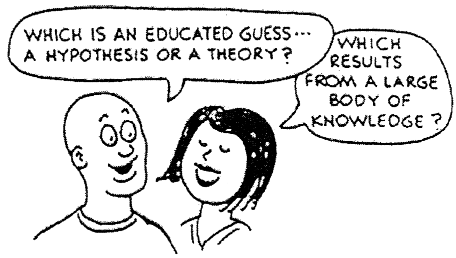
Name ______________________________ Date __________

CONCEPTUAL *Physics* PRACTICE PAGE

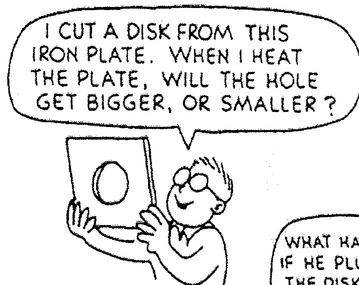
Chapter 1 About Science
Making Hypotheses



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?

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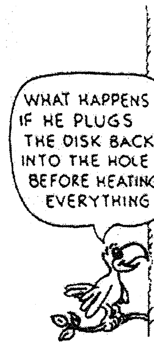

   b. There are often several ways to test a hypothesis. For example, you can perform a physical experiment and witness the results yourself, or you can use the library or internet to find the reported results of other investigators. Which of these two methods do you favor, and why?

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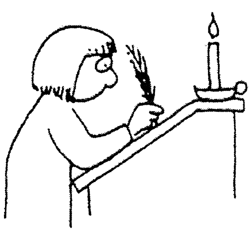

2. Before the time of the printing press, books were hand-copied by scribes, many of whom were monks in monasteries. There is the story of the scribe who was frustrated to find a smudge on an important page he was copying. The smudge blotted out part of the sentence that reported the number of teeth 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?

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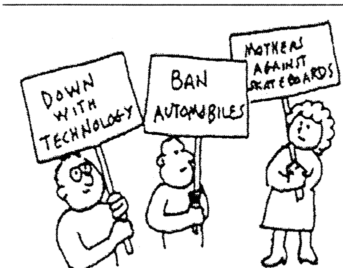


Making Distinctions

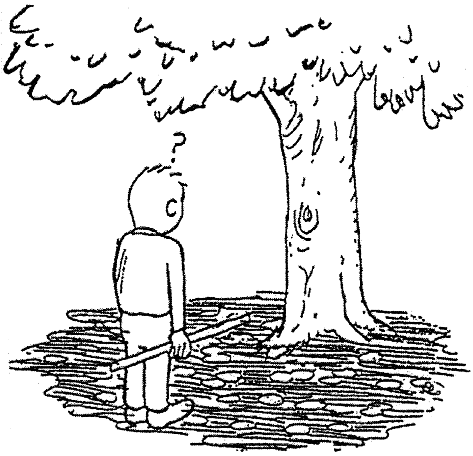
Many people don't seem to see the difference between a thing and the abuse of the thing. For example, a city council that bans skate-boarding may not distinguish between skateboarding and reckless skateboarding. A person who advocates that a particular technology be banned may not distinguish between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

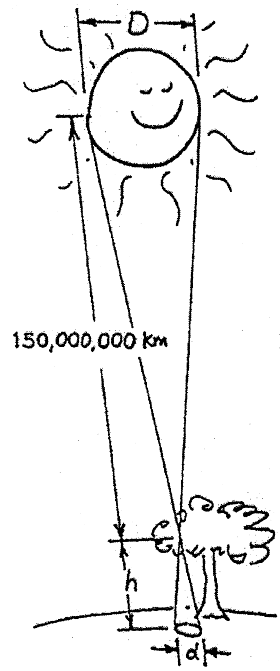
Chapter 1 About Science

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 pin-hole, 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?

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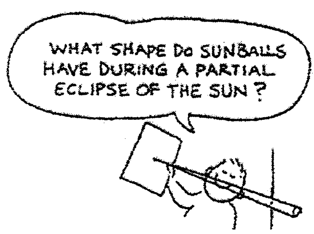
3. Measure the diameter of a small coin. Then place the coin on a viewing area that is perpendicular to the Sun's rays. Position the card so the image of the sunball exactly covers the coin. Carefully measure the distance between the coin and the small hole in the card. Complete the following:

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

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?

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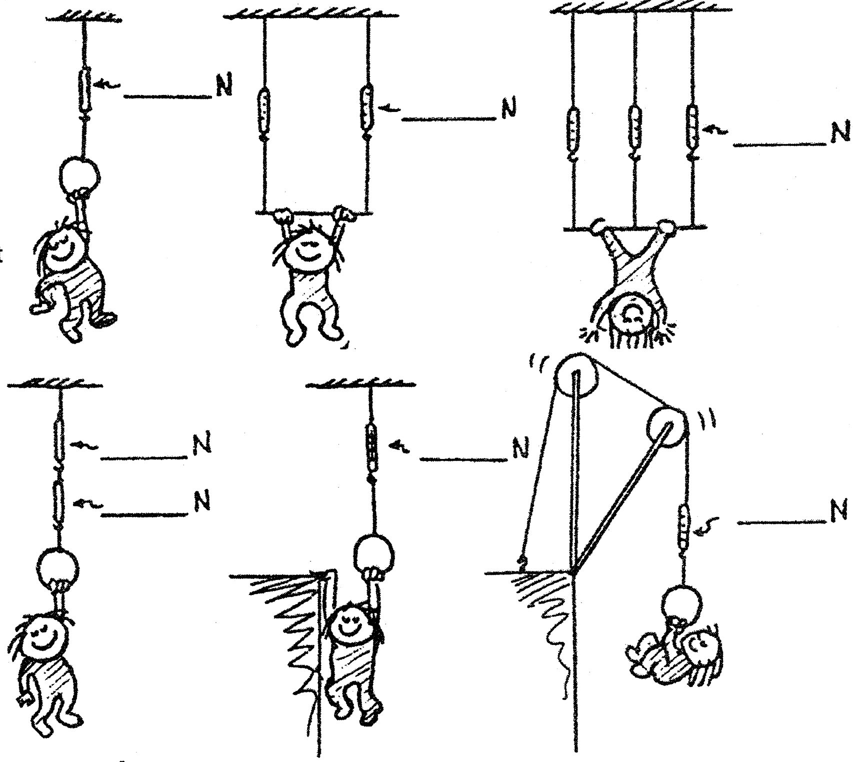
Name ______________________________ Date ____________

CONCEPTUAL **Physics** PRACTICE PAGE

Chapter 2 Newton's First Law of Motion—Inertia

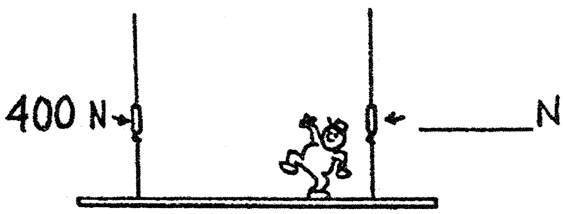
Static Equilibrium

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.

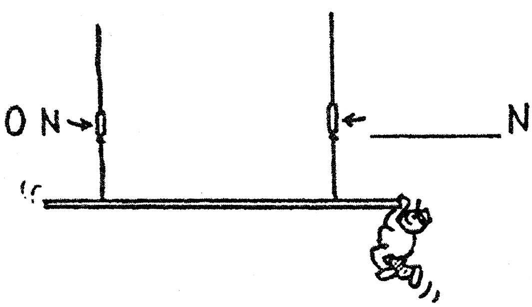


2. When Burl the painter stands in the exact middle of his staging, the left scale reads 600 N. Fill in the reading on the right scale. The total weight of Burl and staging must be

__________ N.



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

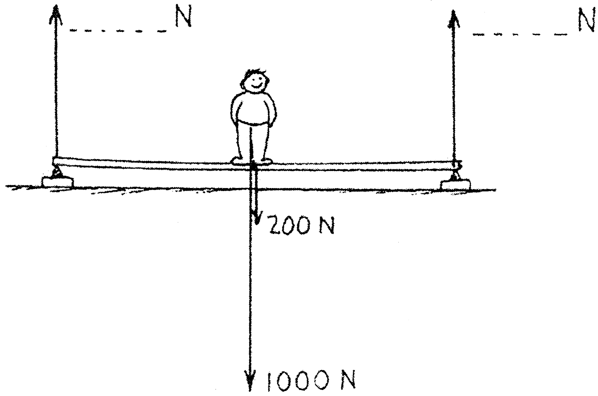


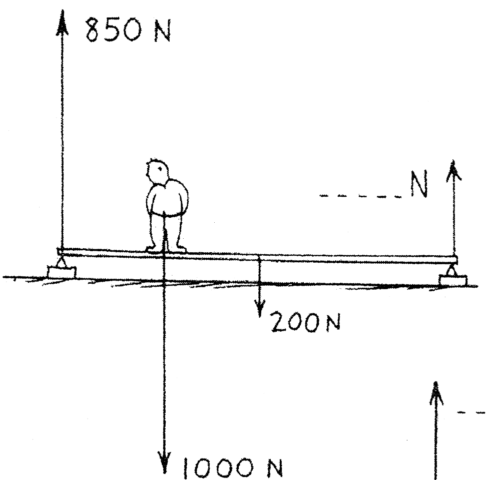
4. In a silly mood, Burl dangles from the right end. Fill in the reading on right scale.

Chapter 2 Newton's First Law of Motion—Inertia

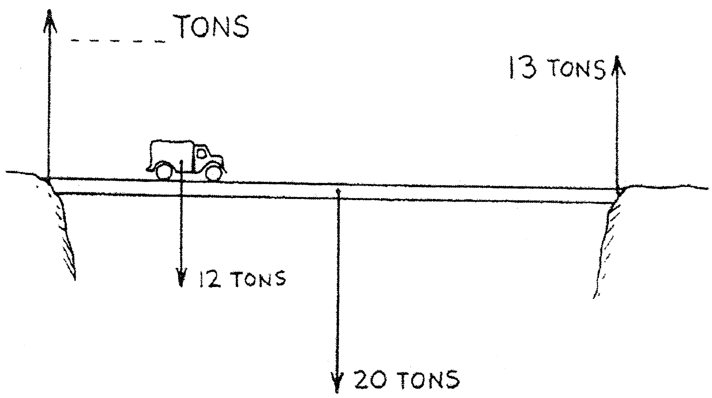
The Equilibrium Rule: $\Sigma F = 0$

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.

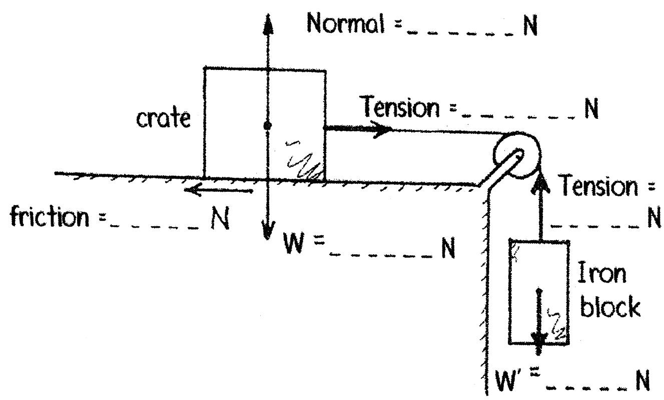




2. When Manuel moves to the left as shown, the scale closest to him reads 850 N. Fill in the weight for the far scale.



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].

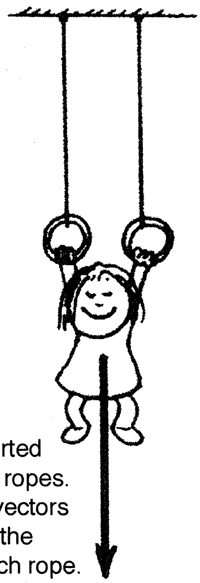
Name ______________________________ Date __________

CONCEPTUAL **Physics** PRACTICE PAGE

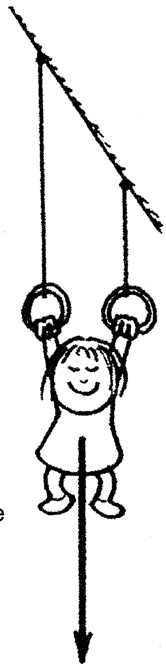
Chapter 2 Newton's First Law of Motion—Inertia

Vectors and Equilibrium

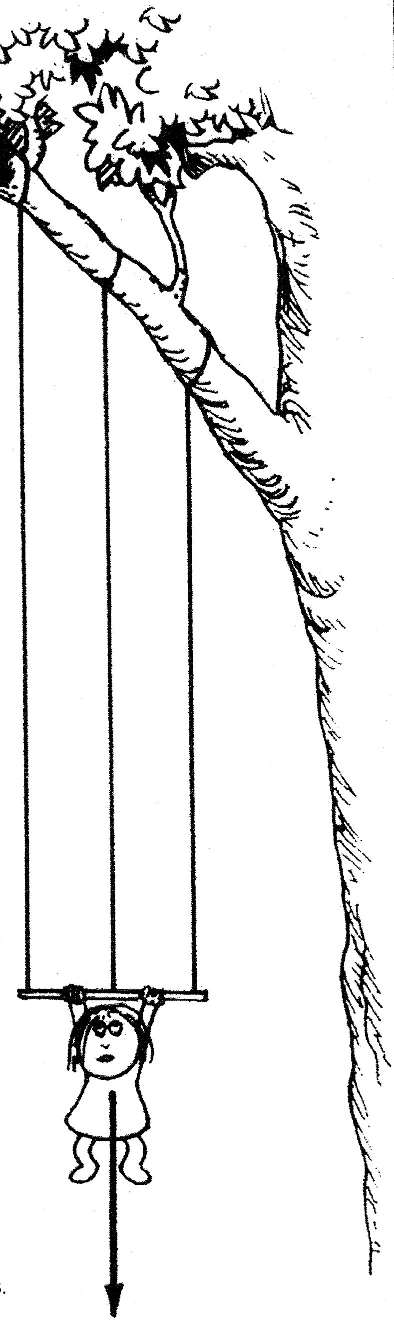
1. Nellie Newton dangles from a vertical rope in equilibrium: $\Sigma F = 0$. The tension in the rope (upward vector) has the same magnitude as the downward pull of gravity (downward vector).



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



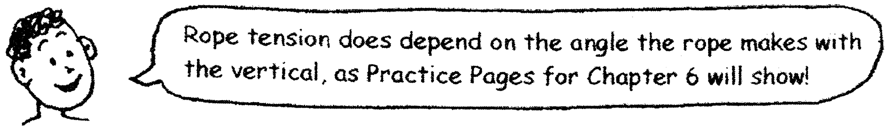
3. This time the vertical ropes have different lengths. Draw tension vectors to scale for each of the two ropes.



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.



Hewitt Drew it!