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ABSTRACT

This is one form of three performance checks booklets (A, B, and C) for Level I of the Intermediate Science Curriculum Study (ISCS). The three booklets are considered one of four major subdivisions of a set of individualized evaluation materials for Level I of the ISCS. This booklet (form A), developed to assess the students' achievement of the objectives of Level I, contains a set of performance checks equivalent to the performance checks of the other two forms (B and C). Each performance check has its own code number which indicates the unit number and identifies whether it is based on core material or excursions. Directions for students' use of performance checks are also included. (HM)

INTERMEDIATE SCIENCE CURRICULUM STUDY

ISCS

INDIVIDUALIZED TESTING SYSTEM

Performance Checks

ISCS LEVEL I
FORM A

SILVER BURDETT
GENERAL LEARNING CORPORATION
Morristown, New Jersey · Park Ridge, Ill. · Palo Alto · Dallas · Atlanta

INDIVIDUALIZED TESTING SYSTEM

ALL LEVELS	**Individualizing Objective Testing** (an ITP module) **Evaluating and Reporting Progress** (an ITP module)
LEVEL I	**Performance Objectives**, ISCS Level I **Performance Checks**, ISCS Level I, Forms A, B, and C **Performance Assessment Resources**, ISCS Level I, Parts 1 and 2
LEVEL II	**Performance Objectives**, ISCS Level II **Performance Checks**, ISCS Level II, Forms A, B, and C **Performance Assessment Resources**, ISCS Level II, Parts 1 and 2
LEVEL III	**Performance Objectives**, ISCS Level III **Performance Checks**, ISCS Level III, ES-WB, Forms A, B, and C WYY-IV, Forms A, B, and C IO-WU, Forms A, B, and C WW-CP, Forms A, B, and C **Performance Assessment Resources**, ISCS Level III, ES-WB WYY-IV IO-WU WW-CP

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FOREWORD

To implement an educational approach successfully, one must match the philosophy of evaluation with that of instruction. This is particularly true when individualization is the key element in the educational approach. Yet, as important as it is to achieve this match, the task is by no means simple for the teacher. In fact, without specific resource materials to help him, he is apt to find the task overwhelming. For this reason, ISCS has developed a set of individualized evaluation materials as part of its Individualized Teacher Preparation (ITP) program. These materials are designed to assist teachers in their transition to individualized instruction and to help them tailor their assessment of students' progress to the needs of all their students.

The two modules concerned with evaluation, *Individualizing Objective Testing* and *Evaluating and Reporting Progress*, can be used by small groups of teachers in in-service settings or by individual teachers in a local school environment. Hopefully, they will do more than give each teacher an overview of individualized evaluation, These ITP modules suggest key strategies for achieving both subjective and objective evaluation of each student's progress. And to make it easier for teachers to put such strategies into practice, ISCS has produced the associated booklets entitled *Performance Objectives*, *Performance Assessment Resources*, and *Performance Checks*. Using these materials, the teacher can objectively assess the student's mastery of the processes, skills, and subject matter of the ISCS program. And the teacher can obtain, at the moment when they are needed, specific suggestions for remedying the student's identified deficiencies.

If you are an ISCS teacher, selective use of these materials will guide you in developing an individualized evaluation program best suited to your own settings and thus further enhance the individualized character of your ISCS program.

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NOTES TO THE STUDENT

Now that you have completed several chapters, excursions, and self-evaluations, you are ready to help your teacher determine how well you are doing. The performance checks in this book will provide your teacher with this information. Then your teacher can help you with things you may not understand and can keep a record of your progress.

Read the next section carefully. It explains some important things about the performance checks in this book, and it gives you specific suggestions for using them.

What You Need to Know about Performance Checks

1. **You do performance checks when you are ready.** Performance checks are somewhat like the questions in the self-evaluations – you do them when you are ready, not when the whole class is ready.
2. **Your teacher or both of you decide how many you do.** Your teacher or you and your teacher together will decide which ones you should do. You are not expected to do all of the performance checks.
3. **There are three forms for each performance check.** Every performance check is written in three forms – A, B, and C. (The title of this booklet tells you whether it is Form A, B, or C.) Usually the answers for each form are different. When you do a check, you will use only one form. The A, B, and C forms are always in different booklets. Within each booklet all the performance objectives for the same unit are listed together. These units are in numerical order. Each unit has performance checks based on core material and performance checks based on excursions.
4. **Each performance check has its own number.** The number is in the outside margin of the page and will look like this: 03-Core-17A or 05-Exc 17-2A. These numbers mean

03	Core	17	A	and	05	Exc	17	2	A
unit	based on core material	check number	form of the check		unit	based on the excursion material	excursion number	check number	form of the check

5. **Each performance check is separated from the other.** There is a line before each performance check and one after it. Some performance checks have several parts, so do everything called for between the lines. When there is no line at the bottom of a page, you can expect to find the check continued onto the next page.

6. **Sometimes you will need to use equipment.** If special materials are needed, they will be in boxes labeled with the same number and sometimes the same letter too as the performance check for which you need them.

7. **Some performance checks have two or more answers.** If more than one answer is correct, you must select all the correct choices. In such cases selecting just one answer is not enough.

8. **Some performance checks have no answers.** Occasionally, you may be asked to do something that is impossible and to explain your answer. If so, say that the task is impossible and explain why.

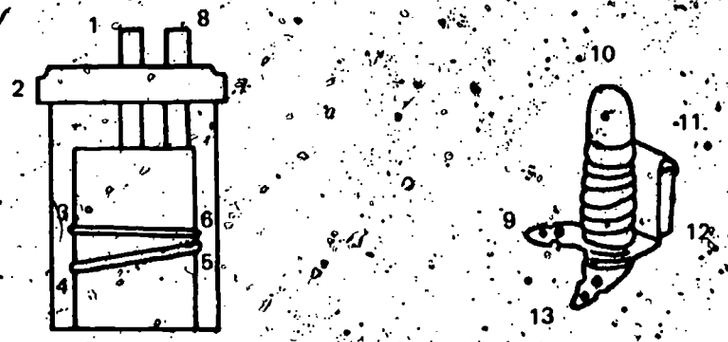
9. **You share books of performance checks and YOU DO NOT WRITE IN THEM.** Write your answers on other paper. Give the number and form of the performance check for each answer you write. If you are to draw a graph, your teacher may provide you with grid paper.

10. **Your teacher or his assistant will collect and mark your checks.** And sometimes you must ask him to watch or assist you as you do a check.

11. **Sometimes a review procedure will be suggested.** If you can't do a performance check, you may be asked to review a part of the text or a self-evaluation question. You may then be checked on the same material, so be sure you understand the material you review. Get help if you need it.

Get two test leads, a bulb and socket, and an ISCS battery from your teacher. Charge the battery for one minute. Get your teacher to watch you. Now connect the bulb to the battery so that the bulb lights. **01-Core-1A**

Study the diagram to see how you should connect test leads to make the bulb light. Then, write the two numbers for each test lead that show where the ends of each lead should be connected. **01-Core-2A**



Something that changes in an activity or experiment and affects the results of it is called **01-Core-3A**

a. an example.
b. a solution.
c. a problem.
d. a variable.

In box 01-Core-4A you will find a circuit all set up. Use the good spare parts in the box to find out why the bulb doesn't light. Which part is bad? **01-Core-4A**

Get batteries A, C, and D from box 01-Core-5. Use any other materials you think you need. Which of the batteries has influence? **01-Core-5A**

A hammer is used to transfer influence to a nail. Why must you swing a hammer before it can drive a nail into wood? **01-Core-6A**

Match the following terms by first listing the numbers (1, 2, and 3) on your paper and then writing after each number the letter (a, b, c, or d) of the correct matching definition. **01-Core-7A**

Terms	Definitions
1. Component	a. A group of objects that directly interact with each other within a system
2. Subsystem	b. A group of objects that interact with each other
3. System	c. An object that does not interact with other objects
	d. An object that is part of a system

01-Core-8A On your paper, write the letter of each diagram which identifies a system. Also explain why the diagram or diagrams you chose represent systems.

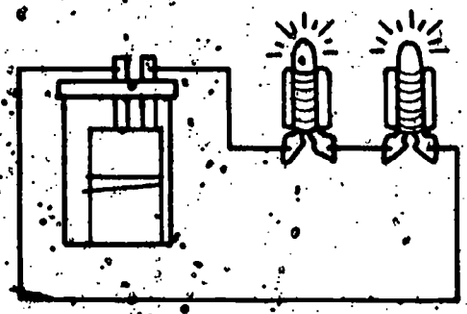


Diagram a

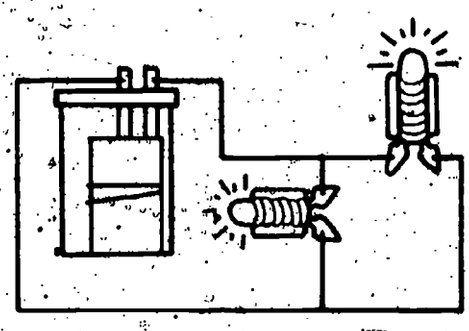


Diagram b

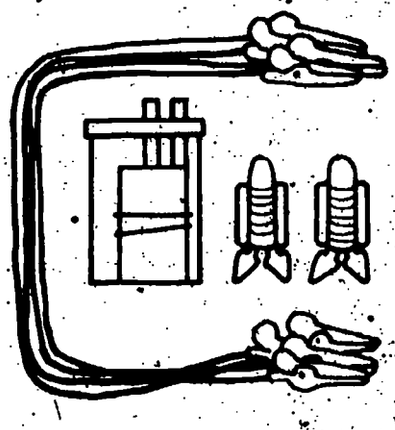
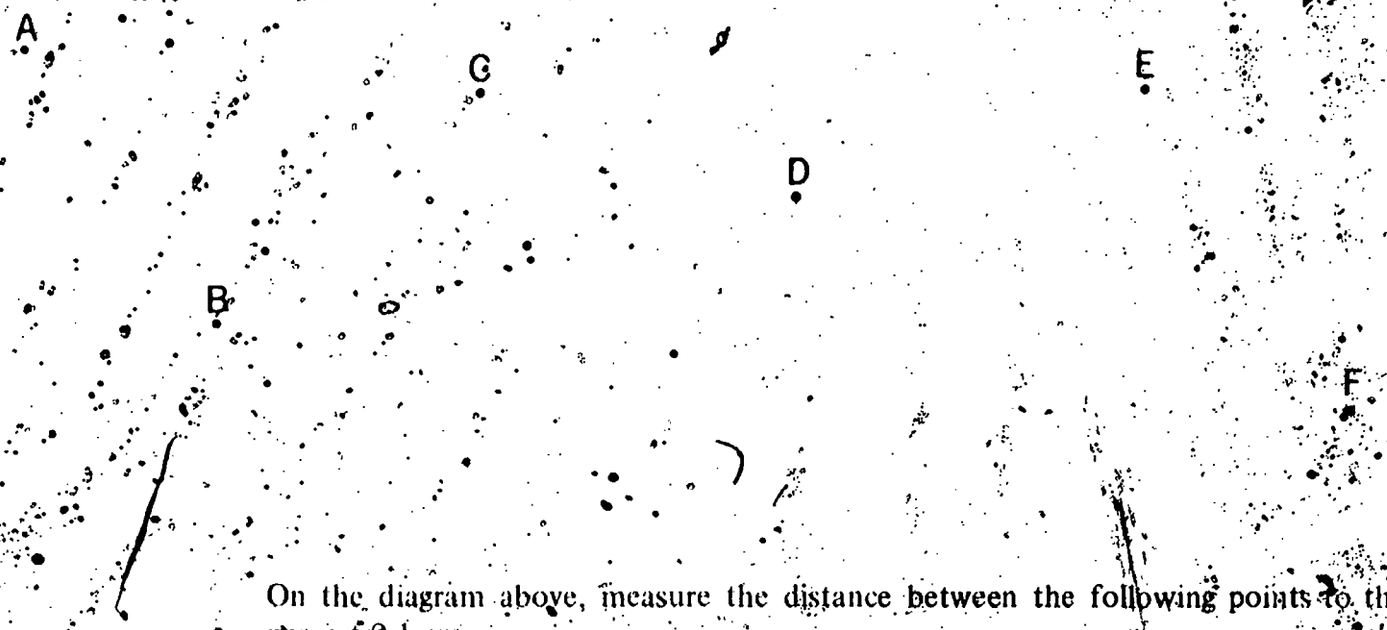


Diagram c

01-Core-9A



On the diagram above, measure the distance between the following points to the nearest 0.1 cm.

1. What is the distance from point A to point B?
2. What is the distance from point C to point F?
3. What is the distance from point D to point E?

01-Core-10A Ask your teacher or his assistant to begin tapping on the desk for you. Tell him when to begin. Use your ISCS timer to find out how long he taps the desk.

01-Core-11A On your paper write the letters of all good reasons for using data tables.

a. Data tables store data in an organized way.
b. Data tables tend to reduce errors by organizing data.
c. Data tables make it easier to find relationships.
d. Data tables help make sure you collect the data you need.
e. All of these.

01-Core-12A

Name of Group Member	No. of Sinkers Dragged	No. of Times Dragged	Distance from Hook to Pulley (cm)	Total Distance Dragged (cm)	Total Time for Dragging (sec)
Sue	1	70	90	6300	130
Betty	2	60	85	5100	110
Sam	3	50	80	4000	105

Study the table. Use it to answer all the questions below.

1. What was the distance in centimeters from hook to pulley when two sinkers were dragged?
2. What was the total distance in centimeters that one sinker was dragged?
3. How many times were the three sinkers dragged?

What is the letter of the phrase below which correctly completes the sentence? An operational definition includes a description of ____ the thing being defined. 01-Core-13A

a. the way to classify
b. the texture and color of
c. the shape or odor of
d. the way to measure

On your paper, divide 12.34 by 2.4. Round off your answer to one number after the decimal point. 01-Core-14A

On your paper, multiply 7.32 X 2.4. 01-Core-15A

Add these three numbers on your paper. 4.35, 3.4, 5.31 01-Core-16A

Subtract 4.57 from 8.7 on your paper. 01-Core-17A

Your teacher will observe you for this check when he can. 01-Core-18A

Your teacher will observe you for this check when he can. 01-Core-19A

Your teacher will observe you for this check when he can. 01-Core-20A

Your teacher will observe you for this check when he can. 01-Core-21A

Your teacher will observe you for this check when he can. 01-Core-22A

01-Exc 01-1A Which of the following tells the main advantage of the metric system which makes it useful in measurement problems?

a. It was developed in France, and most of the early scientists were French.
b. The meter has a more logical historical basis than the yard.
c. The units of the metric system are related by factors of the number ten, and therefore changing from one unit to another is easier.
d. All systems of measurement are of equal value, but scientists needed a common system of units. They happened to choose the metric system.

01-Exc 01-2A The measurement system used in ISCS science is the

a. Hebrew system.
b. English system.
c. Russian system.
d. Metric system.

01-Exc 03-1A In Excursion 3, you studied two forces – lift and drag – acting on two sinkers. One force was greater than the other. You found this by making the two forces act directly on each other. Read the two examples below. Which one directly compares the two variables?

a. Mary ran around the school track. John ran around the block. Who can run faster?
b. John and Mary raced each other around the school track. Who can run faster?

Which of the following is an operational definition? 02-Core-1A

a. A ruler is a device for measuring length.
b. Light is the form of energy which causes the needle of a light meter to move. The amount of needle movement measures the intensity of the light.
c. Mass is the amount of matter in an object and does not vary from place to place.

Suppose that throughout the course everyone in your class used his own force measurer scale marked in washer units. 02-Core-2A

1. Would this cause a problem?
2. Explain your answer.

Suppose you wanted to use your force measurer to find the weight of a small feather. List the letters of all of the following things that you would need for your force measurer. 02-Core-3A

a. A blade thinner than the thin blade you already have
b. A blade thicker than the thin blade, but thinner than the thick blade
c. A scale calibrated in units from 0 N to 0.1 N
d. A longer scale card

Get an ISCS force measurer, 2 blades, paper clips, and a newton scale card from the supply area. From your teacher, get a spinigig disk and a skate wheel. Report to your teacher how much the spinigig disk weighs and how much the skate wheel weighs. 02-Core-4A

Get two objects from box 02-Core-5A. Use an ISCS force measurer, an aluminum cup, paper clips, and a newton scale card to weigh each of the two objects. Write the difference in newtons between the weights. 02-Core-5A

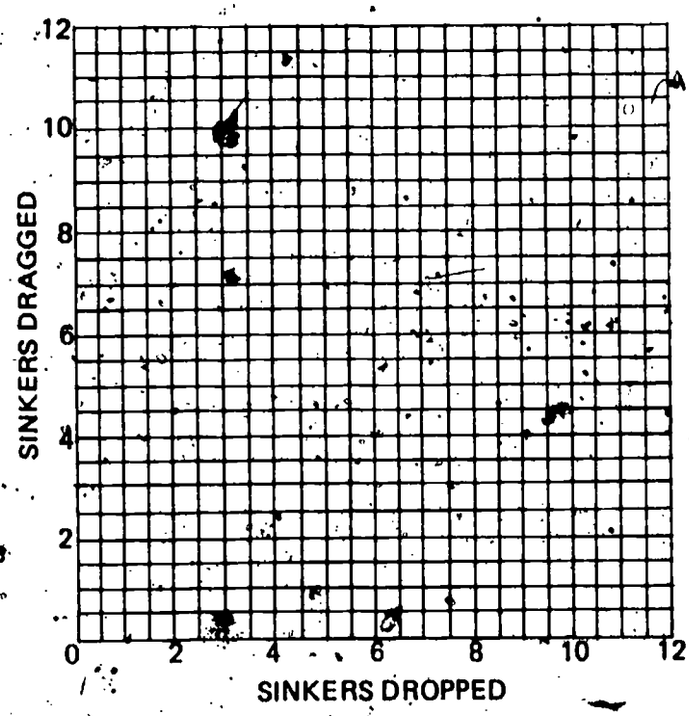
John brought his own washers from home to weigh on his force measurer. He added one washer at a time to a hook on the end of the force measurer blade. He made the data table shown below. 02-Core-6A

Number of Washers on Hook	Weight of Washers (in newtons)
1	0.8
2	1.4
3	2.4
4	2.6
5	2.8
6	3.4

What do you conclude about the weights of the washers John brought from home?

02-Core-7A Larry did Excursion 3, which compares weight and drag. On a separate piece of graph paper, label the axes as shown below. Then construct a graph of Larry's data, which are listed in the table below. The table shows the dragging power of the dropping sinkers. Draw a best-fit line for the plotted points.

Sinkers Dropped	Sinkers Dragged
2	3
4	6
6	9
8	12



02-Core-8A Write an operational definition for *weight*, using an ISCS force measurer in your definition.

02-Core-9A Ask your teacher for a force measurer with an aluminum pin in it. Do not remove the pin.

Answer the following questions by listing the numbers (1, 2, and 3) on your paper and writing after each number the answer to the corresponding question.

1. Does the force measurer have the thin or thick blade attached to it?
2. What is the number of the hole the pin is in?
3. How much force is on the aluminum pin?

02-Core-10A From your teacher, get force measurer scale card 02-Core-10A. Use your force measurer with the thin blade to weigh a sinker. Have your teacher watch you. Report the weight in the units shown on the scale card.

02-Core-11A Write on your paper the name of the metric unit you use in ISCS to measure force.

02-Core-12A Suppose you want to know when a force is acting on a football. Write on your paper two kinds of changes you would look for.

Get a compass and a nail from the supply area. Set the compass on your desk. Bring the nail very near to the compass from three different directions. Watch what happens. **02-Core-13A**

1. Is there a force acting between the nail and the compass?
2. How do you know?

02-Core-14A

Diagram a Diagram b

The two springs being squeezed by the hands are alike.

1. Which diagram shows the greater amount of force being applied?
2. Explain the reason for your choice.

An operational definition answers two questions. Write an operational definition for *force* in which you answer those two questions. **02-Core-15A**

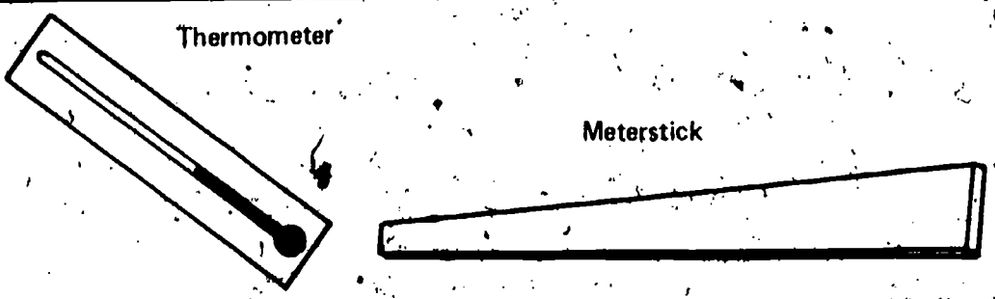
Write on your paper the two questions you would have to answer about something if you wanted to write an operational definition for it. **02-Core-16A**

Two sinkers are attached to the blade of a force measurer, and the blade bends down. Name the force that is pulling on the blade. **02-Core-17A**

John sat on a chair. After a minute, the chair legs gave way and John ended up on the floor. What force caused a change in the shape of the chair? **02-Core-18A**

State two reasons why it is difficult to define operationally such terms as *love* or *beauty*. **02-Core-19A**

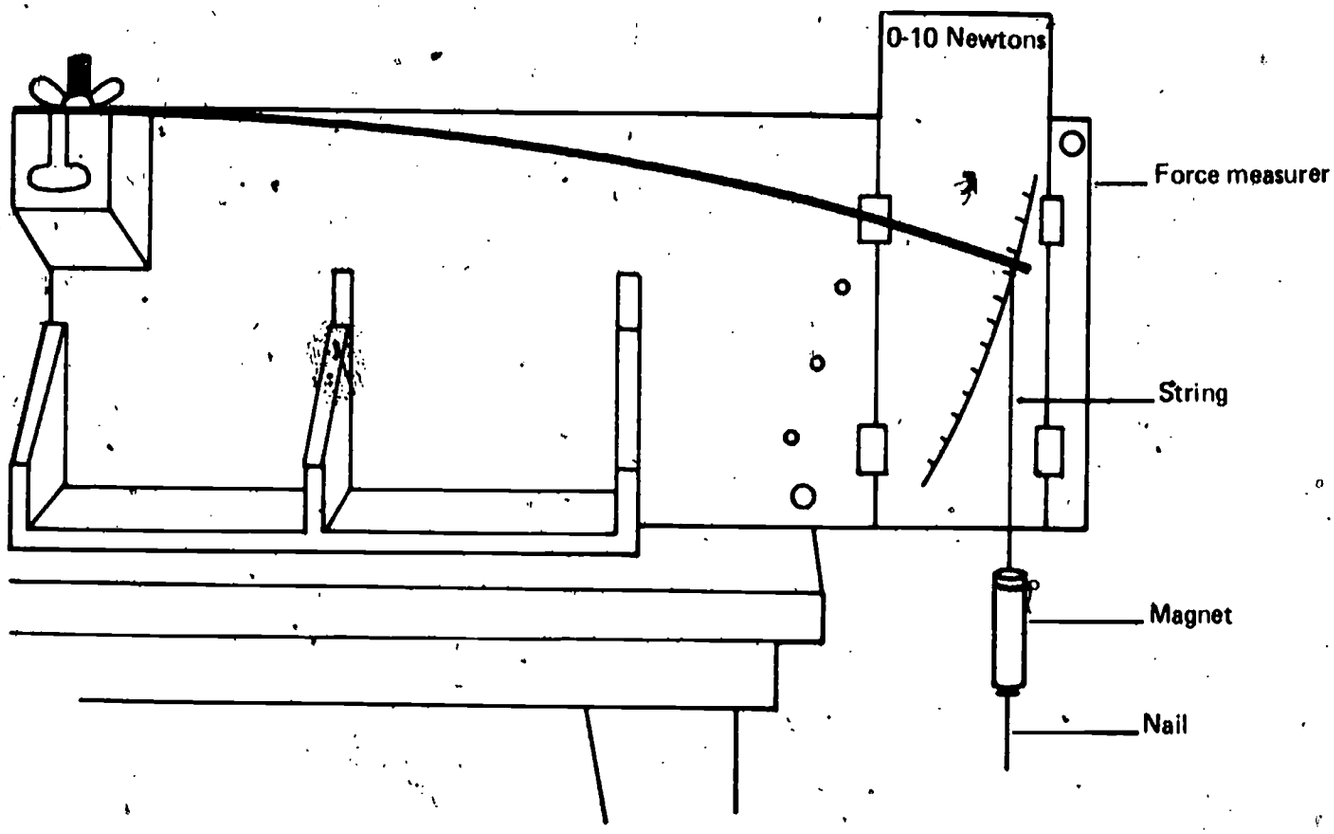
02-Core-20A



Look at the diagrams of the measuring instruments. What needs to be added to them so that you could tell your teacher your measurement without having to show him the thermometer or the meterstick?

02-Core-21A Tie or tape a magnet to a string, as shown below. Hang the magnet on the thick force measurer blade. Measure the combined weight of the magnet and string. Number and record your results for each step of the following.

1. Record the combined weight of the magnet and string.
2. Attach a nail to the magnet as shown. Pull gently on the nail until the magnet releases it. What is the force measurer reading when the magnet releases the nail?
3. How much force did the magnet exert on the nail?



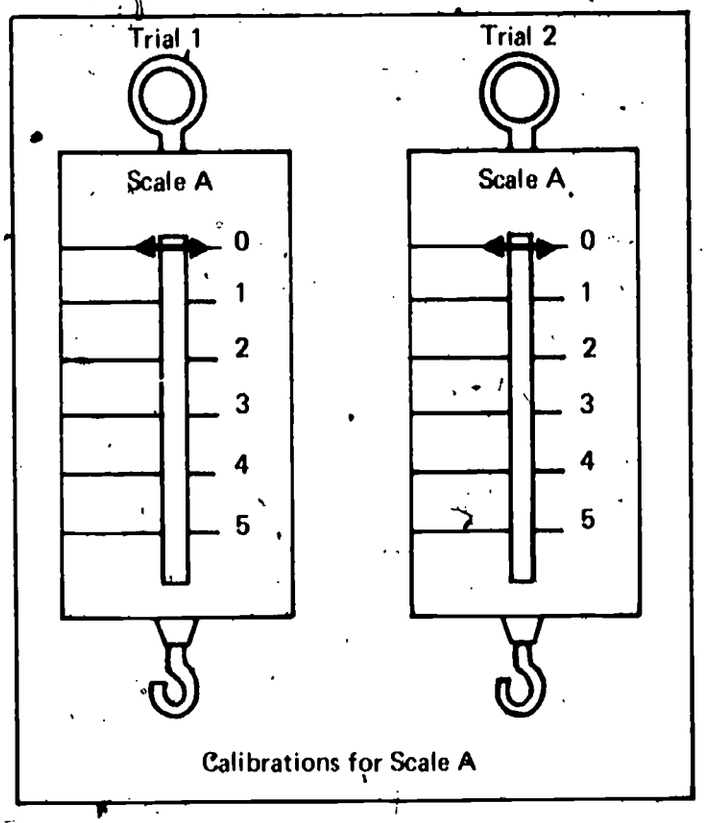
02-Core-22A List the letters of the situations described below in which there is a force acting in addition to gravity and friction.

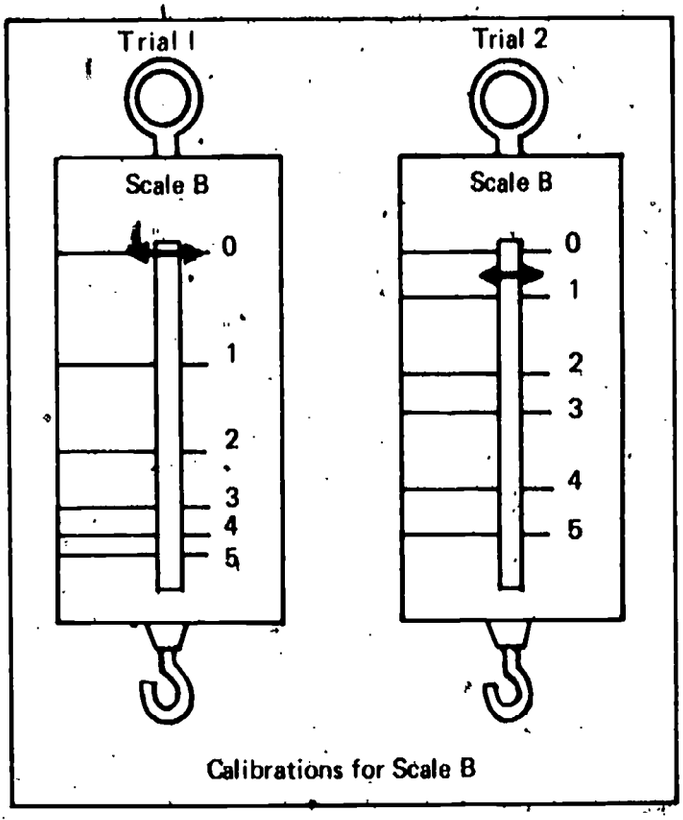
a. A motorcycle parked in a garage
b. A stone smashing through a window
c. A sinker sitting on a shelf
d. Two football players hitting head-on
e. A washer lifted from a desk

02-Core-23A List four things which should be true of an object if it is to be used as a standard unit of measurement.

Sol was given two old and uncalibrated spring scales, A and B. He calibrated each spring scale two times. The two drawings below show the results of his calibrations for each scale. Sol must use one of these two scales in an experiment. **02-Core-24A**

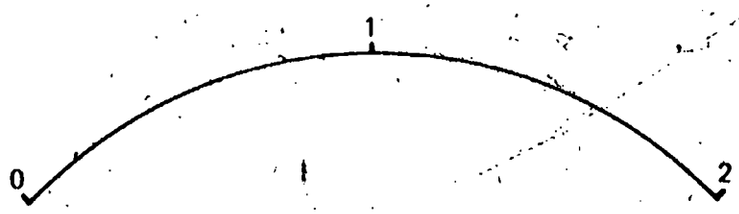
1. Which spring scale should he use?
2. Why?





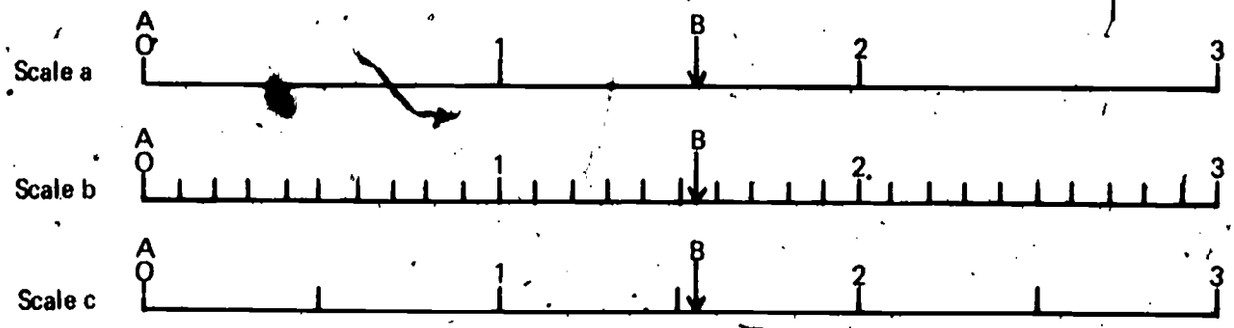
In this course you often make several measurements which you are then asked to multiply and divide. Suppose you were to use the scale below. **02-Exc-06-1A**

1. Would it be easiest to report, multiply, and divide the measurements if the units on the scale were divided into 9, into 10, or into 11 subunits?
2. Why?

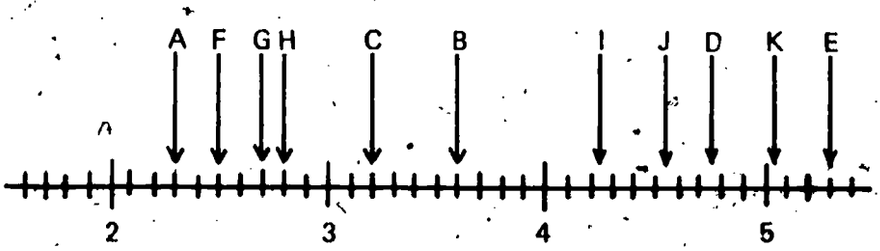


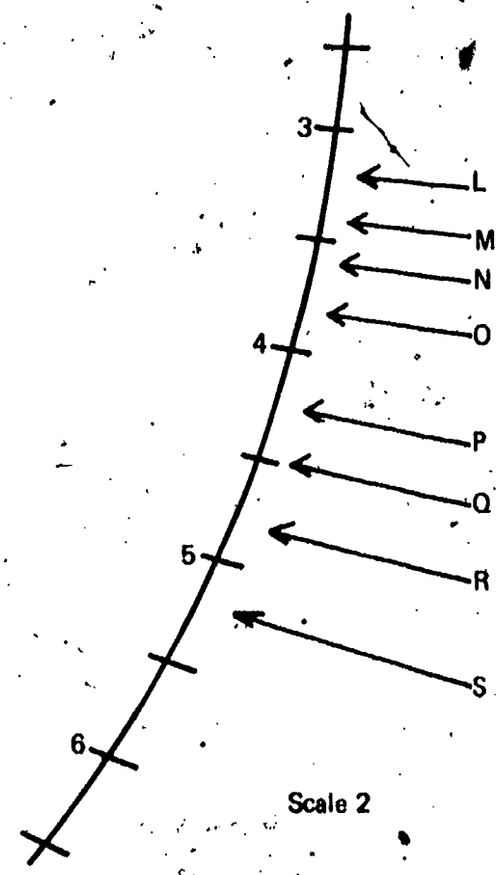
02-Exc 06-2A

1. From which of the three scales below could you report the most accurate measurement of the distance from A to B?
2. Why?



02-Exc 06-3A





Report your answers to both questions below in decimals.

1. On scale 1, what is the reading at H? At I?
2. On scale 2, what is the reading at N? At R?

02-Exc 07-1A

Write the letter of the best answer. When the size of a unit of measurement such as the meter was first determined, it was

a. discovered by scientists.
b. taken from a list of standards passed down through the years.
c. naturally set by something in nature.
d. set by a group of men who agreed on its size.

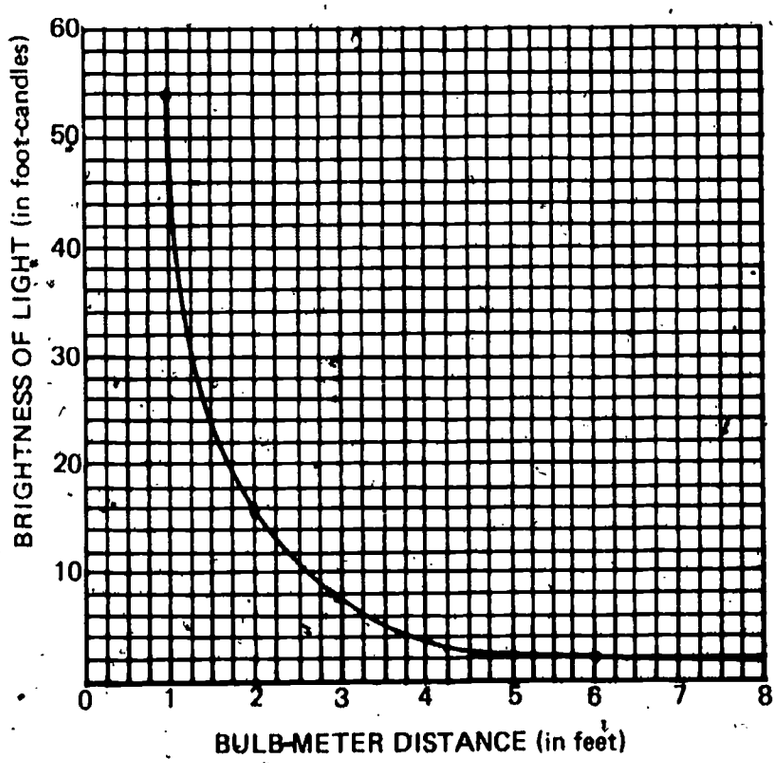
The *palm* is a unit of length based on the width of a man's hand. The *digit* is a unit of length based on the width of a man's index finger. **02-Exc 07-2A**

1. Why aren't measurement units such as the palm and digit used very much today?
2. Why are standard units such as the meter and the gram used instead?

The brightness of a lighted bulb was measured with a light meter at several distances from the bulb. The data were graphed as shown below. Notice that the light brightness decreases as the distance increases. **02-Exc 08-1A**

Compare the change in brightness between the distances of 1 foot and 2 feet with the change between 4 feet and 8 feet. Choose the words which correctly complete the following two sentences.

1. When the bulb and meter are close together, a small change in distance produces a (large)(small) change in brightness.
2. When the meter and bulb are far apart, a large change in distance produces a (large)(small) change in brightness.

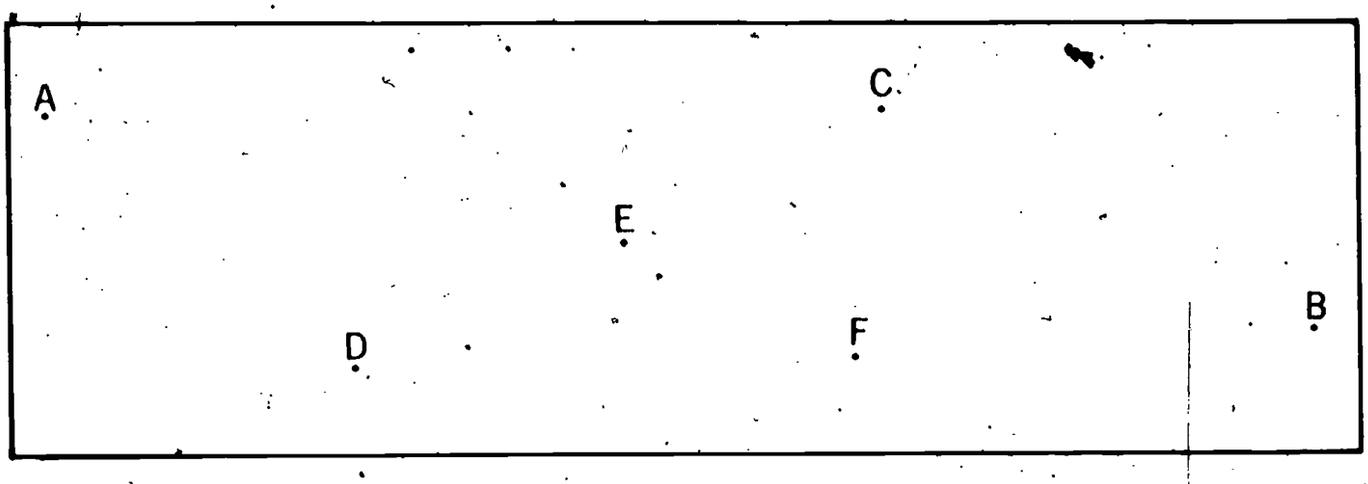


How can you lift a 40 lb box from the floor to the table with the least amount of work being done on the box? Select the best answer below. **03-Core-1A**

a. Lift it with your hands.
b. Push it up an inclined plane.
c. Use a pulley and a rope.
d. Any way you do it, the work on the box is the same.

Measure the distance between each of the three pairs of points, and record your answers in meters. **03-Core-2A**

1. A to B
2. C to D
3. E to F



Make the changes asked for in each of the following cases. **03-Core-3A**

1. 7 cm = ___ m
2. 0.7 m = ___ cm
3. 32 cm = ___ m
4. 4.2 m = ___ cm

What is the metric unit used in ISCS for measuring work? **03-Core-4A**

Find out how much work is done when you lift an electricity measurer base from the floor to your desk top. Get the equipment you need to do this. Record your measurements in newtons and meters, and record the answer in the correct units. **03-Core-5A**

Write an operational definition for *work*. **03-Core-6A**

Complete the sentence below. **03-Core-7A**

Helen lifted the cart from the floor and put it on the table. Her science classmates said she was doing ___ on the cart.

03-Core-8A

A force measurer was used to pull a box across the floor. What measurements below would you use to measure the work done on the box? Choose as many as are needed. Do not calculate the work.

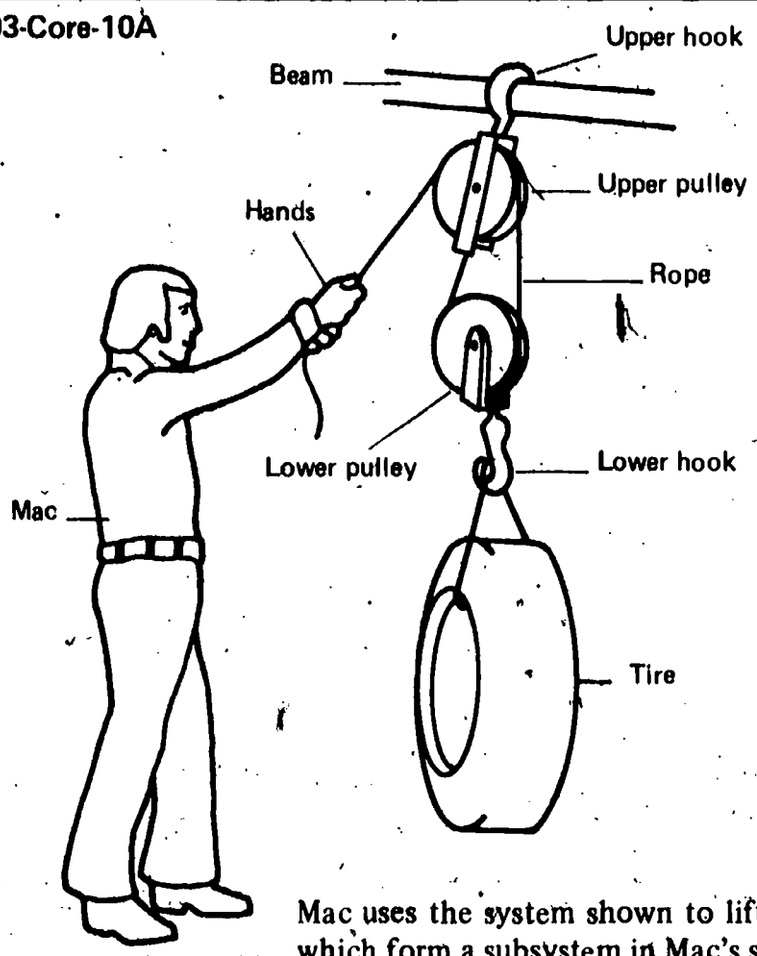
a. The box moved for 80 seconds.
b. The box moved 100 cm.
c. The speed of the box was 1.25 cm per second.
d. The box required 8 newtons of force to be moved.

03-Core-9A

Match the terms *system*, *subsystem*, and *component* with their definitions. Write the number of the term and the letter of the matching definition on your answer sheet.

Terms	Definitions
1. System	a. A person who fights another
2. Subsystem	b. An object that is part of a system
3. Component (of a system)	c. A group of objects that interact directly within a system
	d. A group of objects, such as a hat, a book, a feather, and a clod of dirt
	e. A group of objects that interact with each other

03-Core-10A



Mac uses the system shown to lift heavy truck tires. List four labeled components which form a subsystem in Mac's system.

Study the diagrams below. **03-Core-11A**

1. List the letter of each diagram which shows a single system.
2. Explain why any diagrams you chose represent systems.

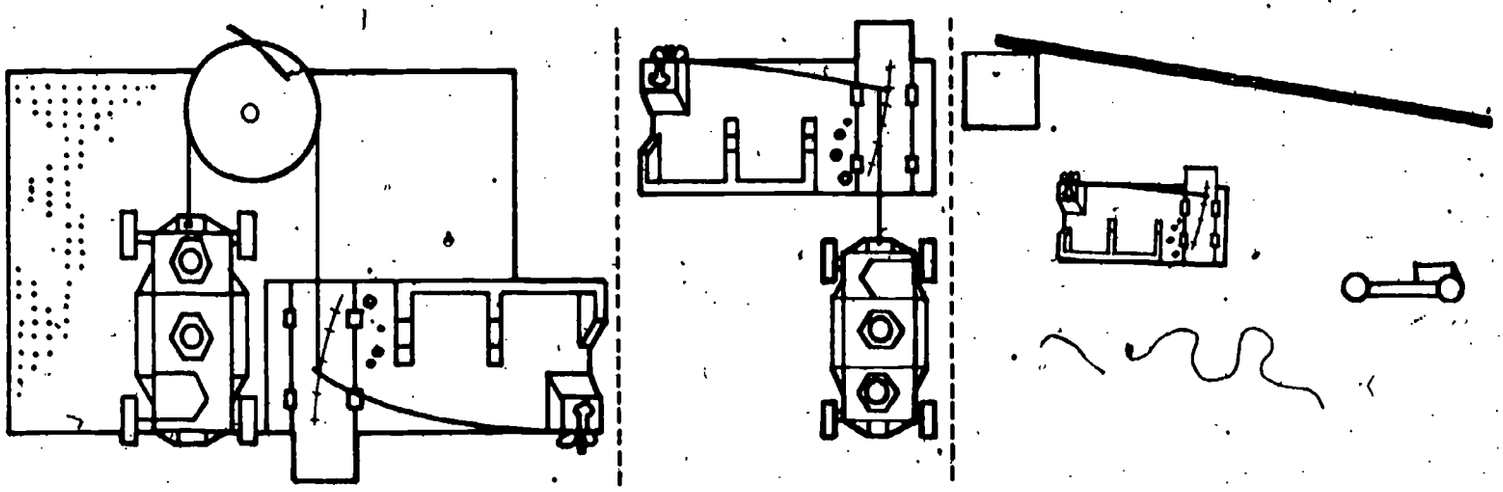
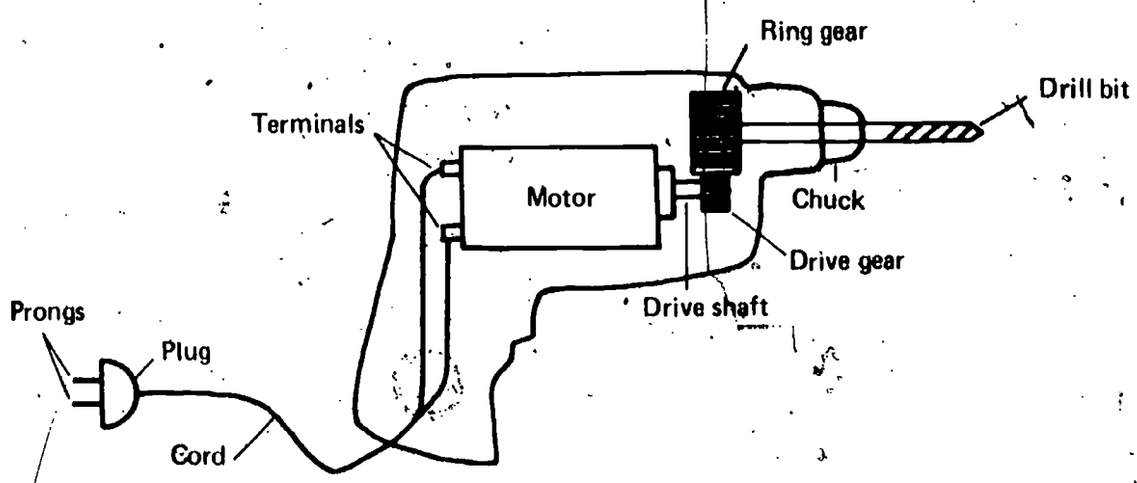


Diagram a Diagram b Diagram c

Study the diagram of the electric drill. **03-Core-12A**

1. List each of the sets of components listed below which can be considered a subsystem.
2. Explain why you selected the sets you did.



Components

a. plug, motor, chuck
b. prongs
c. motor, drive shaft, drive gear
d. ring gear, chuck, drill bit
e. prongs, cord, drive shaft

Select the phrases which describe the relationship between work and systems. A system can **03-Core-13A**

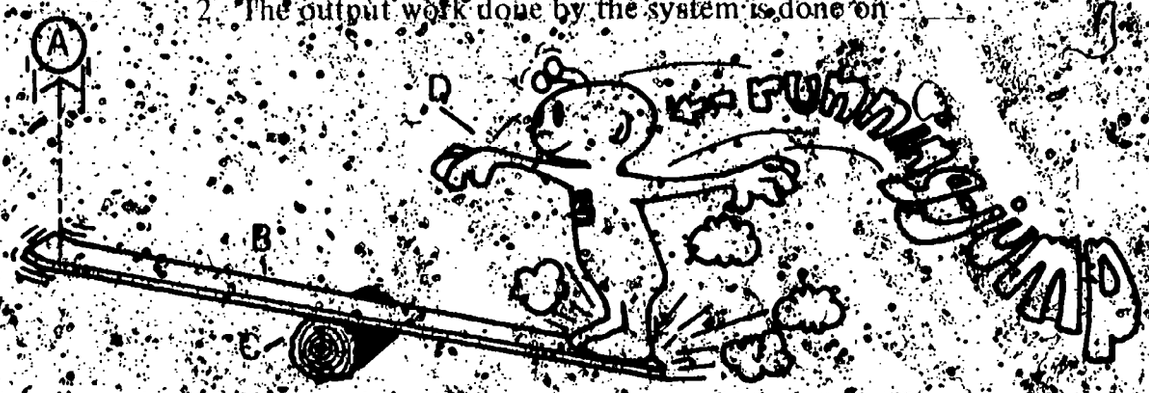
a. be its own source of input work.
b. transfer input work.
c. use input work to do useful work.
d. operate with no input work.

03-Core-14A Look at the diagram below. The hammer (C) hits the board (B) and drives the weight (D) up to hit the bell (A).

1. Select the letter of the input component.
2. Select the letter of the output component.

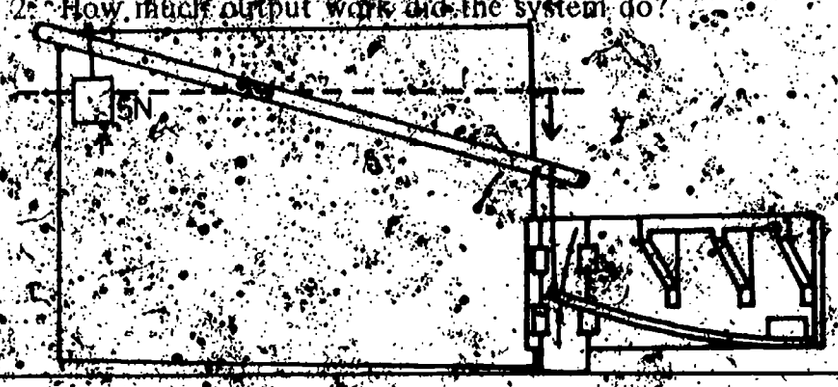
03-Core-15A In the diagram, consider that the ball (A), the balance board (B), the log (C), and Iggy (D) make up a system. After the appropriate numbers, write the letter that identifies the source of the input work in the system and the letter that identifies the object on which the output work is done.

1. The input work is done in the system by ____
2. The output work done by the system is done on ____



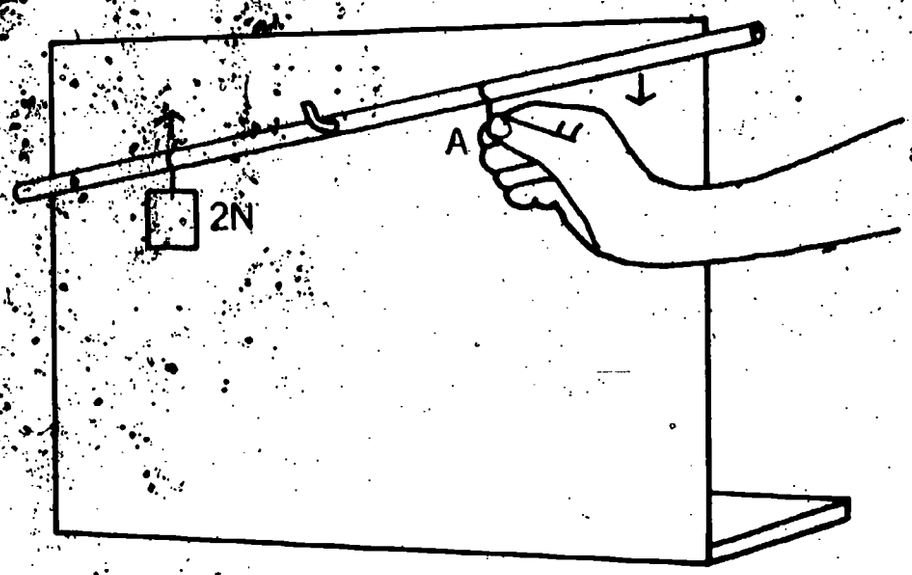
03-Core-16A In the diagram below, think of the balance arm as a system. The force measurer shows a reading of 5 N and was moved down 0.25 m. The 5 N weight moved up 0.13 m.

1. How much input work was done in the system?
2. How much output work did the system do?



Look at the diagram of an equal-arm balance below. Jim pulled hook A, lifting the 2 N weight 0.4 m. He wondered how much input work he had done on the system. What is the best answer that you could give him? **03-Core-17A**

a. Just a little bit less than 0.8 N·m.
b. Exactly 0.8 N·m.
c. Just a little bit more than 0.8 N·m.
d. It is impossible to say, since no force or distance measurements were made of the input work of the system.



Find the average of each of the following two sets of numbers. Show your work. **03-Core-18A**

1. 2.3, 4.5, and 3.8
2. 4.1, 3.0, and 4.3

George punched a hole in the bottom of a paper cup. He tried to count how many drops of water fell from the cup in one minute. His data from several trials are shown in the table below. Why is the average of 46 drops per minute probably closer to the actual count than the individual figures for the six trials? **03-Core-19A**

Trial	Drops Per Minute
1	44
2	47
3	45
4	48
5	47
6	45
Average	46

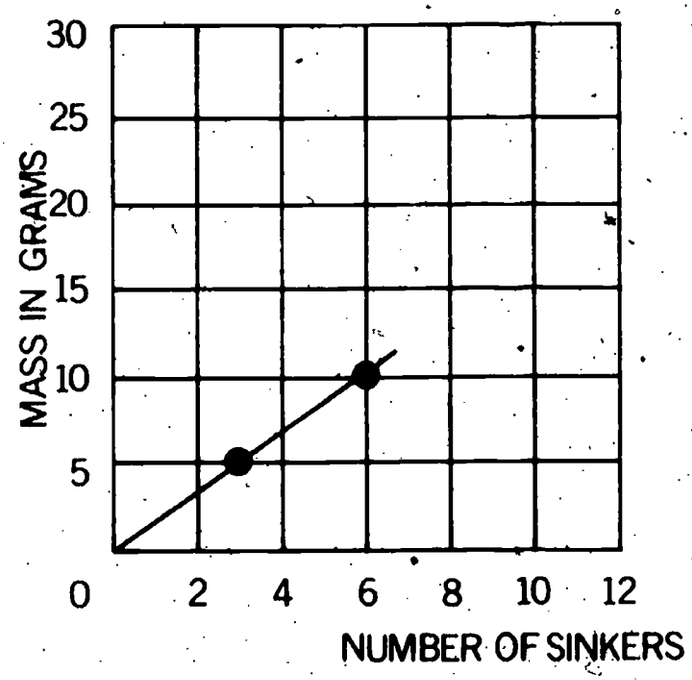
03-Core-20A Six scientists measured the length of the same steel rod with the same meterstick. They got the following data.

Scientist	Length of Rod (in cm)
1	73.8
2	73.9
3	74.1
4	74.0
5	73.9
6	74.1

Why shouldn't they all expect to get the same measurement for the steel rod?

03-Core-21A Get from your teacher either a copy of the graph below or grid paper. (On grid paper, copy the graph below, label the axes, plot the points, and draw the line.) Using the graph, find the mass in grams of the following.

1. 9 sinkers
2. 1 sinker
3. 11 sinkers
4. 4 sinkers



03-Core-22A Juan attached his force measurer to his science textbook. He then pulled the book across his desk. The force measurer reading as the book moved along was 9 newtons. What is the name of the force he was measuring?

03-Core-23A Why is the amount of input work done on a system always greater than the useful output work?

When a drag racer leaves the starting line, its wheels spin vigorously and get hot. What force causes the tires to get hot? **03-Core-24A**

Think of an empty garbage can being dragged across a concrete drive. What would happen to the amount of friction if the can were filled with garbage? **03-Core-25A**

Mr. Smith wanted to determine which kind of grain grew best on his farm. He divided the farm into four sections, 1, 2, 3, and 4. He put a different kind of seed in each section. He also wanted to test whether fertilizer A or B was better for his soil. He put A on sections 1 and 3 and B on sections 2 and 4. What is wrong with Mr. Smith's experiment? **03-Core-26A**

Jack did an activity in which he studied the bouncing of objects. He dropped two sinkers at the same time from shoulder height. One hit the floor; the other landed on a pile of three books. **03-Core-27A**

1. Name a variable that is unchanged in both cases.
2. Name a variable that changes in the two cases.

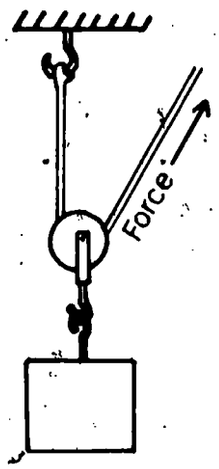
A car tire manufacturer wants to know which of three kinds of cord material – steel, fiberglass, or nylon – will help his tires give the best mileage. **03-Core-28A**

1. What variable will he vary on purpose in his experiment?
2. After the manufacturer has made the changes proposed in part 1, what variable does he study the changes in?

A racing car owner wants to know which fuel will give his car the most speed. Naturally he will make the tests driving his own car. Name two other factors that he must keep unchanged if his trials are to be useful. **03-Core-29A**

In the pulley arrangement shown in the diagram below, the mass and the pulley together weigh 10 N and will be lifted 10 cm. Read the sentences which follow. Select the one quantity in parentheses which best completes each sentence, and record your answers. **03-Exc 9-1A**

1. To raise the mass and pulley 10 cm, the force would have to move (5, 10, 20) cm.
2. The amount of force required to raise the combined weight of 10 N of the mass and the pulley by pulling on the rope would be about (5, 10, 20) newtons.



03-Exc 10-1A In Excursion 10, you worked with pulley systems using movable and fixed pulleys.

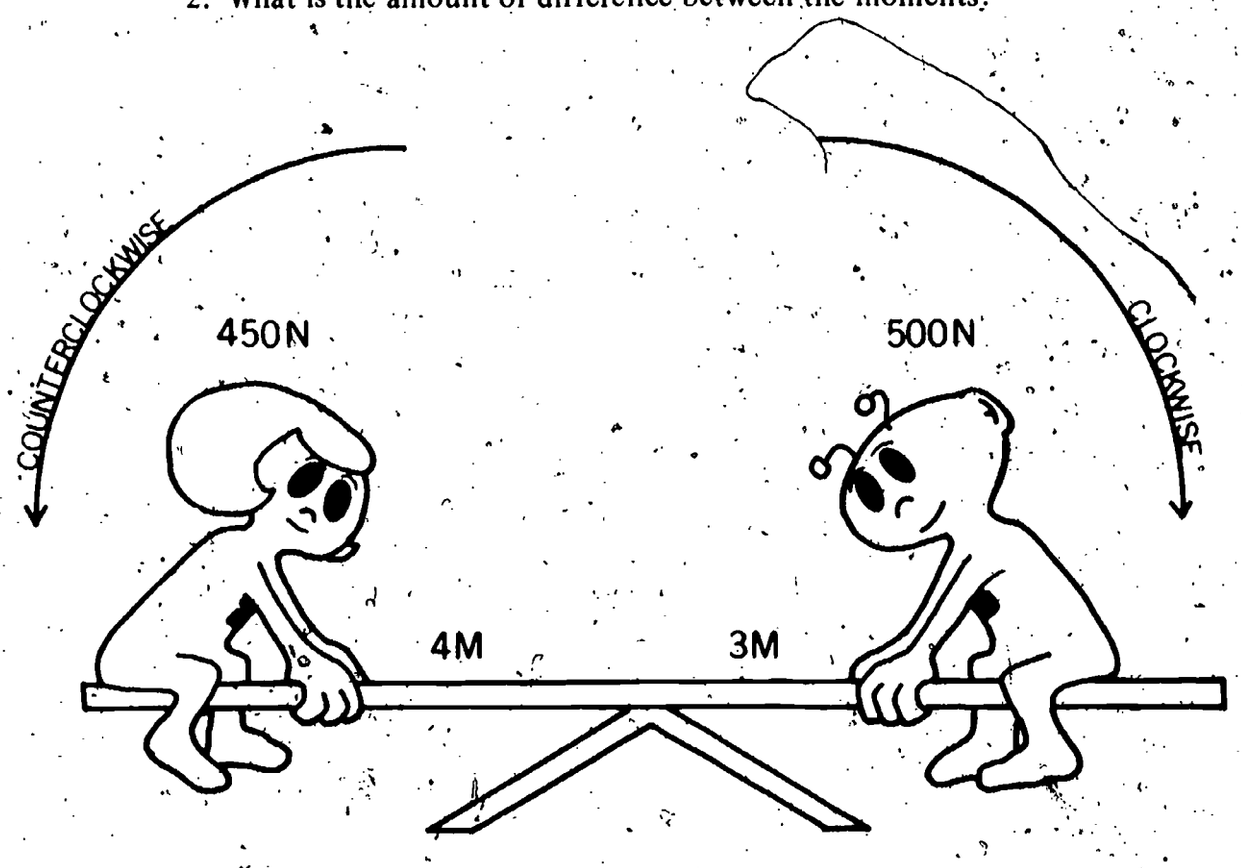
1. In movable pulley systems, how does the input work required to lift an object compare with the output work done on the object?
2. What is the main benefit of using movable pulleys to lift objects?

03-Exc 11-1A Two men tried to load a roll of newsprint onto a truck. They tried to use a ten-foot long plank as an inclined plane. They didn't have enough force to roll the newsprint up the incline.

1. If the men got a twenty-foot long plank for an incline, would the force required to roll the newsprint onto the truck be decreased, increased, or not changed?
2. Why is this the case when a longer plank is used?

03-Exc 12-1A Mrs. Jones holds a seesaw while Johnny, who weighs 500 N, climbs on the right end 3 meters from the pivot. After his sister Alice, who weighs 450 N, gets on the other end at 4 meters, Mrs. Jones lets go.

1. Will the greater moment then cause the seesaw to turn clockwise or counterclockwise?
2. What is the amount of difference between the moments?

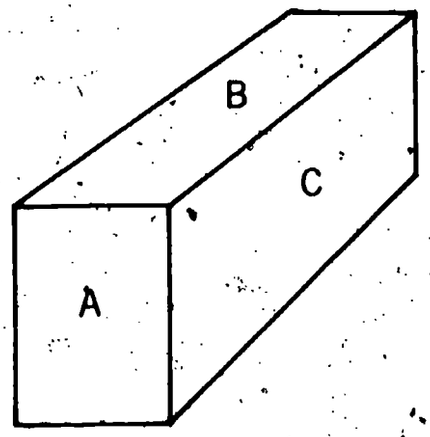


03-Exc 13-1A Find the average to one decimal place for each set of numbers. Show your work.

1. 1¼, 3½, 2¾
2. 2½, 3¼, 2¾

The wood block shown below is dragged three times over a table. Each time a different surface, A, B, or C, is on the table. Which statement below best describes the result? The force of friction **03-Exc 14-1A**

a. will be greatest on surface C because it has the largest area.
b. will be greatest on surface A because there is more weight on it.
c. will be the smallest on surface C because there is less weight per square inch on it.
d. will be the same on all surfaces because the total weight acting on the surface is the same for A, B, and C.



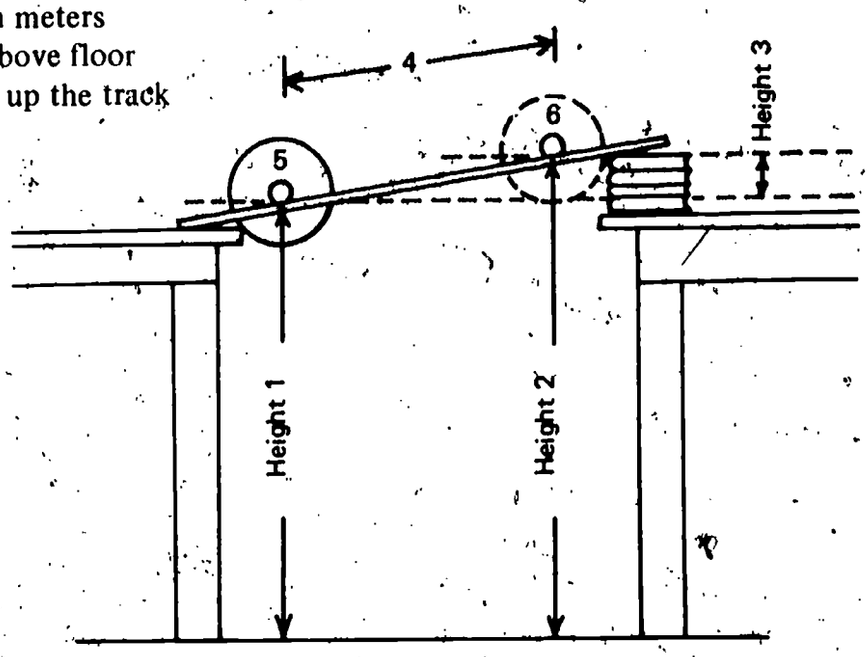
Imagine that a spring is squeezed or a rubber band is stretched. What kind of energy is given to the spring or the rubber band? Select the best answer below. **04-Core-1A**

a. motion energy
b. potential energy
c. gravitational energy
d. frictional energy

Charged batteries, gasoline, and sinkers hanging on a string have potential energy. What is meant by *potential energy* as used in that sentence? **04-Core-2A**

The spinigig is lifted off the track at 5 and set back onto the track at 6. Record the letters of any measurements you would use to calculate the change in the potential energy of the spinigig. **04-Core-3A**

a. Weight of the spinigig in newtons
b. Weight of the spinigig track in newtons
c. Height 3 in meters
d. Height 2 above floor
e. Distance 4 up the track



A trip-hammer is used to drive steel fence posts into the ground. Three different size hammers are raised to different heights above the tops of three posts. Calculate the potential energy of each hammer before it is dropped. Show your calculations and answers on your paper. **04-Core-4A**

Post Size	Weight of Hammer (in newtons)	Height above Post (in meters)
1. Small	28.5	0.8
2. Medium	53.6	1.4
3. Large	75.0	2.0

04-Core-5A

1. If you lift a concrete block off the ground to the top of a wall, do you give it energy?
2. If so, what kind of energy do you give it? If not, why don't you give it energy?

04-Core-6A

What is a metric unit used in ISCS for measuring potential energy due to gravity?

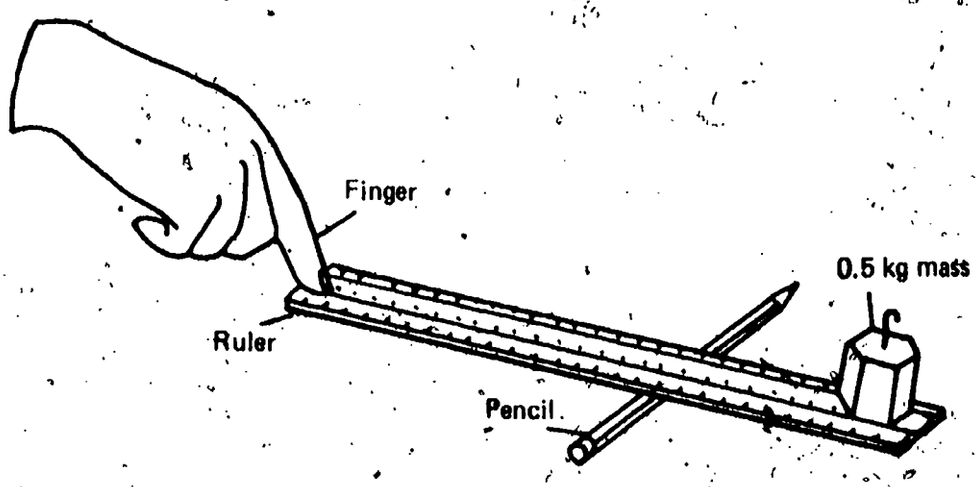
04-Core-7A

Your instructor has suspended an object, labeled 04-Core-7A, above the floor. Use your force measurer and a meterstick to find its potential energy. Show your measurements and calculations.

04-Core-8A

Look at the diagram below. The finger pushing down on the ruler lifts the 0.5 kg mass.

1. Name the component doing the input work.
2. Name the component receiving the output work.



04-Core-9A

Write in your own words what *input work* is.

04-Core-10A

Select the phrase that completes the following sentence. In a system, the object that does work on something else is called the

a. energy supplier.
b. input work.
c. output work.
d. energy receiver.

04-Core-11A

Select the phrase that completes the following sentence. In a system, the object that has work done on it by something else is called the

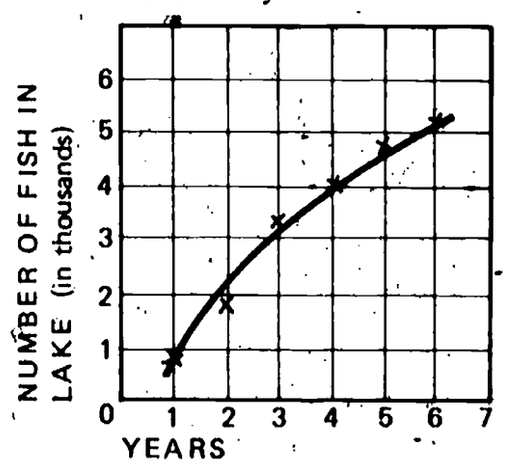
a. input work.
b. output work.
c. energy receiver.
d. energy supplier.

State a way in which you can tell if an object has motion energy. You may use an example if you wish. **04-Core-12A**

Set in the roller bearing blocks, you have a 4-disk spinigig with a string wrapped around its axle. Attached to the string is one sinker that can fall 1 meter and cause the spinigig to spin. What effect would adding more sinkers have on the spinigig's speed of rotation? **04-Core-13A**

Suppose your spinigig turns 5 times in 10 seconds. What is its speed in turns per second? Show your calculations on your paper. **04-Core-14A**

What does the curved line on the grid tell you about the fish population in the lake? (Hint: How does the change in the fish population between the 5th and 6th years compare with the change between the 1st and 2nd years?) **04-Core-15A**

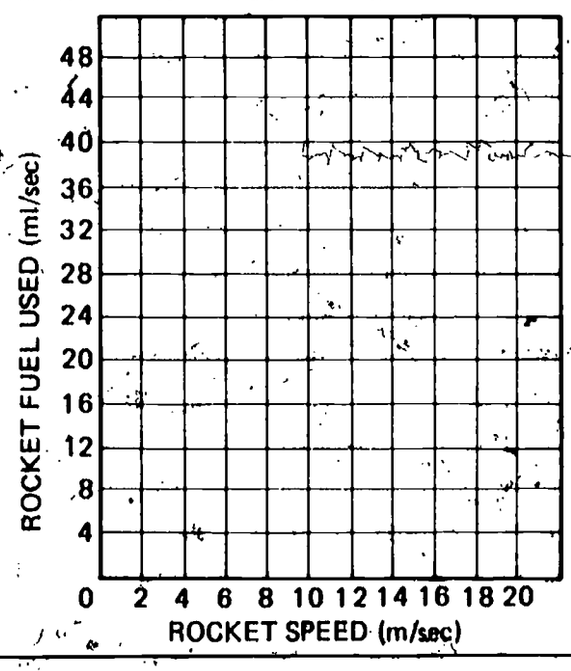


Name the unit used to report the speed of a spinning object such as a spinigig. **04-Core-16A**

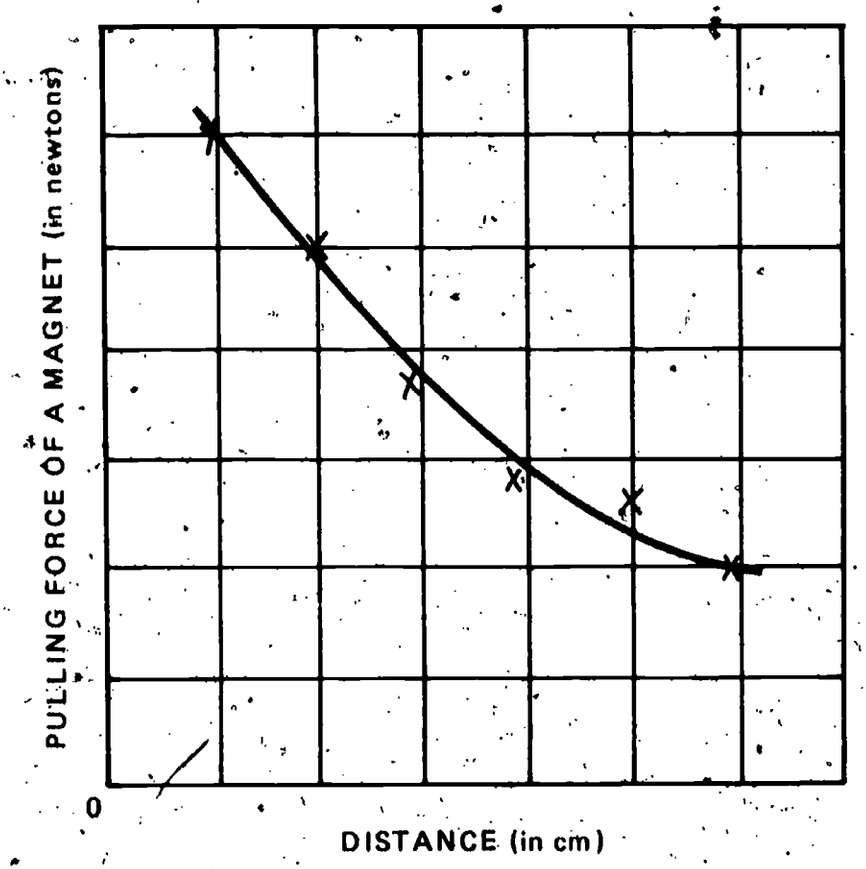
Get some graph paper, draw a pair of axes, and label them as shown below. Use your grid and the table below to plot rocket speed against fuel used. Draw a best-fit line for the plotted points. **04-Core-17A**

Rocket Speed Per Ml of Fuel

Speed (m/sec)	Fuel (ml/sec)
2	13
4	18
6	22
8	25
10	26
12	28
14	29
16	30
18	30



04-Core-18A What two things does the best-fit curved line on the grid below tell you about the magnet?



04-Core-19A A spinigig with 2 disks and a string wrapped around its axle is set into the roller skate wheels and placed on the track. Attached to the string is one sinker that can fall one meter and cause the spinigig to spin. What effect would increasing the number of disks on the spinigig have on its speed of rotation?

04-Core-20A Define *mass*. (Hint: Consider how it is used in the following sentence.) Debbie compared the mass of the sinkers with the mass of the golf ball and found they were equal.

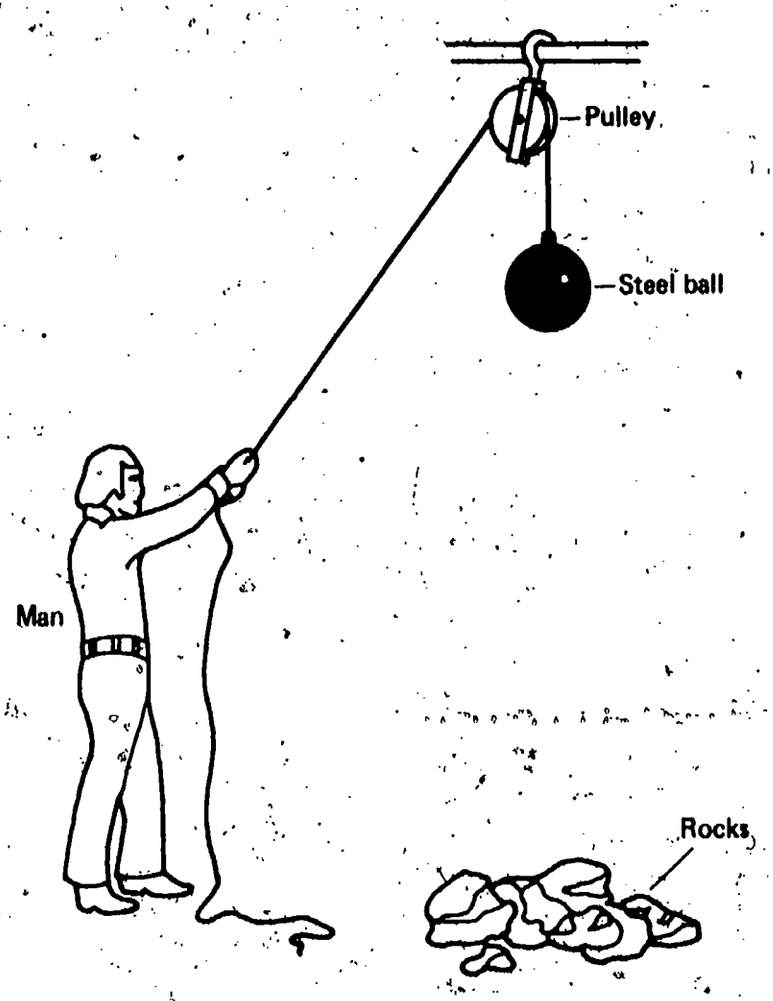
04-Core-21A A tow truck's winch lifted a car from the road. The car gained potential energy. What kind of energy did the winch apply to the car?

04-Core-22A

1. What kind of energy does a large rock have when it is held twenty feet above the ground by a rope?
2. If the rope is cut and the rock falls, its energy changes. What kind of energy is it changed to?
3. What force acts upon the rock to change the energy after the rope is cut?

Look at the diagram below. A steel ball is dropped on rocks to crush them. The ball is lifted to a height of ten feet above the rocks by a man using a pulley. 04-Core-23A

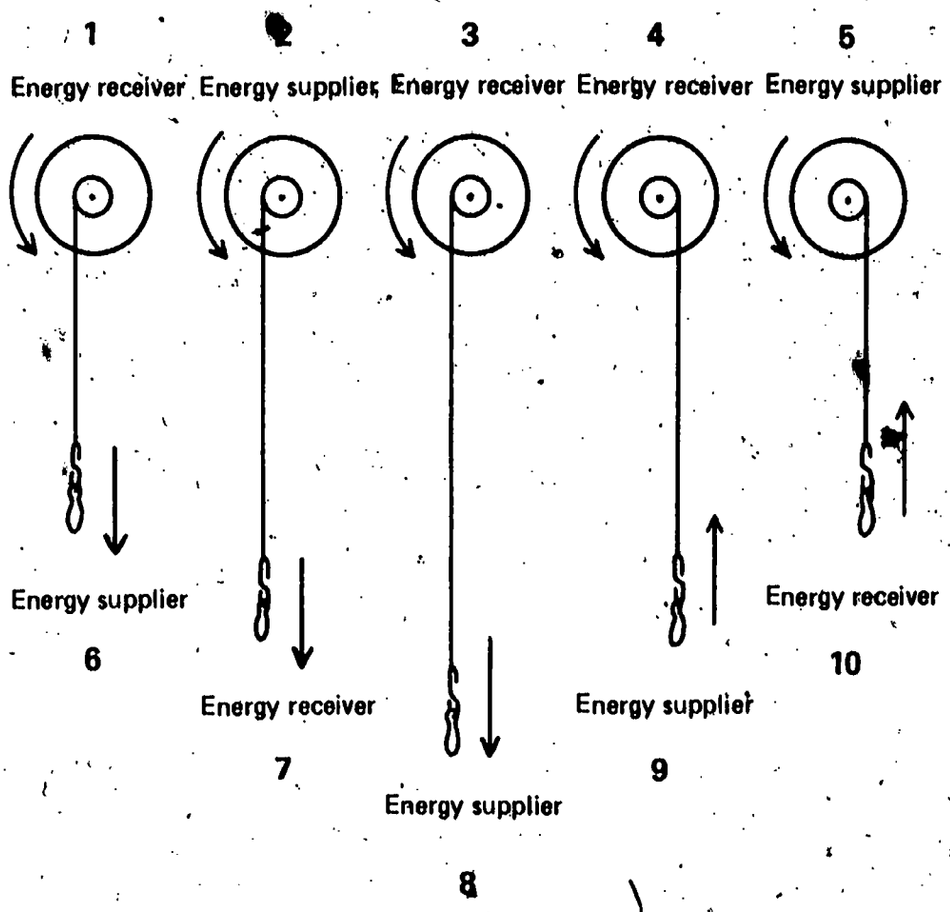
1. Name the supplier of input energy to the system.
2. Name the receiver of output energy from the system.



When your hand moves, it has energy. It can beat on a bongo drum. How could you measure the energy of a moving hand as it strikes the drum? 04-Core-24A

The force required to slide a brick on the sidewalk is 3.5 newtons. Bob threw a baseball at the brick and caused the brick to slide 2.0 meters. If all the motion energy of the baseball was given to the brick, how much motion energy did the baseball have? 04-Core-25A

04-Core-26A In the drawings below, arrows correctly show the direction in which five spinigigs are moving. However, some of the labels are incorrect. List the number of each of the incorrect labels.



04-Exc 15-1A Io is the moon of the planet Jupiter. It is larger than earth's moon. The force of gravity on a 1 kg mass on Io is about 1.78 newtons. On earth, it is about 9.8 newtons.

1. If a golf ball were taken from the earth to Io, would its mass change?
2. What would happen to its weight?
3. How did you know the answers to give?

04-Exc 15-2A One of the astronauts took a golf ball to the moon.

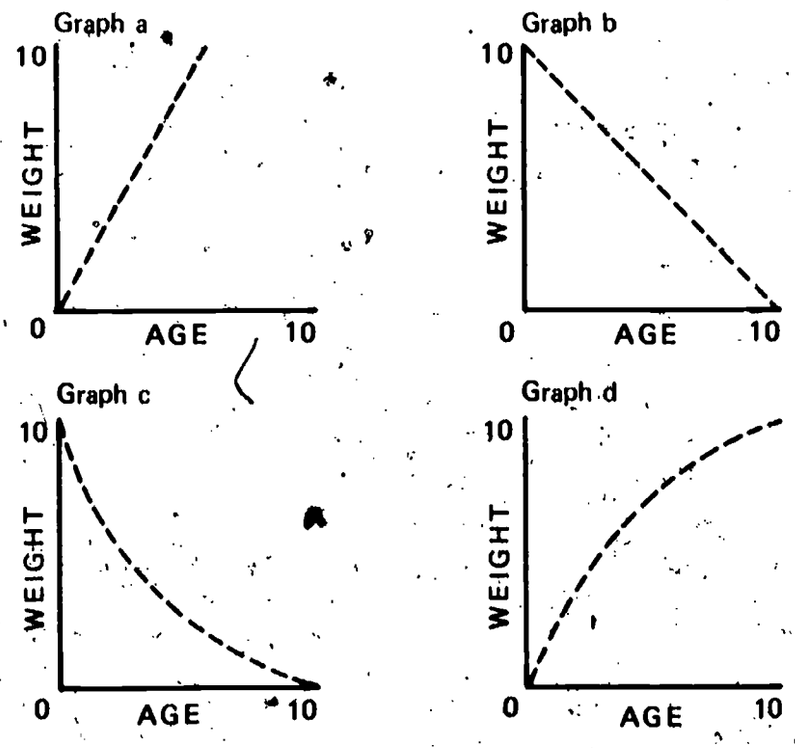
1. Did the mass of the golf ball change during the trip?
2. What have you learned about *mass* that supports your answer?

Answer both 1 and 2 below by selecting the letter that best completes the sentence in each case. **04-Exc 16-1A**

1. Excursion 16, "Forerunners of Space Travel," tells how eleven men who lived from 400 B.C. to 1725 A.D. developed ideas about astronomy. One thing that all of these men did was
   a. invent instruments to measure or observe with.
   b. contribute new ideas.
   c. make maps of the earth or planets.
   d. build rockets or spaceships.
2. Newton said, "If I have seen further than other men, it is because I have stood on the shoulders of giants." He meant that
   a. he was a very modest man and didn't want praise.
   b. he was short himself but could see farther when someone held him up.
   c. he had the advantage of others' ideas and could improve and advance them.
   d. he could explain the gravity that holds stars in galaxies because the others couldn't see outside the solar system.

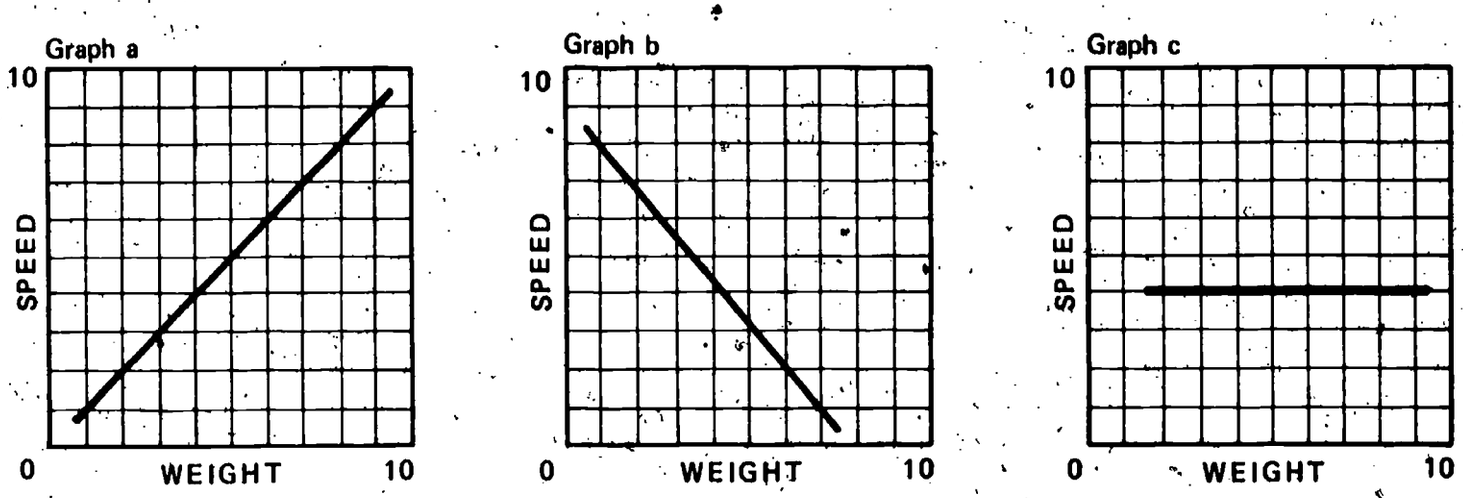
Each of the following four statements describes a relationship between the variables age and weight. Beside the number of each statement, record the letter of the graph below which shows the same relationship. **04-Exc 17-1A**

1. As age increases, weight increases at a constant rate.
2. As age increases, weight decreases at a changing rate.
3. As age increases, weight decreases at a constant rate.
4. As age increases, weight increases at a changing rate.



04-Exc 18-1A After the number of each of the following four statements, write the letter of the graph that illustrates the relationship described in the statement. You may use the letter of a graph more than once.

1. When weight increases at a constant rate, speed decreases at a constant rate.
2. When weight increases at a constant rate, speed is not changed.
3. When weight decreases at a constant rate, speed increases at a constant rate.
4. When weight increases at a constant rate, speed increases at a constant rate.



04-Exc 19-1A A beach ball with water in it has a mass of 15 kg. It has been tossed at a speed of 3 meters per second and is traveling toward you. At the same time a 2 kg exercise ball is thrown toward you at 15 meters per second speed. Use the formula $KE = \frac{1}{2}ms^2$ to answer the following questions. Your answers will be in newton-meters.

1. What is the difference in the energy of the two moving objects? Show your calculations.
2. Which ball would be more difficult to stop?

When a rubber band has been stretched, what kind of energy does it have? 05-Core-1A

05-Core-2A

	Trial 1	Trial 2
Average of force of blade	8.7 N	7.4 N
Distance blade tip moved	0.019 m	0.046 m
Work done on cart	0.141 N·m	0.321 N·m

Brent used his force measurer as the input work supplier to his water-clock cart. When he reviewed his data, he noticed that in Trial 1 he had used a larger force than in Trial 2. But he had done less work on the cart. Could this be true? Explain your answer.

John brought a toy cannon to class. He found it took 1.5 newtons of force to start to compress the spring in the cannon, and the force had to be increased to 6.5 newtons to compress the spring completely. The distance the front of the spring moves when released is 0.06 m. What is the potential energy of the spring when fully compressed? 05-Core-3A

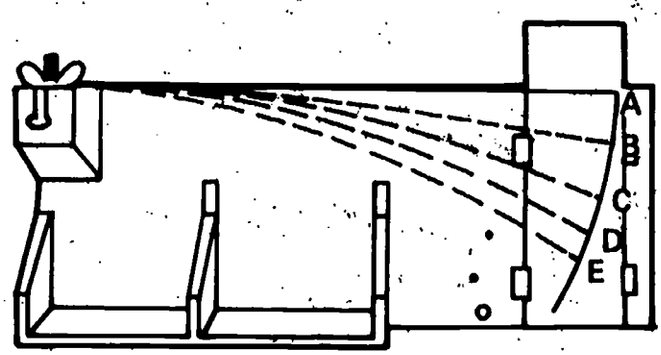
Give an operational definition of *kinetic energy*. 05-Core-4A

A motor is connected to a battery. How can you tell if the motor has kinetic energy? 05-Core-5A

What would you do to measure the amount of kinetic energy a moving cart has? 05-Core-6A

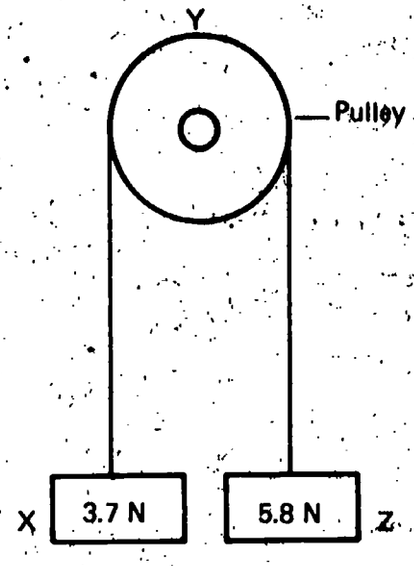
Study the diagram below. Jean pulled the blade of her force measurer all the way back to position E and released it. 05-Core-7A

1. Identify by letter the position at which the potential energy of the blade was the greatest.
2. Identify by letter the position at which the kinetic (motion) energy of the blade was the greatest.



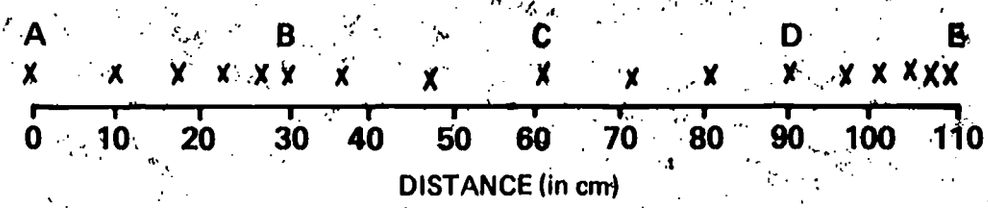
05-Core-8A An object at X weighs 3.7 N. A second object at Z weighs 5.8 N.

1. Which of the following states the direction of movement: X to Y or Z to Y?
2. Which of the following correctly states the amount of force acting to produce the motion: 9.5 N, 2.1 N, or 21.5 N?



05-Core-9A Look at the record below of the movement of a water-clock cart. This record was made by a moving cart which dropped a drop of water every two seconds.

1. List the letters between which the cart's speed is increasing.
2. List the letters between which the cart's speed is decreasing.
3. List the letters between which the cart's speed is constant.



05-Core-10A Suppose you put a ball on an inclined plane and release it without pushing it. What force causes the ball to roll down the incline?

05-Core-11A What force causes a marble rolling across the floor to slow down and stop?

05-Core-12A An electric motor is an energy converter in which electrical energy is changed to useful output kinetic energy. When the output mechanical energy is measured, however, it is always less than the input electrical energy. What force is responsible for this decrease?

1. Write the letter of the best choice to complete the following sentence. **05-Core-13A**
When 84 newton-meters of input work is done by a horse on a treadmill, the treadmill might do
   a. 81.5 newton-meters of output work.
   b. 84 newton-meters of output work.
   c. 88.5 newton-meters of output work.
2. Write the letter of the reason for your choice.
   a. Because the horse doesn't waste any energy
   b. Because the treadmill saves work, as a machine does
   c. Because in a system input work is always greater than output work

---

Choose the correct word to complete the following sentence. "Hot-rod" Saxon always spins the wheels of his Corvette when he takes off from the school parking lot. This causes the temperature of the tires to (increase, decrease, stay the same). **05-Core-14A**

Energy occurs in many forms. List six of these forms. **05-Core-15A**

Think of the changes in energy that occur in the following situation. A box **05-Core-16A**
1. is lifted from the floor,
2. reaches its maximum height of 2 m and stops,
3. falls, and
4. is about to strike the floor.

For each numbered step above, select two things from the table below – the letter (a, b, c, or d) of the phrase which describes the potential energy of the box at that moment and the letter (w, x, y, or z) of the phrase which describes the kinetic energy of the box at the same moment.

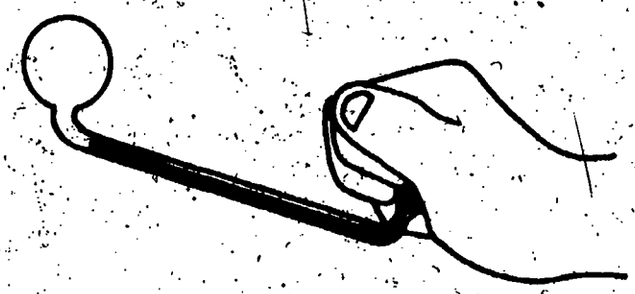
Potential Energy	Kinetic Energy
a. gains potential energy	w. gains kinetic energy
b. loses potential energy	x. receives input of kinetic energy
c. lowest potential energy	y. no kinetic energy
d. greatest potential energy	z. greatest kinetic energy

Describe how you can tell if light energy is present in some way besides seeing the light or an object which the light illuminates. Also state what you would need to do to measure the amount or intensity of the light. **05-Core-17A**

Stephanie agreed that light could light up things and make them visible. She said light couldn't do work, though, and that therefore it isn't energy. Prove that Stephanie is wrong. Name an instrument which shows that light is a form of energy. Tell how the instrument shows that work is being done. **05-Core-18A**

05-Core-19A Get a palm glass, and tilt it until all the liquid is in one of the bulbs. Hold the full bulb gently in your hand, as shown in the picture below. Be sure the cross tube is below the bulbs and the empty bulb is higher. Choose the correct answer below. What causes the liquid to move toward the other bulb?

a. Heat energy
b. Light energy
c. Pressure
d. Gravity



CAUTION: HOLD GENTLY.

05-Core-20A Give two examples which show that electrical energy can be changed into kinetic energy.

05-Core-21A Read the following story. While working on Chapter 10, Johnnie put nails into holes 1 and 3 of the force measurer and pushed the cart back until the blade touched the nail in hole 3. (You may look at a force measurer if you wish.) Then he observed the following things.

1. The blade went forward (from hole 3 to hole 1), pushing the cart.
2. The cart lifted the sinkers.
   His partner stopped the cart, but it slipped.
3. The sinkers fell.
4. The cart slammed into the blade and pushed it back from hole 1.
5. The cart went forward, raising the sinkers.
6. The sinkers lay flat on the floor.

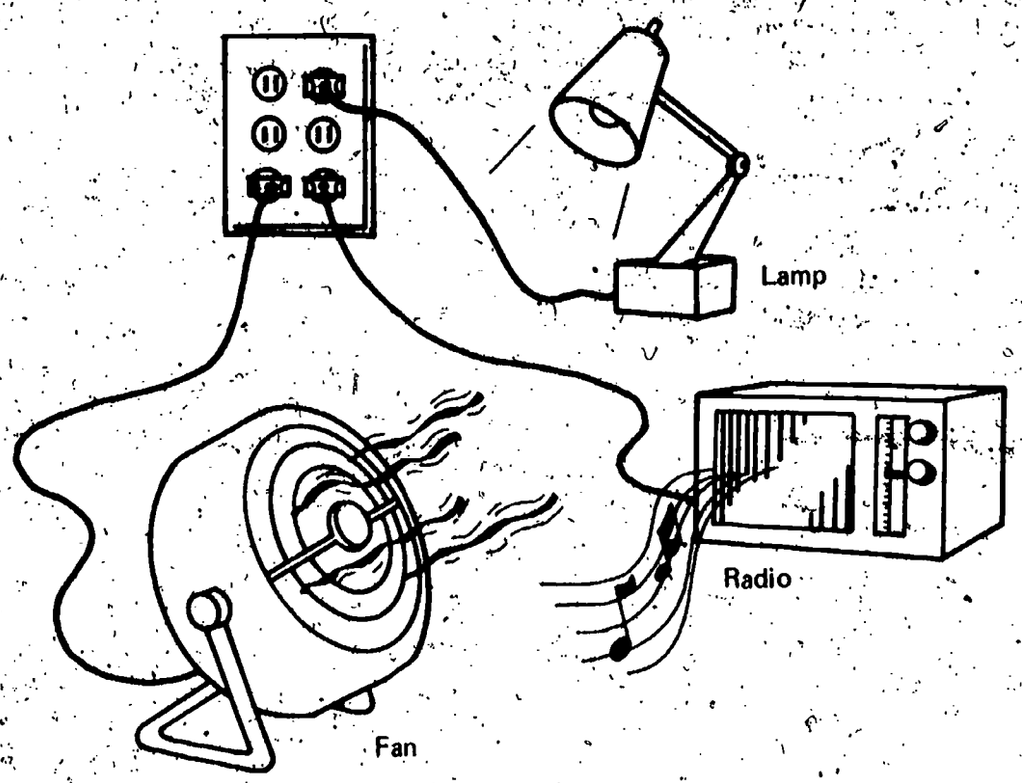
Beside the number of each step, write P-K if potential energy is being changed to kinetic energy and K-P if kinetic energy is being changed to potential energy. Write N if there is no change in the form of energy.

05-Core-22A Write the letters of all the statements that identify characteristics of energy. Energy can

a. be converted from one form to another.
b. be measured by speed times distance.
c. be destroyed.
d. exist in more than one form.
e. be transferred from one system to another.

Examine the diagram below. **05-Core-23A**

1. State the form or forms of input energy shown in the diagram.
2. State the form or forms of output energy shown in the diagram.



In your home, there are many things which convert one form of energy into another. **05-Core-24A**

1. List three such energy converters found in your home.
2. State the form of the input and the output energy for each. For example, light bulb: input energy – electrical; output energy – heat and light.

A water clock drips 37 drops in 18 seconds. The water-clock cart leaves a trail of water drops 3 cm apart. What is the speed of the cart in centimeters per second? **05-Exc 20-1A**

Pepito, an ISCS student, noticed an ant walking around the circumference of a spinigig disk which hung in the rack. The timer was going, so he timed the ant. It took 14 seconds for each trip around. How far did the ant walk in one trip? At what speed was it moving? You may get a spinigig, 50 cm of string, and a meterstick to make whatever measurements you need. Show your measurements and your calculations. Report your answer in centimeters per second. **05-Exc 21-1A**

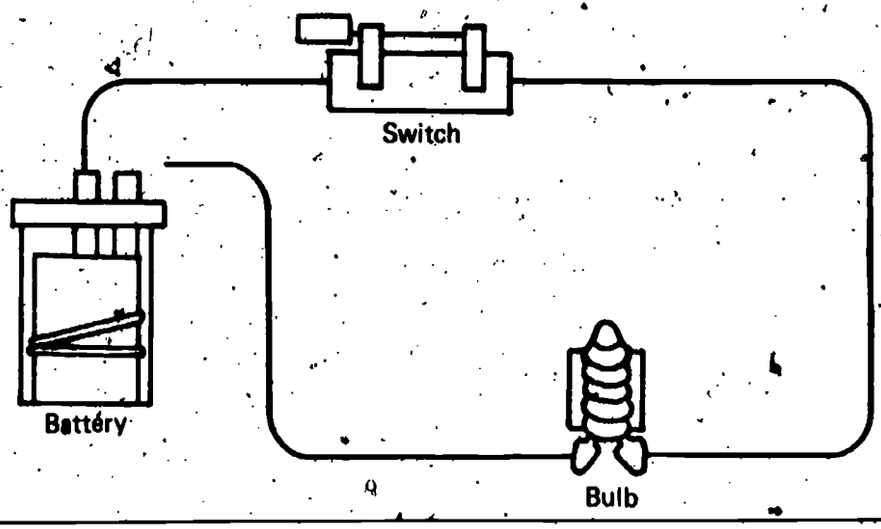
The following things are known about a rocket. **05-Exc 22-1A**

a. It has a mass of 1,800 mass units.
b. It has a thrust of 750,000 lbs.
c. It has a speed of 17,500 miles per hour.
d. It has an acceleration of 0 to 7,000 mph in 4.5 sec.

Write the letter of each variable needed to calculate the rocket's momentum.

Assume that the equipment shown in the diagram below is all in good working order. **06-Core-1A**

1. Will the bulb light?
2. Why do you believe the bulb will or will not light?



Get the bottle of blue solution labeled 06-Core-2. This is the same as the solution you used in Chapter 12. Which material in these solutions was responsible for the reddish-brown coating on the carbon rod? **06-Core-2A**

a. Water
b. Copper
c. Sulfate
d. Oxygen

The carbon rod in box 06-Core-3 was coated with a substance during the activities done in Chapter 12. Name the material that coats the carbon rod. **06-Core-3A**

A car battery is properly connected to an electric battery charger. Choose the letter of the sentence below which describes the energy conversion that takes place within the battery during charging. **06-Core-4A**

a. Electrical energy is changed into kinetic energy.
b. Chemical energy is changed into electrical energy.
c. Light energy is changed into heat energy.
d. Electrical energy is changed into chemical energy.

In what form is energy stored in a battery? **06-Core-5A**

1. What happens inside a rechargeable automobile battery when it is being charged? **06-Core-6A**
2. When it discharges to the automobile, what happens inside the battery?

Luis has a battery, 2 bulbs, and 3 test leads. What must he do to make a complete electrical circuit? You may use a diagram as part of your answer. **06-Core-7A**

06-Core-8A Go get 1 charged flashlight battery, 2 bulbs and sockets, and 3 test leads. Using these materials, connect the two bulbs in a series circuit. Show your teacher what you have done.

06-Core-9A Diagram a circuit that shows a ~~switch,~~ a battery, a motor, and two light bulbs connected in series.

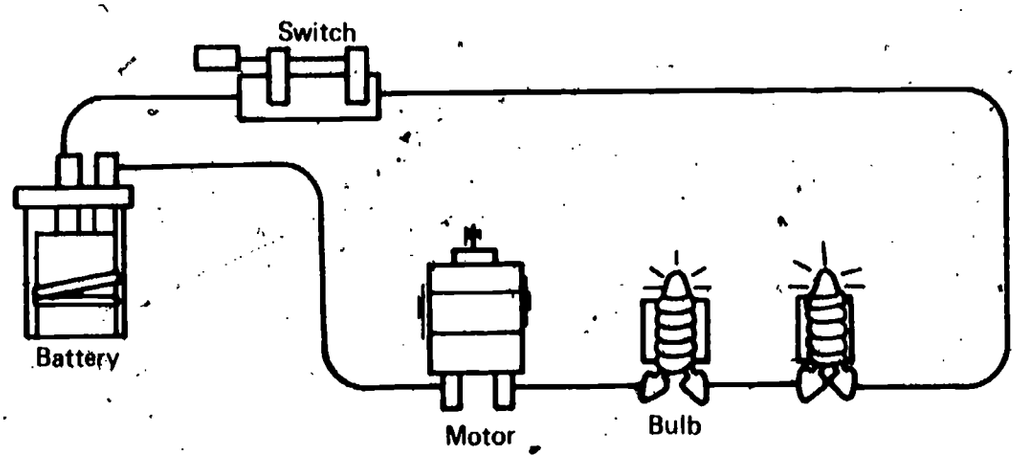
06-Core-10A For each of the following statements, tell whether the electrical devices mentioned are wired in *parallel* or in *series* with each other. Write *series* or *parallel* on your answer sheet next to the number for each statement.

1. Suppose a fuse (circuit breaker) in a house is removed and that causes the television set in the living room to go off. How are the fuse (circuit breaker) and the television wired?
2. A toaster and a light are both plugged into the receptacles of a wall outlet. The toast pops up, and the toaster shuts off. But the light remains on. How are the toaster and the light wired?
3. Suppose you wish to roast meat in an electric oven. You set the electric timer on your oven for two hours. At the end of two hours, the timer rings and shuts off. The oven also shuts off. How are the timer and the oven wired?

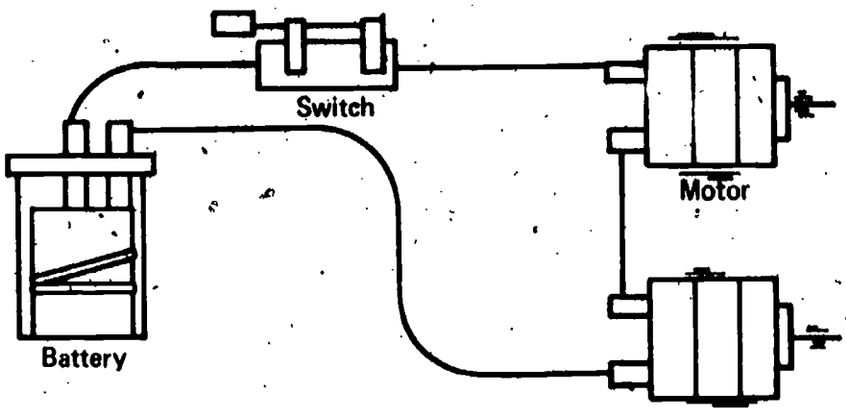
06-Core-11A Diagram a circuit containing a battery, a motor, and two bulbs wired in parallel.

06-Core-12A Get the following: 1 charged "D" size battery, 3 bulbs and sockets, and 6 test leads. Using these materials, connect the three bulbs in a parallel circuit. Show your teacher what you have done.

06-Core-13A Look at the circuit diagramed below. Suppose one more bulb is added in series with the circuit. How would this affect the amount of electrical energy the motor and the other bulbs receive?



The amount of current flowing in the circuit diagramed below can be reduced in several ways. State one way in which the current can be reduced but not stopped. **06-Core-14A**



Each diagram below represents either a series or a parallel circuit. On your paper, beside the number of each diagram, name the type of circuit it shows. **06-Core-15A**

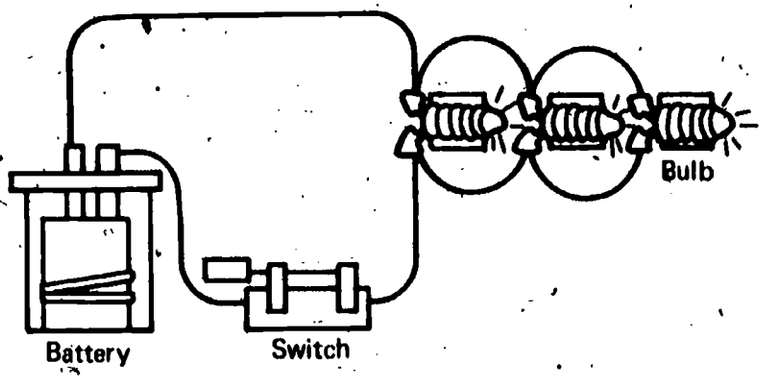


Diagram 1

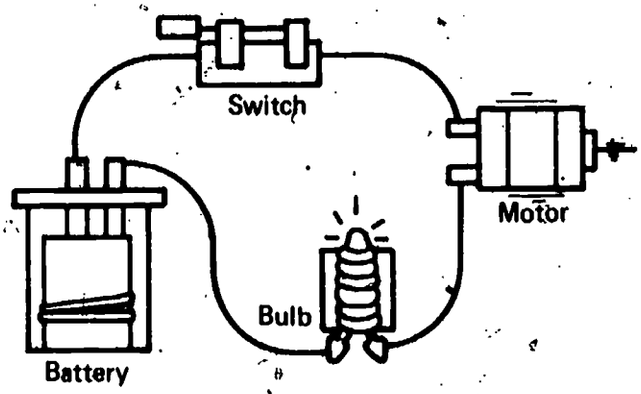


Diagram 2

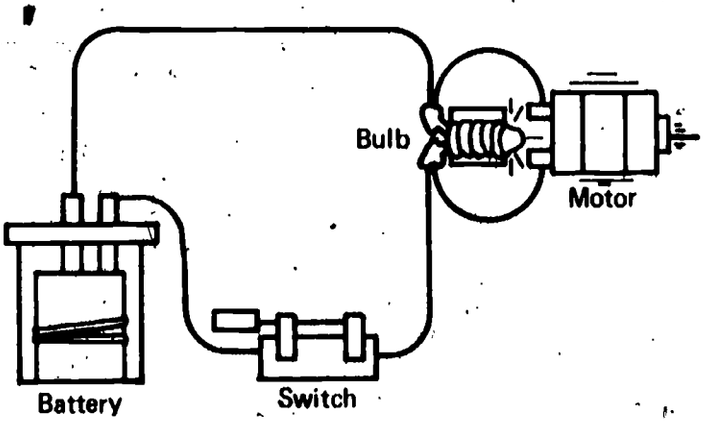


Diagram 3

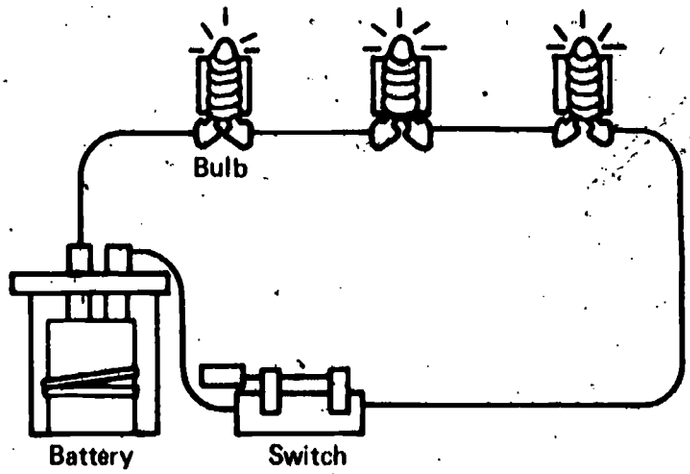
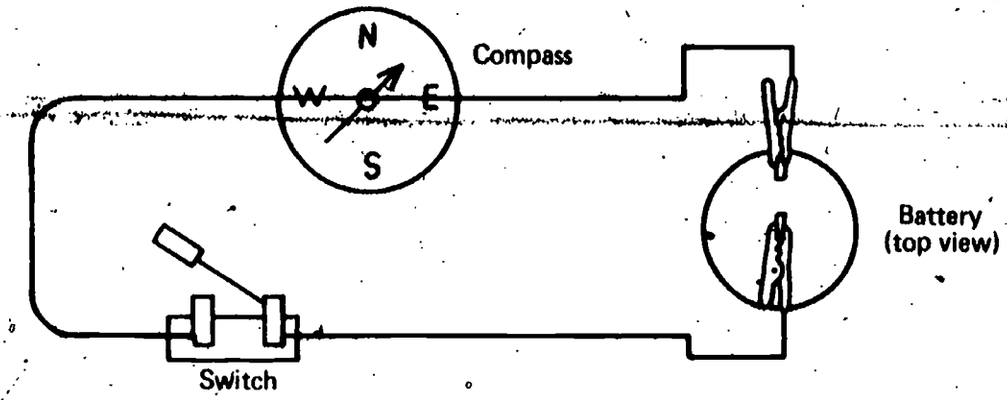


Diagram 4

06-Core-16A When electricity is passed through a resistor, the temperature of the resistor rises. What causes this?

06-Core-17A Suppose that a compass with its magnetic needle is placed under the wire of an electrical circuit, as shown below. What will happen when the switch is closed?



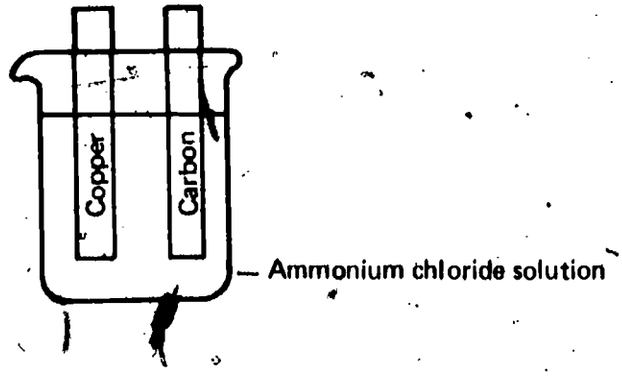
06-Core-18A How does changing the number of loops in a coil of wire affect its magnetic strength?

06-Core-19A Record the letter of each statement below which identifies a characteristic of energy. Energy can

a. be measured by speed multiplied by distance.
b. be destroyed.
c. exist in more than one form.
d. be transferred from one system to another.

06-Exc 23-1A This battery, as it is pictured, will not produce enough electricity to light a bulb. Write the letter of any change listed below which would let the battery produce more electrical energy.

a. Using strips made of different metals
b. Using a beaker rather than a battery jar
c. Using a different solution, such as copper sulfate
d. Using a cardboard divider



Chemical energy can be stored and then changed to other forms. Write the letters of any sentences below in which it is possible to say that the stored chemical energy is changing to other forms. **06-Exc 24-1A**

a. The brown coating on the lead strip in your ISCS battery disappeared when electricity was produced.

b. The zinc metal strip turned copper-colored when placed in copper sulfate solution and the solution got hot.

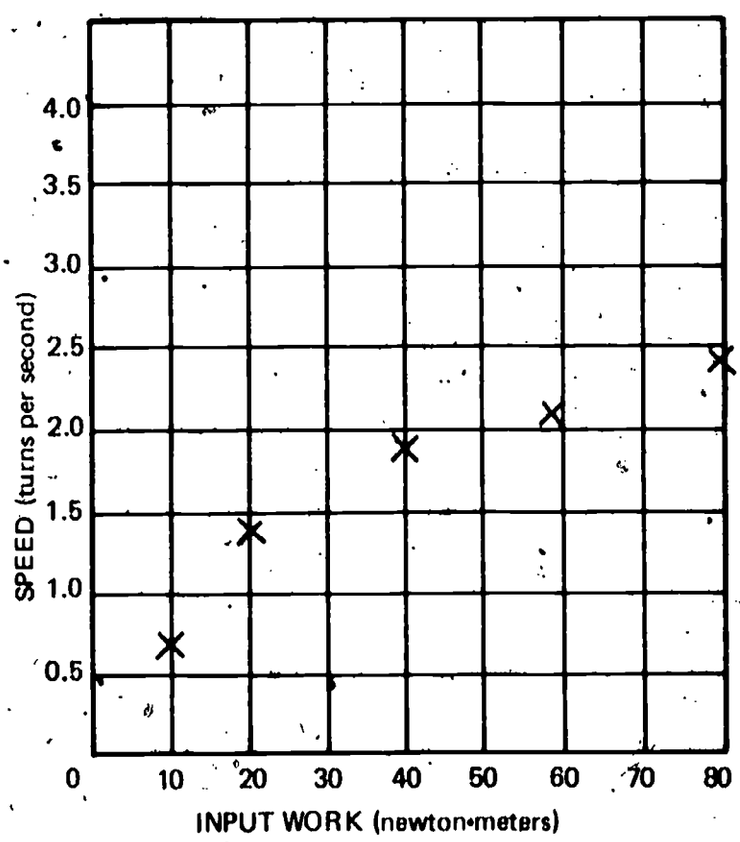
c. The addition of glycerine to potassium permanganate produced light.

d. None of those are correct.

Nick measures the weight of a beaker, using a balance like you use in your ISCS course. He gets a weight of 25.0 g. Next he measures the same beaker using a more precise balance – a centigram, or *triple beam balance,* as it is sometimes called. He gets a weight of 24.98 g. Finally, he uses an electrical balance, which gives him a weight of 24.976 g. Nick says now he knows that the 25.0 g weight he recorded earlier is in error and that the weight of the beaker is exactly 24.976 g. **06-Exc 25-1A**

1. Do you agree or disagree with Nick?
2. Why?

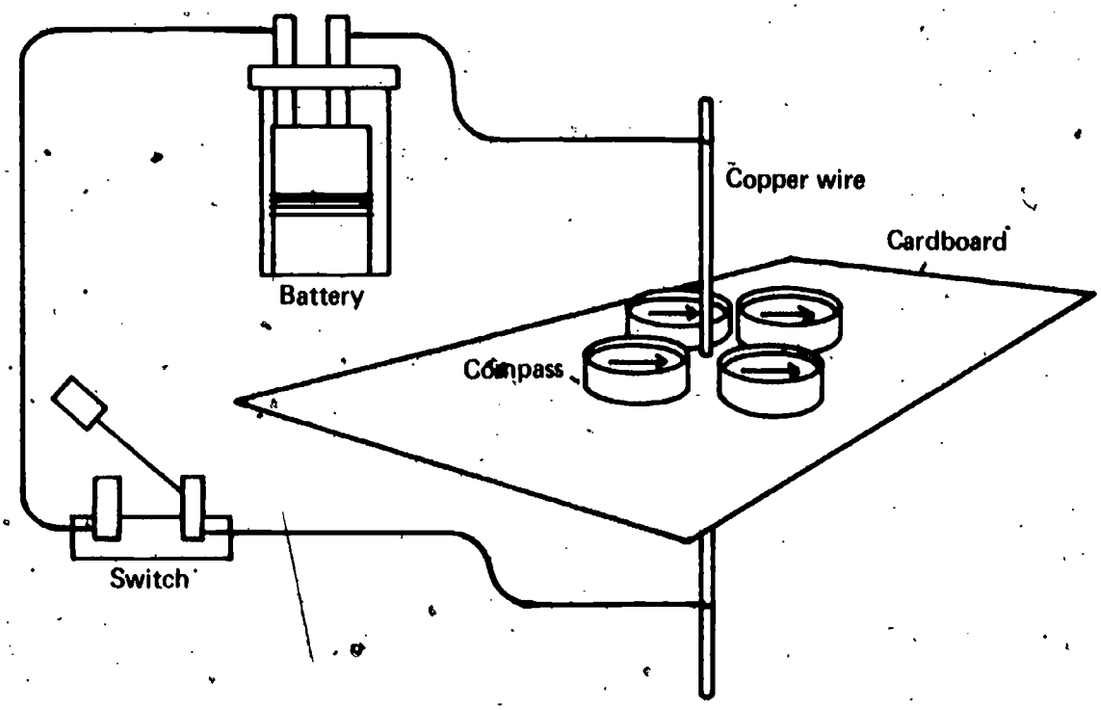
Luis plotted points for data he collected using a spinigig. The points were located as shown on the grid below. Get grid paper from your teacher. Label the axis, and plot the points as shown below. Then draw the best-fit line for the points. **06-Exc 25-2A**



06-Exc 26-1A The electrical outlets in Iggy's house are wired in parallel. Write the letter of the sentence below that explains what that means.

a. The circuit contains more light bulbs than if it had been wired in series.
b. The TV, stove, and stereo will work whether or not they are switched on.
c. If the TV is switched off, the fan also stops running.
d. The electricity can flow through the circuits in any one of several paths.
e. All of the above are correct.

06-Exc 27-1A The following diagram shows a copper wire passing through a piece of cardboard on which several compasses have been placed. On your answer sheet, trace the cardboard and compasses. Then, use arrows to show the direction the compass needles will point when the switch is closed and electricity is passing through the wire.



Select the answer which is not true of a scientific model. **07-Core-1A**

a. It explains observations.
b. It is an experimental observation.
c. It may in some cases be represented by a physical object or a sketch.
d. It is useful.

Select the best answer. Scientific models come into existence by being **07-Core-2A**

a. discovered in nature, using telescopes.
b. found among data and pieced together.
c. extracted from nature, using microscopes.
d. thought up by men, using their observations.

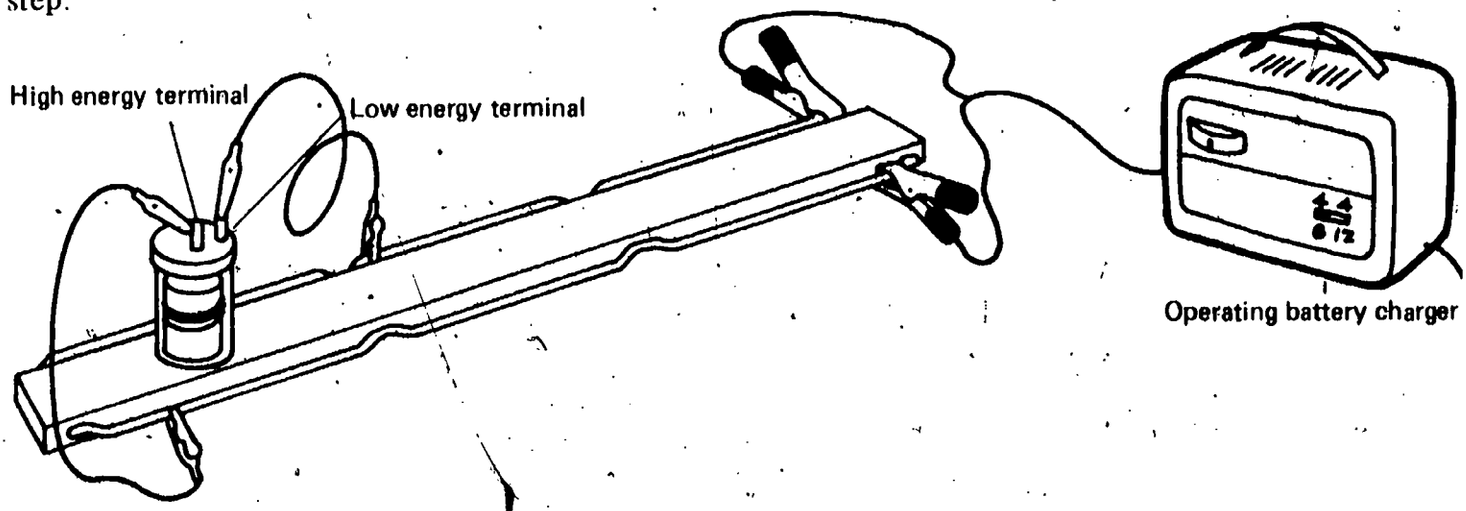
State two things a good scientific model does. **07-Core-3A**

Select the statement below which best fits your understanding of the models that scientists use. A scientific model **07-Core-4A**

a. provides correct answers to all scientific questions.
b. describes what actually happens in nature and therefore is correct.
c. is not used because it is correct, but because it is useful in explaining observations and predicting other observations.
d. cannot be shown to be incorrect.

The ISCS model for electricity uses the idea of the electroparticle. List three characteristics that are assumed to be true of the ISCS electroparticle. **07-Core-5A**

The diagram below shows an ISCS battery charger and an ISCS battery. On your answer sheet, describe the path through the battery-battery charger circuit that we assume electroparticles follow. Tell what happens to the electroparticles at each step. **07-Core-6A**



Can scientists develop more than one model which can be used to explain light? If not, why not? If so, how would a scientist decide which model to use? **07-Core-7A**

07-Core-8A Using the electroparticle model, describe the process of charging a battery.

07-Core-9A When a charged battery is connected to a light bulb and the circuit is complete, the bulb lights. Using the ISCS electroparticle model, explain how the energy travels through the circuit and how it makes the bulb light.

07-Core-10A Tell what happens at the poles (terminals) of a battery when there is a complete circuit to a motor. Explain your answer in terms of the ISCS electroparticle model.

07-Core-11A Use the electroparticle model to explain what happens to the current flow in a circuit when a resistor is added.

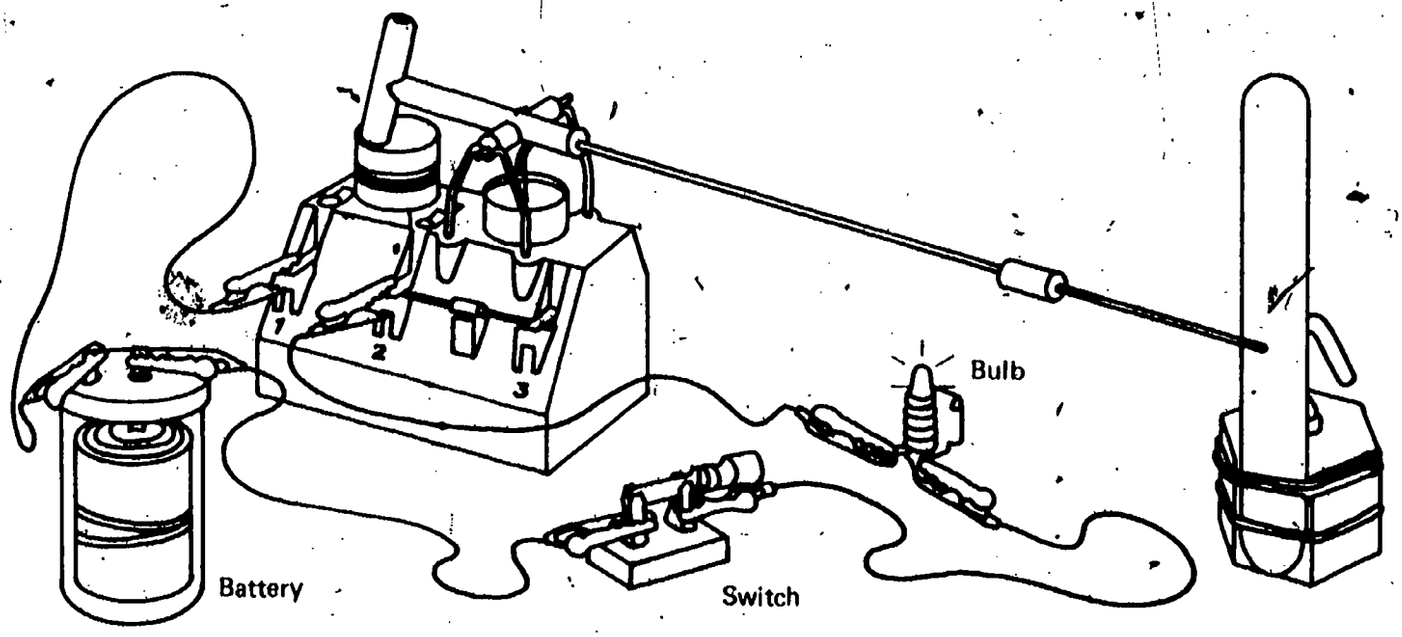
07-Core-12A A circuit contains a charged battery, an electric motor, and a resistor. Which factor in the list below determines how many electroparticles will pass through the resistor in two minutes if the battery has a good charge?

a. The charge of the battery
b. The size of the electric motor
c. The size of the electroparticles
d. The energy of each electroparticle

07-Core-13A List three things about the flow of electricity through a circuit that are not explained by the ISCS electroparticle model.

07-Core-14A When you use an ammeter to measure the current received by a circuit, you must connect it in series with the circuit. Why?

07-Core-15A Study the diagram below to determine how the electricity measurer is connected in the circuit. When it is connected in this manner, what does it measure?



Select the best answer below. Accepted units of measurement come into existence when they are **07-Core-16A**

a. found by experience.
b. defined by people.
c. set by nature.
d. experimentally discovered by scientists.

One way to describe electricity is to use the electroparticle model. Using this model, describe the process of charging a battery. **07-Core-17A**

Name the standard unit for measuring electrical current. **07-Core-18A**

What is the standard unit for measuring electrical energy carried by an electroparticle? **07-Core-19A**

Carefully study the setup your teacher has assembled in box 07-Core-20. As it is set up, it is an ammeter. Change it into a voltmeter. Show your setup to your teacher. **07-Core-20A**

Get an ISCS electricity measurer kit, four D batteries in holders, five test leads, and a blank tongue depressor mounted on a ½ kg mass with rubber bands. Using these materials, make a voltmeter scale for the electricity measurer. **07-Core-21A**

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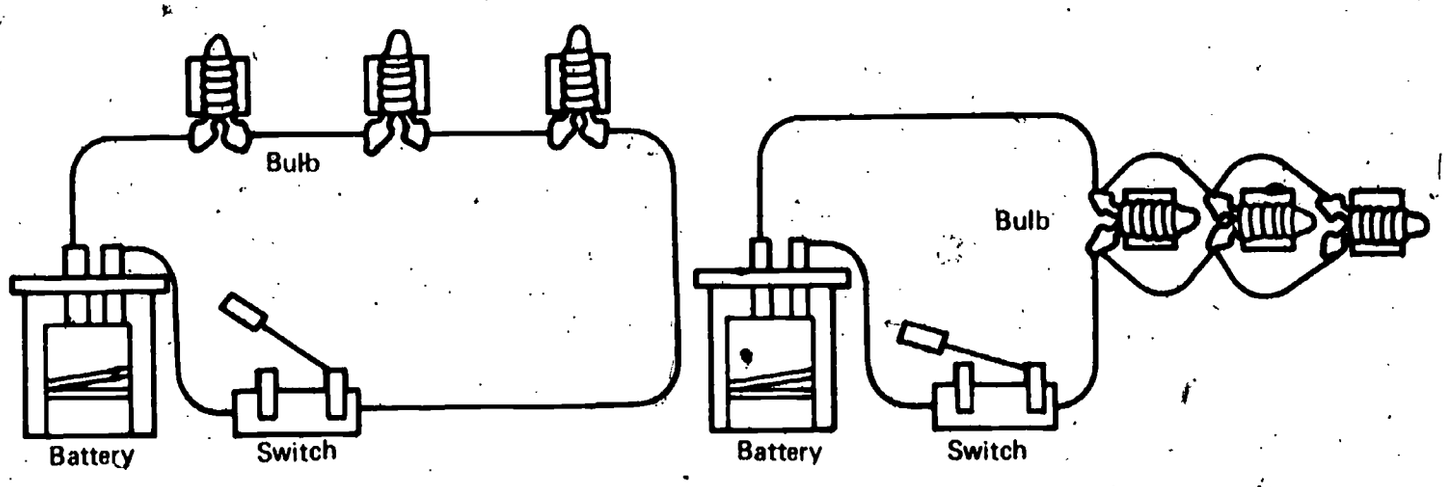
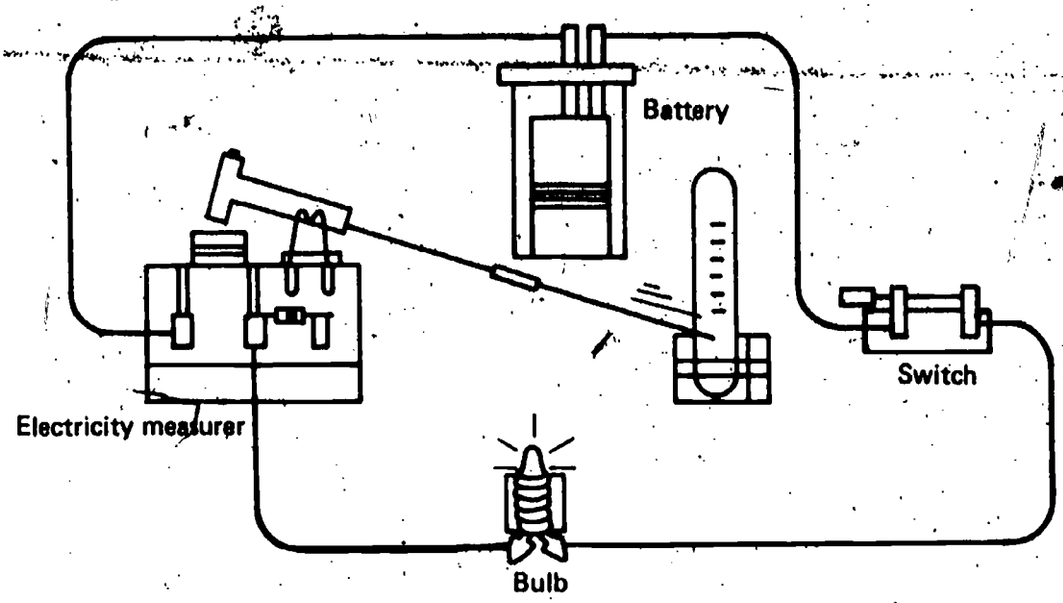
1. Construct circuit A. Close the switch and measure the current flow, and report your measurements. Show your ammeter hookup to your teacher.
2. Then hook up circuit B. Close the switch and measure and report the total current flowing in the circuit. Again show your hookup to your teacher. **07-Core-22A**

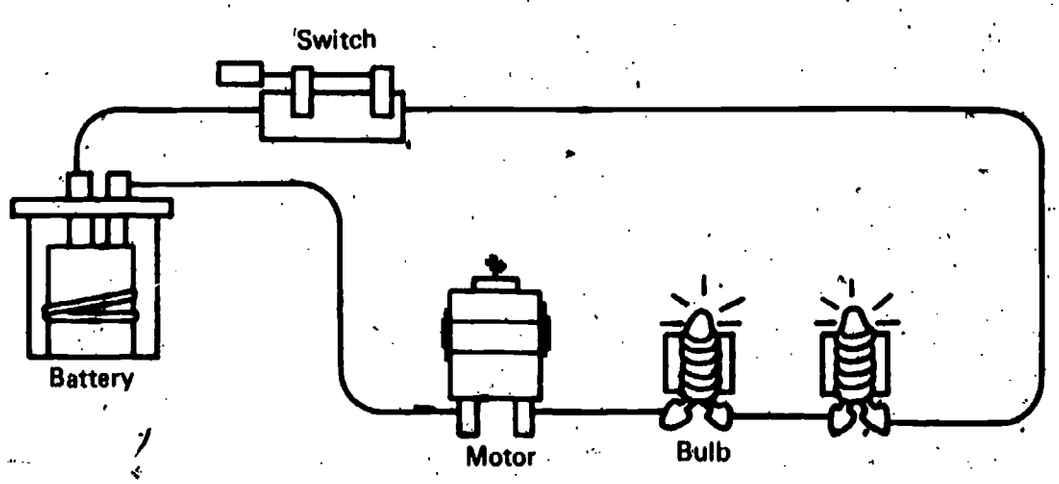


Circuit A Circuit B

07-Core-23A John connects an electricity measurer, closes the switch, and the pointer moves downward on the scale, as shown in the diagram below. What can he do to cause the pointer to deflect upward on the scale?



07-Core-24A How will adding one more bulb in series in this circuit affect the amount of electrical energy each of the other bulbs receives?



A stoppered bottle with a message inside has been thrown into a calm sea by a prisoner on a pirate ship. The captain sees the bottle and tries to shoot it with the ship's cannon. All he does is make waves with the cannon balls. The waves pass under the floating bottle. Which of the following statements best describes the motion of the bottle in the water? **07-Exc 28-1A**

a. Away from the ship
b. Towards the ship
c. Up and down in nearly the same spot
d. Impossible to answer unless you know if the waves are moving away from or toward the ship

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Place 2 inches of water in a water trough, and put a small cork in the middle of it. With a pencil, slowly tap the surface of the water at one end of the pan, creating a series of waves. Does the cork-water system move horizontally towards or away from the wave source, or doesn't the system move horizontally at all? What, if anything, travels across the water's surface? **07-Exc 28-2A**

Read the following story. Assume that both persons are stating correct facts. Zack Zap is training people to operate light shows. He explains the theory of series circuits, using the electroparticle model of electricity. This model is fairly simple and explains all the observations his students will make. One of his students brings in a new book which explains series circuits, using the new, but complicated, electron model for electricity. Would the student be right to say that because the electroparticle model is incomplete, it is wrong and should never be used? Explain your answer. **07-Exc 28-3A**

Select the best answer below. The gravitron, a particle of gravity, is a model proposed to explain gravity. Most scientists will accept the gravitron model **07-Exc 29-1A**

a. if forces other than gravity can also be explained in terms of gravitrons.
b. if thinking about gravity as tiny particles is useful in explaining gravity.
c. if a law is passed that gravity can only exist if it is in the tiny particles described in the model.
d. only if gravitrons are seen in experiments.

Suppose that in 1970 nearly all scientists accepted the wave model for heat. This would mean that **07-Exc 29-2A**

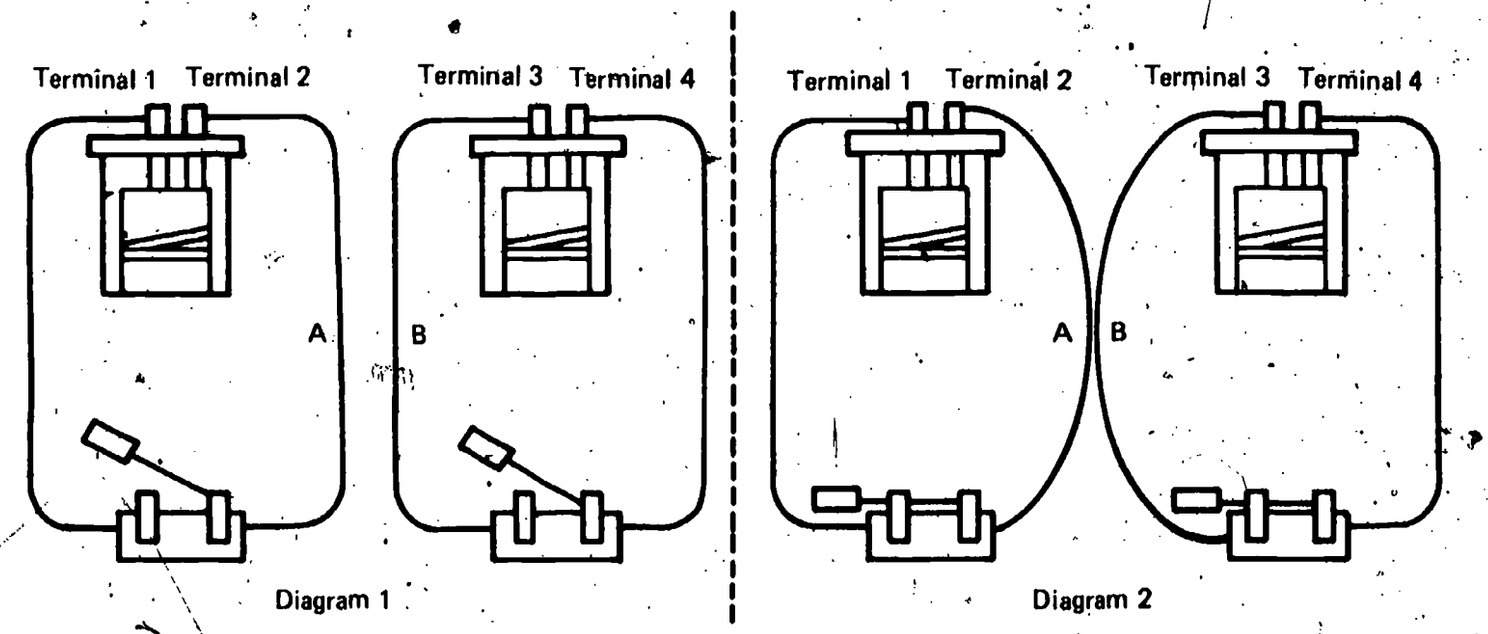
a. they had direct proof that heat traveled in waves.
b. at least a few scientists had observed heat traveling as waves.
c. thinking about heat as though it traveled in waves explained the observations made to that date.
d. heat had the exact properties of a water wave.
e. no other model could fit the observations made to date.

07-Core-29-3A Pretend that nearly all scientists accept the electroparticle model of electricity described in Excursion 29. Choose the entry below which best describes one of the things that acceptance implies.

a. Scientists have seen electricity traveling as electroparticles.
b. The model must be revised to incorporate any new observations that don't agree with it.
c. No other model could fit the observations made to date.
d. It answers all their questions about electricity.
e. None of the above are correct.

07-Core-30-1A Two wires, A and B, are positioned as in Diagram 1 when the switches are open. Diagram 2 shows that when the switches are closed, wires A and B will attract each other. Suppose that in Diagram 2 in the circuit containing wire A the electroparticles come out of the battery through terminal 1 and reenter the battery through terminal 2.

1. Through which terminal in the circuit containing wire B do the electroparticles come out of the battery?
2. Through which terminal in the circuit containing wire B do the electroparticles go back into the battery?



07-Exc 3I-1A Which of the following statements is the best description of scientists?

a. Scientists all exhibit behavior patterns like Ampere's.
b. Scientists are completely different from other people.
c. Scientists' personalities vary like those of any other group of people.
d. Scientists are a group of people who were geniuses even as children.
e. Scientists are so involved with their work that they do not have time to be polite.

A toy manufacturer wants to make two battery-operated walking dolls which operate on two ordinary batteries. He advertises one doll as "Walking Wilma – she walks slowly, but she'll walk longer than any other doll you can buy." He advertises the other doll as "Running Rowena – she runs short races faster than any other doll made today." **07-Exc 32-1A**

For each doll, state whether the doll's batteries should be connected in series or in parallel. Explain your choices, using the electroparticle model.

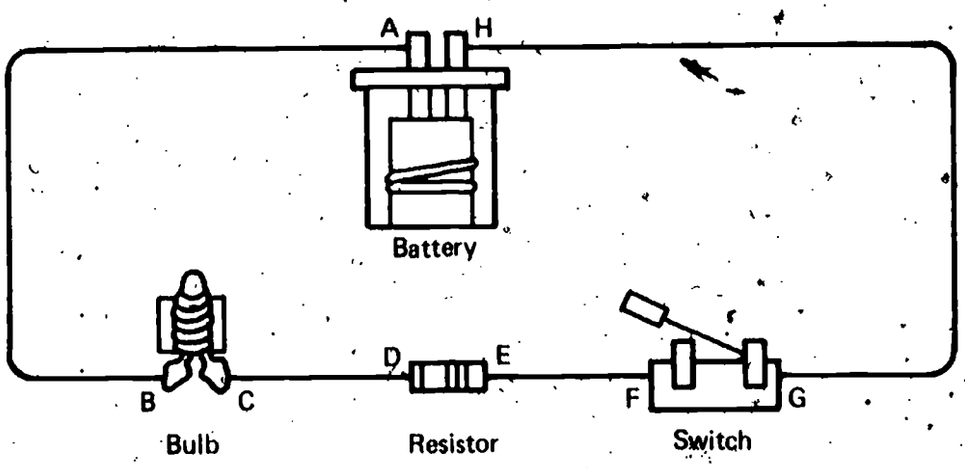
Susie the Snoozing Doll operates on two batteries connected in parallel. The motor that operates her arms and the motor that operates her legs as she stretches can be thought of as two similar resistors. The manufacturer plans a new, improved Susie who can move her head from side to side. This movement will require a third motor (resistor). In addition, the manufacturer plans to add a third battery in parallel. Will a voltmeter reading taken on the new improved Susie be more than, equal to, or less than a voltmeter reading taken on the older version of Susie? Explain your answer, using the electroparticle model. **07-Exc 33-1A**

Wanda the Walking Doll operates on two batteries and motors connected in series. The motor that operates her arms and the motor that operates her legs can be thought of as two resistors. The manufacturer plans a new, improved Wanda, who can move her head. This movement will be a third motor the same as the other two. In addition to the motor, the manufacturer plans to add a third battery in series. Will an ammeter reading taken in the new, improved Wanda be more than, equal to, or less than an ammeter reading taken in the older version of Wanda? Explain your answer, using the electroparticle model. **07-Exc 33-2A**

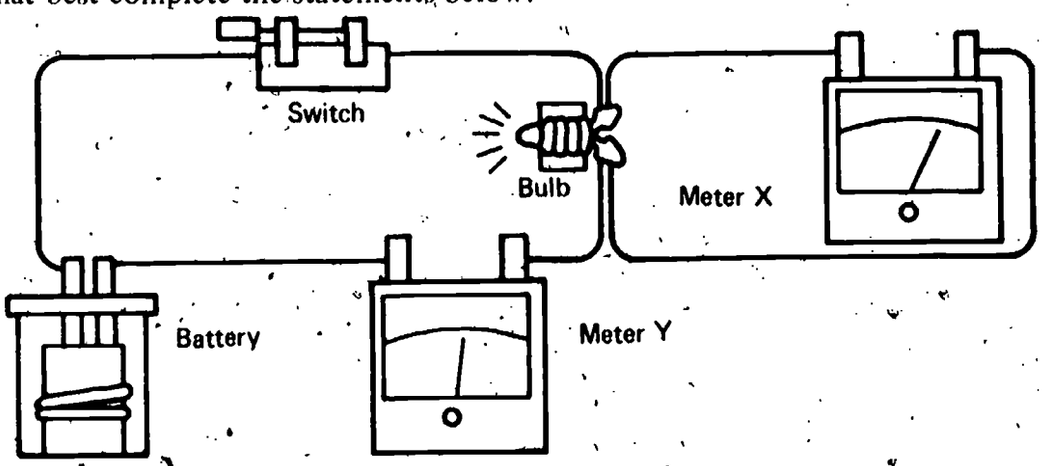
To measure the current flowing through a circuit, you must connect an ammeter in series with the circuit rather than parallel to it. Use the electroparticle model to explain why. **08-Core-1A**

Suppose you need to measure the voltage available to a motor in a circuit. How should the voltmeter be connected into the circuit? If you wish, you may use a diagram as part of your answer. **08-Core-2A**

Study the circuit below. Describe how you could detect and measure voltage at the bulb when the switch is closed. Name any other piece of equipment you would need. Tell which letters on the diagram show the places where the equipment should be connected. **08-Core-3A**



In the diagram below, the meters are correctly connected to measure current and voltage. Decide for yourself how each meter is connected and whether it is an ammeter or a voltmeter. Then, record on your answer sheet the words in parentheses that best complete the statements below. **08-Core-4A**



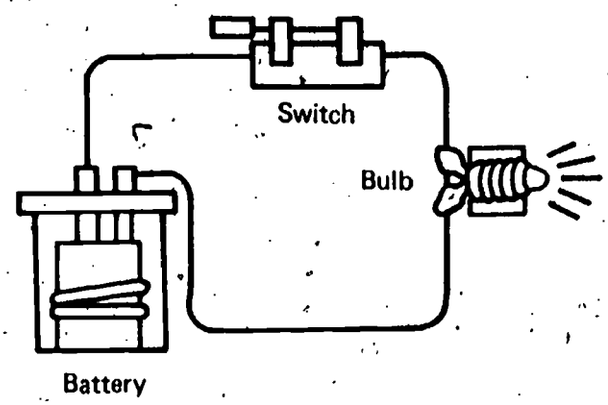
1. Meter X is connected in (series, parallel) with the light bulb. Therefore, Meter X is (an ammeter, a voltmeter).
2. Since Meter Y is connected in (series, parallel) with the light bulb, it is (an ammeter, a voltmeter).

08-Core-5A A light bulb receives 0.2 amperes and 6 volts for 10 seconds. Find the total electrical energy received by the bulb. Show your work, and use the correct units.

08-Core-6A Choose the correct answer below. What is the formula for calculating the total electrical energy supplied in a given circuit?

a. Volts plus amperes divided by time
b. Volts minus amperes plus time
c. Volts times amperes times time
d. Volts divided by amperes times time

08-Core-7A Below is a diagram of a complete circuit in which a bulb is lit. What three variables must you measure to determine the total amount of electrical energy that the bulb receives?



08-Core-8A Get the assembled circuit in box 08-Core-8A, an electricity measurer, a timer; voltmeter and ammeter scales, and two test leads. Disconnect the battery, charge it, and replace it in the circuit. Measure how much electrical energy is supplied to one of the bulbs in the circuit in a fifteen-second period. Report your measurements and calculations.

08-Core-9A Dr. Blades sent his students to the Everglades to collect data about birds. Jim and Pat were to collect data on species of birds. Their observations are shown in the chart below.

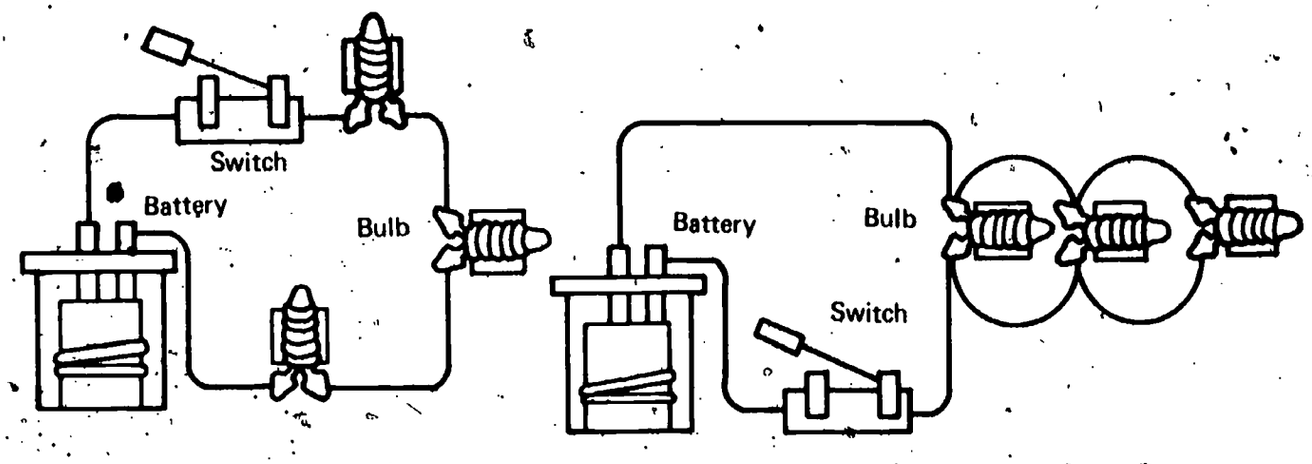
Student	No. of Birds	No. of Nests	Eggs per Nest	Food per Bird	No. of Birds in Flock
Jim	565	300	2 to 4	about 1 lb of insects per day	4 to 6
Pat	lots	lots	average	lots of insects	small

For what two reasons do scientists prefer the kinds of observations Jim made?

Electricity is used to do many things. From the list below, select only those situations in which electrical energy does work which you can actually observe. Electrical energy **08-Core-10A**

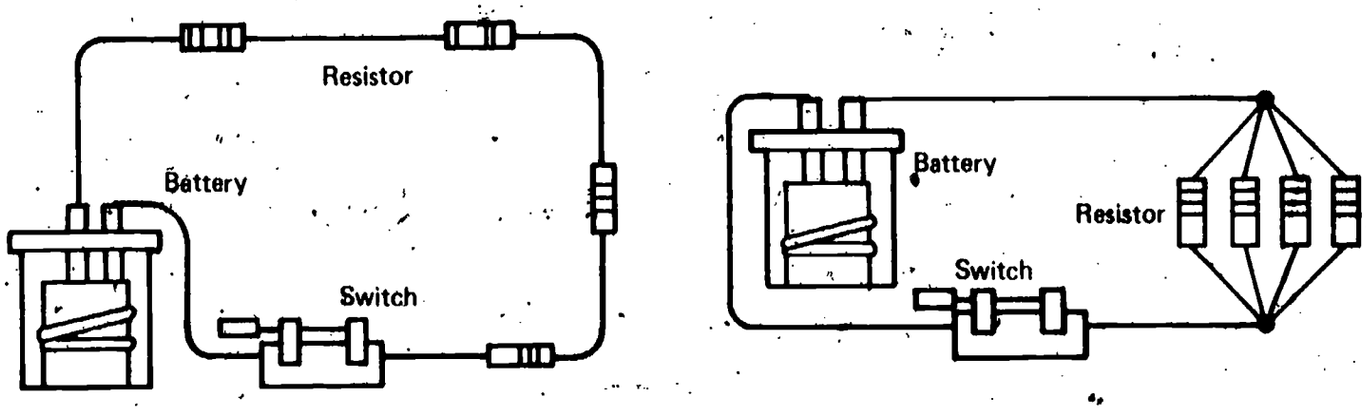
a. heats a burner on an electric stove.
b. operates a mixer.
c. operates a radio.
d. operates a fan.
e. operates an electric lawn mower.

The diagrams below are of two electrical circuits labeled Circuits A and B. Get a voltmeter and the materials to construct the circuits. After constructing the circuits as shown, measure the voltage across each entire circuit. Record the voltage, and show your setup to your teacher. Be sure your battery is charged before you make your measurements. **08-Core-11A**



Circuit A Circuit B

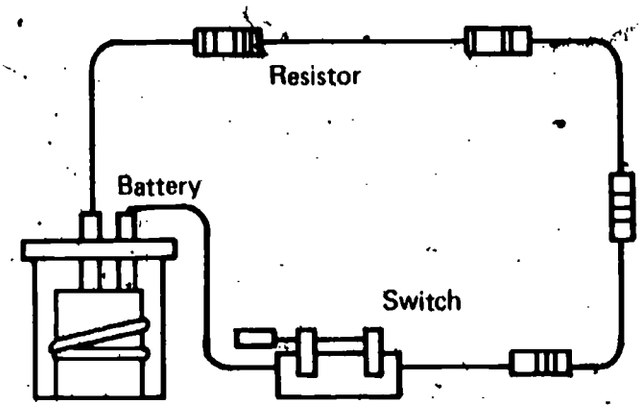
Circuits A and B are shown below. Each contains one ISCS battery and four resistors connected by test leads. However, Circuit A has more total resistance to current flow than Circuit B. All of the resistors in both circuits are the same. Why does Circuit A have more total resistance than Circuit B? **08-Core-12A**



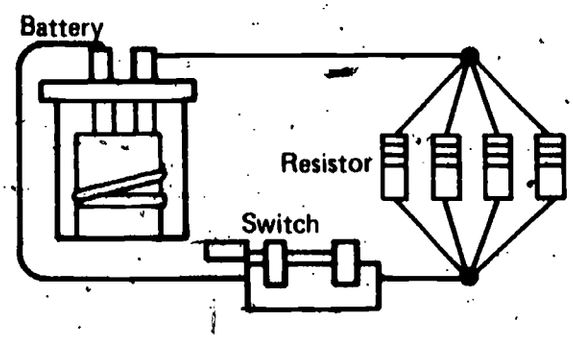
Circuit A Circuit B

08-Core-13A Circuit A and Circuit B below both have identical components, but they are connected differently. Select the phrases in parentheses which best complete the sentences.

1. In Circuit A, the current flows through (each resistor by a separate path, all resistors one after another).
2. In Circuit A, the total resistance to current flow is (less than, greater than) the current flow in Circuit B.

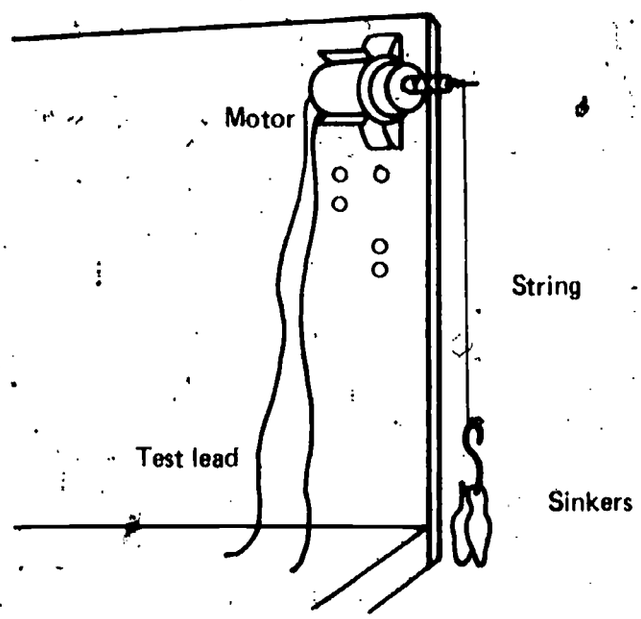


Circuit A



Circuit B

08-Core-14A Operationally define *battery energy*, using the equipment shown below. (Hint: Remember that an operational definition answers two questions.)



In the following problem, let quart cans of oil stand for energy being supplied from one location to another. After the number of each question, write the letter of the statement below which answers it best. **08-Exc 34-1A**

Imagine that a large number of quart cans of Number 30 motor oil are to be removed from a warehouse and stacked in a truck outside the warehouse.

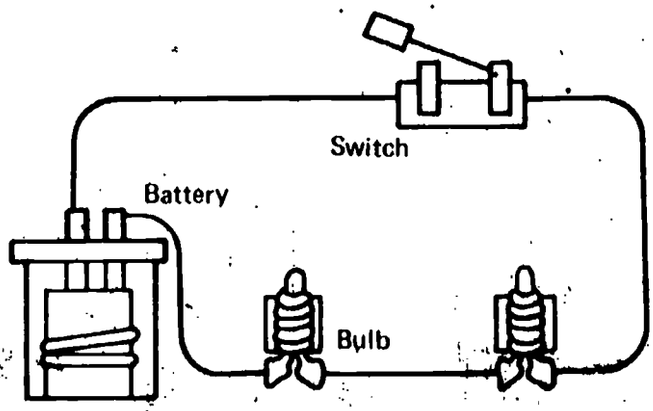
1. Which part of the operation is most like an electroparticle?
2. Which part of the operation is most like a volt?
3. Which part of the operation is most like an ampere?

a. The length of time a person works
b. The number of cans a person can carry at one time
c. The number of persons available to move the cans
d. The quality of the oil
e. The number of cans put on the truck per hour

There is a floor lamp next to Iggy's favorite reading chair. Record the letters of all of the variables in the list below which affect the power received by the bulb when it is turned on. **08-Exc 35-1A**

a. The voltage reading at the lamp is 120 volts.
b. The current flowing through the lamp is one ampere.
c. The bulb releases 20 calories of heat per minute.
d. The bulb is a soft-white bulb.
e. There are two other lighted 100-watt bulbs in the room.
f. The bulb has just been turned off after burning for two hours.

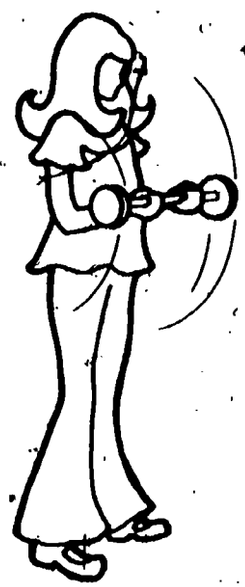
Set up the circuit shown in the diagram. Be sure you use a freshly charged battery. Then connect one electricity measurer as an ammeter and the other as a voltmeter to measure the current flow and voltage of this circuit. Calculate the power of the circuit. Record your answer, and show it to your teacher before you dismantle your setup. **08-Exc 35-2A**



08-Exc 36-1A The wires in Tessie the Tumbling Doll are all made of the same thickness of copper. The resistance of the wire is 3 ohms when the voltage is 9 volts and the current is 3 amps. (A different model of Tessie is identical except that more batteries are required, thus producing more voltage and current. What would you expect the resistance of the wire to be in this version of Tessie – more than, equal to, or less than 3 ohms? Explain your answer, using the electroparticle model.

08-Exc 37-1A Get the box labeled 08-Exc 37-1. What will happen if the taped magnet is turned so that its taped end is away from the coil? Explain your answer.

08-Exc 38-1A Phyllis the Physical Fitness Doll has a motor inside her which causes her to move her arms up and down, lifting a weight. Describe what you would need to know in order to determine how much work the toy's motor can do in two minutes.



08-Exc 39-1A In Excursion 39, you were told: "You have learned about electricity from activities like the ones in the textbook without too much trouble. It was the explorers who had a hard time." What helps have you had that the explorers did not have which makes your learning about electricity easier than theirs? You may refer to Excursion 39 to answer the question.

Fill the air piston with water to the 2.0 cc mark. Then show the air piston to your teacher. **09-Core-1A**

Box 09-Core-2 contains an air piston partly filled with a liquid. Look at the air piston, and record the volume of liquid in it. **09-Core-2A**

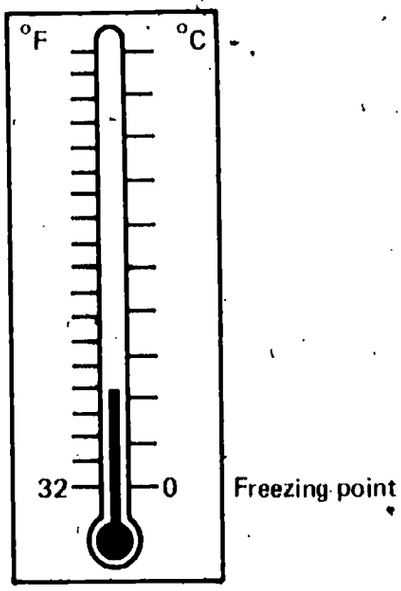
Which of the following will result from increasing the temperature of water? **09-Core-3A**

a. The volume of the water increases.
b. The mass of the water changes.
c. The water glows.
d. The water changes to iodine.

A company needs to design a device which will show very tiny changes in temperature and will have the temperature marks on the scale widely spaced. If you had to build such a device, what would you use for the expanding substance in it? **09-Core-4A**

a. Carbon dioxide
b. Water
c. Iron
d. Plastic

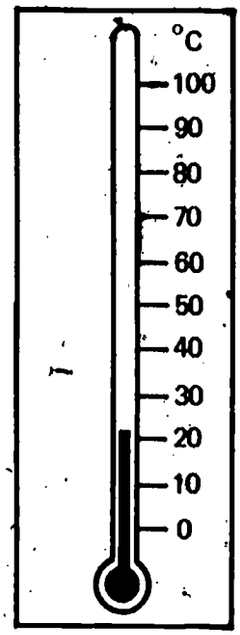
As shown below, a Fahrenheit and a Celsius thermometer scale have different numbers to indicate the freezing point of water. Explain why the freezing point can be represented by two different numbers. **09-Core-5A**



Mrs. Collins went to the store to buy a piece of rope. She wanted 40 pinkies (40 little-finger lengths) of the rope. A young clerk measured the rope with her pinkie. When Mrs. Collins measured the rope, using her own pinkie, it measured only 38 pinkies. Feeling that she had been cheated by the clerk who measured the rope, she went to the manager of the store and complained. What is necessary to avoid such confusion in the future? **09-Core-6A**

09-Core-7A What is the standard unit used by scientists and in ISCS for measuring temperature?

09-Core-8A What happens to water when its temperature registers 0°C and when its temperature registers 100°C on the thermometer shown below?



09-Core-9A Get a beaker of water and measure its temperature. Report the temperature to your teacher.

09-Core-10A You have used a thermometer which contains a liquid in a tube. Describe how it works.

09-Core-11A Mrs. Pickens couldn't get the lid off a pickle jar. She turned the jar upside down and lowered the lid into a pan of hot water. Soon, she was able to twist the lid off easily. Why did heating the lid cause it to loosen?

09-Core-12A Suppose that you have been given a sample of liquid water whose mass you know. You have taken its temperature before and after heating it. Write an operational definition for the change in its heat content.

09-Core-13A How many calories are required to raise 25 grams of water from 20°C to 30°C in three minutes?

09-Core-14A A 100 g sample of water was heated for ten minutes. The temperature was 25°C higher after heating than before. What would the temperature change be if a 50 g sample of water were heated under the same conditions for ten minutes?

a. 12.5°C
b. 25°C
c. 50°C
d. 75°C

What does a thermometer measure? **09-Core-15A**

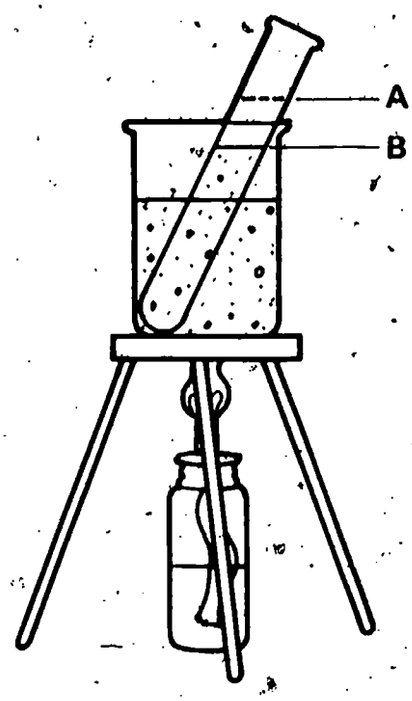
Which of the following is a standard unit for measuring heat? **09-Core-16A**

a. temperature
b. degree
c. calorie
d. Celsius

One model for heat assumes that heat is a substance which can flow between objects and whose quantity determines the temperature of objects. What are two observable properties of heat that support this heat-substance model? **09-Core-17A**

The diagram shows that the level of water in the test tube was at B before the test tube was heated in the beaker of water. After heating, the water in the tube rose to level A. The heat-substance model can explain this. From the following list, select the letters of the four statements which support the heat-substance explanation of how heat gets from the burner flame into the water in the test tube. The heat substance must **09-Core-18A**

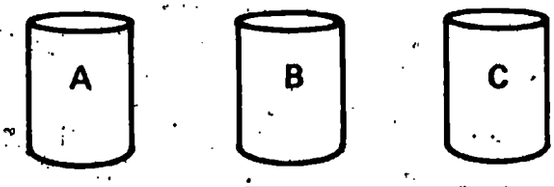
a. be composed of large particles.
b. be able to move.
c. take up space.
d. be pushed.
e. move as rapidly as light.
f. have mass.
g. be able to reproduce.
h. be made up of tiny particles.



Suppose someone said that cold objects have cold substance in them and that when a hot and a cold object are placed together, the cold substance flows into the hot object and the cold object gets warmer, not because it gains heat but because it loses cold substance. Use the activities you have done with heat and their results to show that it is heat, not cold, that is transferred. **09-Core-19A**

09-Core-20A The aluminum cans labeled A, B, and C are identical. Each has a mass of 40 grams. Assume that A is heated, B is cooled, and C is left at room temperature. Which of the following results can you expect?

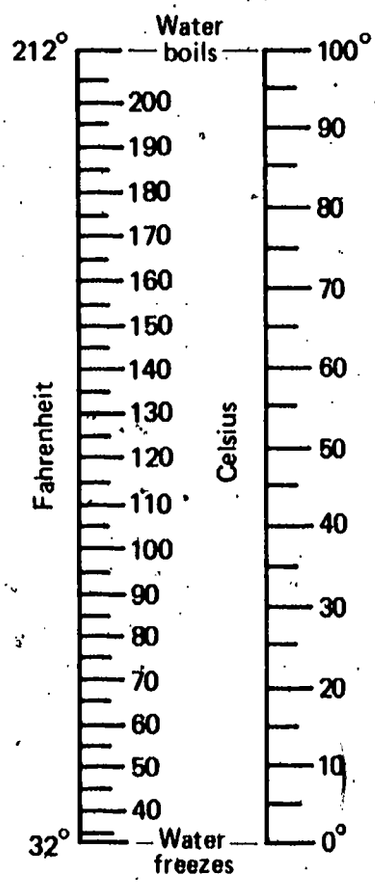
a. B will weigh more than either A or C.
b. B will weigh less than either A or C.
c. A will be larger than B or C.
d. The size of B will not change.



09-Exc 40-1A Which of the following characteristics make a liquid a bad choice for a thermometer used to measure the temperature of water samples?

a. A boiling temperature lower than water's
b. A boiling temperature higher than water's
c. A freezing temperature lower than water's
d. A freezing temperature higher than water's
e. None of the above

09-Exc 41-1A If you hear the TV weather girl say that the temperature will drop 10° tonight, does it make any difference whether she means a temperature drop of 10° Celsius or a temperature drop of 10° Fahrenheit? Explain your answer, using information from the diagram below.



Calories are defined using water as a standard. Define *calorie* in terms of water. **09-Exc 42-1A**

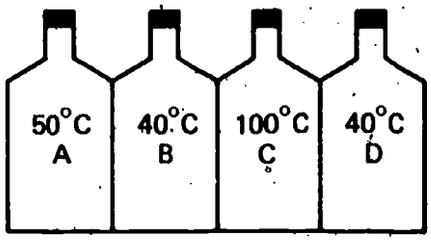
Suppose you go swimming with the Polar Bear Club in winter, and you go swimming at the beach in the summer. In which case does your body need to supply more calories? Explain your answer. **09-Exc 43-1A**

In each of the following cases, 700 calories were supplied to 1000 g of the substance named. Which of them would show the greatest temperature change? **09-Exc 44-1A**

a. Hydrogen, whose specific heat is 3.41
b. Helium, whose specific heat is 1.24
c. Water, whose specific heat is 1.00
d. Sulfur, whose specific heat is 0.175

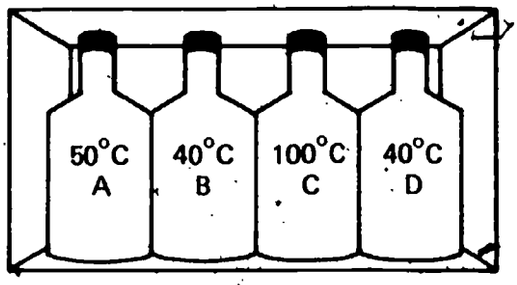
Assume that four containers of water, A, B, C, and D, are placed in contact with each other as shown. Select the response below which indicates the directions of heat flow that occur as the containers touch each other. Ignore the heat lost to the air. **10-Core-1A**

a. B to A, B to C, and D to C
b. A to B, C to B, and C to D
c. A to B, B to C, and C to D
d. B to A, C to B, and D to C



The four containers, A, B, C, and D, each hold the same amount of water. They are placed in contact with each other inside a box which allows no heat to escape or enter. Approximately what will be the temperature of the water in container B after one hour? **10-Core-2A**

a. Between 60°C and 70°C
b. Between 55°C and 60°C
c. More than 70°C
d. Less than 55°C

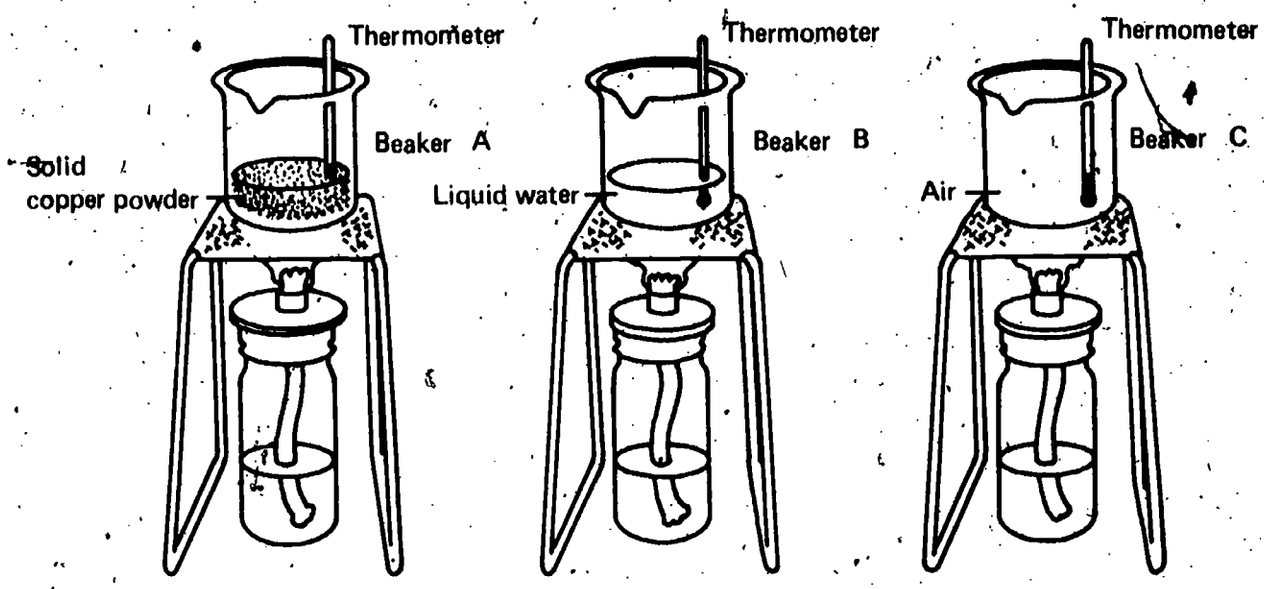


A new substance is formed that exists as a gas, a liquid, and a solid, depending on its temperature. In which state of matter would you expect it to be the poorest conductor of heat? **10-Core-3A**

a. Gas
b. Liquid
c. Solid
d. Either b or C
e. Texas

10-Core-4A Jerry lit burners under the three beakers (A, B, and C) at the same time. He also put thermometers into the beakers at equal distances from the heat source, as shown.

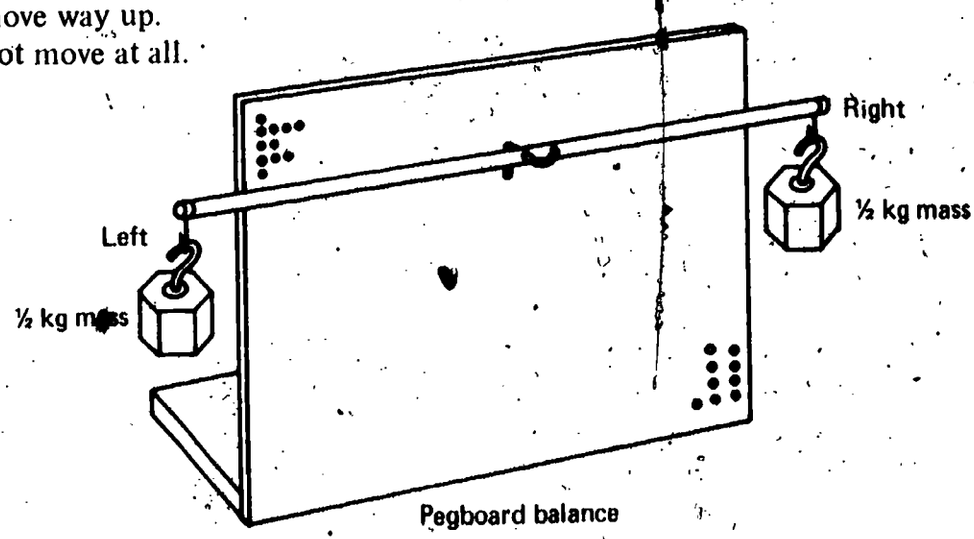
1. In which of the beakers will the thermometer begin to show changes in temperature first?
2. Why?



10-Core-5A A couple of students suggested to their teacher that Activities 20-7 and 20-8 did not provide good enough reasons to reject the heat-substance model. They said that the balance they used was too crude to detect any slight changes in the mass of the water. What change could you make in the activities which would make it possible to detect small changes in mass?

10-Core-6A Two ½ kg masses are exactly balanced on the pegboard balance as shown. Suppose the left-hand mass is heated until it gets red hot. The right-hand mass would

a. move down.
b. move up slightly.
c. move way up.
d. not move at all.



In the following story, assume that both doctors' facts are correct. Dr. Bright is an eye doctor who writes prescriptions for glasses. The model he uses assumes that light travels in straight lines except when it goes from one substance to another; then, it bends. Dr. Hoberman, a physicist, uses a model which says that light is like a wave and does not travel in straight lines. **10-Core-7A**

Dr. Hoberman says to Dr. Bright, "Your model and equations aren't used by scientists anymore. The model does not fit all the observations made, and it does not suggest further experiments."

Dr. Bright answers, "The model I use explains all the observations included in the optics of lens making. Furthermore, the arithmetic involved is fairly simple and quick. If I used the equations of your wave theory, my patients would be blind before I got their glasses ready."

1. Should Dr. Bright stop using the older model and use the newer, broader model which explains more phenomena of light?
2. Why did you give the answer you did?

Select the best answer. Scientific models come into existence by being **10-Core-8A**

a. discovered in test tubes.
b. found in nature by direct observation.
c. produced as part of the data of an experiment.
d. thought up by people.

Select the letter of the phrase below which best completes this sentence. Scientists use the heat-as-energy model because it **10-Core-9A**

a. provides correct answers to all questions about heat.
b. describes what heat actually is in nature and is therefore correct.
c. helps to explain observations and to predict other observations.
d. is the only true model for heat, and scientists found it.

Scientists accept the heat-as-energy model for heat. This means that **10-Core-10A**

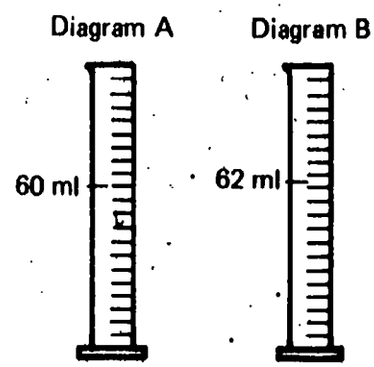
a. they have direct proof that heat is energy.
b. at least a few scientists have seen heat as energy with their own eyes.
c. thinking about heat as though it is energy explains most of the observations made to date.
d. heat has the exact properties of a wave.
e. no other model could fit the observations made to date.

10-Core-11A Heat-as-energy and heat-substance are two models used to explain heat. Study the chart below, and then answer the two questions that follow.

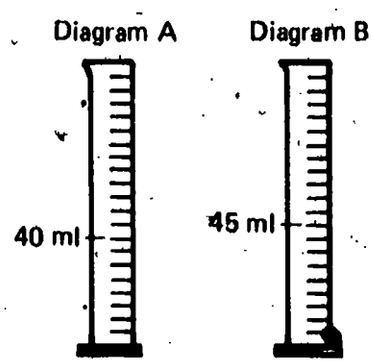
SITUATION	CAN BE EXPLAINED BY	
	Heat-as-Energy	Heat-Substance
Water doesn't increase weight when heated.	X	
Water increases volume when heated.	X	X
A metal rod gets longer when heated.	X	X
Spaghetti tastes better when hot than when cold.		

1. Based on the information in the chart, which is the better model?
2. Give a reason for your answer.

10-Core-12A Arnold heated 60 ml of a liquid for five minutes. After heating it, he remeasured the liquid and found that it had a volume of 62 ml. Look at the diagram below. Using the heat-substance model, explain the 2 ml increase in volume.



10-Core-13A Ralph heated 40 ml of a liquid to 20°C. After it was heated, he remeasured the liquid and found that it had a volume of 45 ml. Using the heat-as-energy model, explain how the liquid could increase in volume.



Touch two palm size pieces of paper. Rub them together rapidly between your hands, noting any change that occurs. **10-Core-14A**

1. If you keep rubbing them together, how long will they continue to produce the effect you observed?
2. Explain your answer in terms of the heat-as-energy model.

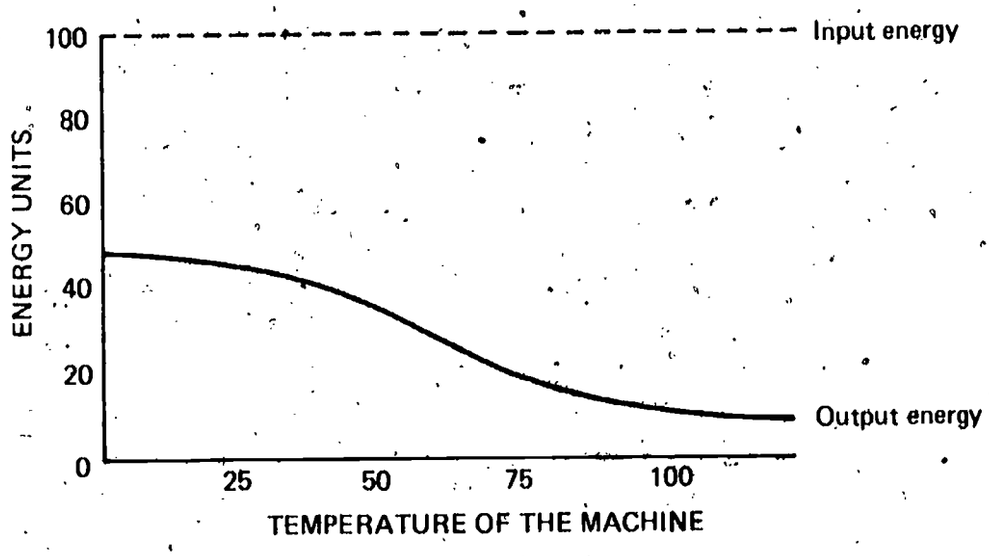
Suppose that the energy within a substance called gunk could be measured and that the substance could exist as a solid, a liquid, or a gas, depending on the amount of energy it contained. Draw a line like the one shown below on your answer sheet to represent different amounts of energy. Mark the place on this line where you would expect to find each state of the gunk, using S for solid, L for liquid, and G for gas. **10-Core-15A**

Low energy ——————————— High energy

Use the heat-as-energy model to explain why it is true that there is more heat in 2,000 ml of water at 30°C than in 50 ml of water at 90°C. **10-Core-16A**

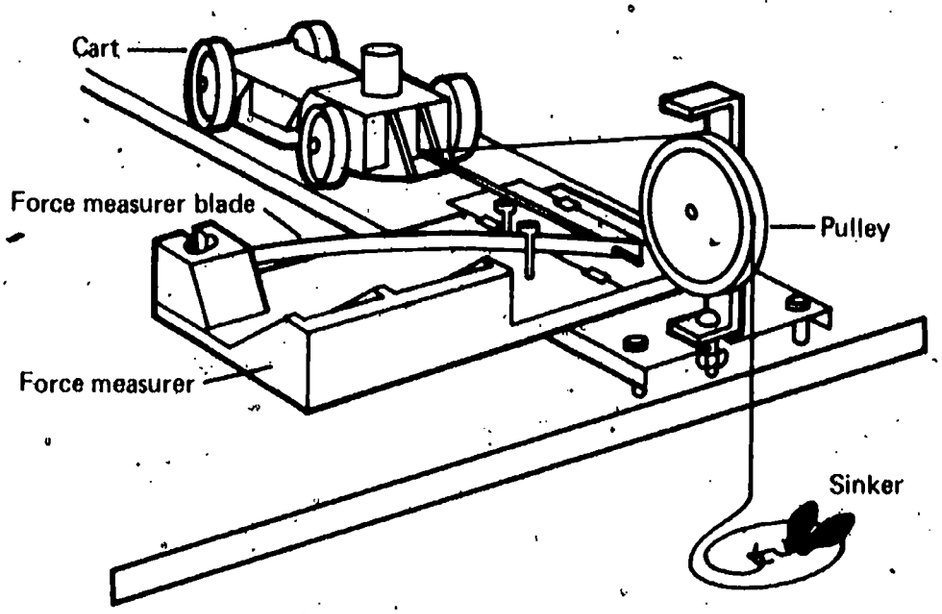
Using the heat-as-energy model, explain how a thermometer works to measure hot and cold materials. **10-Core-17A**

10-Core-18A



Look at the graph above. The amount of input energy supplied to the machine is a constant 100 units, represented by the dotted line on the graph. The solid line on the graph represents the output energy plotted against the temperature change. Explain what happens to the input energy as the amount of usable output energy decreases.

10-Core-19A In Activity 10-12, diagramed below, you converted the potential energy of the blade into the motion energy of the cart. You found that the kinetic energy of the cart was less than the potential energy of the blade. Use your heat-as-energy model to explain what appears to be a loss of usable energy.

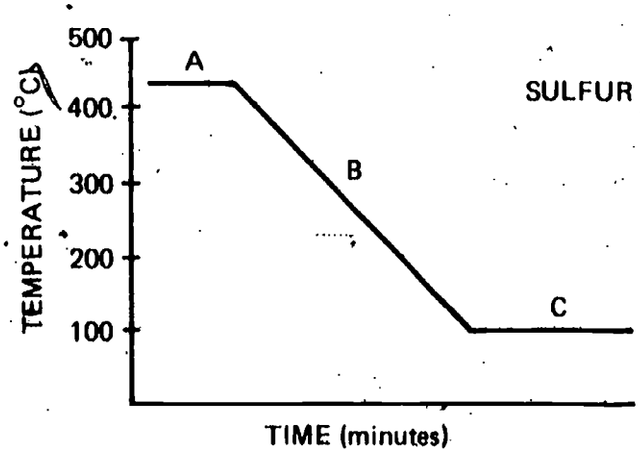


10-Exc 45-1A During the winter, Iggy visits a friend in the North who has bunk beds in his bedroom. Iggy is offered the upper bunk. The heating vent through which the bedroom is heated is on the wall near the floor. Will Iggy be warmer than, just as warm as, or cooler than his friend who is sleeping in the bottom bunk? Explain your answer.

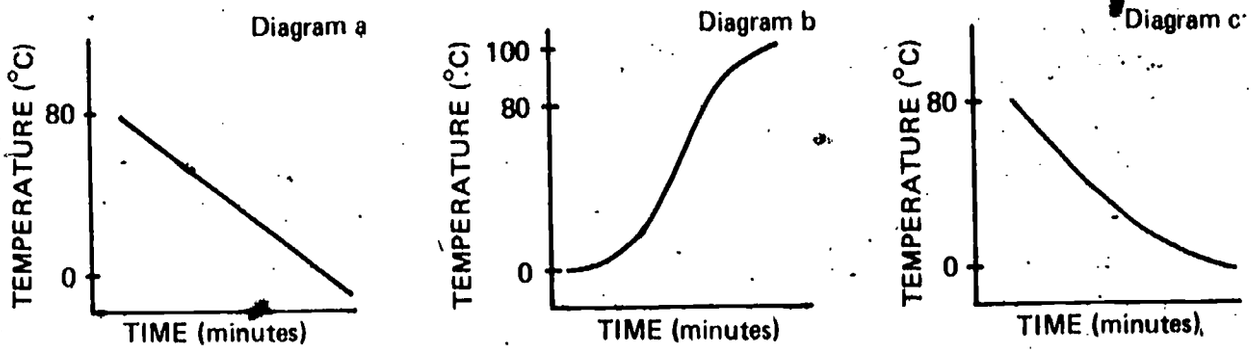
10-Exc 46-1A A scientific model is discarded when

a. the developer of the model dies.
b. a model which is less broad, but easier to understand, is developed.
c. new observations produce contradictions within the model.
d. a more complicated, mathematically-based model is developed.

10-Exc 47-1A Consider the cooling curve for sulfur shown in the graph below. Describe the processes that are taking place in sections A, B, and C.



Which of the following time-temperature graphs best describes the cooling behavior of water when it changes to ice? **10-Exc 47-2A**



Water is held in place behind a dam. It has potential energy. When the dam is opened, water spills out. The water now has kinetic energy (motion energy). As the water falls, it turns a large wheel, or turbine. The turbine generates electricity to produce power for the nearby city. Has all of the potential energy that was stored in the water behind the dam been converted to electrical energy? If not, where did the lost energy go or where did the gained energy come from? **10-Exc 48-1A**