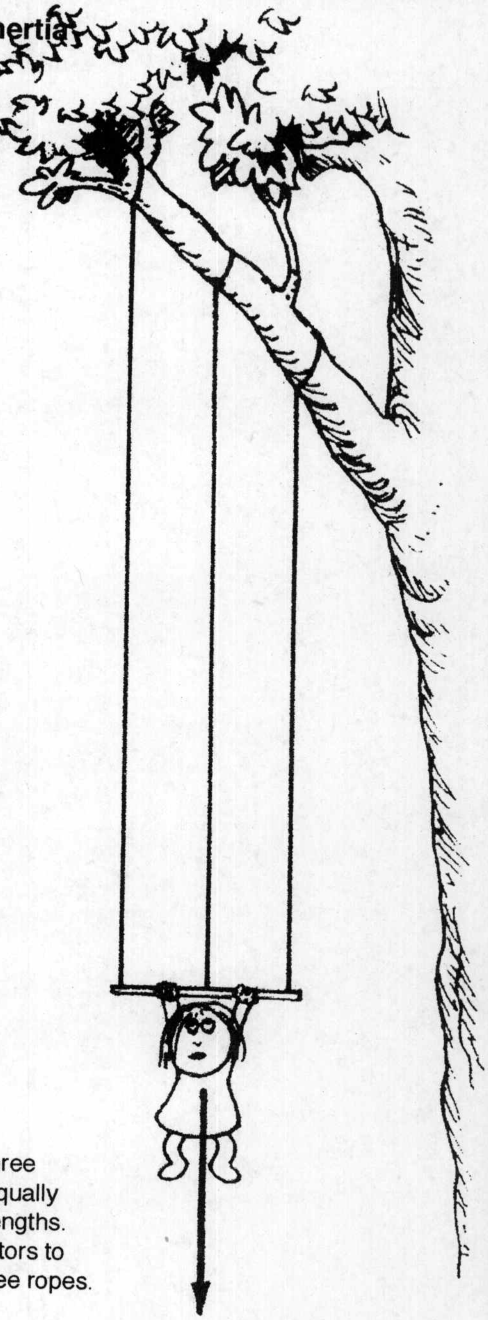
1. Nellie Newton dangles from a vertical rope in equilibrium: $\Sigma F = 0$. The tension in the rope (upward vector) has the same magnitude as the downward pull of gravity (downward vector).



2. Nellie is supported by two vertical ropes. Draw tension vectors to scale along the direction of each rope.



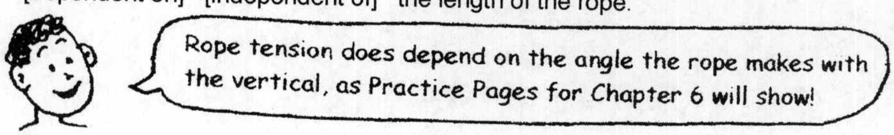
3. This time the vertical ropes have different lengths. Draw tension vectors to scale for each of the two ropes.



4. Nellie is supported by three vertical ropes that are equally taut but have different lengths. Again, draw tension vectors to scale for each of the three ropes.

Circle the correct answer:

5. We see that tension in a rope is [dependent on] [independent of] the length of the rope. So the length of a vector representing rope tension is [dependent on] [independent of] the length of the rope.



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CONCEPTUAL *Physics* PRACTICE PAGE

Chapter 3 Linear Motion

Free Fall Speed

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

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

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

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

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

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

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

8. What will its speed be 6 seconds after you shoot it? ______________

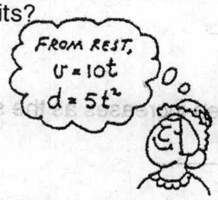
Speed after 7 seconds? ______________

Free Fall Distance

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

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

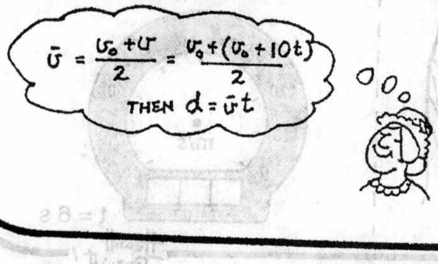
3.a. Aunt Minnie drops a penny into a wishing well, and it falls for 3 seconds before hitting the water. How fast is it going when it hits? ______________

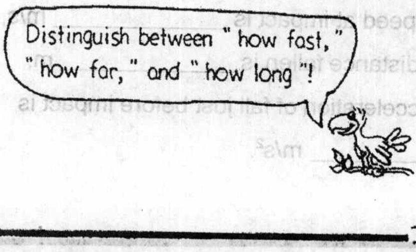


b. What is the penny's average speed during its 3-second drop? ______________

c. How far down is the water surface? ______________

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? ______________

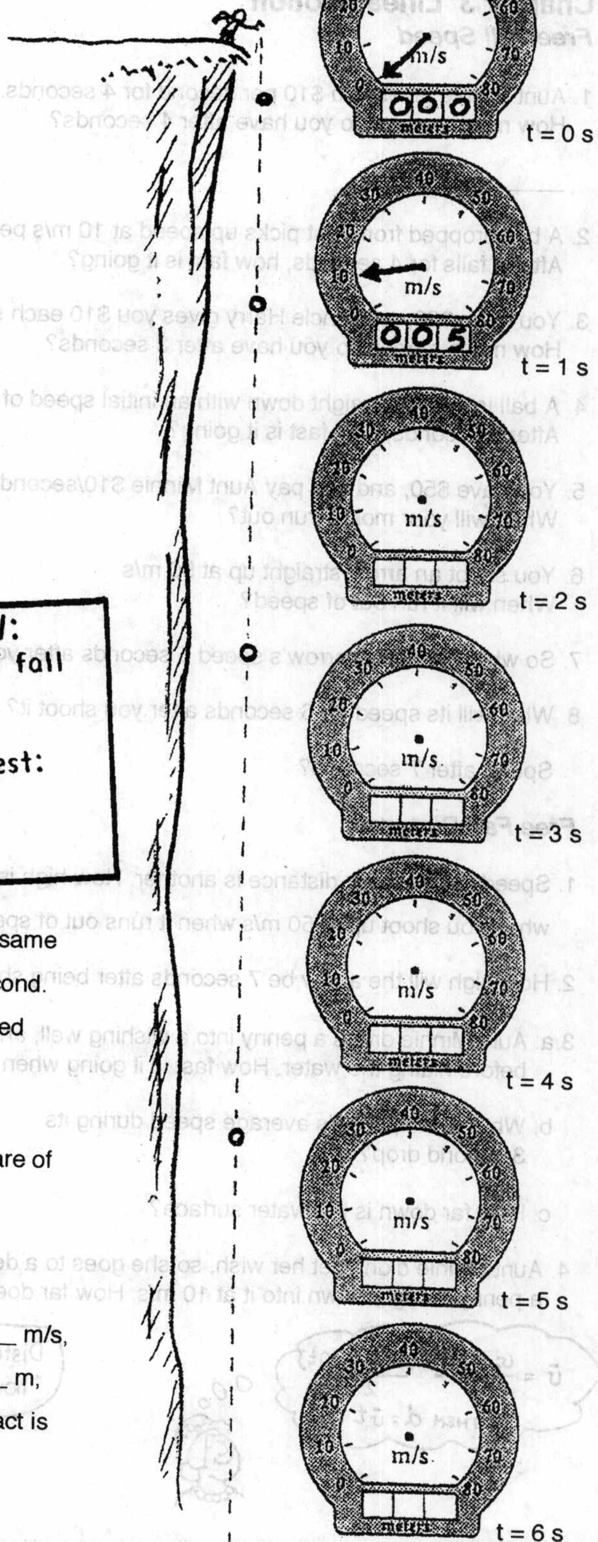




Hewitt Drew it!

Chapter 3 Linear Motion
Acceleration of Free Fall

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 indicate 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 of succeeding seconds of fall are not shown and are left for you to complete. So 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.



YOU NEED TO KNOW:

Instantaneous speed of fall from rest:

$$v = gt$$

Distance fallen from rest:

$$d = v_{average}t$$

or

$$d = \frac{1}{2}gt^2$$

1. The speedometer reading increases the same amount, _______________ m/s, each second. This increase in speed per second is called _______________.

2. The distance fallen increases as the square of the _______________.

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

Hewitt Drew it!

Name ______________________________ Date ______________

CONCEPTUAL *Physics* PRACTICE PAGE

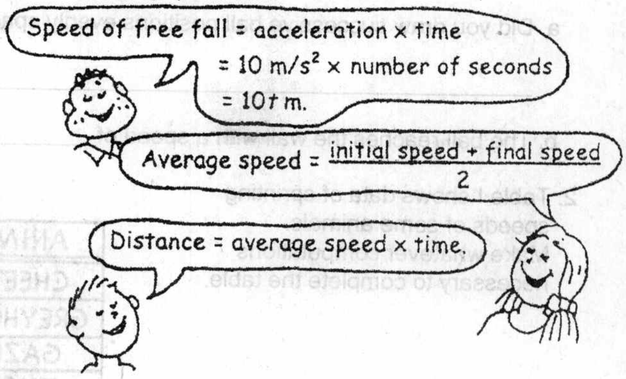
Chapter 3 Linear Motion

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 two or three 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:

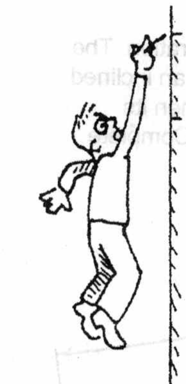
1. If you step off a table and it takes one-half second to reach the floor, what will be the speed when you meet the floor? ______________



2. What will be your average speed of fall? ______________

3. What will be the distance of fall? ______________

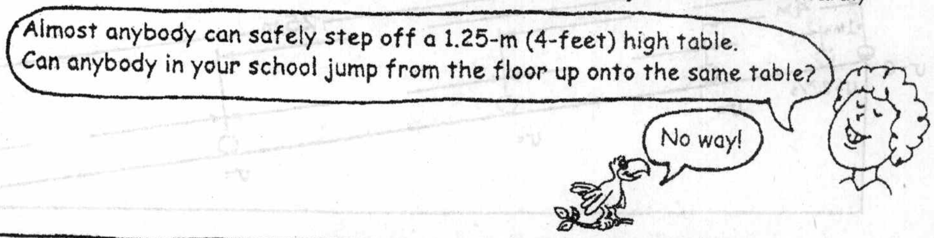
4. So how high is the surface of the table above the floor? ______________

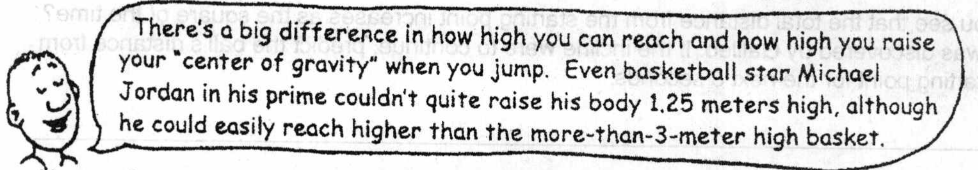


Jumping ability is best measured by a standing vertical jump. Stand facing a wall with feet flat on the floor and arms extended upward. Make a mark on the wall at the top of your reach. Then make your jump and at the peak make another mark. The distance between these two marks measures your vertical 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.)





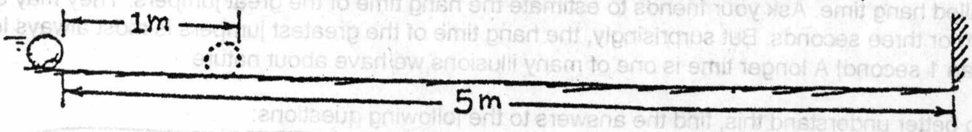
Here we're talking about vertical motion. How about running jumps? We'll see in Chapter 10 that the height of a jump depends only on the jumper's vertical speed at launch. While airborne, the jumper's horizontal speed remains constant while the vertical speed undergoes acceleration due to gravity. While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

CONCEPTUAL *Physics* PRACTICE PAGE

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.

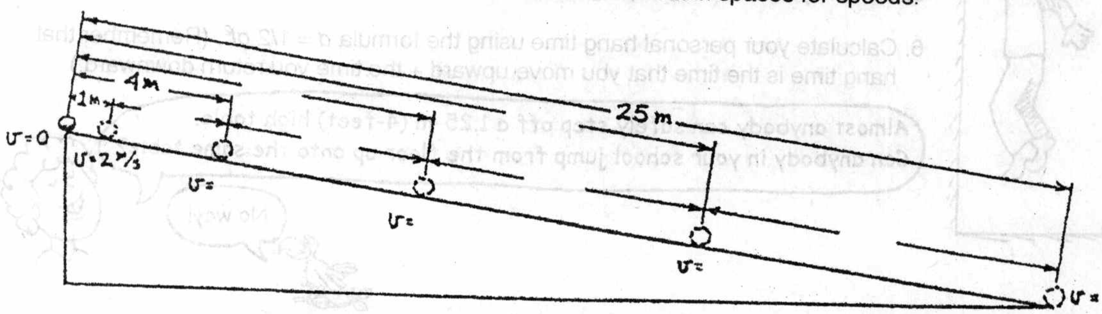
2. Table I shows data of sprinting speeds of some animals. Make whatever computations necessary to complete the table.

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 at 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!

Name ______________________________ Date ____________

CONCEPTUAL Physics PRACTICE PAGE

Chapter 4 Newton's Second Law of Motion

Mass and Weight

Learning physics is learning the connections among concepts in nature, and also learning to distinguish between closely-related concepts. Velocity and acceleration, previously treated, are often confused. Similarly in this chapter, we find that mass and weight are often confused. They aren't the same! Please review the distinction between mass and weight in your textbook. To reinforce your understanding of this distinction, circle the correct answers below.

Comparing the concepts of mass and weight, one is basic—fundamental—depending only on the internal makeup of an object and the number and kind of atoms that compose it. The concept that is fundamental is [mass] [weight].

The concept that additionally depends on location in a gravitational field is [mass] [weight].

[Mass] [Weight] is a measure of the amount of matter in an object and only depends on the number and kind of atoms that compose it.

It can correctly be said that [mass] [weight] is a measure of "laziness" of an object.

[Mass] [Weight] is related to the gravitational force acting on the object.

[Mass] [Weight] depends on an object's location, whereas [mass] [weight] does not.

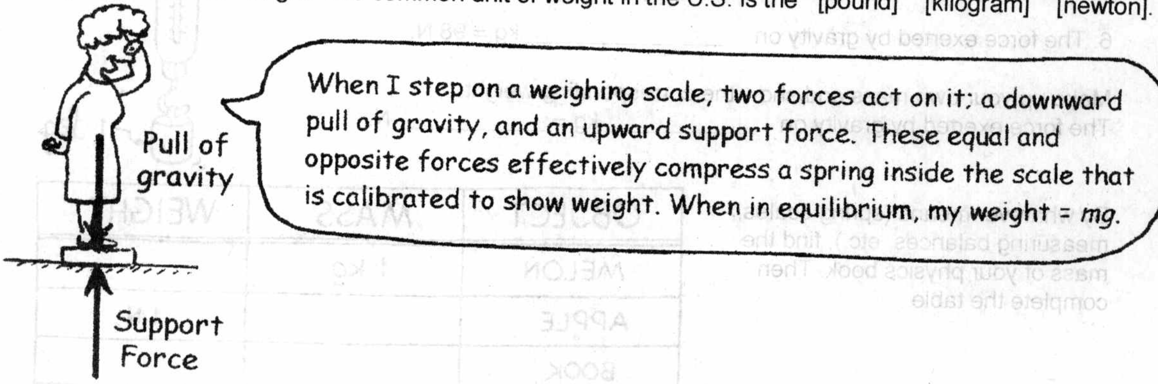
In other words, a stone would have the same [mass] [weight] whether it is on the surface of Earth or on the surface of the Moon. However, its [mass] [weight] depends on its location.

On the Moon's surface, where gravity is only about 1/6th Earth gravity [mass] [weight] [both the mass and the weight] of the stone would be the same as on Earth.

While mass and weight are not the same, they are [directly proportional] [inversely proportional] to each other. In the same location, twice the mass has [twice] [half] the weight.

The Standard International (SI) unit of mass is the [kilogram] [newton], and the SI unit of force is the [kilogram] [newton].

In the United States, it is common to measure the mass of something by measuring its gravitational pull to Earth, its weight. The common unit of weight in the U.S. is the [pound] [kilogram] [newton].



thanx to Daniela Taylor

Hewitt Drew it!