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ABSTRACT

This manual is part of a series of materials designed to reinforce essential concepts in physical science through interactive, language-sensitive, problem-solving exercises emphasizing cooperative learning. The manual is intended for limited-English-proficient (LEP) students in beginning physical science classes. The materials are for teams of two students, the student and the tutor, with a separate workbook for each. Questions appear in the student workbook, prompts and answers in the otherwise identical tutor workbook. This combined document consists of the "Tutor Version" followed by the "Student Version." Unit 2 focuses on physical science terminology, symbolism, and graphic representations. A glossary of physical science terms and notations is given, followed by exercises testing comprehension and vocabulary. Students are encouraged to consult the glossary, which reinforces terms and provides practice in manipulating the language. A section describing the uses of various graph types is included, and students are asked to interpret, select, and draw graphs. The final section covers chemistry, including laboratory safety, equipment, experimental design, symbolic notation, and basic molecular concepts. (MSE)

ED329102

ENGLISH SKILLS FOR PHYSICAL SCIENCE

UNIT 2 - PHYSICAL SCIENCE TERMINOLOGY

Center for Language Education and Research

Center for Applied Linguistics

Arlington County Public Schools

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TUTOR VERSION

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TEACHER'S GUIDELINES

These materials are designed to reinforce essential concepts in physical science through the use of interactive, language-sensitive problem solving exercises. The targeted students are limited English proficient (LEP) students in beginning physical science classes.

It is intuitively obvious that students have difficulty learning content information unless that content is cognitively accessible to them; that is, unless it is presented to them in a comprehensible way. Good teachers have always done this; they assess students' knowledge and start their explanations from the students' understanding. But for LEP students, making the content cognitively accessible includes not only building content explanations from their base knowledge but also presenting the content in comprehensible language forms. It is only when accessible content is presented through accessible language that either is successfully mastered.

Language-sensitive instruction does not "dumb down" the curriculum; it merely makes the existing content material cognitively accessible to the student. This is accomplished through modifications such as deciding which specialized vocabulary items are truly necessary at the beginning levels and presenting them at a manageable rate; recognizing that some everyday words (serrated, slimy) are unfamiliar to LEP students and must also be treated as new vocabulary; making certain that the language used makes explicit connections between related facts and their unifying concepts; and avoiding the highly complex sentence structures so often found in scientific and technical writing. And if the material is cognitively accessible, students are not limited to rote memorization of poorly grasped facts but can bring higher cognitive processes to bear on their attempts to assimilate the information.

The ability to solve problems—that is, the ability to apply learned information to new and different situations—has long been recognized as a goal of education. There is, however, a growing body of research which suggests that problem-solving is the very process through which effective learning is accomplished. Problem-solving is perhaps particularly important in the sciences, where "facts" change so rapidly due to leaps in technology that memorization is becoming all but obsolete as a scientific tool.

Thus, problem solving is moving from product to process. One of the goals of the educational system, then, should surely be to help students develop the necessary problem-solving skills. Many different paradigms have been developed to demonstrate problem-solving techniques, but most rely at least upon identifying the problem, isolating the relevant facts, and setting these facts in the proper relationship to each other in order to determine a solution.

Cooperative learning and problem-solving are natural partners; the problem-solving tasks of identifying, isolating, and relating facts readily lend themselves to this kind of mutual effort, with each member contributing his own understanding to the problem at hand. The point of cooperative learning is that students are able to help each other learn; they can share ideas, model appropriate strategies, and otherwise move each other toward mastery of the specified material. Students are compelled to clarify their thoughts about the subject matter because they must convey their ideas to each other and must reconcile conflicting impressions as they work toward a solution.

Cooperative learning is an equally effective partner to language learning. Language is learned most effectively when it is used for real communication, as the vehicle for thoughts rather than as an end in itself. Cooperative learning requires students to carry out involved verbal tasks such as explaining, clarifying, and negotiating, where the content of the message is the central concern.

Thus the educational strategies underlying these materials serve to complement each other in ways that elicit the abilities of students who might otherwise be unable to express themselves. Language-sensitive instruction provides the students with appropriate comprehensible information; problem-solving tasks guide them toward successful assimilation of that knowledge; and cooperative learning compels them to articulate their understanding of the material as they work together toward mastery of the content.

ORGANIZATION OF MATERIALS

The materials are designed to be used by teams of two students, the Student and the Tutor. A separate workbook is provided for each member of the team. The question for each task appears in the Student workbook, with accompanying prompts and answers in the Partner workbook.

ORGANIZING THE STUDENT/TUTOR TEAMS

If the class consists of both native and non-native speakers of English, use native/non-native teams. This will provide the best language model for the non-native students. If the class consists only of non-native speakers, try to team students of different language backgrounds to encourage their use of English rather than their native language.

CONTENT

Unit 1 focuses on solving word problems using 5 common formulas in physical science. There are five sections, each dealing with a different formula.

Each section begins with questions about the formula itself. It is important to reinforce the meaning of the symbols in the formula and their relationship. These questions discuss the formula in qualitative terms.

The remainder of each section is devoted to word problems which require the target formula. The workbook takes a step approach to problem-solving. Rather than emphasizing the numerical answer, these questions guide the student, step by step, through the *process* of solving a problem. For each word problem, the student must answer questions that measure comprehension of the content of the question, ability to translate words to symbols, and finally, the ability to correctly put the numbers into the equation.

Unit 2 focuses on physical science terminology, symbolism, and graphic representations. A glossary of physical science terms and notations is given. The glossary is followed by exercises which test comprehension of vocabulary. Students are encouraged to consult the glossary for help. This not only reinforces the terms, but provides practice in manipulating the language.

Interpreting and drawing graphs is often a difficult task for students. Therefore, a section describing the uses of various graph types has been included. Students are asked to interpret graphs. Eventually they are given data and required to choose the appropriate type of graph and to draw the graph.

The final section covers chemistry, including safety in the laboratory, equipment, experimental design, symbolic notation, and basic molecular concepts. Since the number of elements and compounds is so great, there will doubtless be some substances emphasized here that are not covered by all teachers. It may be necessary to instruct students to skip compounds that have not been covered in class.

TERMS

<u>Accelerate</u> — To move faster and faster. When an object accelerates, its speed increases. (see acceleration, speed)

<u>Acceleration</u> — An increase in speed. Acceleration is the rate of change of speed and is measured in units of distance divided by units of time squared. An example is 3 meters per second squared ($3m/sec^2$). This would mean that an object's speed increased by 3 meters a second every second.

<u>Action force</u> — A force that acts on an object

<u>Amplitude</u> — The maximum displacement of a particle in a wave. The greater the amplitude of sound waves (thus, the higher the waves are), the louder the sound.

<u>Atom</u> — The smallest unit of an element. An atom contains electrons and a nucleus. The nucleus is made up of protons and neutrons.

<u>Base unit</u> — A standard unit of measurement. Other units are described in terms of base units. For example, a centimeter is one one hundredth of a meter. The meter is the base unit for length. (The <u>centi</u>- part means "one hundredth.")

<u>Boiling</u> — The act of changing from a liquid to a gas by heating

<u>Boiling point</u> — The temperature where a substance begins to boil. When a substance boils, it goes from being liquid to being gaseous. (see evaporation)

<u>Catalyst</u> — A substance that changes how fast a chemical reaction takes place. Catalysts can either speed up or slow down a chemical reaction. (see react)

<u>Centripetal Force</u> — When an object travels in a circular path, this force acts toward the center of the circular path.

<u>Chemical change</u> — When a substance undergoes a chemical change, it becomes a different substance. Because it is no longer the same substance, it no longer has the same properties.

<u>Chemical formula</u> — Used to show how many atoms of each element are in a compound. For example, the chemical formula for water is H_2O. (A water molecule has two atoms of hydrogen and one atom of oxygen.) Chemical formulas use symbols (like abbreviations) for elements.

Chemical reactivity	A property of an element. If an element has a high chemical reactivity, it reacts with other elements easily. If an element has a low chemical reactivity, it reacts less easily with other elements. (see react)
Coefficient	The numbers used in front of symbols and formulas in an equation. These numbers are used to balance chemical equations.
Compression	The densest concentration of particles in a kind of wave called a compressional wave. In a compressional wave, the particles vibrate in the same direction that the wave moves. (see rarefaction)
Condensation	The change from gas to liquid. When a substance condenses, it goes from being gaseous to being liquid.
Conduction	The passage of electricity or heat through a substance (see electricity, heat)
Convection	The transfer of heat energy by the movement of the matter containing the heat. Convection occurs in gasses and liquids, but not in solids. (see heat energy)
Corrosion	Any destructive chemical change occurring in a metal. When some metals corrode, they become rusty. (see chemical change)
Covalent bond	A type of bond between atoms. In a covalent bond, atoms share electrons (see atom, electron)
Decelerate	To move slower and slower. When an object decelerates, its speed decreases. (see accelerate, speed)
Deceleration	A decrease in speed. Deceleration is the rate of decrease in speed, or how fast an object slows down. (see acceleration, speed)
Density	The measure of how much mass an object has per unit of volume. The most dense substance will have a lot of mass in a small volume. The least dense substance will have very little mass in a large volume. Density is often measured in grams per cubic centimeter (g/cm^3). Water has a density of one gram per cubic centimeter. That means every cubic centimeter of water has a mass of one gram. (see volume)
Diffraction	A change in the movement of light or other waves caused by obstacles in the medium (see diffraction grating)

Distillation	A process by which the parts of a mixture are physically separated. Distillation involves evaporation and condensation. (see condensation, evaporation)
Displacement reaction	A reaction in which one element takes the place of (or displaces) another in a compound
Double displacement reaction	A reaction in which two elements switch places in compounds (see displacedment reaction)
Efficiency	How much work a machine produces compared to how much work goes into the machine. If a machine produces a lot of work (if it has a high work output) and little work goes into the machine (it has a low work input), then the machine's efficiency is high. (see machine, work)
Effort	The part of a lever where force is applied. (see lever, 3rd class lever)
Electricity	The movement of electrons (see electron)
Electrolysis	Breaking a compound into simpler substances by putting a current of electricity through the compound (see electricity)
Electron	a particle that has a negative charge and goes around (or orbits) an atom's nucleus. (see atom)
Energy	The ability to do work, to keep up a force through a distance. You need a lot of energy to run a mile. (see work)
Endothermic reaction	A chemical reaction that takes heat from its environment
Evaporation	The change from liquid to gas. When a substance evaporates, it goes from being liquid to being gaseous.
Exothermic reaction	A chemical reaction that gives off heat into its environment
Fluorescent	This word describes a substance that gives off light when it is exposed to radiation. (see radiation)
Force	Something that causes an object to accelerate, decelerate, or change direction by pushing or pulling.
Freezing	The change in matter from liquid to solid
Friction	A force between two surfaces that works to stop motion. (see force)
Fulcrum	The fixed point that a lever moves on. (see lever)

Gas	Matter that has no constant volume or shape
Gravitational force	The force of attraction between pieces of matter (see gravity)
Gravity	A force of attraction that is present between all pieces of matter. The amount of the force depends on the mass of the objects and the distance between them. Gravity is the force that keeps the planets moving around the sun, and people on the earth.
Heat	The total amount of energy within a substance
Heat of Condensation	The joules per gram of a vapor that are given up when the vapor condenses, but stays at the same temperature (see condensation)
Heat of fusion	The heat necessary to turn one gram of a solid into a liquid
Heat of vaporization	The heat necessary to turn one gram of a liquid into a gas. (see vaporization)
Inertia	The tendency for an object that is not moving to remain at rest. Inertia is also the tendency for a moving object to keep moving. A force can overcome inertia. (see force)
Ion	A particle that is formed when atoms lose or gain electrons. An ion is a charged particle.
Ionization	The formation of ions by dissolving a molecular compound into water. (see ion)
Kinetic energy	Energy that is contained inside an object in motion
Lever	A simple machine. A bar that moves on a fixed point. (see fulcrum, machine)
1st Class Lever	A kind of lever where the fulcrum is in the middle. (see fulcrum)
2nd Class Lever	A kind of lever where the resistance is in the middle.
3rd Class Lever	A kind of lever where the effort is in the middle. (see effort)
Liquid	Matter that has no shape of its own. Liquids like water or milk, take on the shape of the container they are in. Liquids have constant volumes.

<u>Liquify</u> To turn matter into a liquid. If you melt a solid, you liquify it. (see liquid, melting)

<u>Machine</u> An object that makes work easier. A machine makes work easier by changing the speed, amount, or direction of a force. (see force, work)

<u>Magnetic field</u> A space with magnetic forces. (see magnetic force, magnetism)

<u>Magnetic force</u> The force of attraction between particles with opposite electric charges (see magnetism)

<u>Magnetism</u> An attraction between particles with opposite electric charges. (Particles with similar electric charges repel each other. Instead of being attracted to each other, particles with the same charge move away from each other.)

<u>Mass</u> The amount of matter in an object.

<u>Matter</u> Anything that takes up space. Everything in the universe is made of matter. (see mass)

<u>Melting</u> The change in matter from solid to liquid (see liquid, solid)

<u>Metal</u> A substance with these physical properties: it reflects light, conducts heat and electricity well, and it can be pounded into different shapes. (see conduction, electricity, physical property, reflection)

<u>Momentum</u> An object's velocity multiplied by its mass. A 10 Kg object with a velocity ot 6 Km/hr has more momentum than a 4 Kg object with a velocity of 3 Km/hr. (see mass, velocity)

<u>Noise</u> Any kind of sound formed by irregular vibration. Noise is something you hear that is different from the other sounds around you.

<u>Nuclear energy</u> The energy released by fission or fusion. Nuclear energy also means the system of making electricity using radioactive elements. (see fission, fusion, radioactivity)

<u>Nuclear fission</u> The break up of a complex nucleus into two simpler nuclei. This break up releases energy. (see energy)

<u>Nuclear force</u> The force holding parts of an atom's nucleus together

Nuclear fusion	The joining of two nuclei to make one nucleus. This releases energy. (see energy)
Physical change	A change in a physical property (see physical property)
Physical property	A quality of a substance that can be observed without changing the substance's chemical structure. Size and shape are examples of physical properties.
Potential energy	Energy that is contained inside an object that has the possibility of doing work because of its position. (The object can be at rest or in a position of possible energy.)
Power	The rate of work done. Power is equal to work over time. Power is measured in watts. (see rate, work)
Pressure	The amount of force applied in a unit of area. Pressure is equal to force divided by area. (see force)
Product	The substance left after a chemical change. (see chemical change)
Pulley	A simple machine using ropes and wheels. (see simple machine)
Radiation	The movement of heat from areas with high temperatures to areas with low temperatures. In this way, radiation is like conduction and convection. But radiation also means the energy released by atoms when their nuclei change. (see atom, energy, conduction, convection)
Radioactivity	The giving off of high energy radiation from radioactive atoms. (see atom, radiation)
Rarefaction	The least dense concentration of particles in a kind of wave called a compressional wave. In a compressional wave, the particles vibrate in the same direction that the wave moves in. (see compression)
Rate	A rate is a ratio, usually over time. For example, speed (which is the rate of movement) is really the ratio of distance traveled to time. In the same way, acceleration is the ratio of speed to time.
React	When some substances are mixed, a chemical change happens. When substances react, they undergo chemical changes.
Reaction force	A force acting in the opposite direction of an action force. A reaction force is equal to an action force.

Reflection	A wave or ray bouncing off of a surface. If a surface reflects light, that means light bounces off the surface.
Refraction	A wave or ray bending. Refraction is caused by the wave or ray slowing down as it moves from one substance into another.
Resistance	Something that slows down or prevents motion. Resistance in an electrical circuit opposes the flow of electrons. Resistance in a lever works against effort. (see effort, electricity, lever)
Simple machine	A machine that is a lever, pulley, wheel and axle, inclined plane, screw, or wedge. A machine that has simple machines for its parts is called a compound machine. (see machine)
Solid	A piece of matter that has a specific shape and volume
Solubility	The measure of how much of a substance will dissolve in a given amount of another substance. The substance that dissolves in another substance is called the "solute." The substance that the solute dissolves in is called the "solvent."
Specific heat	The heat necessary to increase the temperature of a substance by one degree Celsius (see temperature)
Speed	A measure of motion, of how fast something is moving. Speed is measured in units of distance divided by units of time. An example of this is mph - miles per hour.
Stable	A word that describes nuclei that are not radioactive. Unstable nuclei are radioactive. (see radioactivity)
Standard	A fixed amount used for comparisons in measurements
Structural formula	The formula of a chemical compound where each atom is shown in its position in the molecule. H=O=H is the structural formula of water. (see chemical formula)
Sublimation	The change from solid to gas. When a substance sublimates, it goes from being solid to being gaseous without ever being liquid.
Synthesis reaction	A chemical reaction where two or more compounds are combined innto a single compound
Temperature	The degree to which something is hot or cold as measured on a scale such as Fahrenheit, Celsius, or Kelvin.

Vaporization	The change from liquid to gas. Vaporization is another word for evaporation.
Velocity	Speed and direction of movement We use velocity when we talk about the action of forces, acceleration, and deceleration. It takes force to change the velocity of an object. (see acceleration, deceleration, force, speed)
Volume	The amount of space an object or substance takes up
Weight	The force of gravity acting on the mass of an object. (see gravity, mass)
Work	Force exerted over a distance. That is, work is equal to the force applied to an object multiplied by the distance the object moved. This is shown in the equation W= F x d. Work is measured in joules (see force)

LAWS/EFFECTS
TESTS

Boyle's Law	This law states that the space that a gas takes up will get smaller when the pressure is increased, as long as the temperature stays the same.
Charles's Law	This law states that the space that a gas takes up will get larger when the temperature increases, as long as the pressure stays the same.
Conservation of Momentum	In all interactions between objects momentum is conserved. If one object loses momentum, another object gains momentum. (see momentum)
Doppler Effect	The change in apparent frequency of a wave caused by the movement of the source of the wave.
Flame test	When an element is placed in a flame, it gives off colors. The flame test is a procedure in which elements are identified by noting these colors.
Law of Conservation of Mass	In a chemical reaction, the total mass of all the chemicals going into the reaction equals the total mass of all the products after the reaction. Mass is conserved. (see mass, product)
Law of Multiple Proportions	This law states that if the same elements combine in different ratios, different compounds will be formed.
Law of Reflection	This law states that the angle made when an object or wave hits a reflecting surface will equal the angle made when an object or wave is reflected by the surface. Another way to say this is that the angle of incidence is the same as the angle of reflection.
Newton's Law of Gravitation	This law states that the gravitational attraction or pull between two objects can be calculated using the masses of the objects and the distance between them. The attraction is proportional to one mass times the other, divided by the distance between them squared. (see gravity)
Newton's 1st Law of Motion	This law states that an object at rest (not moving) will remain at rest unless a force causes it to move. An object will continue moving in a straight line unless a force causes it to stop or change direction.
Newton's 2nd Law of Motion	This law states that the amount of acceleration of an object depends upon the force applied to the object and the mass of the object. Newton made this into a formula: $F=m \times a$, or force = mass x acceleration. (see acceleration, force, mass)

Newton's 3rd Law of Motion	For every action (force), there is an equal and opposite reaction (force). (see force)
Ohm's Law	This law states that current is equal to the voltage divided by the resistance of the conductor. I=V/R
Photoelectric Effect	Certain metals will release electrons when they are hit by light.

EXPERIMENTAL METHOD TERMS

Conclusion	The belief that you come to through observation and experimentation
Control	A group or activity used as a standard. The experimental group is compared to the control. In this way, the effects of the experimental conditions can be observed and measured. (see experimental)
Experiment	A group of tests. The tests are observed in order to prove or disprove a hypothesis. Certain parts are present in every good experiment: hypothesis, observation, a control, and a conclusion. (see conclusion, control, hypothesis, observation)
Experimental	A group that has something special done to it. This group is observed and compared to the control group. In this way, the hypothesis can be proved or disproved. (see control, hypothesis)
Hypothesis	An idea that can be verified (shown to be true) through experimentation and observation (see observation)
Observation	The noticing and recording of events as part of an experiment. (see experiment)
Results	The measurements or other data on which conclusions are made. Results are found by observing the experimental group and comparing it with the control group. (see conclusion)
Theory	A description of certain events or phenomena based on experimentation. Compare this with hypothesis which is a description made before experimentation.

UNITS AND SYMBOLIC NOTATION

Absolute zero (0)	The lowest temperature that you can bring a substance to. This temperature is equal to -273 degrees Celsius or 0 Kelvin.
Alpha particle (α)	These particles have a positive charge and are made up of a helium nucleus with two protons and two neutrons.
Alternating current (A.C.)	Electrons in a circuit that change directions over and over. (sec direct current)
Anode (+)	A positive electrode that gains electrons in an electrical circuit.
Atomic mass number (A)	The number of protons plus the number of neutrons in an atom
Atomic mass unit (a.m.u.)	A unit of measurement equal to one twelfth the mass of the carbon isotope with 12 neutrons and protons.
Atomic number (Z)	The number of protons in the nucleus of an atom
Beta particle (β)	Electrons that come from radioactive atoms
Cathode (-)	A negative electrode that releases electrons in an electric circuit. (see anode)
Celsius (C)	A temperature scale where the freezing point of water is set at 0°C and the boiling point is set at 100°C.
Centimeter (cm)	One one hundredth of a meter. There are about 2.54 centimeters in an inch.
Coulomb (c)	The unit of measurement of an electric charge
Density (g/cm^3)	The measure of how much mass an object has per unit of volume. The most dense substance will have a lot of mass in a small volume. The least dense substance will have very little mass and a large volume. Density is often measured in grams per cubic centimeter (g/cm^3). Water has a density of one gram per cubic centimeter. That means every cubic centimeter of water has a mass of one gram.
Direct current (D.C.)	Electric current where the electrons always go in the same direction. (see alternating current)
Gamma ray (γ)	Energy waves of high frequency containing photons. Gamma rays have no charge.
Gram (g)	A measure of mass equal to one one thousandth of a kilogram. A gram is the mass of one cubic centimeter of water.

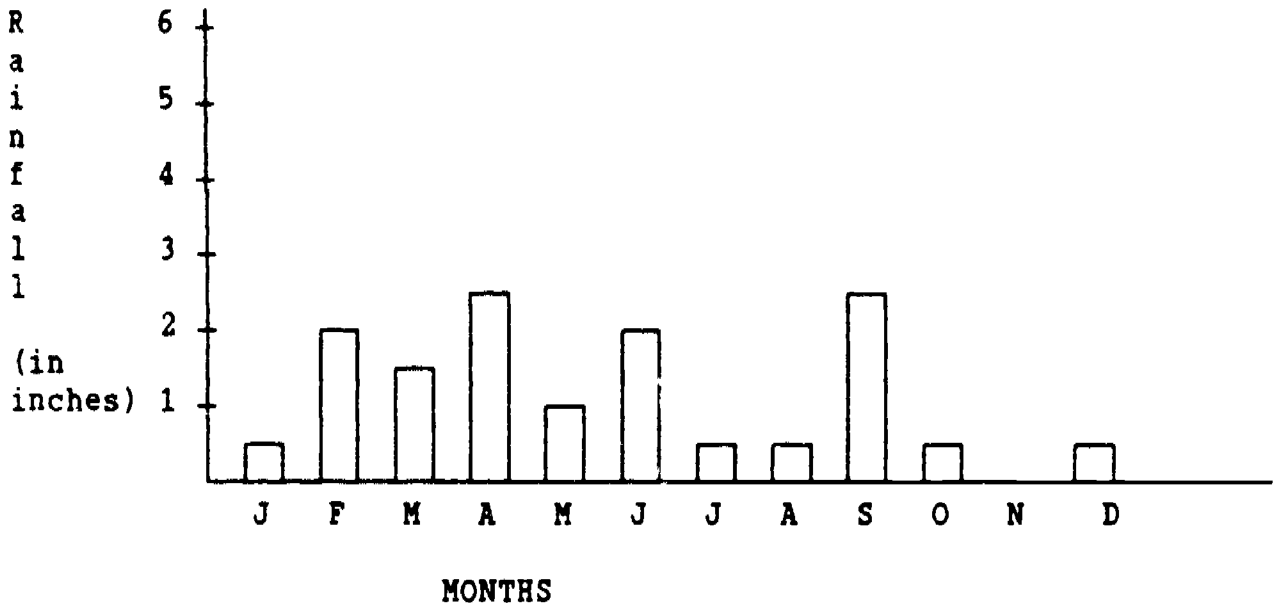
Hertz (Hz)	A measure of the number of cycles per second. It is used to measure anything that oscillates (swings back and forth) like alternating current or sound waves. FM radio stations operate in megahertz (one million hertz).
Hydronium ion	(H_3O^+)A water molecule with one extra hydrogen atom. It has a positive charge.
Joule (J)	The amount of energy or work required to maintain a force of one newton for one meter. (see force, work)
Kilogram (Kg)	The base unit of measurement for mass. A kilogram is equal to 1000 grams. As a measure of weight it is about the same as 2.2 pounds.
Kilometer (Km)	One thousand meters. A kilometer is about six tenths of a mile.
Kilowatt-hour (KWH)	The energy produced by a power of one kilowatt (equal to 1000 watts) in an hour. (see energy, watt)
Liter (L)	The volume of liquid that fills a cube that is ten centimeters on a side. A liter is equal to one thousand cubic centimeters.
Mechanical advantage (m.a.)	The ratio of the force created to the force applied when using a machine. (see force, machine)
Meter (m)	The base unit of measurement for distance. A meter is about 39.37 inches.
Miles per hour (mph)	A speed which is the distance, measured in miles, divided by the time, measured in hours.
Milliliter (mL)	A unit of measurement equal to one one thousandth of a liter. A milliliter is the volume of liquid occupying one cubic centimeter.
Millimeter (mm)	A unit of measurement equal to one one thousandth of a meter
Newton (N)	A unit of measurement of force. One newton is the amount of force needed to accelerate one kilogram at the rate of one meter per second squared. (see acceleration, force)
Ohm (Ω)	The unit of measurement of resistance to electricity. (see resistance)
Pascal (Pa)	A unit of measurement of pressure. (see pressure)
pH	A measure of the acidity of a solution

Standard temperature and pressure (STP)	Standards used for measuring the amount of a gas in a fixed volume
Subscript ($X_{\#}$)	A number written below the line of other letters. In chemistry, subscripts tell you how many atoms of each kind are in a molecule. For example, the subscript in H_2O tells you that in every molecule of water, there are two hydrogen atoms and one oxygen atom.
Volt (V)	A unit of measurement of the force of flowing electricity. (see electricity, force)
Watt (W)	A unit of measurement of power. (see power)

TYPES OF GRAPHS

Bar graph — A graph used for displaying and comparing values

Rainfall in 1986 by month



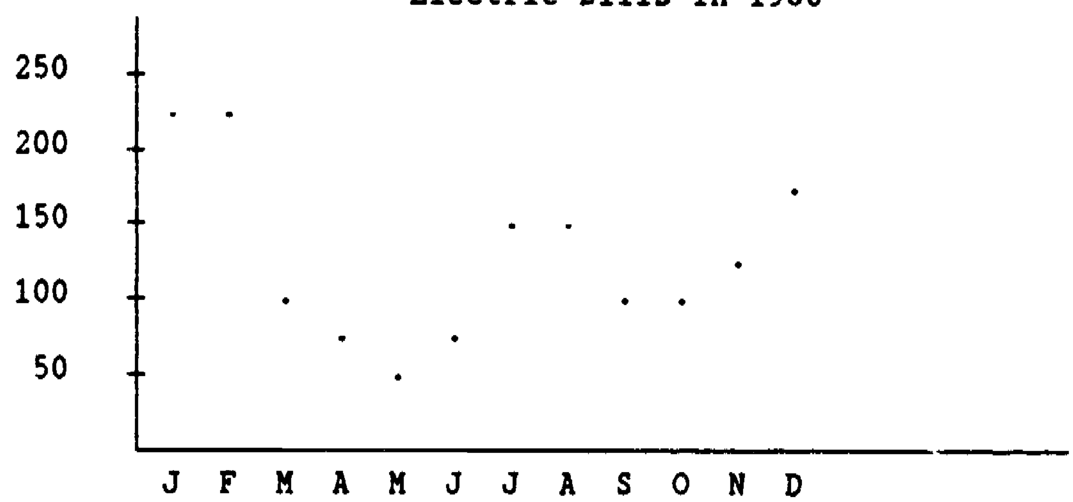
Circle graph — (also called "pie graph) A graph used to show the composition of something, or how something is broken down into parts.

How John spends his time every day

free time
sleeping
meals
TV
school

<u>Line graph</u> A graph used to show trends and changes, usually over time

Electric bills in 1986



AFFIXES

Endo-	Can usually be translated as "in" or "inside." (see endothermic reaction)
Exo-	Can usually be translated as "out" or "outside." (see exothermic reaction)
-meter	As a suffix, this means "measurer." So a voltmeter is something that measures voltage.
Micro-	This prefix has two meanings. One of them is "very small," as in microscope which is something that allows you to look at (or scope) very small things. The other meaning of micro- is "one millionth." a micro-second is a unit of time one millionth of a second long.
Photo-	This prefix can usually be translated as "light." A photograph is a picture (or graph) made with light. (see photoelectric effect)
-stat	Can usually be translated as "keeping still" or as "something that maintains." A thermostat is something that maintains temperature.
Tele-	Usually, this can be translated by "far away." A telescope is something that allows you to look at things from far away.
Therm-	This can be translated as "heat" or "temperature." (see thermostat)

EQUIPMENT

Balance	A scale for measuring mass of solid (dry) substances
Barometer	A device that measures air pressure
Beaker	A glass container shaped like a cup
Calorimeter	A device that measures heat energy
Cloud chamber	An instrument that finds nuclear particles by forming cloud tracks or cloud vapors
Computer	An electronic device that solves problems and performs mathematical calculations
Concave mirror	A bowl-shaped mirror
Convex lens	A lens whose edges are thinner than its center
Convex mirror	A mirror that bulges in the middle
Electromagnet	A magnet created by sending an electric current through a coil of wire around a core of soft iron
Erlenmeyer flask	A large glass container with a wide base and a narrow top (similar to a cone). It is used for mixing materials (at least one a liquid) in chemical tests.
Eye dropper	A small tube used for transferring liquids drop by drop
Filter paper	Heavy paper with small holes used for separating solid substances from liquid. The liquid is poured through the paper. The solid things in the liquid stay on the paper.
Funnel	A cone-shaped piece of glass equipment with a wide top and narrow, tube-shaped bottom. It is used for moving substances from containers with large openings to containers with small openings.
Galvanometer	A coil of wire that moves between the poles of a magnet. A galvanometer detects small electric currents.
Geiger counter	A device that detects and measures levels of radioactivity
Graduated cylinder	A cylinder marked so that exact measurements of the volume of liquids can be made
Goggles	Protective eyeglasses usually made of clear plastic that completely cover the eyes to protect them during chemical experiments

Laboratory burner	A device for creating a small, constant flame for use in chemical experiments. The burner is connected to a gas source by rubber tubing.
Microscope	An instrument that uses lenses to make small objects appear larger
Mortar and pestle	A cup or bowl and a bar used to grind or mash substances. The pestle is the bar and the mortar is the cup or bowl.
Parallel circuit	An electric circuit where separate currents pass through different parts of the circuit. (see series circuit)
Petri dish	A shallow dish used for growing cultures and storing specimens
Photoelectric cell	An instrument that produces an electric current when it is hit by light
Plane mirror	A flat mirror. Other kinds of mirrors are concave and convex.
Prism	A solid, transparent object that can separate light into its parts and show a rainbow of colors through refraction. This rainbow is called a spectrum. (see refraction, diffraction grating)
Reflecting telescope	A telescope that uses a parabolic (curved) mirror to magnify (enlarge) images.
Refracting telescope	A telescope that uses convex lenses to magnify (enlarge) images. (see convex lens)
Ripple tank	A shallow box filled with water used to study the motion of waves
Series circuit	An electric circuit in which the same current passes through all of the parts of the circuit
Test tube	A small glass container used for conducting chemical tests or holding materials
Thermometer	A device for measuring temperature
Thermostat	An instrument that regulates (controls) temperature. (see temperature)
Transistor	A semiconductor used in electrical equipment. Transistors are most commonly used in radios, televisions, and stereos to amplify sounds (to make the sounds louder).

<u>Voltmeter</u> An instrument that measures voltage between two points of an electric circuit. (see volt)

<u>Watch glass</u> A shallow bowl used as a surface for evaporating water or covering beakers. (see evaporation)

II. General Questions

> Read the questions below out loud to your partner. Answer the questions out loud also. You may use the glossary for help if necessary.

TUTOR: Listen as your partner reads the questions. The answers are printed below. Help your partner look terms up in the glossary if necessary.

1. Besides miles per hour (mph), what are some other ways to measure speed?

   Answer: meters per second, kilometers per hour

2. If Newton's laws are true, a marble rolling along a flat surface slows down and eventually stops. Is there a force acting on the marble to make it stop? What force?

   Answer: Yes. Friction is acting against the motion of the marble and slows it down.

3. Would you rather have 10 pounds of gold or 6 kilograms of gold?

   Answer: 6 kilograms. One (1) kilogram equals 2.2 pounds. Six (6) kilograms equals 13.2 pounds. Therefore, 6 kilograms is more than 10 pounds.

4. When you light a match, does an endothermic or exothermic reaction take place?

   Answer: exothermic. Heat is given off.

5. Would something with a density of .8 g/cm³ float or sink in water? Why?

   Answer: It would float because it is less dense than water. And water's density is 1 g/cm³.

6. Which sounds higher, the horn of a car that is moving towards you, or the horn of a car that is not moving?

   Answer: The horn of the moving car sounds higher. Remember, the Doppler effect says that the change in the frequency is caused by the movement of the sound waves.

7. Carbon has 6 protons and 6 neutrons. What is its atomic mass number?

   Answer: 12. The atomic mass number is the number of protons plus the number of neutrons.

8. Where do you commonly find thermostats?

Answer: A thermostat is something that controls the temperature. Thermostats can be found in homes, offices, stores, refrigerators, freezers, heaters, etc.

9. What type of current, alternating or direct, is usually found in houses?

Answer: alternating current

10. How do refraction and reflection differ?

Answer: When a ray or a wave is reflected, it bounces off a surface. When a ray or wave is refracted, it bends.

11. a) Which is stronger, nuclear force or magnetic force?
b) If the nucleus contains protons which are positively charged, why doesn't the nucleus fly apart, since particles with like charges repel each other?

**Answers: a) Nuclear force is stronger than magnetic force.
b) The nucleus doesn't fly apart because the nuclear force is stronger than the magnetic force.**

12. Which conducts electricity better, wood or metal?

Answer: Metal. In fact, conducting electricity well is one of the basic properties of metal.

13. Would you weigh more on the earth or on the moon?

Answer: On the earth. The force of gravity is stronger on earth than it is on the moon.

14. How do we measure weight?

Answer: We use scales to measure weight.

15. Where can you find convex lenses?

Answer: Convex lenses are used in eyeglasses, refracting telescopes, etc.

16. How many megahertz does radio station WXYZ 95.8 have?

Answer: 95.8 megahertz. Remember that megahertz is one million hertz and a hertz is one vibration of sound per second.

17. Where can you find "electric eyes?"

Answer: Automatic door openers, alarm systems, etc. An "electric eye" is a device that has a photoelectric cell.

18. What is the difference between mass and weight?

Answer: Weight is the force of gravity acting on a mass. An object's weight changes as the force of gravity changes, but mass stays the same.

19. Which is hotter, 60° F or 60° C?

Answer: 60° C. 60 degrees Celsius is equal to 140 degrees Fahrenheit (140 ° F). 60° F is equal to 15.7° C.

20. Energy and work are measured in the same units. What are they?

Answer: joules

21. What does a calorimeter do?

Answer: It measures calories (or heat).

22. Name a simple machine that would make it easier for you to lift a heavy load onto a truck.

Answer: An inclined plane would help you put it up into the truck. Wheels would help you roll the load instead of sliding it. Pulleys would help you lift the load. A lever would help you raise the load into the truck.

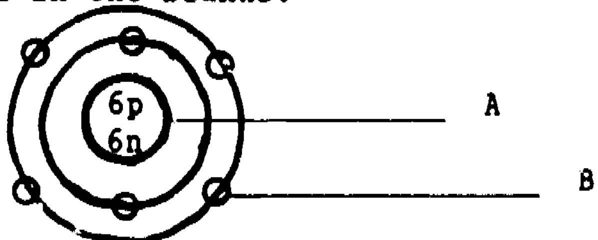
23. Both "thermal blanket" and "thermal underwear" have "therm-" in them. What does this tell you about how these things are used?

Answer: "Therm-" means heat, and thermal blankets and thermal underwear keep you warm.

24. If chemicals X and Y react more easily than chemicals Y and Z, what does this tell you about X's chemical reactivity?

Answer: This tells you that the chemical reactivity of X is higher than the chemical reactivity cf Z. X reacts with Y more easily than Z reacts with Y.

25. Fill in the blanks:



Answers: A - nucleus
B - electron

26. Which of the following could you see in a room with no light?
A. infrared waves
B. thermal material
C. fluorescent material
D. photoelectric cell

Answer: C. Fluorescent materials give off light. Infrared waves are a kind of invisible light. Thermal material provides heat, but does not give off light. And a photoelectric cell doesn't give off light, but it does release electrons when it is hit by light.

27. If you are floating on a raft in a swimming pool, and you throw a heavy ball, a force will act on you and push you back. What kind of force does this represent?

Answer: Reaction force. It acts in the opposite direction of an action force. The action force is the force you applied to the ball.

28. What is the difference between kinetic and potential energy?

Answer: Kinetic energy is contained in a moving object. It is energy in motion. Potential energy is the energy in an object at rest. It has the possibility for motion. For instance, a car falling off a cliff has kinetic energy. A car hanging off the edge of a cliff has potential energy.

29. What happens to a glass of water that stands in the hot sun all day?

Answer: Water will evaporate. It changes to a gas.

30. Put the letter of the correct definition in the blank next to the word.

barometer	(C)
computer	(F)
concave mirror	(J)
graduated cylinder	(G)
microscope	(E)
photoelec-tric cell	(A)
prism	(H)
ripple tank	(D)
thermostat	(B)
voltmeter	(I)

A. material that releases electrons when light hits it.

B. an instrument that controls temperature

C. an instrument that measures air pressure

D. a shallow box filled with water used to study the motion of waves

E. an instrument that uses lenses to enlarge small objects

F. an electronic device that performs calculations and solves problems

G. a cylinder marked so that exact measurements can be made

H. a solid, transparent object that separates light by refraction

I. an instrument that measures voltage

J. a bowl-shaped surface that reflects light

31. If tap water boils faster than saltwater, what do you know about salt water's boiling point?

    Answer: You know that salt water has a higher boiling point than tap water. It must be heated longer and reach a higher temperature before it boils.

32. If three compounds react and form a new compound, what type of reaction has happened?

    Answer: synthesis reaction

33. Suppose you have two machines and you put 40 joules of work into each one. The first machine has a work output of 35 joules. The second machine has a work output of 32.5 joules. Which machine has a higher efficiency? Why?

    Answer: The first machine has a higher efficiency. The same amount of work went into both machines, but the first machine put out more work than the second machine. Therefore, the ratio of work output to work input (efficiency) is larger with the first machine.

34. Why do people use Geiger counters to find Uranium?

    Answer: Because Uranium is a radioactive element, and Geiger counters detect radioactivity.

35. Rust on a car is an example of
    A. condensation
    B. convection
    (C) corrosion
    D. cathode

36. Which is higher, water's heat of fusion, or its heat of vaporization? What does this tell you?

    Answer: Water's heat of vaporization is higher than its heat of fusion. (Its heat of vaporization is 2260 joules per gram, but its heat of fusion is 334 joules per gram.) This means that it takes more heat to evaporate one gram of water than it takes to melt one gram of frozen water.

37. Why do helium balloons float in the air?

    Answer: Because helium is lighter than air.

38. What force keeps shoelaces tied?

Answer: friction

39. Would the horn of a car sound lower if it were moving toward you or away from you?

Answer: It would sound lower if it were moving <u>away</u> from you. The sound waves are further apart, and the frequency and pitch decrease when the horn moves away from you. When the horn moves <u>towards</u> you, the sound waves are closer together, and the frequency and pitch are higher.

40. Where would you weigh more, at the beach or on a high mountain?

Answer: On the beach. When you are on the beach, you are closer to the center of the earth, and so the force of gravity is stronger.

41. Size and shape are examples of physical properties. Can you think of others?

Answer: texture, color, mass, etc.

42. What are the atomic numbers for the following? (Use the Periodic Table if you need help.)

a. rubidium	c. manganese
b. lead	d. silver

Answer:

a. 37	**c. 25**
b. 82	**d. 47**

43. Name something that uses direct current.

Answer: a battery

44. If a person ran a ten kilometer race, how many miles did he run?

Answer: 6 miles. 1 kilometer is equal to .6 miles.

45. Resistance is measured in what units?

Answer: Ohms

46. What is the boiling point of water?

Answer: 212° F. Remember, boiling point is the temperature at which a substance begins to boil. It changes from being liquid to being gas. (The temperature is 100° C or Celsius. So, 100° C = 212° F.)

47. When you go outside in cold weather, you can see your breath. How do you explain this?

Answer: Condensation. Your breath condenses.

48. Match each term on the left with its symbol on the right.

absolute zero	(+)
alpha particle	(C)
alternating current	(α)
anode	(A.C.)
cathode	(γ)
gamma ray	(mph)
watt	(β)
beta particle	(0 K)
Celsius	(-)
miles per hour	(W)

49. Decide whether each of the following is a solid, a liquid, or a gas.
A. carbon dioxide
B. coal
C. transmission fluid
D. the helium in a balloon
E. acid
F. oxygen
G. table salt
H. aluminum
I. mercury

Answers:			
	A. gas	**D. gas**	**G. solid**
	B. solid	**E. liquid**	**H. solid**
	C. liquid	**F. gas**	**I. liquid**

50. You have found your dog sleeping on your bed. What tendency do you have to overcome to push your dog off your bed?

Answer: Inertia. Inertia is the tendency for an object that is not moving to remain at rest.

51. When you turn the volume up on your radio, what part of the sound waves are you changing?

Answer: You are changing the amplitude.

52. Tell whether each of the following is a 1st, 2nd, or 3rd class lever.
   A. fingernail clippers
   B. tweezers
   C. bottle opener
   D. hockey stick

Answers:
A. first class
B. second class
C. second class
D. third class

53. Pick the word that fits best.
In a decomposition reaction, (one, several) compound is (fused, bent, broken) into (one, several) compounds.

Answer: In a decomposition reaction, <u>one</u> compound is <u>broken</u> into <u>several</u> compounds.

54. You buy a string of electric lights for decoration. There are twenty lights on the string. If one light goes out, all the lights go out. Is this an example of a parallel or series circuit? Explain.

Answer: This is an example of a series circuit. The same electrical current passes through all the parts of the circuit, so if the current is interrupted by one broken light, the current won't pass through any of the lights.

55. What do you call water in its solid state?

Answer: ice. **(Water in its gaseous state is called steam.)**

56. What makes the atomic number of iodine higher than the atomic number of nitrogen?

    Answer: The number of protons in an atom of iodine is greater than the number of protons in an atom of nitrogen. An element's atomic number is the number of protons in an atom.

57. What happens to the volume of water when it freezes?

    Answer: The volume expands (gets bigger).

58. Which would serve more people, a liter of cola or a quart of cola?

    Answer: A liter of cola would serve more people. A quart is equal to .95 liters; a liter is equal to 1.06 quarts.

59. Has a car decelerated or accelerated if it goes from 90 kilometers per hour (kph) to 75 kph?

    Answer: The car has decelerated. When something decelerates, it slows down.

60. Fill in the blanks to complete these descriptions of metal. Choose the correct word.
    A. Metals conduct (light, <u>heat</u>) and electricity.
    B. Light is (absorbed, <u>reflected</u>) by metals.
    C. Metals (<u>can</u>, can't) be pounded into different shapes.

61. What do all levers have in common?

    Answer: All levers are simple machines and make work easier. All levers involve effort, resistance, and a fulcrum.

62. Why does a container of a gas explode when it gets too hot?

    Answer: When the gas is heated, the pressure gets greater until the container can't hold the gas inside anymore.

63. If you drop a brick with a mass of .7kg and a brick with a mass of 2kg, which will hit the ground first?

    Answer: Both bricks will hit the ground at the same time because both are acted upon by gravity. The acceleration of both of them is exactly the same.

64. What is the difference between nuclear fusion and nuclear fission?

Answer: Nuclear fusion is the joining of two nuclei to make a single nucleus. Nuclear fission is the breakup of a complex nucleus into two simpler nuclei. Both nuclear fission and nuclear fusion release energy.

65. Which is more efficient, a car with a manual transmission, or a car with an automatic transmission? Why?

Answer: The manual transmission is more efficient because it uses less fuel.

66. Which of the following is not a rate?
A. acceleration
B. speed
C. pressure
D. frequency

Answer: C. Pressure is the ratio of force to area. All of the others are ratios involving time. Acceleration is the ratio of change of speed to time. Speed is the ratio of movement to time. And the frequency of a sound is how many vibrations there are in a second.

67. At how many megahertz does your favorite radio station broadcast?

Answers will vary. (Remember that a megahertz is one million hertz.)

68. Where is the pressure greater, on the ocean floor or on a mountain top?

Answer: The ocean floor. The pressure of water is greater than the pressure of air.

69. Which is longer, five meters or six yards of fabric?

Answer: Six yards of fabric. A yard is equal to .9 meters.

70. Which one of the following terms does not belong? Why?
A. evaporation
B. sublimation
C. condensation
D. boiling point
E. melting

Answer: B. sublimation is the change from solid to gas directly. All the other terms have something to do with liquids. Evaporation is the change from liquid to gas. And melting is the change from solid to liquid. Condensation is the change from gas to liquid, and boiling point is the temperature at which liquid changes to gas.

Read the problem. Circle the letter of the closest paraphrase of the underlined part or parts.

71. Over eighty percent of all known compounds contain carbon. What percent of all known compounds do not contain carbon?
    A. At least eighty percent of all known compounds have carbon in them. What percent don't?
    B. If greater than 80% of all known compounds have carbon, then what percent don't?
    C. If no fewer than 80 compounds have carbon in them, how many don't?

72. Radium melts at 700 Celsius. Barium melts at 850 Celsius. Which element has the greatest tolerance to heat?
    A. Barium has a lower boiling point than radium, which boils at 700 C.
    B. The temperature at which barium melts is 150 C higher than that of radium.
    C. The temperature at which barium melts is 150 C less than that of radium.

73. One newton of force is required to cause a one kilogram mass to be accelerated at the rate of one meter per second each second. How many are needed to accelerate a two kilogram mass?
    A. How many meters per second each second are accelerated by a two kilogram mass?
    B. What is the acceleration of a two kilogram mass?
    C. What number of newtons are needed to accelerate a two kilogram mass at one meter per second each second?

Some science words are easily confused. Read the following sentences and phrases. Pick the item in the pair that fits.

TUTOR: Help your partner answer the questions below, using the glossary when necessary. The answers are given.

1. The transfer of heat through a solid. (conduction/convection)

2. The unit of force (neutron/newton)

3. Gas under pressure has a smaller volume. (Boiling/Boyle's Law)

4. Light moving through water bends. (refraction/reflection)

5. A bowl-shaped mirror. (concave/convex)

6. A chemical reaction that gives off heat. (endothermic/exothermic)

Laws/Effects/Tests

Match each item on the left with the correct example or definition on the right.

TUTOR: Help your partner look terms up in the glossary if necessary.

Newton's 1st law of motion	Guns recoil. When they are shot, they kick back.
Newton's 3rd law of motion	Gas in an insulated bag would have a smaller volume on the ocean floor than on dry land.
Charles's law	If you push two toy trucks, the heavier of the two trucks will accelerate slower.
Boyle's law	The sound of a motorcycle's engine seems to change as the motorcycle passes you.
photoelectric effect	A marble rolls on top of a completely flat table without changing course.
Doppler effect	Your presence can be detected if you step in front of a beam of light.
Newton's 2nd law of motion	A balloon left out in the sun will expand.

Match each item on the left with the correct example or definition on the right.

TUTOR: Help your partner look terms up in the glossary if necessary.

MATCHING FOR EXPERIMENTAL METHOD TERMS

hypothesis	3 of the plants watered with salt water died. The other two only grew 1.2 cm. None of the plants watered with tap water died. All these plants grew at least 2.7 cm.
control group	Salt water is probably worse for plants than regular tap water.
experimental group	Every day I measure all the plants. Also, I check to see whether any of them have died.
observation	Plants watered with regular tap water
results	Salt water is worse for plants than regular tap water. Plants that are watered with salt water have a better chance of dying and don't grow as much.
conclusion	Plants watered with salt water

AFFIX EXERCISES

speedometer	the way that plants convert sunlight into food
endoskeleton	an insulated container that keeps liquids hot
photosynthesis	an instrument that measures how fast an object moves
micrometer	the ability to move objects from far away
thermos	an outer skeleton, like the skeletons of insects or crabs
telekinesis	an inner skeleton, like the skeletons of people, birds, or tigers
exoskeleton	a unit of length equal to one millionth of a meter

III. Graphs

Remember that certain graphs go better in certain situations. A circle graph works best when you want to show how big all the parts of something are. A line graph works best when you want to show how something changes. Usually this type of graph is used to show trends through time, but it can also show how things in a series compare with each other or how a single process changes. A bar graph is usually used when you want to compare things that are not in a series or things that are not parts of a bigger thing, but are separate.

Choose the type of graph to represent the problem.

TUTOR: Listen as your partner reads the questions. The answers are given below.

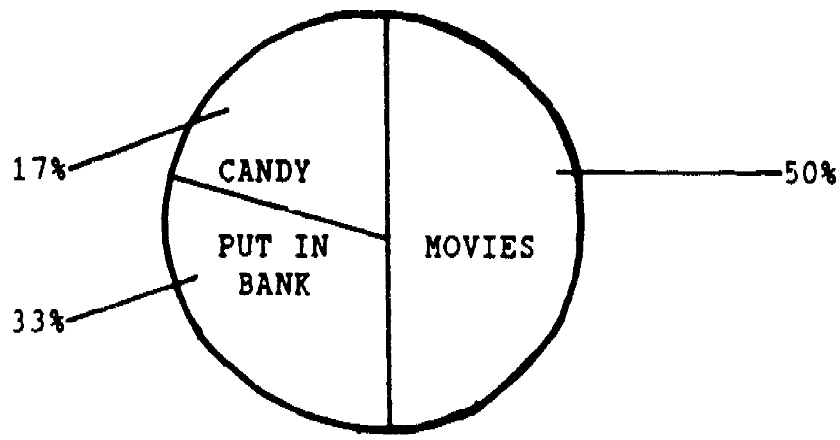
1. You know that Mary spent thirty minutes studying math. She also spent thirty-five minutes studying science and forty minutes reading for English class. Pick the type of graph that would best represent how long Mary studied for each class.
   (A.) Bar graph
   B. Circle graph
   C. Line graph

2. You have an idea that more and more snow falls every winter. If you know how much snow fell in every winter for the last nine years, what type of graph would you use to see if you're right?
   A. Bar graph
   B. Circle graph
   (C.) Line graph

3. A couple went on vacation for 10 days. They spent a total of 1 day just travelling from one place to the next. They ended up spending 4 days in England, 2 days in Scotland, and 3 days in France. Pick the type of graph that would best represent how the couple spent their 10-day vacation.
   A. Bar graph
   (B.) Circle graph
   C. Line graph

Reading Graphs

4. This graph shows how Tommy uses his weekly allowance. Look at the graph and answer the following questions.

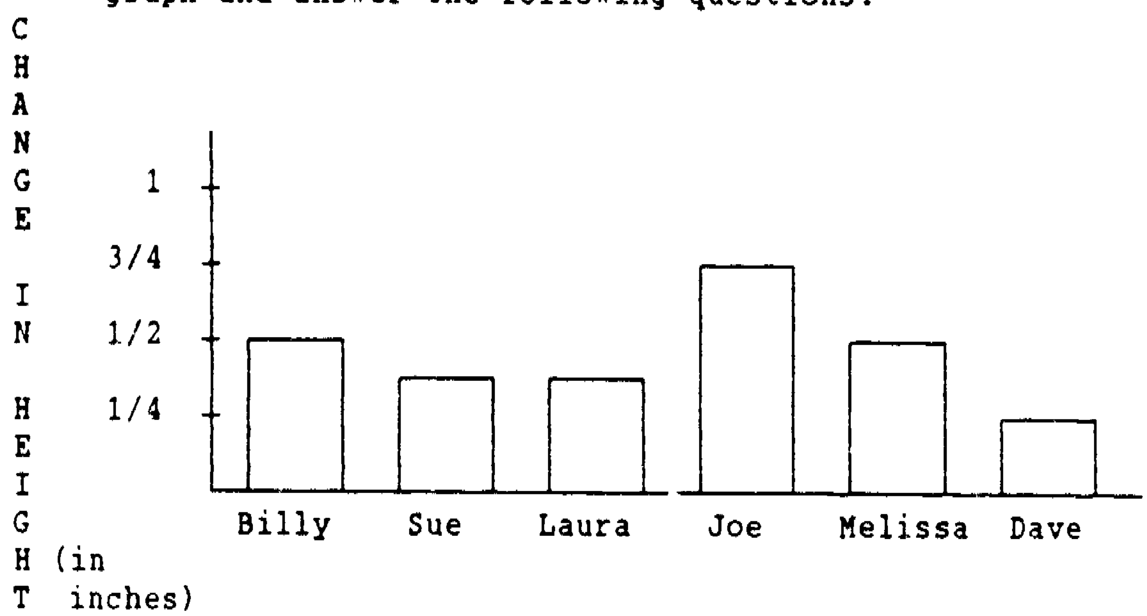


A. Does this graph tell you how much money Tommy gets every week?
No

B. What percentage of his allowance does Tommy spend on candy?
17%

C. Does Tommy spend all his allowance money every week?
No, he saves 33%.

5. This graph shows how much six cousins grew in the last year. Look at the graph and answer the following questions.

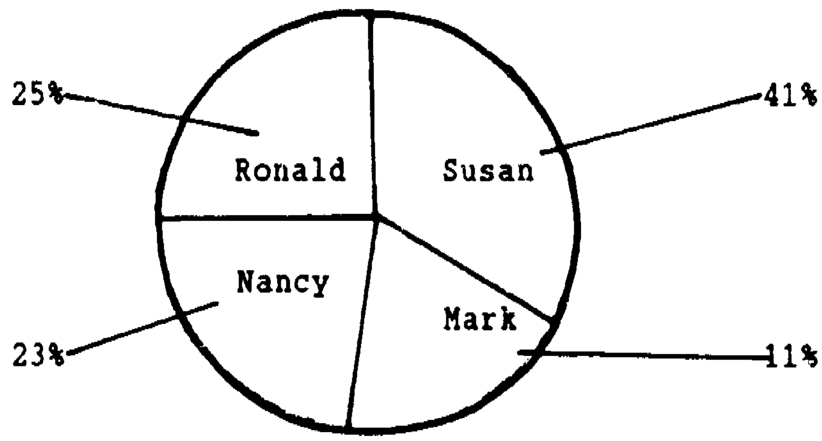


A. Who grew the most in the last year?
Joe

B. How much did Melissa grow?
a half inch

C. Who grew the least in the last year?
Dave

6. Lakeville Intermediate School held an election. This graph shows what percentage of the vote went to each candidate. Using the graph, answer these questions.

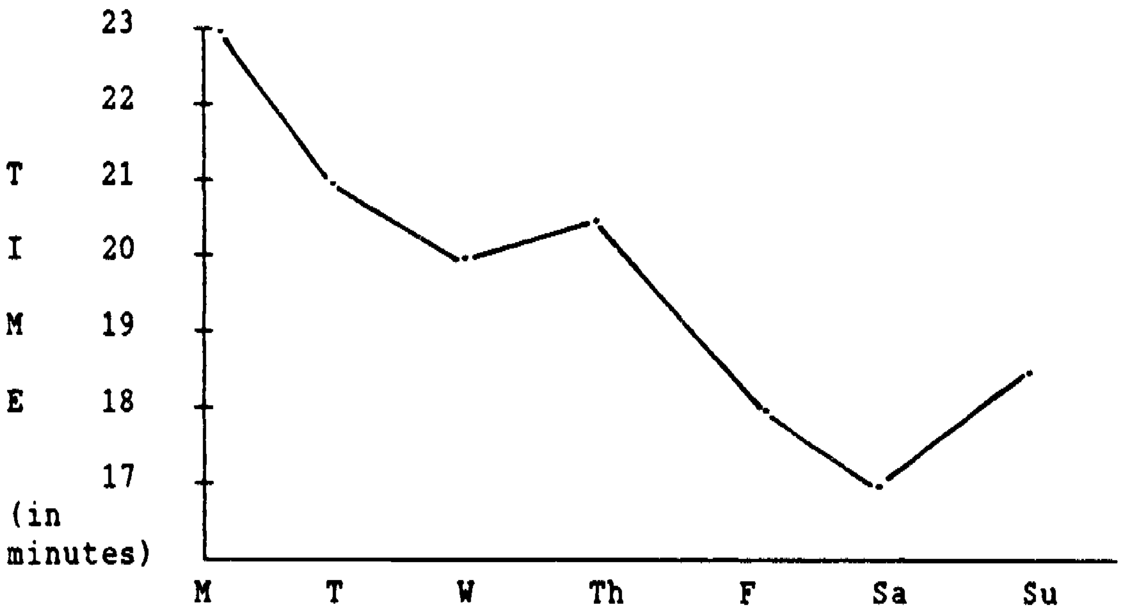


A. Who won the election?
   Susan

B. Who came in second?
   Ronald

C. What percentage of the votes did Mark get?
   11%

7. Dwight runs 3 miles every day. This graph shows how fast Dwight ran this distance every day last week. Using the graph, answer these questions.



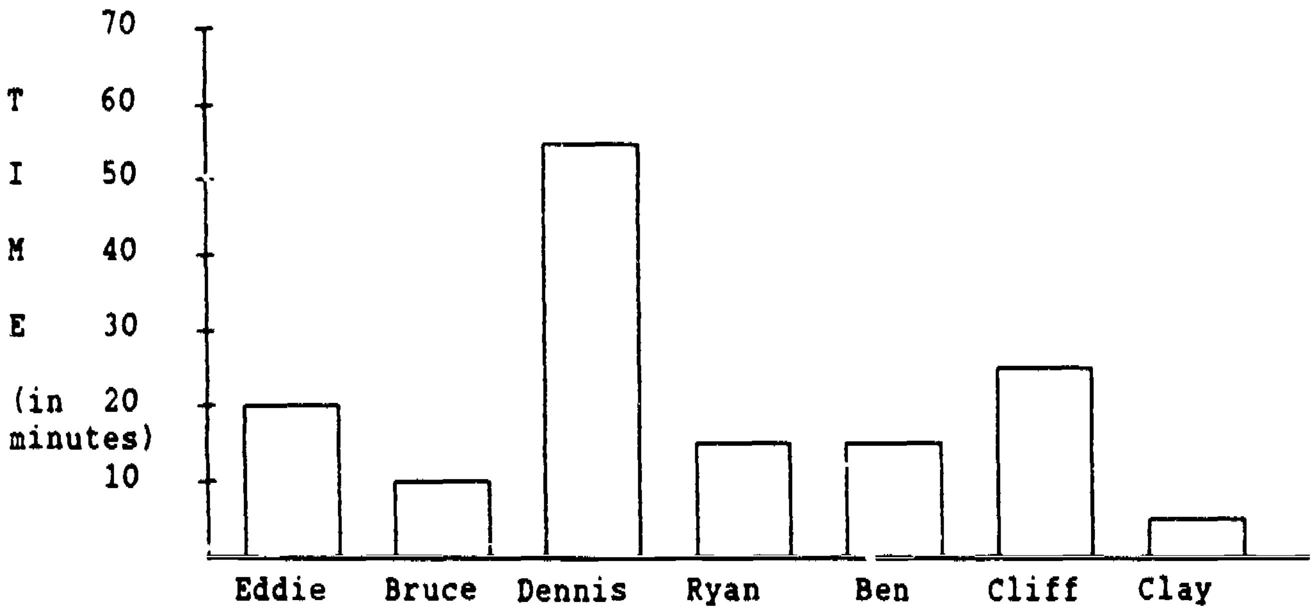
A. How long did it take Dwight to run 3 miles on Friday?
   18 minutes

B. On which day did Dwight run slower, Tuesday or Saturday?
   Tuesday

C. On which day did it take Dwight 20 minutes to run 3 miles?
   Wednesday

D. What is the pattern for Dwight's speeds? Does he get faster or slower during the week?
   faster

8. Seven people drove from their homes to a party on Saturday night. This graph shows how long it took each person to get to the party. Using the graph, answer these questions.

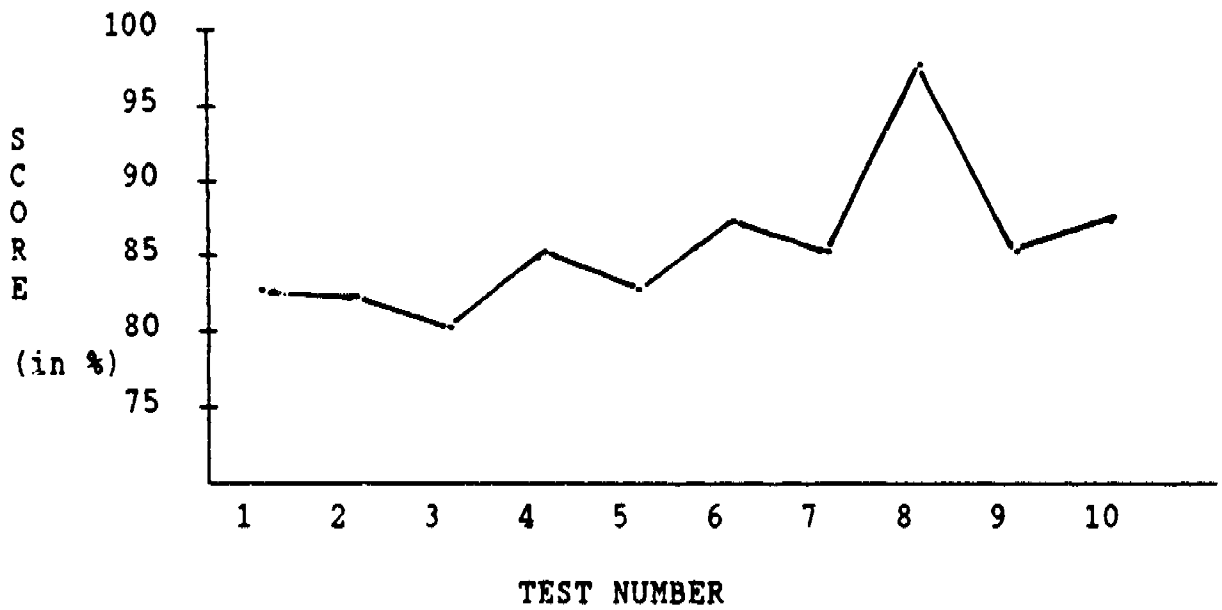


A. Who took 55 minutes to get to the party?
   Dennis

B. Who got to the party the fastest?
   Clay

C. Who got to the party faster, Eddie or Cliff?
   Eddie

9. Nadine took 10 tests last semester in math. This graph shows her test scores. Read the graph and answer the following questions.



A. What was Nadine's score on test number 4?
   85%

B. Which test did Nadine score the highest on?
   Test #8

C. What was the lowest score Nadine received?
   80%

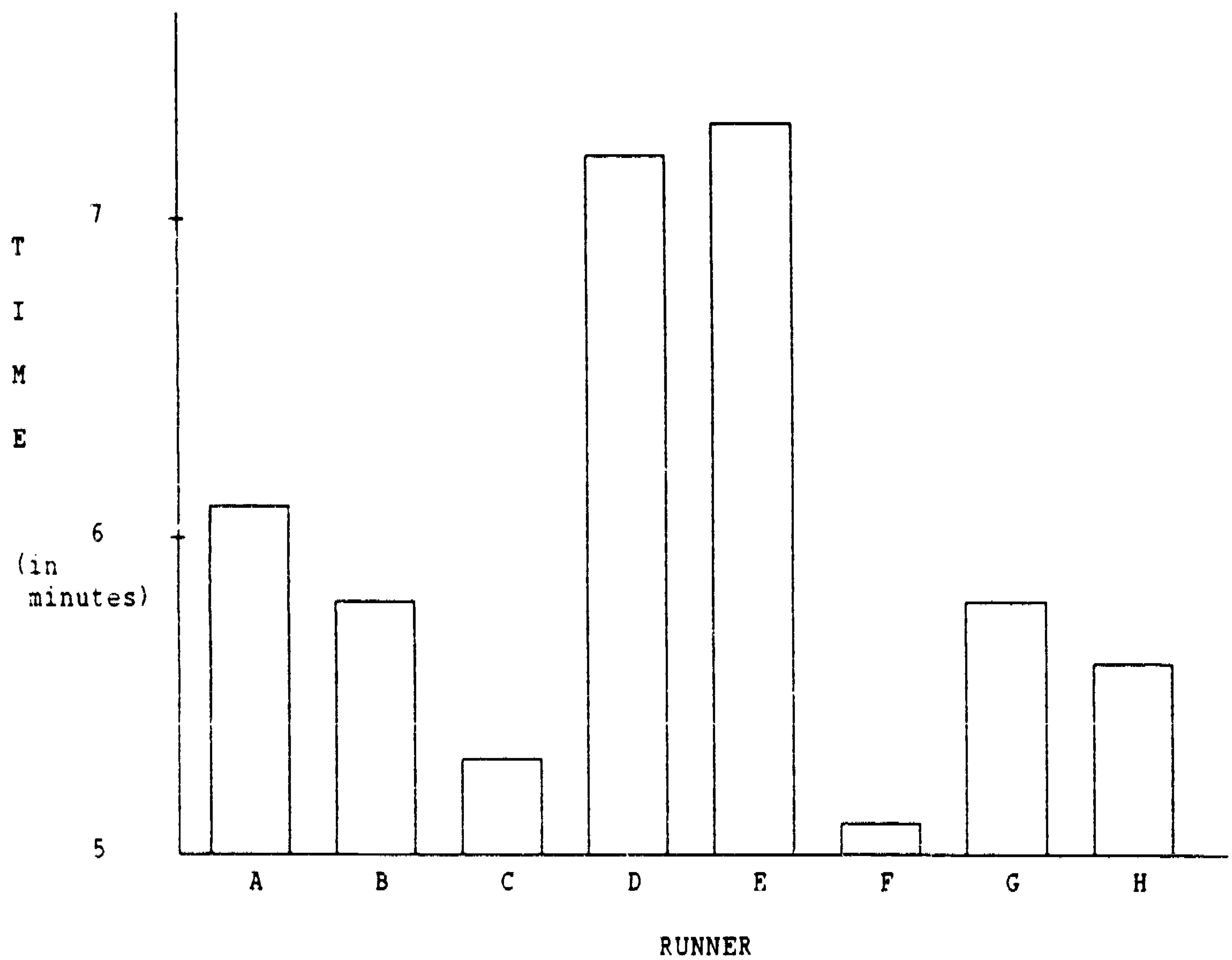
Drawing Graphs

10. You want to use a graph to show how fast eight separate runners ran a mile. Which type of graph would best represent the runners' times?
    (A) Bar graph
    B. Circle graph
    C. Line graph

Here are the numbers you will need to put in your graph.

Runner	Time (in minutes)
Alphonse	6.1
Bert	5.8
Charles	5.3
Damien	7.2
Erol	7.3
Franklin	5.1
Graham	5.8
Hugh	5.6

Now draw the graph.



11. You want to use a graph to show how much of the library each of the following sections takes up: fiction, filmstrips, reference, science, art, and music.

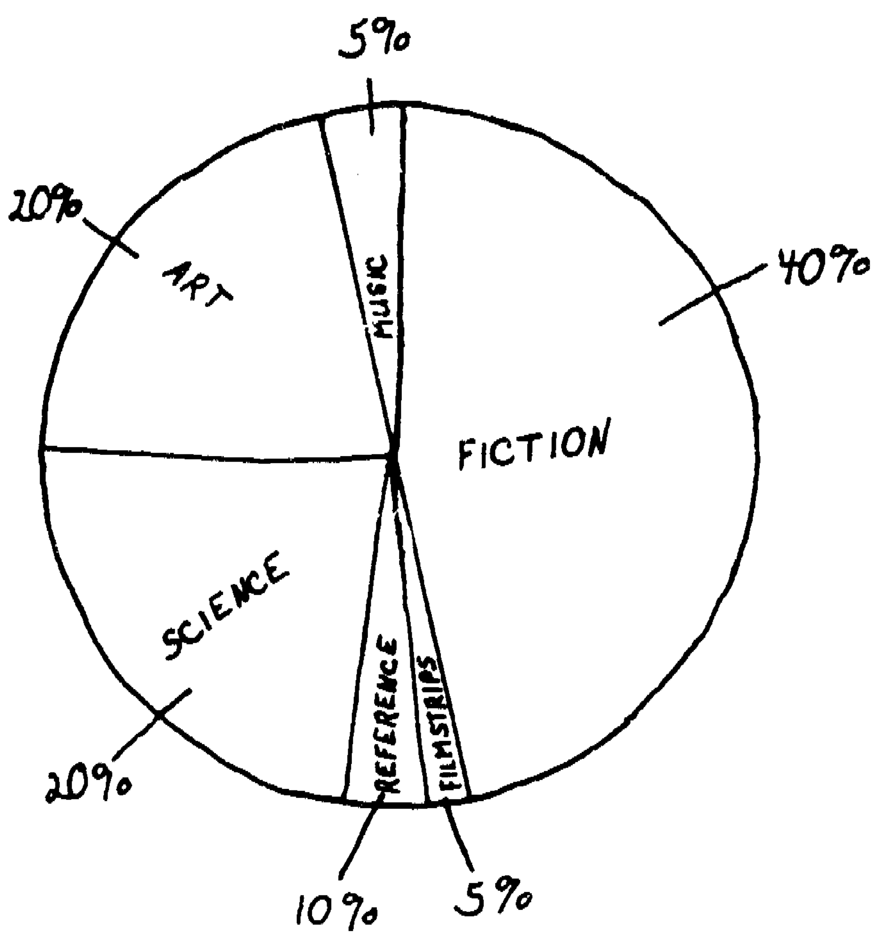
Which type of graph would best show how much of the library is devoted to each of these different sections?

A. Bar graph
(B.) Circle graph
C. Line graph

Here is the information you will need.

Section	How much space it takes up (in %)
fiction	40%
filmstrips	5%
reference	10%
science	20%
art	20%
music	5%

Now draw the graph.



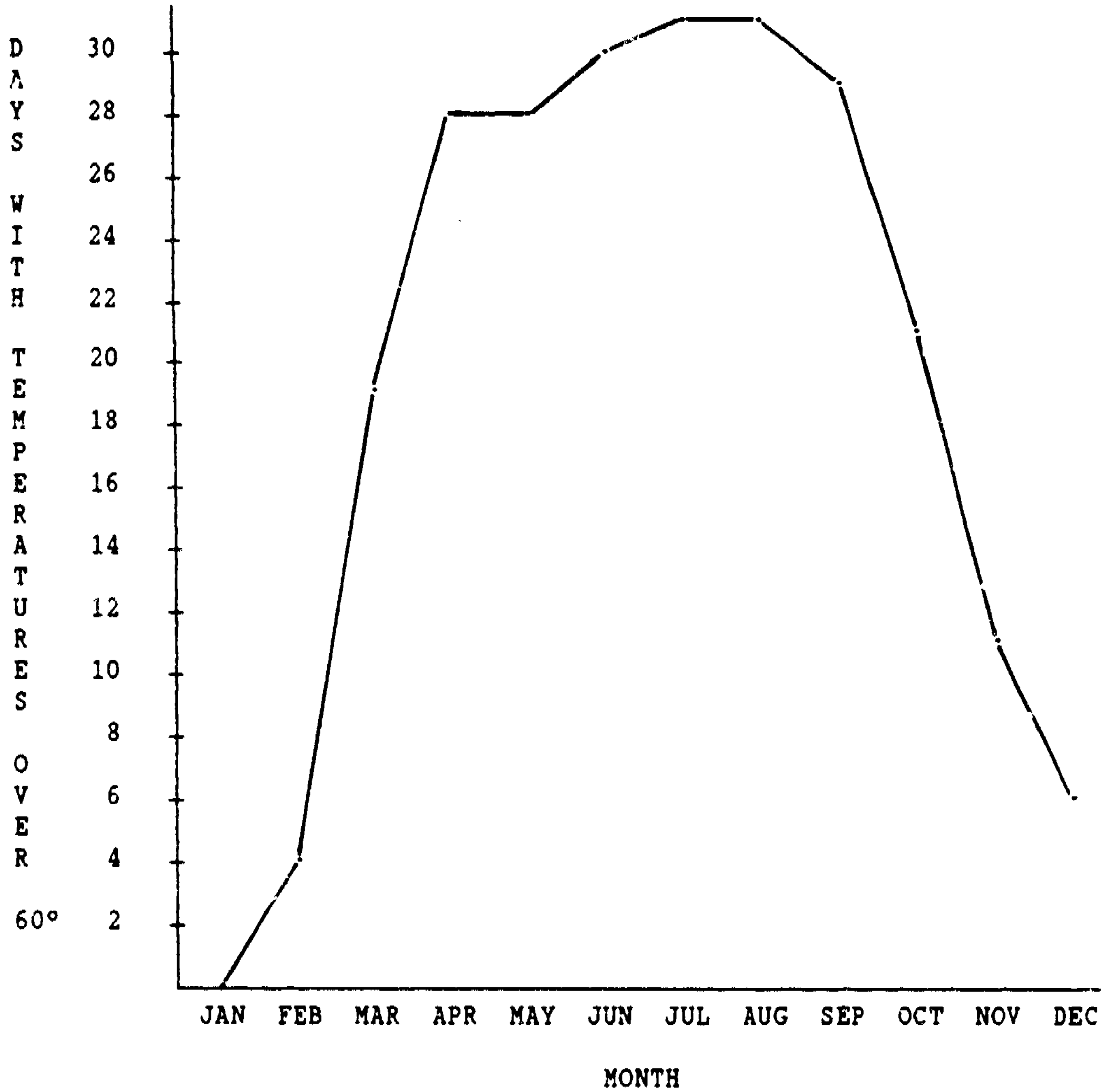
12. You want to draw a graph to show how many days in each month had temperatures over 60° F.

Which type of graph would best represent this?
A. Bar graph
B. Circle graph
(C.) Line graph

Here is the information you will need to make your graph.

Month	Days with Temperatures over 60° F
January	0
February	4
March	19
April	28
May	28
June	30
July	31
August	31
September	29
October	21
Nov mber	11
Dec mber	6

Now draw the graph.


DAYS WITH TEMPERATURES OVER 60°
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
MONTH

13. You want to draw a graph to show what percent of your school's 200 athletes are involved in baseball, football, basketball, soccer, track, tennis, or golf.

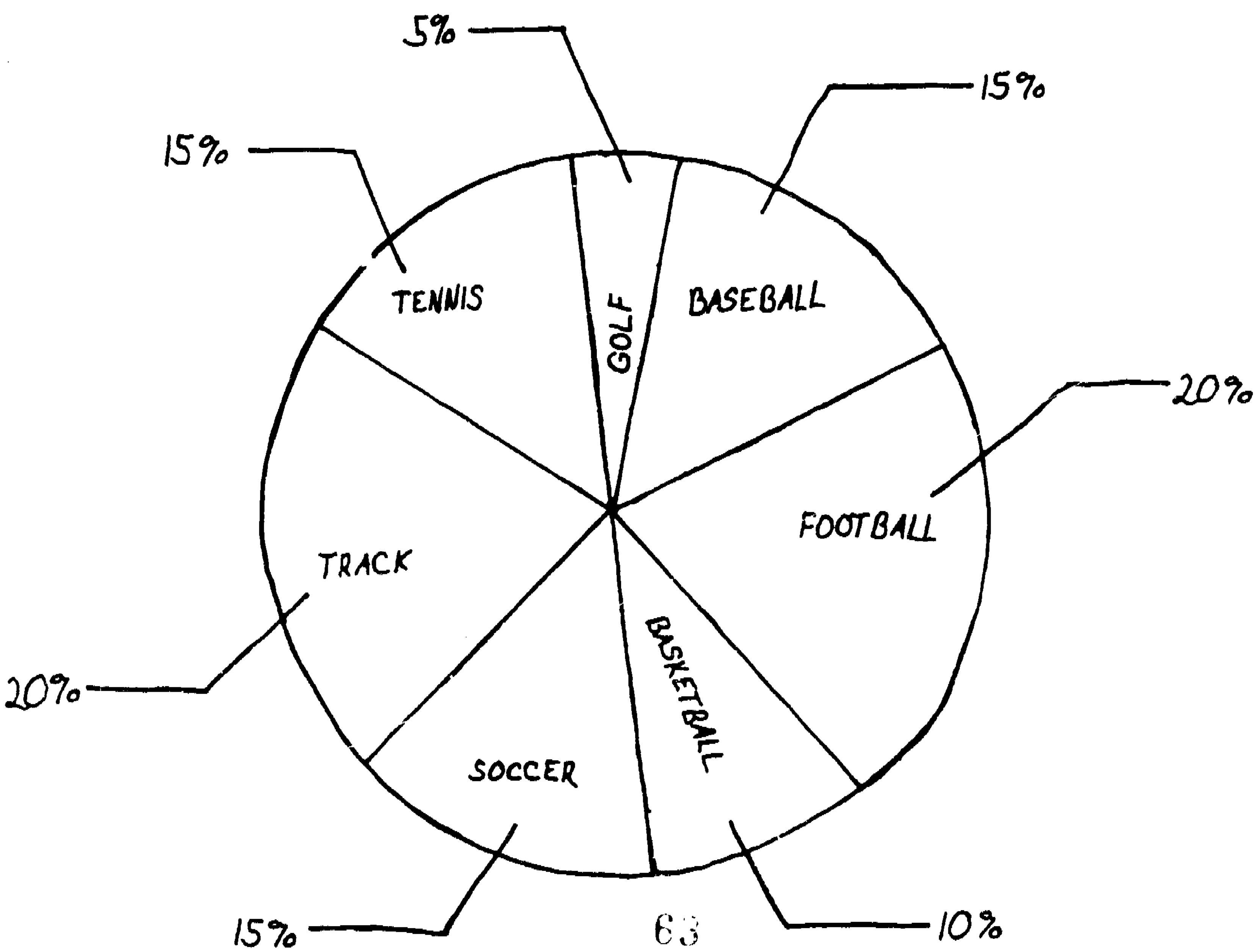
What type of graph would best represent and let you compare the parts of that collection of athletes engaged in each sport?

A. Bar graph
(B.) Circle graph
C. Line graph

Here is the information you will need.

Sport	% of Athletes Involved in Sport
baseball	15%
football	20%
basketball	10%
soccer	15%
track	20%
tennis	15%
golf	5%

Now draw the graph.



14. You want to make a graph to show how many fish each person on a camping trip caught.

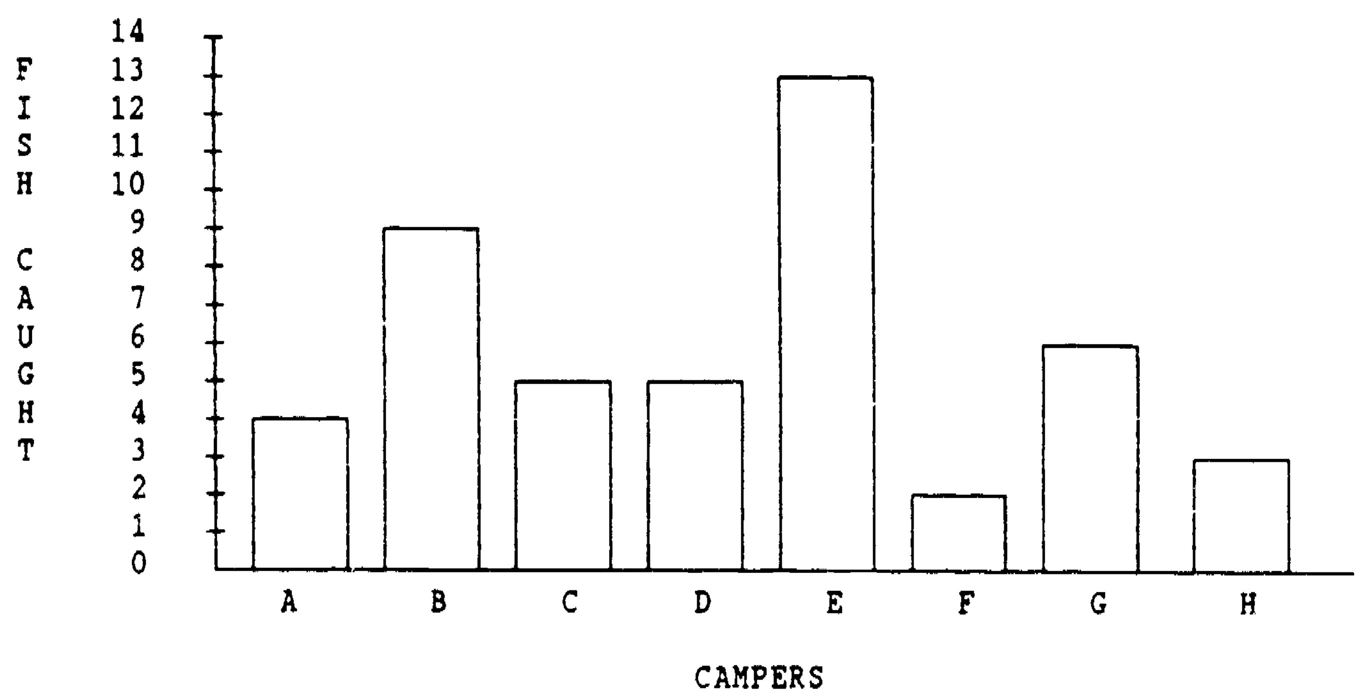
Which type of graph would best represent and let you compare the number of fish each camper caught?

(A) Bar graph
B. Circle graph
C. Line graph

Here is the information you will need.

Camper	Number of Fish Caught
Alice	4
Betty	9
Carlos	5
Deborah	5
Everett	13
Fiona	2
Gil	6
Helen	3

Now draw the graph.



15. You want to draw a graph to show how many new buildings have been built in the city every year for the past ten years.

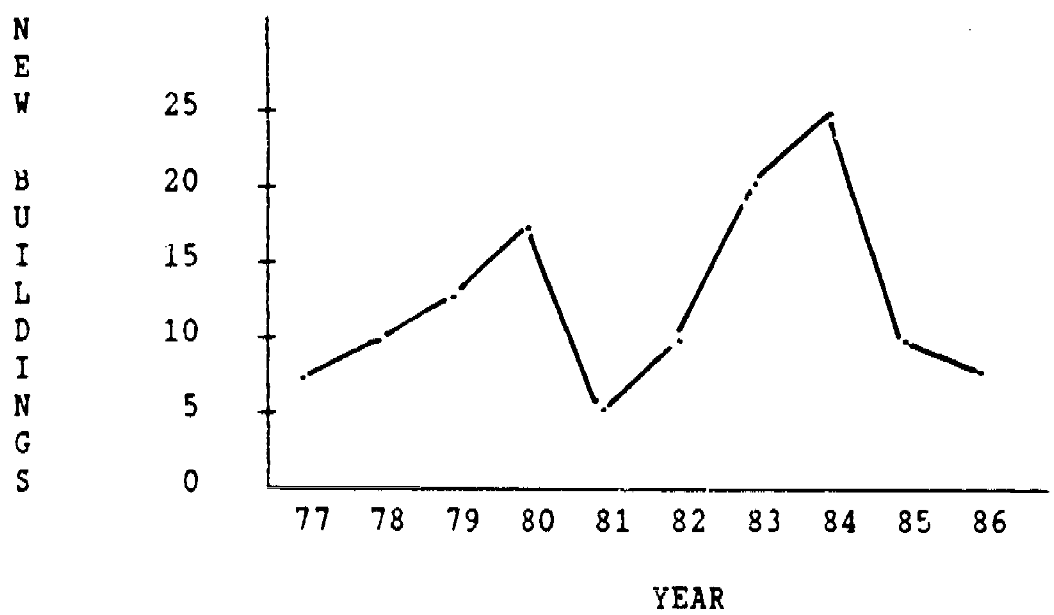
What type of graph would best represent this problem and help you see changes or trends?

A. Bar graph
B. Circle graph
(C.) Line graph

Here is the information you will need.

Year	Number of New Buildings
1977	7
1978	9
1979	13
1980	17
1981	5
1982	9
1983	20
1984	24
1985	9
1986	8

Now draw the graph.



IV. CHEMISTRY

A. SAFETY IN THE CLASSROOM

1. Read the following paragraph.

When you work in the lab, it is important to be careful so you don't get hurt. Before working with chemicals, it is very important to put on a lab apron and safety glasses. Look around the room to find the fire extinguisher. Remember where it is. You may need it one day. When working with chemicals, it is important to understand and follow all directions carefully. If you have to mix water and acid, never pour the water into the acid because the acid can splash on you. It is better to add the acid slowly to the water. If acid spills, wash the area immediately with lots of water. Don't put chemicals up to your nose to smell them. And never taste chemicals - they might be poisonous. It is also important to keep papers and notebooks away from flames to prevent fire. When you have finished your work in the lab, put all equipment back into its proper place. Make sure the water and gas are turned off, and electrical equipment is unplugged. Leave the lab safe and clean for the next person.

2. Fill in the blanks with the correct word. Choose from these words:

acid	safety glasses
fire extinguisher	smell
lab apron	taste
open flame	understand & follow directions
poisonous	water

a. Before performing experiments and mixing chemicals, it is important to put on a __lab apron__ and __safety glasses__.

b. If __acid__ spills, make sure you wash the area with water immediately.

c. Always look around the room to find the __fire extinguisher__. Finding it before accidents happen can save time later.

d. Never __smell__ or __taste__ chemicals. They might be __poisonous__.

e. Always __understand & follow directions__ when working in the lab.

f. Make sure your notebooks and papers are not near an __open flame__.

g. Never pour __water__ into acid.

Circle the best answer.

3. A lab apron is important because
   A. your tea‹ .er told you to put it on.
   (B.) it can protect you if something spills on you.
   C. it matches the safety glasses.

4. Acid
   (A.) can burn you.
   B. isn't very dangerous.
   C. shouldn't be poured into water.

5. If acid spills,
   A. wi"e it off with your hands.
   B. leave it for the next person to clean up.
   (C.) immediately wash it off with water.

6. If clothing catches on fire
   (A.) put it out by smothering it with a blanket or towel.
   B. run.
   C. try to put the fire out with chemicals you have nearby.

7. If you are heating something in a test tube
   A. point the test tube toward yourself.
   (B.) point the test tube away from yourself.
   C. it doesn't matter where you point the test tube.

8. Glass tubing that has been heated
   A. can be touched right after being heated.
   B. should be given to a friend to hold.
   (C.) should be touched only after it has cooled.

9. Chemicals
   A. are okay to smell directly.
   (B.) should never be smelled directly.
   C. are okay to taste.

10. When you finish your work,
   A. leave the room immediately.
   B. let the next person clean up.
   (C.) clean your work area.

11. When you finish your experiment
   (A.) turn off water and gas.
   B. leave everything on so the next person can use it.
   C. keep electrical equipment plugged in.

12. If you don't understand how to do an activity or experiment
   A. make a guess.
   (B.) ask your teacher for help.
   C. ask a friend.

B. EQUIPMENT

Match the name of the equipment with its picture.

Erlenmeyer flask (B)

graduated cylinder (C)

test tube rack (H)

Petri dish (G)

microscope (I)

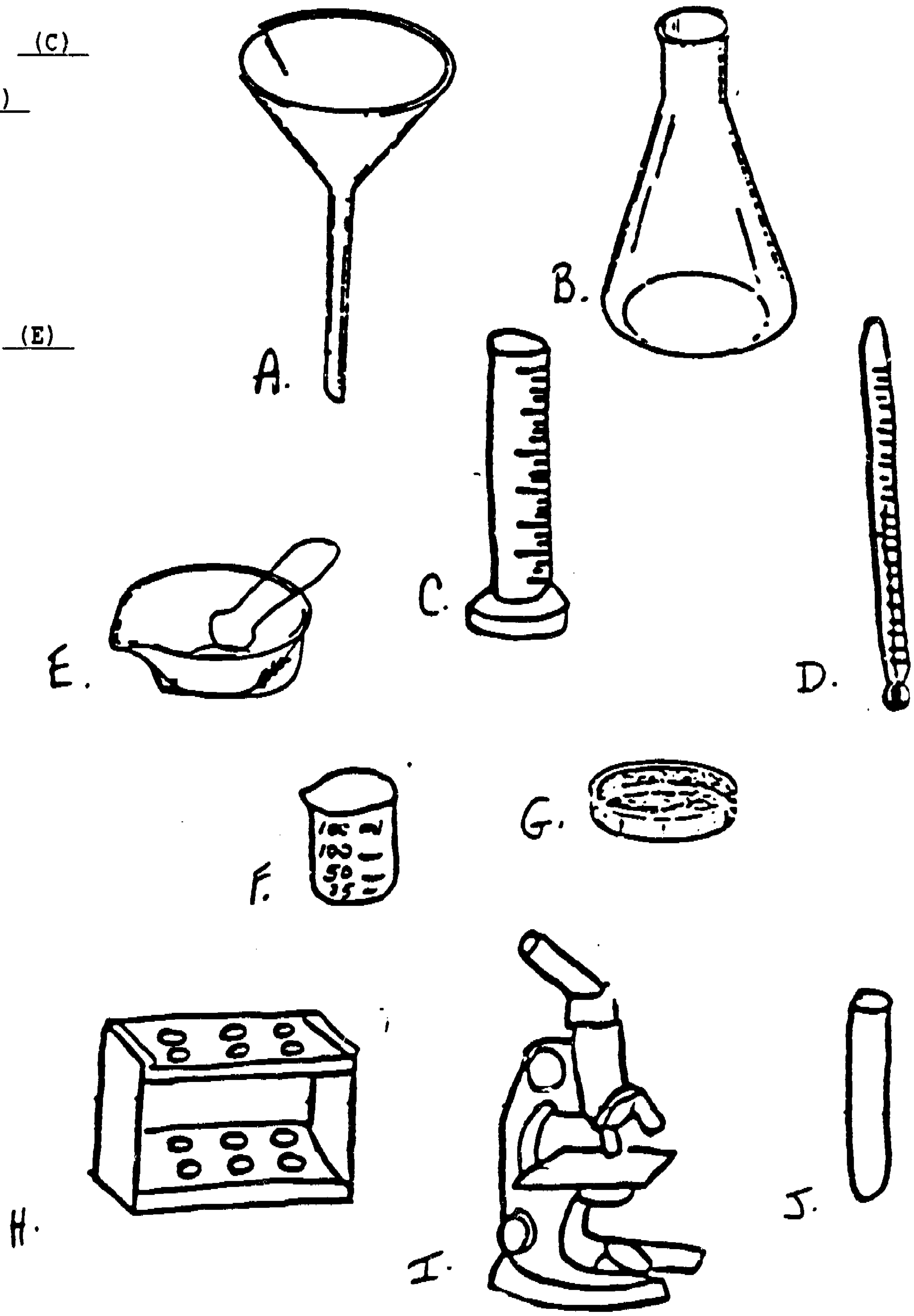
test tube (J)

mortar and pestle (E)

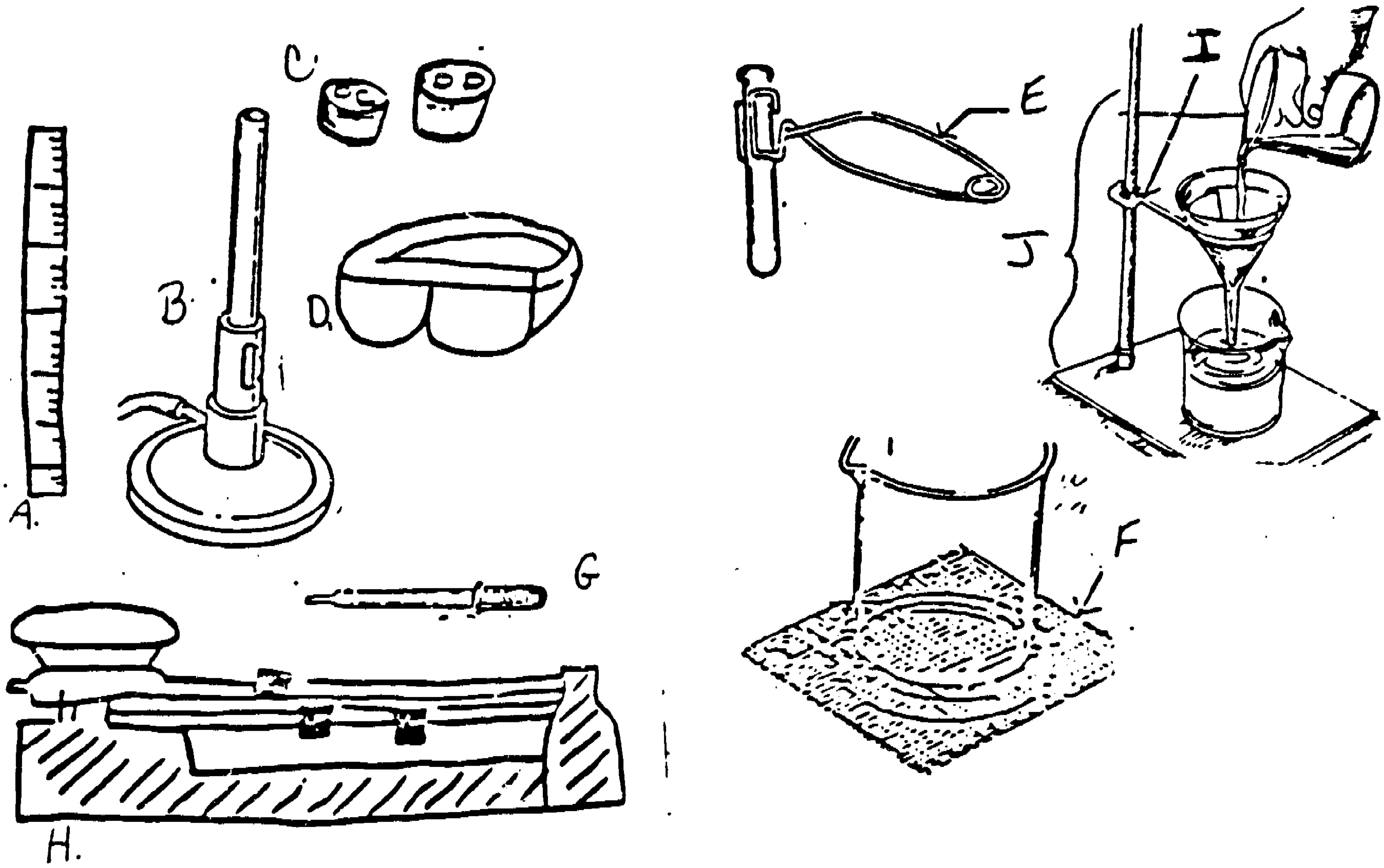
funnel (A)

thermometer (D)

beaker (F)



Match the picture with its name.



rubber stoppers (C)

goggles (D)

ruler (A)

laboratory burner (B)

eye dropper (G)

test tube holder (E)

wire gauze (F)

balance (H)

ring stand (J)

ring clamp (I)

Match what you need to do with the equipment that will help you do it.

Measure exactly 20 milliliters of water	mortar & pestle
Look closely at a plant cell	eyedropper
Find out how hot a solution is	goggles
Protect your eyes	graduated cylinder
Grind something into a powder	balance
Count out three drops of a liquid	thermometer
Measure how long a spring is	laboratory burner
Heat a solution in a test tube	funnel
Weigh blocks used in an experiment	microscope
Pour a solution into a test tube	ruler

There are several types of glass containers used in experiments. Sometimes you can use any of the types. But often there is one type of container that would be most useful for that experiment. A beaker, an Erlenmeyer flask, and a test tube are all glass containers.

Beakers come in many sizes, from small to very large. They usually have a wide opening, like a cup. Beakers also hold a specific volume of liquid (like a "250 ml beaker"). Beakers are useful when the contents are going to be stirred or other apparatus (like a test tube or another beaker) is going to be put inside the first beaker.

An Erlenmeyer flask is a large container with a wide base and a small opening at the top. It may or may not have a volume measurement marked on it. An Erlenmeyer flask is good for swirling or mixing solutions because it is difficult for the liquid to splash out of the small opening. However, the small opening makes it a bad choice in an experiment where other containers will be inserted into the flask.

A test tube is a small, long container. It cannot stand, but needs to be placed in a rack to hold it upright. Test tubes do not have volume measurement markings. They hold small amounts of material. Test tubes are often used when you perform a series of tests. (For example, if you have ten substances and you plan to add acid to each one and see how each reacts, you could line up 10 test tubes, each with 1 substance, and add acid to each.)

Read the experiment descriptions below. At each numbered step decide what piece of equipment would be used. Choose your answers from the list below. You may use a piece of equipment more than once. Read the entire experiment before deciding on the equipment.

TUTOR: Check your partners answers.

A.
1) Label a small container.
2) Find the mass of the container and record.
3) Measure 25ml of water and pour it into the container.
4) Find the mass of the container and the water.
Find the density of the water.

EQUIPMENT
1) (beaker)
2) (balance)
3) (graduated cylinder)
4) (balance)

balance
beaker
eye dropper
graduated cylinder
pestle
test tube
test tube holder
watch glass

B.
1) Fill a large container with ice.
2) Measure 250 grams of salt and sprinkle over the ice.
3) Measure out 5ml of water.
4) Add water to a small container which will fit inside the large container.
5) Stire the ice-salt mixture slowly.
6) Measure and record the temperature of the ice-salt mixture and the water in the small container at the end of every minute. Do this until the temperatures are equal.

1) (beaker)
2) (balance)
3) (graduated cylinder)
4) (test tube)
5) (glass rod)
6) (thermometer)

balance
beaker
Erlenmeyer flask
eye dropper
funnel
glass rod
graduated cylinder
laboratory burner
petri dish
test tube
thermometer
wire gauze

C.

1) Using tweezers, place a few crystals of cobalt chloride in a small container.
2) Heat the container and record any color change.
3) Set the container aside to cool.
4) Add a few drops of water to the cooled container.
5) Place 3ml of nickel sulfate in the container.

Record any changes you observe.

1) (test tube)
2) (laboratory burner & test tube clamp)
3) (test tube rack)
4) (eye dropper)
5) (graduated cylinder)

balance
Erlenmeyer flask
eye dropper
graduated cylinder
laboratory burner
ring clamp
test tube
test tube holder
test tube rack
thermometer
wire gauze

Read the following experiment. Fill in the blanks with the correct pieces of equipment.

Using a ____________________, measure 4ml of water. Add the water to an empty ____________________. Using the ____________________, measure out 1 gram of table salt and add it to the water. What happens? Now, using an ____________________, add 4 drops of mineral oil to the solution. Close the tube with a ____________________ and shake. Record what happens.

List all the equipment needed for the following experiments.

TUTOR: Check your partners answers. Read the explanations if your partner has trouble deciding what equipment to use.

1. Dissolve 3 grams of powdered copper sulfate in 18ml of water in a glass container. Place a strip of zinc in the water and watch for a reaction.

balance
beaker
tweezers
graduated cylinder
glass rod

A beaker is the best choice for a container because the contents need to be stirred and something is going to be placed in the beaker later.

A balance must be used to measure the copper sulfate because it is a solid. A graduated cylinder must be used to measure the water because it is a liquid and a precise amount is needed for the experiment. You cannot measure precise volumes, like 18ml, with a beaker.

2. Place 1 gram of iron filings and 1 gram of sulfur together in a small glass container. Hold the container over a flame for 1 minute. Let it cool. Record any changes you observe.

balance
test tube holder
test tube rack
test tube
bunsen burner

A test tube is preferable to a beaker in this experiment because the experiment calls for small amounts of material and the materials are to be heated. It is easier to hold a test tube in a flame than a beaker.

A balance is used to measure the elements because they are both solids. Note that the measurement amount is in grams (mass) not liters (volume).

C. CHEMICAL SYMBOLS

Listen to the name of each chemical expression and identify its symbolic representation.

TUTOR: Say each expression for your partner. Your partner will circle the symbolic form that s/he hears. Check all answers.

EXAMPLE:

You say: "Nitrous Oxide"
Student circles: N_2O NO N_2O_3

Tutor says	Student Circles
1. nitrogen (I) oxide	N_2O
2. dinitrogen trioxide	N_2O_3
3. water	H_2O
4. helium	He
5. ammonium phosphate	$(NH_4)_3PO_4$
6. ozone	H_3O
7. silica	SiO_2
8. rust	Fe_2O_3
9. ethane	C_2H_6
10. butane	C_4H_{10}

Listen to the chemical formulas and identify their names.

TUTOR: Say each chemical form for your partner. Check the answers s/he circles.

EXAMPLE:

You say: "H-2-O"

Student circles: water ozone hydrogen dioxide

Tutor says	Student circles
11. H_2SO_4	sulfuric acid
12. KNO_3	potassium nitrate
13. CO_2	carbon dioxide
14. $AgNO_3$	silver nitrate
15. MgO	magnesium oxide
16. $2KClO_3(c)$	potassium chlorate
17. 2Kcl(c)	potassium chloride
18. $NaHCO_3$	baking soda
19. $CuSO_4(aq)$	copper (II) sulphate
20. NaOH	sodium hydroxide

TUTOR: Check your partner's answers. The correct answers are indicated below.

21. Match each chemical formula with its correct written form.

N_2O	sodium hydroxide
H_2O	baking soda
$(NH_4)_3PO_4$	magnesium oxide
SiO_2	carbon dioxide
C_2H_6	sulfuric acid
H_2SO_4	nitrogen oxide
CO_2	ethane
MgO	silica
$NaHCO_3$	ammonium phosphate
$NaOH$	dihydrogen oxide

Write the written forms of the following chemical elements and compounds.

TUTOR: Check all answers. The correct answers are given.

EXAMPLE: H_2O water

22. NO nitrous oxide
23. C carbon
24. $Al(OH)_3$ aluminum hydroxide
25. Ag silver
26. $NaHCO_3$ baking soda
27. NH_4^+ ammonium
28. CO_2 carbon dioxide
29. $FeCl_3$ iron (III) chloride
30. MnO_2 manganese dioxide
31. $CH_3COOC_6H_4COOH$ acetylsalicylic acid (aspirin)

Listen to the names of each element or compound and write down the corresponding chemical formula.

TUTOR: Say the following expressions to your partner. Your partner will repeat the expressions and then write the corresponding chemical formulas.

EXAMPLE:

You say: "silver"

Student says: "silver"

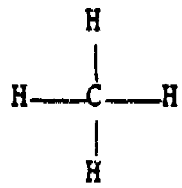
Student writes: Ag

32.	carbon	C
33.	fluorine	F
34.	zirconium	Zr
35.	rubidium	Rb
36.	nickel	Ni
37.	ozone	O_3
38.	table salt	NaCl
39.	methane	CH_4
40.	chloroform	$CHCl_3$
41.	methanol	CH_3OH

Interpreting formulas for organic compounds.

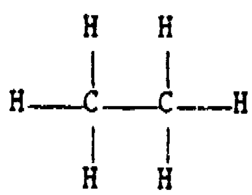
TUTOR: Help your partner interpret the following structural formulas. Ask questions and give advice as indicated in the example.

EXAMPLE:



You ask: "What does 'H' represent?"
Student says: "Hydrogen."
You ask: "What does 'C' represent?"
Student says: "Carbon."
You ask: "How many hydrogen atoms are there?"
Student says: "Four."
You ask: "How many carbon atoms are there?"
Student says: "One."
You ask: "Can you write the chemical formula?"
Student writes/says: CH_4 / C-H-four
You ask: "Can you say that another way?"
Student says: "Methane."

42.



What does 'H' represent? hydrogen

What does 'C' represent? carbon

How many hydrogen atoms are there? six

How many carbon atoms are there? two

Can you write the chemical formula? C_2H_6

Can you say that another way? ethane

Classify the elements according to their position on the Periodic Table of the Elements.

TUTOR: Help your partner classify the elements according to their positions on the Periodic Table of the Elements. Ask questions and give advice as indicated in the example.

EXAMPLE:

Student reads: "Er."	Student replies:
You ask: What does "Er" represent?	Erbium
What group does Erbium belong to?	It's a rare earth element in Group 3B.
Is it solid, liquid or gas?	It's a solid.
What's its atomic number?	Its number is 68.
What's its atomic weight?	Its atomic weight is 167.
How many electrons does it have in its outer electron shell?	It has 2 electrons in its outer shell.
Which period is Erbium in?	It's in period 6.
Can you name some other elements in period 6?	Yes, Barium, Tantalum,...
Can you name some other rare earth elements?	Yes, Lanthanum, Cerium,...

Student reads: Tutor asks:

43. B (see questions above and/ or ask similar questions)
44. F
45. Rn
46. Fm
47. Xe
48. H
49. V
50. Co
51. He
52. Zr

ALPHABETICAL LISTING OF GLOSSARY TERMS

ENGLISH SKILLS FOR PHYSICAL SCIENCE

UNIT 2 - PHYSICAL SCIENCE TERMINOLOGY

STUDENT VERSION

Center for Language Education and Research

Center for Applied Linguistics

Arlington County Public Schools

I. Glossary
   Terms
   Laws/Effects/Tests
   Experimental Method Terms
   Units and Symbolic Notation
   Types of Graphs
   Affixes
   Equipment

II. General Questions

III. Graphs

IV. Chemistry
   A. Safety
   B. Equipment
   C. Chemical Symbols

V. Alphabetical index of terms in the glossary

TERMS

Accelerate — To move faster and faster. When an object accelerates, its speed increases. (see acceleration, speed)

Acceleration — An increase in speed. Acceleration is the rate of change of speed and is measured in units of distance divided by units of time squared. An example is 3 meters per second squared ($3m/sec^2$). This would mean that an object's speed increased by 3 meters a second every second.

Action force — A force that acts on an object

Amplitude — The maximum displacement of a particle in a wave. The greater the amplitude of sound waves (thus, the higher the waves are), the louder the sound.

Atom — The smallest unit of an element. An atom contains electrons and a nucleus. The nucleus is made up of protons and neutrons.

Base unit — A standard unit of measurement. Other units are described in terms of base units. For example, a centimeter is one one hundredth of a meter. The meter is the base unit for length. (The centi- part means "one hundredth.")

Boiling — The act of changing from a liquid to a gas by heating

Boiling point — The temperature where a substance begins to boil. When a substance boils, it goes from being liquid to being gaseous. (see evaporation)

Catalyst — A substance that changes how fast a chemical reaction takes place. Catalysts can either speed up or slow down a chemical reaction. (see react)

Centripetal Force — When an object travels in a circular path, this force acts toward the center of the circular path.

Chemical change — When a substance undergoes a chemical change, it becomes a different substance. Because it is no longer the same substance, it no longer has the same properties.

Chemical formula — Used to show how many atoms of each element are in a compound. For example, the chemical formula for water is H_2O. (A water molecule has two atoms of hydrogen and one atom of oxygen.) Chemical formulas use symbols (like abbreviations) for elements.

<u>Chemical reactivity</u> — A property of an element. If an element has a high chemical reactivity, it reacts with other elements easily. If an element has a low chemical reactivity, it reacts less easily with other elements. (see react)

<u>Coefficient</u> — The numbers used in front of symbols and formulas in an equation. These numbers are used to balance chemical equations.

<u>Compression</u> — The densest concentration of particles in a kind of wave called a compressional wave. In a compressional wave, the particles vibrate in the same direction that the wave moves. (see rarefaction)

<u>Condensation</u> — The change from gas to liquid. When a substance condenses, it goes from being gaseous to being liquid.

<u>Conduction</u> — The passage of electricity or heat through a substance (see electricity, heat)

<u>Convection</u> — The transfer of heat energy by the movement of the matter containing the heat. Convection occurs in gasses and liquids, but not in solids. (see heat energy)

<u>Corrosion</u> — Any destructive chemical change occurring in a metal. When some metals corrode, they become rusty. (see chemical change)

<u>Covalent bond</u> — A type of bond between atoms. In a covalent bond, atoms share electrons (see atom, electron)

<u>Decelerate</u> — To move slower and slower. When an object decelerates, its speed decreases. (see accelerate, speed)

<u>Deceleration</u> — A decrease in speed. Deceleration is the rate of decrease in speed, or how fast an object slows down. (see acceleration, speed)

<u>Density</u> — The measure of how much mass an object has per unit of volume. The most dense substance will have a lot of mass in a small volume. The least dense substance will have very little mass in a large volume. Density is often measured in grams per cubic centimeter (g/cm^3). Water has a density of one gram per cubic centimeter. That means every cubic centimeter of water has a mass of one gram. (see volume)

<u>Diffraction</u> — A change in the movement of light or other waves caused by obstacles in the medium (see diffraction grating)

Distillation	A process by which the parts of a mixture are physically separated. Distillation involves evaporation and condensation. (see condensation, evaporation)
Displacement reaction	A reaction in which one element takes the place of (or displaces) another in a compound
Double displacement reaction	A reaction in which two elements switch places in compounds (see displacedment reaction)
Efficiency	How much work a machine produces compared to how much work goes into the machine. If a machine produces a lot of work (if it has a high work output) and little work goes into the machine (it has a low work input), then the machine's efficiency is high. (see machine, work)
Effort	The part of a lever where force is applied. (see lever, 3rd class lever)
Electricity	The movement of electrons (see electron)
Electrolysis	Breaking a compound into simpler substances by putting a current of electricity through the compound (see electricity)
Electron	a particle that has a negative charge and goes around (or orbits) an atom's nucleus. (see atom)
Energy	The ability to do work, to keep up a force through a distance. You need a lot of energy to run a mile. (see work)
Endothermic reaction	A chemical reaction that takes heat from its environment
Evaporation	The change from liquid to gas. When a substance evaporates, it goes from being liquid to being gaseous.
Exothermic reaction	A chemical reaction that gives off heat into its environment
Fluorescent	This word describes a substance that gives off light when it is exposed to radiation. (see radiation)
Force	Something that causes an object to accelerate, decelerate, or change direction by pushing or pulling.
Freezing	The change in matter from liquid to solid
Friction	A force between two surfaces that works to stop motion. (see force)
Fulcrum	The fixed point that a lever moves on. (see lever)

<u>Liquify</u> — To turn matter into a liquid. If you melt a solid, you liquify it. (see liquid, melting)

<u>Machine</u> — An object that makes work easier. A machine makes work easier by changing the speed, amount, or direction of a force. (see force, work)

<u>Magnetic field</u> — A space with magnetic forces. (see magnetic force, magnetism)

<u>Magnetic force</u> — The force of attraction between particles with opposite electric charges (see magnetism)

<u>Magnetism</u> — An attraction between particles with opposite electric charges. (Particles with similar electric charges repel each other. Instead of being attracted to each other, particles with the same charge move away from each other.)

<u>Mass</u> — The amount of matter in an object.

<u>Matter</u> — Anything that takes up space. Everything in the universe is made of matter. (see mass)

<u>Melting</u> — The change in matter from solid to liquid (see liquid, solid)

<u>Metal</u> — A substance with these physical properties: it reflects light, conducts heat and electricity well, and it can be pounded into different shapes. (see conduction, electricity, physical property, reflection)

<u>Momentum</u> — An object's velocity multiplied by its mass. A 10 Kg object with a velocity of 6 Km/hr has more momentum than a 4 Kg object with a velocity of 3 Km/hr. (see mass, velocity)

<u>Noise</u> — Any kind of sound formed by irregular vibration. Noise is something you hear that is different from the other sounds around you.

<u>Nuclear energy</u> — The energy released by fission or fusion. Nuclear energy also means the system of making electricity using radioactive elements. (see fission, fusion, radioactivity)

<u>Nuclear fission</u> — The break up of a complex nucleus into two simpler nuclei. This break up releases energy. (see energy)

<u>Nuclear force</u> — The force holding parts of an atom's nucleus together

Nuclear fusion	The joining of two nuclei to make one nucleus. This releases energy. (see energy)
Physical change	A change in a physical property (see physical property)
Physical property	A quality of a substance that can be observed without changing the substance's chemical structure. Size and shape are examples of physical properties.
Potential energy	Energy that is contained inside an object that has the possibility of doing work because of its position. (The object can be at rest or in a position of possible energy.)
Power	The rate of work done. Power is equal to work over time. Power is measured in watts. (see rate, work)
Pressure	The amount of force applied in a unit of area. Pressure is equal to force divided by area. (see force)
Product	The substance left after a chemical change. (see chemical change)
Pulley	A simple machine using ropes and wheels. (see simple machine)
Radiation	The movement of heat from areas with high temperatures to areas with low temperatures. In this way, radiation is like conduction and convection. But radiation also means the energy released by atoms when their nuclei change. (see atom, energy, conduction, convection)
Radioactivity	The giving off of high energy radiation from radioactive atoms. (see atom, radiation)
Rarefaction	The least dense concentration of particles in a kind of wave called a compressional wave. In a compressional wave, the particles vibrate in the same direction that the wave moves in. (see compression)
Rate	A rate is a ratio, usually over time. For example, speed (which is the rate of movement) is really the ratio of distance traveled to time. In the same way, acceleration is the ratio of speed to time.
React	When some substances are mixed, a chemical change happens. When substances react, they undergo chemical changes.
Reaction force	A force acting in the opposite direction of an action force. A reaction force is equal to an action force.

<u>Reflection</u>	A wave or ray bouncing off of a surface. If a surface reflects light, that means light bounces off the surface.
<u>Refraction</u>	A wave or ray bending. Refraction is caused by the wave or ray slowinq down as it moves from one substance into another.
<u>Resistance</u>	Something that slows down or prevents motion. Resistance in an electrical circuit opposes the flow of electrons. Resistance in a lever works against effort. (see effort, electricity, lever)
<u>Simple machine</u>	A machine that is a lever, pulley, wheel and axle, inclined plane, screw, or wedge. A machine that has simple machines for its parts is called a <u>compound machine</u>. (see machine)
<u>Solid</u>	A piece of matter that has a specific shape and volume
<u>Solubility</u>	The measure of how much of a substance will dissolve in a given amount of another substance. The substance that dissolves in another substance is called the "solute." The substance that the solute dissolves in is called the "solvent."
<u>Specific heat</u>	The heat necessary to increase the temperature of a substance by one degree Celsius (see temperature)
<u>Speed</u>	A measure of motion, of how fast something is moving. Speed is measured in units of distance divided by units of time. An example of this is mph - miles per hour.
<u>Stable</u>	A word that describes nuclei that are not radioactive. Unstable nuclei are radioactive. (see radioactivity)
<u>Standard</u>	A fixed amount used for comparisons in measurements
<u>Structural formula</u>	The formula of a chemical compound where each atom is shown in its position in the molecule. H=O=H is the structural formula of water. (see chemical formula)
<u>Sublimation</u>	The change from solid to gas. When a substance sublimates, it goes from being solid to being gaseous without ever being liquid.
<u>Synthesis reaction</u>	A chemical reaction where two or more compounds are combined innto a single compound
<u>Temperature</u>	The degree to which something is hot or cold as measured on a scale such as Fahrenheit, Celsius, or Kelvin.

Vaporization	The change from liquid to gas. Vaporization is another word for evaporation.
Velocity	Speed and direction of movement. We use velocity when we talk about the action of forces, acceleration, and deceleration. It takes force to change the velocity of an object. (see acceleration, deceleration, force, speed)
Volume	The amount of space an object or substance takes up
Weight	The force of gravity acting on the mass of an object. (see gravity, mass)
Work	Force exerted over a distance. That is, work is equal to the force applied to an object multiplied by the distance the object moved. This is shown in the equation W= F x d. Work is measured in joules. (see force)

LAWS/EFFECTS
TESTS

Boyle's Law	This law states that the space that a gas takes up will get smaller when the pressure is increased, as long as the temperature stays the same.
Charles's Law	This law states that the space that a gas takes up will get larger when the temperature increases, as long as the pressure stays the same.
Conservation of Momentum	In all interactions between objects momentum is conserved. If one object loses momentum, another object gains momentum. (see momentum)
Doppler Effect	The change in apparent frequency of a wave caused by the movement of the source of the wave.
Flame test	When an element is placed in a flame, it gives off colors. The flame test is a procedure in which elements are identified by noting these colors.
Law of Conservation of Mass	In a chemical reaction, the total mass of all the chemicals going into the reaction equals the total mass of all the products after the reaction. Mass is conserved. (see mass, product)
Law of Multiple Proportions	This law states that if the same elements combine in different ratios, different compounds will be formed.
Law of Reflection	This law states that the angle made when an object or wave hits a reflecting surface will equal the angle made when an object or wave is reflected by the surface. Another way to say this is that the angle of incidence is the same as the angle of reflection.
Newton's Law of Gravitation	This law states that the gravitational attraction or pull between two objects can be calculated using the masses of the objects and the distance between them. The attraction is proportional to one mass times the other, divided by the distance between them squared. (see gravity)
Newton's 1st Law of Motion	This law states that an object at rest (not moving) will remain at rest unless a force causes it to move. An object will continue moving in a straight line unless a force causes it to stop or change direction.
Newton's 2nd Law of Motion	This law states that the amount of acceleration of an object depends upon the force applied to the object and the mass of the object. Newton made this into a formula: F=m x a, or force = mass x acceleration. (see acceleration, force, mass)

Newton's 3rd Law of Motion	For every action (force), there is an equal and opposite reaction (force). (see force)
Ohm's Law	This law states that current is equal to the voltage divided by the resistance of the conductor. I=V/R
Photoelectric Effect	Certain metals will release electrons when they are hit by light.

EXPERIMENTAL METHOD TERMS

Conclusion	The belief that you come to through observation and experimentation
Control	A group or activity used as a standard. The experimental group is compared to the control. In this way, the effects of the experimental conditions can be observed and measured. (see experimental)
Experiment	A group of tests. The tests are observed in order to prove or disprove a hypothesis. Certain parts are present in every good experiment: hypothesis, observation, a control, and a conclusion. (see conclusion, control, hypothesis, observation)
Experimental	A group that has something special done to it. This group is observed and compared to the control group. In this way, the hypothesis can be proved or disproved. (see control, hypothesis)
Hypothesis	An idea that can be verified (shown to be true) through experimentation and observation (see observation)
Observation	The noticing and recording of events as part of an experiment. (see experiment)
Results	The measurements or other data on which conclusions are made. Results are found by observing the experimental group and comparing it with the control group. (see conclusion)
Theory	A description of certain events or phenomena based on experimentation. Compare this with hypothesis which is a description made before experimentation.

UNITS AND SYMBOLIC NOTATION

<u>Absolute zero</u> (0) — The lowest temperature that you can bring a substance to. This temperature is equal to -273 degrees Celsius or 0 Kelvin.

<u>Alpha particle</u> (α) — These particles have a positive charge and are made up of a helium nucleus with two protons and two neutrons.

<u>Alternating current</u> (A.C.) — Electrons in a circuit that change directions over and over. (see direct current)

<u>Anode</u> (+) — A positive electrode that gains electrons in an electrical circuit.

<u>Atomic mass number</u> (A) — The number of protons plus the number of neutrons in an atom

<u>Atomic mass unit</u> (a.m.u.) — A unit of measurement equal to one twelfth the mass of the carbon isotope with 12 neutrons and protons.

<u>Atomic number</u> (Z) — The number of protons in the nucleus of an atom

<u>Beta particle</u> (β) — Electrons that come from radioactive atoms

<u>Cathode</u> (-) — A negative electrode that releases electrons in an electric circuit. (see anode)

<u>Celsius</u> (C) — A temperature scale where the freezing point of water is set at 0°C and the boiling point is set at 100°C.

<u>Centimeter</u> (cm) — One one hundredth of a meter. There are about 2.54 centimeters in an inch.

<u>Coulomb</u> (c) — The unit of measurement of an electric charge

<u>Density</u> (g/cm^3) — The measure of how much mass an object has per unit of volume. The most dense substance will have a lot of mass in a small volume. The least dense substance will have very little mass and a large volume. Density is often measured in grams per cubic centimeter (g/cm^3). Water has a density of one gram per cubic centimeter. That means every cubic centimeter of water has a mass of one gram.

<u>Direct current</u> (D.C.) — Electric current where the electrons always go in the same direction. (see alternating current)

<u>Gamma ray</u> (γ) — Energy waves of high frequency containing photons. Gamma rays have no charge.

<u>Gram</u> (g) — A measure of mass equal to one one thousandth of a kilogram. A gram is the mass of one cubic centimeter of water.

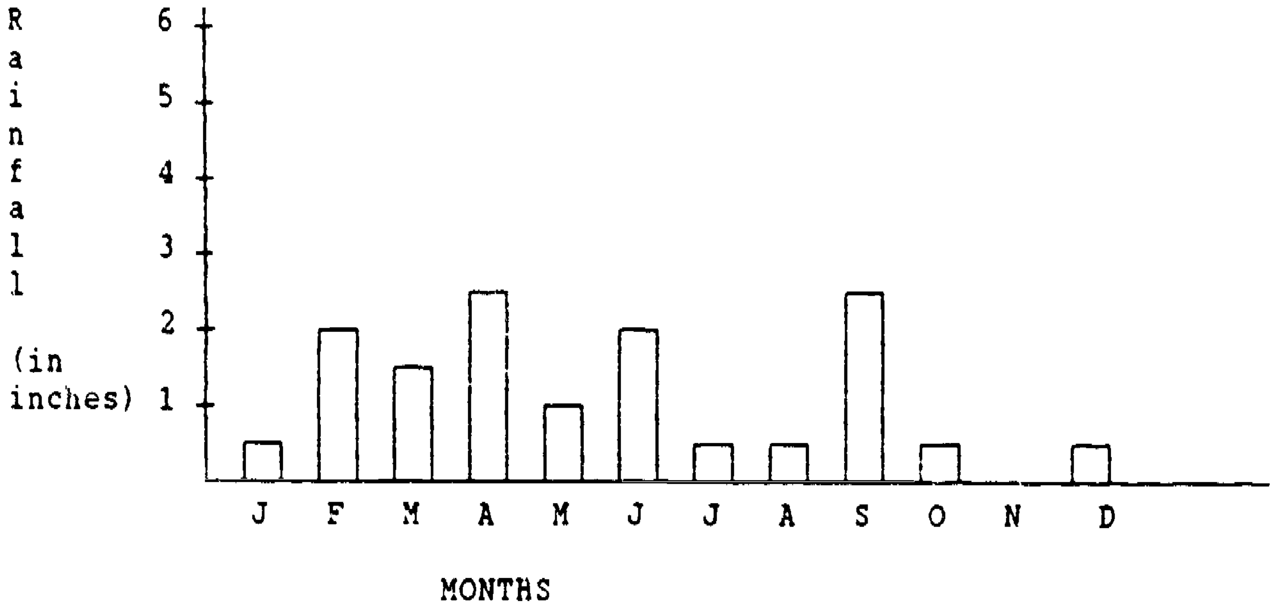
Hertz (Hz)	A measure of the number of cycles per second. It is used to measure anything that oscillates (swings back and forth) like alternating current or sound waves. FM radio stations operate in megahertz (one million hertz).
Hydronium ion	(H_3O^+)A water molecule with one extra hydrogen atom. It has a positive charge.
Joule (J)	The amount of energy or work required to maintain a force of one newton for one meter. (see force, work)
Kilogram (Kg)	The base unit of measurement for mass. A kilogram is equal to 1000 grams. As a measure of weight it is about the same as 2.2 pounds.
Kilometer (Km)	One thousand meters. A kilometer is about six tenths of a mile.
Kilowatt-hour (KWH)	The energy produced by a power of one kilowatt (equal to 1000 watts) in an hour. (see energy, watt)
Liter (L)	The volume of liquid that fills a cube that is ten centimeters on a side. A liter is equal to one thousand cubic centimeters.
Mechanical advantage (m.a.)	The ratio of the force created to the force applied when using a machine. (see force, machine)
Meter (m)	The base unit of measurement for distance. A meter is about 39.37 inches.
Miles per hour (mph)	A speed which is the distance, measured in miles, divided by the time, measured in hours.
Milliliter (mL)	A unit of measurement equal to one one thousandth of a liter. A milliliter is the volume of liquid occupying one cubic centimeter.
Millimeter (mm)	A unit of measurement equal to one one thousandth of a meter
Newton (N)	A unit of measurement of force. One newton is the amount of force needed to accelerate one kilogram at the rate of one meter per second squared. (see acceleration, force)
Ohm (Ω)	The unit of measurement of resistance to electricity. (see resistance)
Pascal (Pa)	A unit of measurement of pressure. (see pressure)
pH	A measure of the acidity of a solution

Standard temperature and pressure (STP)	Standards used for measuring the amount of a gas in a fixed volume
Subscript (X_n)	A number written below the line of other letters. In chemistry, subscripts tell you how many atoms of each kind are in a molecule. For example, the subscript in H_2O tells you that in every molecule of water, there are two hydrogen atoms and one oxygen atom.
Volt (V)	A unit of measurement of the force of flowing electricity. (see electricity, force)
Watt (W)	A unit of measurement of power. (see power)

TYPES OF GRAPHS

<u>Bar graph</u> A graph used for displaying and comparing values

Rainfall in 1986 by month



<u>Circle graph</u> (also called "pie graph) A graph used to show the composition of something, or how something is broken down into parts.

How John spends his time every day

free time

sleeping

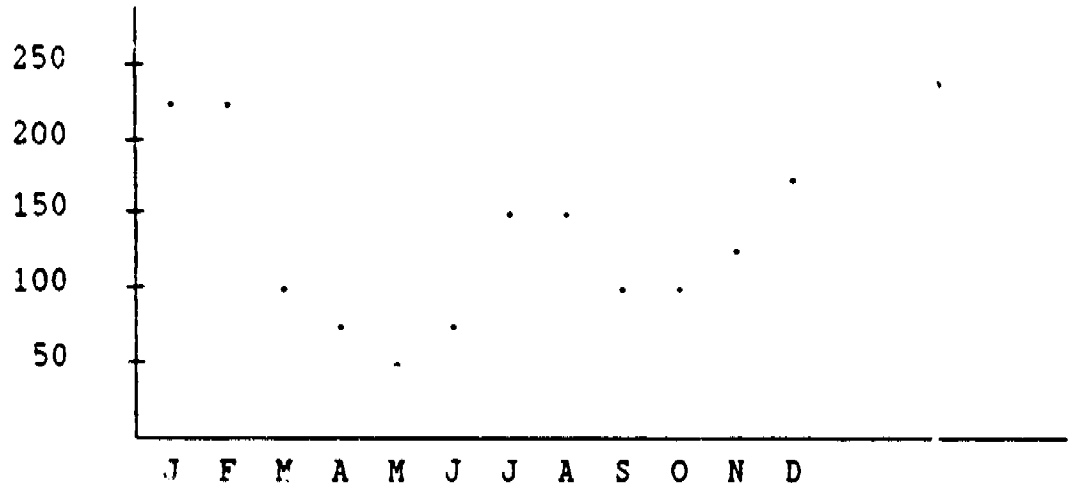
meals

TV

school

<u>Line graph</u> A graph used to show trends and changes, usually over time

Electric bills in 1986



AFFIXES

<u>Endo</u>-	Can usually be translated as "in" or "inside." (see endothermic reaction)
<u>Exo</u>-	Can usually be translated as "out" or "outside." (see exothermic reaction)
-<u>meter</u>	As a suffix, this means "measurer." So a voltmeter is something that measures voltage.
<u>Micro</u>-	This prefix has two meanings. One of them is "very small," as in <u>microscope</u> which is something that allows you to look at (or scope) very small things. The other meaning of <u>micro</u>- is "one millionth." a micro-second is a unit of time one millionth of a second long.
<u>Photo</u>-	This prefix can usually be translated as "light." A photograph is a picture (or graph) made with light. (see photoelectric effect)
-<u>stat</u>	Can usually be translated as "keeping still" or as "something that maintains." A thermostat is something that maintains temperature.
<u>Tele</u>-	Usually, this can be translated by "far away." A telescope is something that allows you to look at things from far away.
<u>Therm</u>-	This can be translated as "heat" or "temperature." (see thermostat)

EQUIPMENT

Balance	A scale for measuring mass of solid (dry) substances
Barometer	A device that measures air pressure
Beaker	A glass container shaped like a cup
Calorimeter	A device that measures heat energy
Cloud chamber	An instrument that finds nuclear particles by forming cloud tracks or cloud vapors
Computer	An electronic device that solves problems and performs mathematical calculations
Concave mirror	A bowl-shaped mirror
Convex lens	A lens whose edges are thinner than its center
Convex mirror	A mirror that bulges in the middle
Electromagnet	A magnet created by sending an electric current through a coil of wire around a core of soft iron
Erlenmeyer flask	A large glass container with a wide base and a narrow top (similar to a cone). It is used for mixing materials (at least one a liquid) in chemical tests.
Eye dropper	A small tube used for transferring liquids drop by drop
Filter paper	Heavy paper with small holes used for separating solid substances from liquid. The liquid is poured through the paper. The solid things in the liquid stay on the paper.
Funnel	A cone-shaped piece of glass equipment with a wide top and narrow, tube-shaped bottom. It is used for moving substances from containers with large openings to containers with small openings.
Galvanometer	A coil of wire that moves between the poles of a magnet. A galvanometer detects small electric currents.
Geiger counter	A device that detects and measures levels of radioactivity
Graduated cylinder	A cylinder marked so that exact measurements of the volume of liquids can be made
Goggles	Protective eyeglasses usually made of clear plastic that completely cover the eyes to protect them during chemical experiments

Laboratory burner	A device for creating a small, constant flame for use in chemical experiments. The burner is connected to a gas source by rubber tubin·.
Microscope	An instrument that uses lenses to make small objects appear larger
Mortar and pestle	A cup or bowl and a bar used to grind or mash substances. The pestle is the bar and the mortar is the cup or bowl.
Parallel circuit	An electric circuit where separate currents pass through different parts of the circuit. (see series circuit)
Petri dish	A shallow dish used for growing cultures and storing specimens
Photoelectric cell	An instrument that produces an electric current when it is hit by light
Plane mirror	A flat mirror. Other kinds of mirrors are concave and convex.
Prism	A solid, transparent object that can separate light into its parts and show a rainbow of colors through refraction. This rainbow is called a spectrum. (see refraction, diffraction grating)
Reflecting telescope	A telescope that uses a parabolic (curved) mirror to magnify (enlarge) images.
Refracting telescope	A telescope that uses convex lenses to magnify (enlarge) images. (see convex lens)
Ripple tank	A shallow box filled with water used to study the motion of waves
Series circuit	An electric circuit in which the same current passes through all of the parts of the circuit
Test tube	A small glass container used for conducting chemical tests or holding materials
Thermometer	A device for measuring temperature
Thermostat	An instrument that regulates (controls) temperature. (see temperature)
Transistor	A semiconductor used in electrical equipment. Transistors are most commonly used in radios, televisions, and stereos to amplify sounds (to make the sounds louder).

Voltmeter	An instrument that measures voltage between two points of an electric circuit. (see volt)
Watch glass	A shallow bowl used as a surface for evaporating water or covering beakers. (see evaporation)

II. General Questions

Read the questions below out loud and answer them. You may use the glossary for help if necessary.

1. Besides miles per hour (mph), what are some other ways to measure speed?

2. If Newton's laws are true, a marble rolling along a flat surface slows down and eventually stops. Is there a force acting on the marble to make it stop? What force?

3. Would you rather have 10 pounds of gold or 6 kilograms of gold?

4. When you light a match, does an endothermic or exothermic reaction take place?

5. Would something with a density of .8 g/cm^3 float or sink in water? Why?

6. Which sounds higher, the horn of a car that is moving towards you, or the horn of a car that is not moving?

7. Carbon has 6 protons and 6 neutrons. What is its atomic mass number?

8. Where do you commonly find thermostats?

9. What type of current, alternating or direct, is usually found in houses?

10. How do refraction and reflection differ?

11. a) Which is stronger, nuclear force or magnetic force?
b) If the nucleus contains protons which are positively charged, why doesn't the nucleus fly apart, since particles with like charges repel each other?

12. Which conducts electricity better, wood or metal?

13. Would you weigh more on the earth or on the moon?

14. How do we measure weight?

15. Where can you find convex lenses?

16. How many megahertz does radio station WXYZ 95.8 have?

17. Where can you find "electric eyes?"

18. What is the difference between mass and weight?

19. Which is hotter, 60° F or 60° C?

20. Energy and work are measured in the same units. What are they?

21. What does a calorimeter do?

22. Name a simple machine that would make it easier for you to lift a heavy load onto a truck.

23. Both "thermal blanket" and "thermal underwear" have "therm-" in them. What does this tell you about how these things are used?

24. If chemicals X and Y react more easily than chemicals Y and Z, what does this tell you about X's chemical reactivity?

25. Fill in the blanks:

6p ______________ A
6n
______________ B

26. Which of the following could you see in a room with no light?
   A. infrared waves
   B. thermal material
   C. fluorescent material
   D. photoelectric cell

27. If you are floating on a raft in a swimming pool, and you throw a heavy ball, a force will act on you and push you back. What kind of force does this represent?

28. What is the difference between kinetic and potential energy?

29. What happens to a glass of water that stands in the hot sun all day?

30. Put the letter of the correct definition in the blank next to the word.

barometer	______	A. material that releases electrons when light hits it.
computer	______	B. an instrument that controls temperature
concave mirror	______	C. an instrument that measures air pressure
graduated cylinder	______	D. a shallow box filled with water used to study the motion of waves
microscope	______	E. an instrument that uses lenses to enlarge small objects
photoelectric cell	______	F. an electronic device that performs calculations and solves problems
prism	______	G. a cylinder marked so that exact measurements can be made
ripple tank	______	H. a solid, transparent object that separates light by refraction
thermostat	______	I. an instrument that measures voltage
voltmeter	______	J. a bowl-shaped surface that reflects light

31. If tap water boils faster than saltwater, what do you know about salt water's boiling point?

32. If three compounds react and form a new compound, what type of reaction has happened?

33. Suppose you have two machines and you put 40 joules of work into each one. The first machine has a work output of 35 joules. The second machine has a work output of 32.5 joules. Which machine has a higher efficiency? Why?

34. Why do people use Geiger counters to find Uranium?

35. Rust on a car is an example of
    A. condensation
    B. convection
    C. corrosion
    D. cathode

36. Which is higher, water's heat of fusion, or its heat of vaporization? What does this tell you?

37. Why do helium balloons float in the air?

38. What force keeps shoelaces tied?

39. Would the horn of a car sound lower if it were moving toward you or away from you?

40. Where would you weigh more, at the beach or on a high mountain?

41. Size and shape are examples of physical properties. Can you think of others?

42. What are the atomic numbers for the following? (Use the Periodic Table if you need help.)
   a. rubidium
   b. lead
   c. manganese
   d. silver

43. Name something that uses direct current.

44. If a person ran a ten kilometer race, how many miles did he run?

45. Resistance is measured in what units?

46. What is the boiling point of water?

47. When you go outside in cold weather, you can see your breath. How do you explain this?

48. Match each term on the left with its symbol on the right.

absolute zero	(+)
alpha particle	(C)
alternating current	(α)
anode	(A.C.)
cathode	(γ)
gamma ray	(mph)
watt	(β)
beta particle	(0 K)
Celsius	(-)
miles per hour	(W)

49. Decide whether each of the following is a solid, a liquid, or a gas.
A. carbon dioxide
B. coal
C. transmission fluid
D. the helium in a balloon
E. acid
F. oxygen
G. table salt
H. aluminum
I. mercury

50. You have found your dog sleeping on your bed. What tendency do you have to overcome to push your dog off your bed?

51. When you turn the volume up on your radio, what part of the sound waves are you changing?

52. Tell whether each of the following is a 1st, 2nd, or 3rd class lever.
    A. fingernail clippers
    B. tweezers
    C. bottle opener
    D. hockey stick

53. Pick the word that fits best.
    In a decomposition reaction, (one, several) compound is (fused, bent, broken) into (one, several) compounds.

54. You buy a string of electric lights for decoration. There are twenty lights on the string. If one light goes out, all the lights go out. Is this an example of a parallel or series circuit? Explain.

55. What do you call water in its solid state?

56. What makes the atomic number of iodine higher than the atomic number of nitrogen?

57. What happens to the volume of water when it freezes?

58. Which would serve more people, a liter of cola or a quart of cola?

59. Has a car decelerated or accelerated if it goes from 90 kilometers per hour (kph) to 75 kph?

60. Fill in the blanks to complete these descriptions of metal. Choose the correct word.
    A. Metals conduct (light, heat) and electricity.
    B. Light is (absorbed, reflected) by metals.
    C. Metals (can, can't) be pounded into different shapes.

61. What do all levers have in common?

62. Why does a container of a gas explode when it gets too hot?

63. If you drop a brick with a mass of .7kg and a brick with a mass of 2kg, which will hit the ground first?

64. What is the difference between nuclear fusion and nuclear fission?

65. Which is more efficient, a car with a manual transmission, or a car with an automatic transmission? Why?

66. Which of the following is not a rate?
    A. acceleration
    B. speed
    C. pressure
    D. frequency

67. At how many megahertz does your favorite radio station broadcast?

68. Where is the pressure greater, on the ocean floor or on a mountain top?

69. Which is longer, five meters or six yards of fabric?

70. Which one of the following terms does not belong? Why?
    A. evaporation
    B. sublimation
    C. condensation
    D. boiling point
    E. melting

Some science words are easily confused. Read the following sentences and phrases. Pick the item in the pair that fits.

1. The transfer of heat through a solid. (conduction/convection)
2. The unit of force (neutron/newton)
3. Gas under pressure has a smaller volume. (Boiling/Boyle's Law)
4. Light moving through water bends. (refraction/reflection)
5. A bowl-shaped mirror. (concave/convex)
6. A chemical reaction that gives off heat. (endothermic/exothermic)

Laws/Effects/Tests

Match each item on the left with the correct example or definition on the right.

Newton's 1st law of motion	Guns recoil. When they are shot, they kick back.
Newton's 3rd law of motion	Gas in an insulated bag would have a smaller volume on the ocean floor than on dry land.
Charles's law	If you push two toy trucks, the heavier of the two trucks will accelerate slower.
Boyle's law	The sound of a motorcycle's engine seems to change as the motorcycle passes you.
photoelectric effect	A marble rolls on top of a completely flat table without changing course.
Doppler effect	Your presence can be detected if you step in front of a beam of light.
Newton's 2nd law of motion	A balloon left out in the sun will expand.

Match each item on the left with the correct example or definition on the right.

MATCHING FOR EXPERIMENTAL METHOD TERMS

hypothesis	3 of the plants watered with salt water died. The other two only grew 1.2 cm. None of the plants watered with tap water died. All these plants grew at least 2.7 cm.
control group	Salt water is probably worse for plants than regular tap water.
experimental group	Every day I measure all the plants. Also, I check to see whether any of them have died.
observation	Plants watered with regular tap water
results	Salt water is worse for plants than regular tap water. Plants that are watered with salt water have a better chance of dying and don't grow as much.
conclusion	Plants watered with salt water

AFFIX EXERCISES

speedometer	the way that plants convert sunlight into food
endoskeleton	an insulated container that keeps liquids hot
photosynthesis	an instrument that measures how fast an object moves
micrometer	the ability to move objects from far away
thermos	an outer skeleton, like the skeletons of insects or crabs
telekinesis	an inner skeleton, like the skeletons of people, birds, or tigers
exoskeleton	a unit of length equal to one millionth of a meter

III. Graphs

Remember that certain graphs go better in certain situations. A circle graph works best when you want to show how big all the parts of something are. A line graph works best when you want to show how something changes. Usually this type of graph is used to show trends through time, but it can also show how things in a series compare with each other or how a single process changes. A bar graph is usually used when you want to compare things that are not in a series or things that are not parts of a bigger thing, but are separate.

Choose the type of graph to represent the problem.

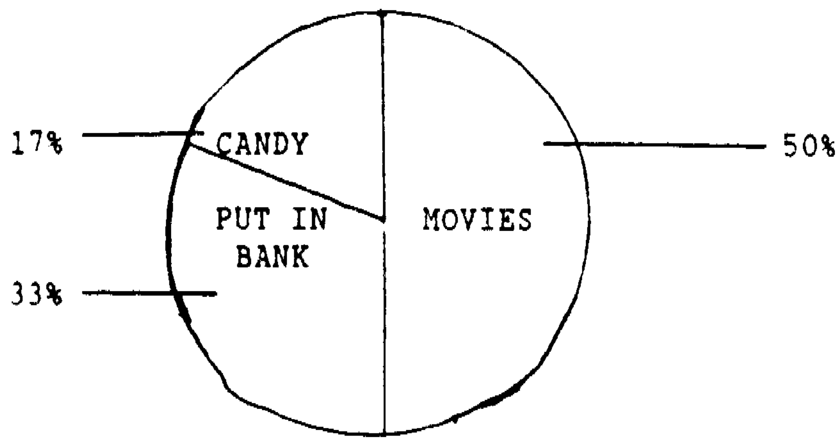
1. You know that Mary spent thirty minutes studying math. She also spent thirty-five minutes studying science and forty minutes reading for English class. Pick the type of graph that would best represent how long Mary studied for each class.
   A. Bar graph
   B. Circle graph
   C. Line graph

2. You have an idea that more and more snow falls every winter. If you know how much snow fell in every winter for the last nine years, what type of graph would you use to see if you're right?
   A. Bar graph
   B. Circle graph
   C. Line graph

3. A couple went on vacation for 10 days. They spent a total of 1 day just travelling from one place to the next. They ended up spending 4 days in England, 2 days in Scotland, and 3 days in France. Pick the type of graph that would best represent how the couple spent their 10-day vacation.
   A. Bar graph
   B. Circle graph
   C. Line graph

Reading Graphs

4. This graph shows how Tommy uses his weekly allowance. Look at the graph and answer the following questions.

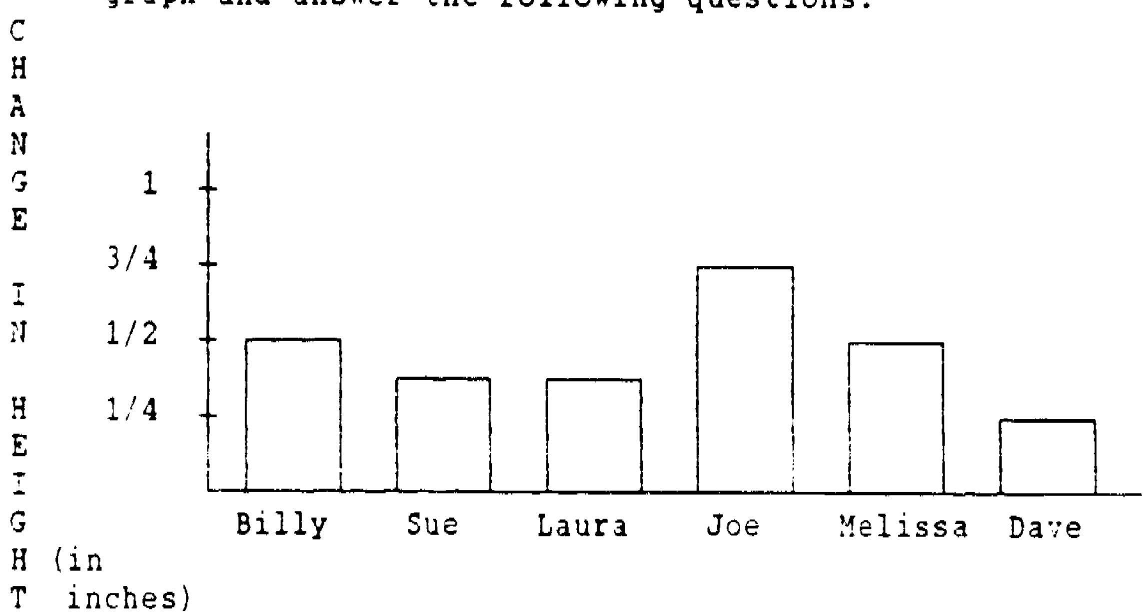


A. Does this graph tell you how much money Tommy gets every week?

B. What percentage of his allowance does Tommy spend on candy?

C. Does Tommy spend all his allowance money every week?

5. This graph shows how much six cousins grew in the last year. Look at the graph and answer the following questions.

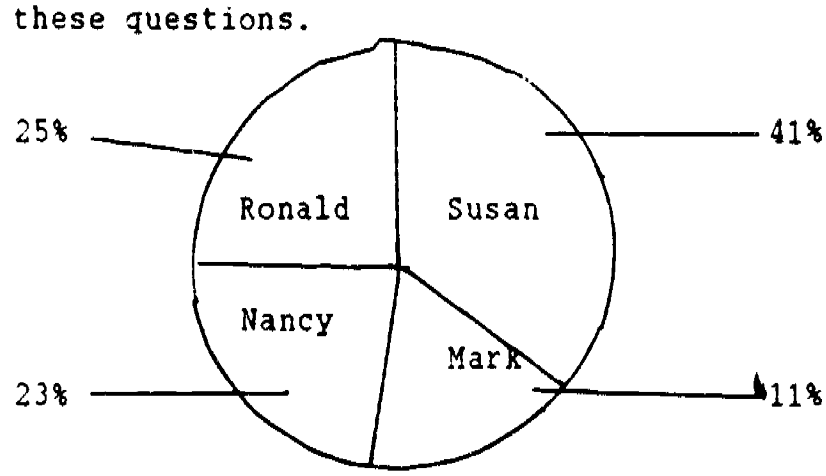


A. Who grew the most in the last year?

B. How much did Melissa grow?

C. Who grew the least in the last year?

6. Lakeville Intermediate School held an election. This graph shows what percentage of the vote went to each candidate. Using the graph, answer these questions.

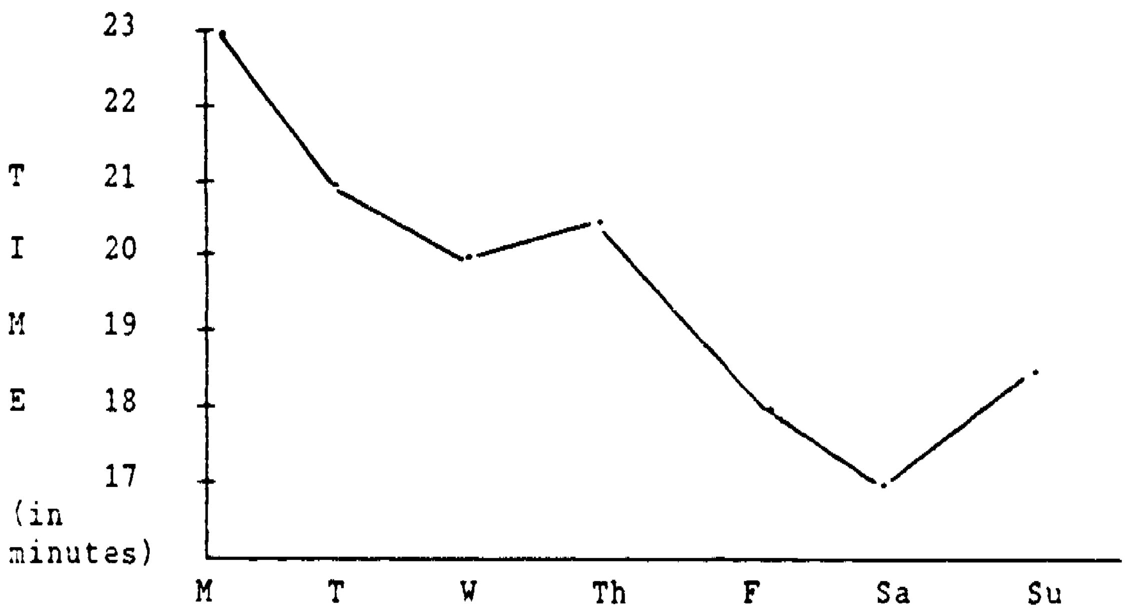


A. Who won the election?

B. Who came in second?

C. What percentage of the votes did Mark get?

7. Dwight runs 3 miles every day. This graph shows how fast Dwight ran this distance every day last week. Using the graph, answer these questions.



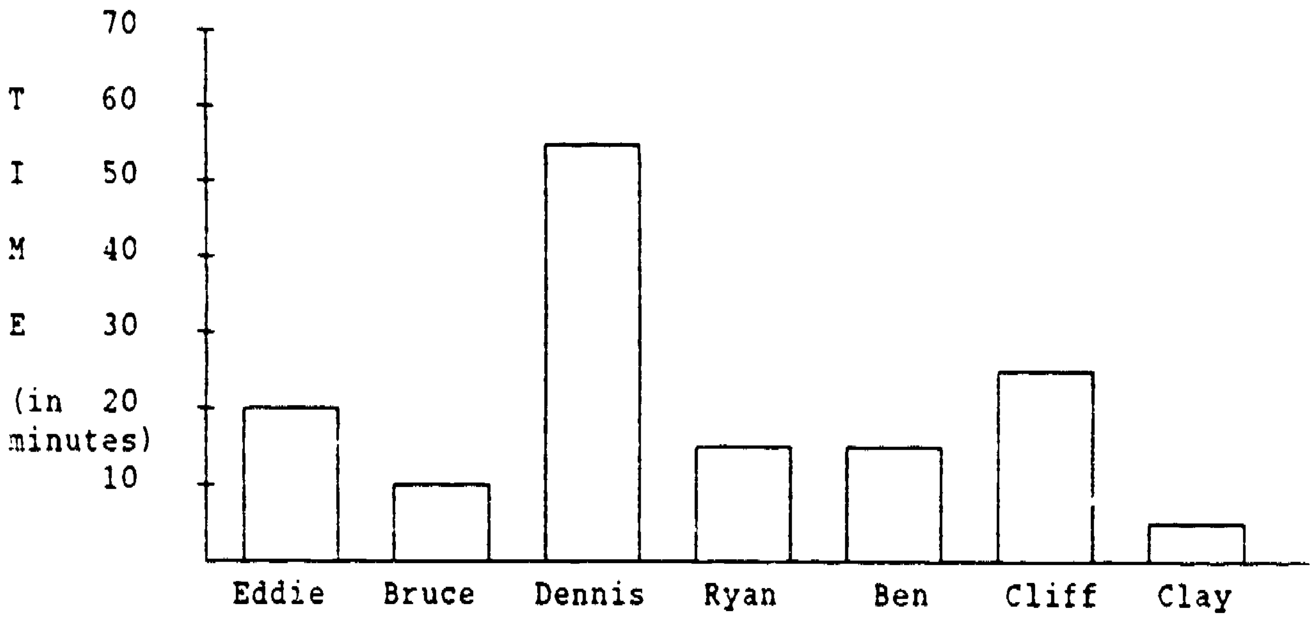
A. How long did it take Dwight to run 3 miles on Friday?

B. On which day did Dwight run slower, Tuesday or Saturday?

C. On which day did it take Dwight 20 minutes to run 3 miles?

D. What is the pattern for Dwight's speeds? Does he get faster or slower during the week?

8. Seven people drove from their homes to a party on Saturday night. This graph shows how long it took each person to get to the party. Using the graph, answer these questions.

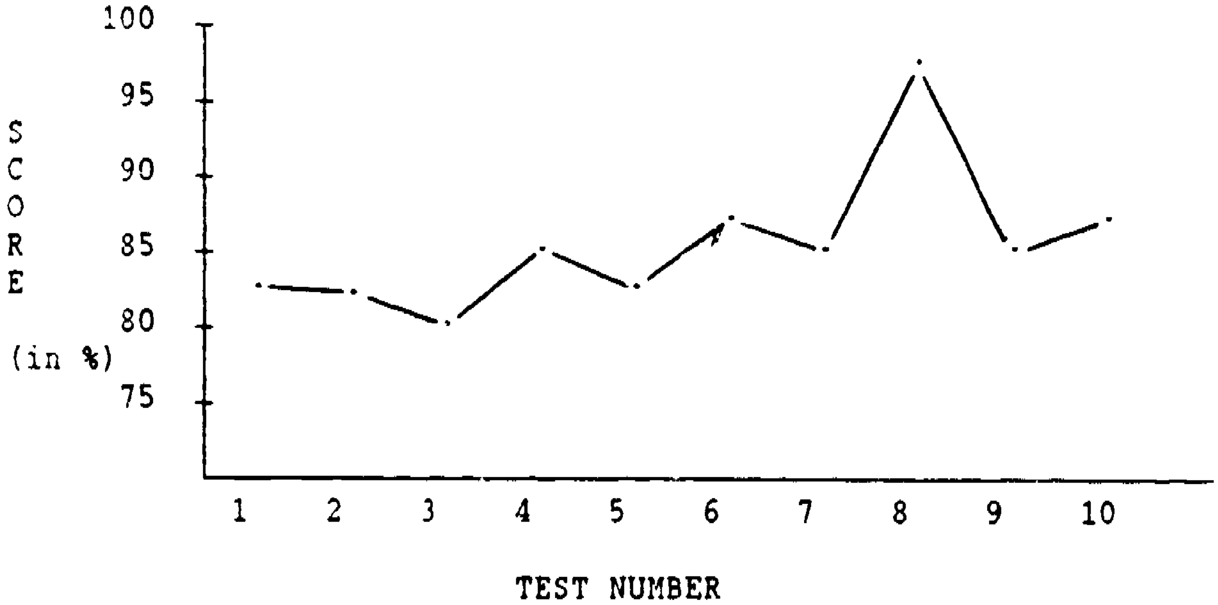


A. Who took 55 minutes to get to the party?

B. Who got to the party the fastest?

C. Who got to the party faster, Eddie or Cliff?

9. Nadine took 10 tests last semester in math. This graph shows her test scores. Read the graph and answer the following questions.



A. What was Nadine's score on test number 4?

B. Which test did Nadine score the highest on?

C. What was the lowest score Nadine received?

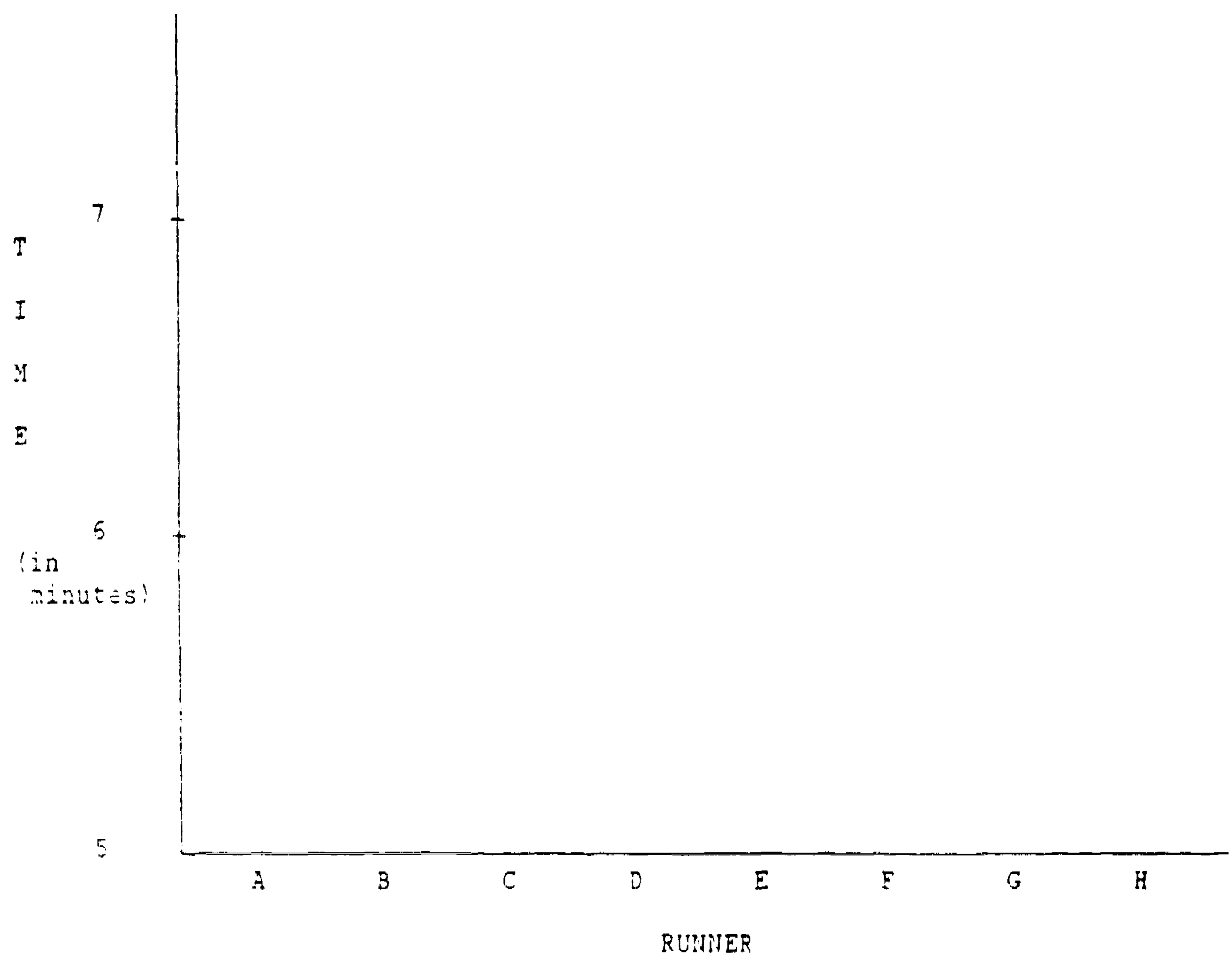
Drawing Graphs

10. You want to use a graph to show how fast eight separate runners ran a mile. Which type of graph would best represent the runners' times?
    A. Bar graph
    B. Circle graph
    C. Line graph

    Here are the numbers you will need to put in your graph.

Runner	Time (in minutes)
Alphonse	6.1
Bert	5.8
Charles	5.3
Damien	7.2
Erol	7.3
Franklin	5.1
Graham	5.8
Hugh	5.6

Now draw the graph.



11. You want to use a graph to show how much of the library each of the following sections takes up: fiction, filmstrips, reference, science, art, and music.

Which type of graph would best show how much of the library is devoted to each of these different sections?

A. Bar graph
B. Circle graph
C. Line graph

Here is the information you will need.

Section	How much space it takes up (in %)
fiction	40%
filmstrips	5%
reference	10%
science	20%
art	20%
music	5%

Now draw the graph.

12. You want to draw a graph to show how many days in each month had temperatures over 60° F.

Which type of graph would best represent this?
A. Bar graph
B. Circle graph
C. Line graph

Here is the information you will need to make your graph.

Month	Days with Temperatures over 60° F
January	0
February	4
March	19
April	28
May	28
June	30
July	31
August	31
September	29
October	21
November	11
December	6

Now draw the graph.

13. You want to draw a graph to show what percent of your school's 200 athletes are involved in baseball, football, basketball, soccer, track, tennis, or golf.

What type of graph would best represent and let you compare the parts of that collection of athletes engaged in each sport?
A. Bar graph
B. Circle graph
C. Line graph

Here is the information you will need.

Sport	% of Athletes Involved in Sport
baseball	15%
football	20%
basketball	10%
soccer	15%
track	20%
tennis	15%
golf	5%

Now draw the graph.

14. You want to make a graph to show how many fish each person on a camping trip caught.

Which type of graph would best represent and let you compare the number of fish each camper caught?

A. Bar graph
B. Circle graph
C. Line graph

Here is the information you will need.

Camper	Number of Fish Caught
Alice	4
Betty	9
Carlos	5
Deborah	5
Everett	13
Fiona	2
Gil	6
Helen	3

Now draw the graph.

15. You want to draw a graph to show how many new buildings have been built in the city every year for the past ten years.

What type of graph would best represent this problem and help you see changes or trends?

A. Bar graph
B. Circle graph
C. Line graph

Here is the information you will need.

Year	Number of New Buildings
1977	7
1978	9
1979	13
1980	17
1981	5
1982	9
1983	20
1984	24
1985	9
1986	8

Now draw the graph.

IV. CHEMISTRY

A. SAFETY IN THE CLASSROOM

1. Read the following paragraph.

When you work in the lab, it is important to be careful so you don't get hurt. Before working with chemicals, it is very important to put on a lab apron and safety glasses. Look around the room to find the fire extinguisher. Remember where it is. You may need it one day. When working with chemicals, it is important to understand and follow all directions carefully. If you have to mix water and acid, never pour the water into the acid because the acid can splash on you. It is better to add the acid slowly to the water. If acid spills, wash the area immediately with lots of water. Don't put chemicals up to your nose to smell them. And never taste chemicals - they might be poisonous. It is also important to keep papers and notebooks away from flames to prevent fire. When you have finished your work in the lab, put all equipment back into its proper place. Make sure the water and gas are turned off, and e[illegible]ical equipment is unplugged. Leave the lab safe and clean for the next person.

2. Fill in the blanks with the correct word. Choose from these words:

acid	safety glasses
fire extinguisher	smell
lab apron	taste
open flame	understand & follow directions
poisonous	water

a. Before performing experiments and mixing chemicals, it is important to put on a ______________ and ____________________.

b. If __________ spills, make sure you wash the area with water immediately.

c. Always look around the room to find the ______________________. Finding it before accidents happen can save time later.

d. Never ___________ or ___________ chemicals. They might be _______________.

e. Always ______________________ ____________ when working in the lab.

f. Make sure your notebooks and papers are not near an ______________.

g. Never pour _________ into acid.

Circle the best answer.

3. A lab apron is important because
   A. your teacher told you to put it on.
   B. it can protect you if something spills on you.
   C. it matches the safety glasses.

4. Acid
   A. can burn you.
   B. isn't very dangerous.
   C. shouldn't be poured into water.

5. If acid spills,
   A. wipe it off with your hands.
   B. leave it for the next person to clean up.
   C. immediately wash it off with water.

6. If clothing catches on fire
   A. put it out by smothering it with a blanket or towel.
   B. run.
   C. try to put the fire out with chemicals you have nearby.

7. If you are heating something in a test tube
   A. point the test tube toward yourself.
   B. point the test tube away from yourself.
   C. it doesn't matter where you point the test tube.

8. Glass tubing that has been heated
   A. can be touched right after being heated.
   B. should be given to a friend to hold.
   C. should be touched only after it has cooled.

9. Chemicals
   A. are okay to smell directly.
   B. should never be smelled directly.
   C. are okay to taste.

10. When you finish your work,
    A. leave the room immediately.
    B. let the next person clean up.
    C. clean your work area.

11. When you finish your experiment
    A. turn off water and gas.
    B. leave everything on so the next person can use it.
    C. keep electrical equipment plugged in.

12. If you don't understand how to do an activity or experiment
    A. make a guess.
    B. ask your teacher for help.
    C. ask a friend.

B. EQUIPMENT

Match the name of the equipment with its picture.

Erlenmeyer flask _____

graduated cylinder _____

test tube rack _____

Petri dish _____

microscope _____

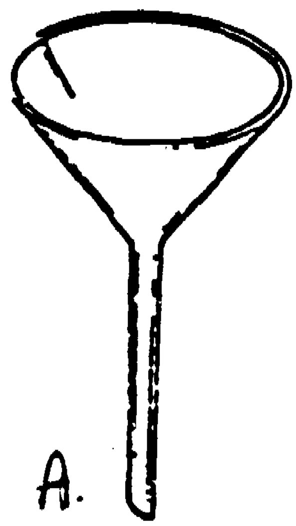
test tube _____

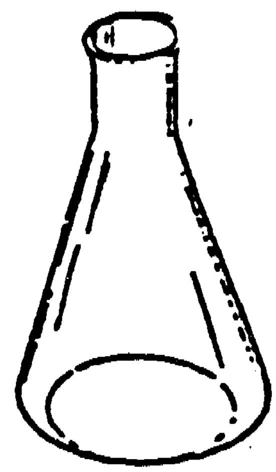
mortar and pestle _____

funnel _____

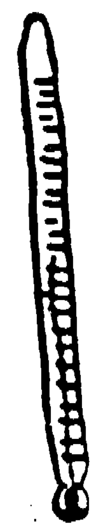
thermometer _____

beaker _____


A.


B.


C.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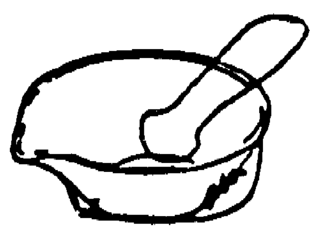
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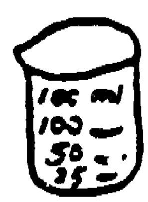
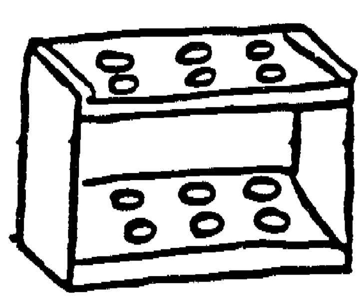

F.

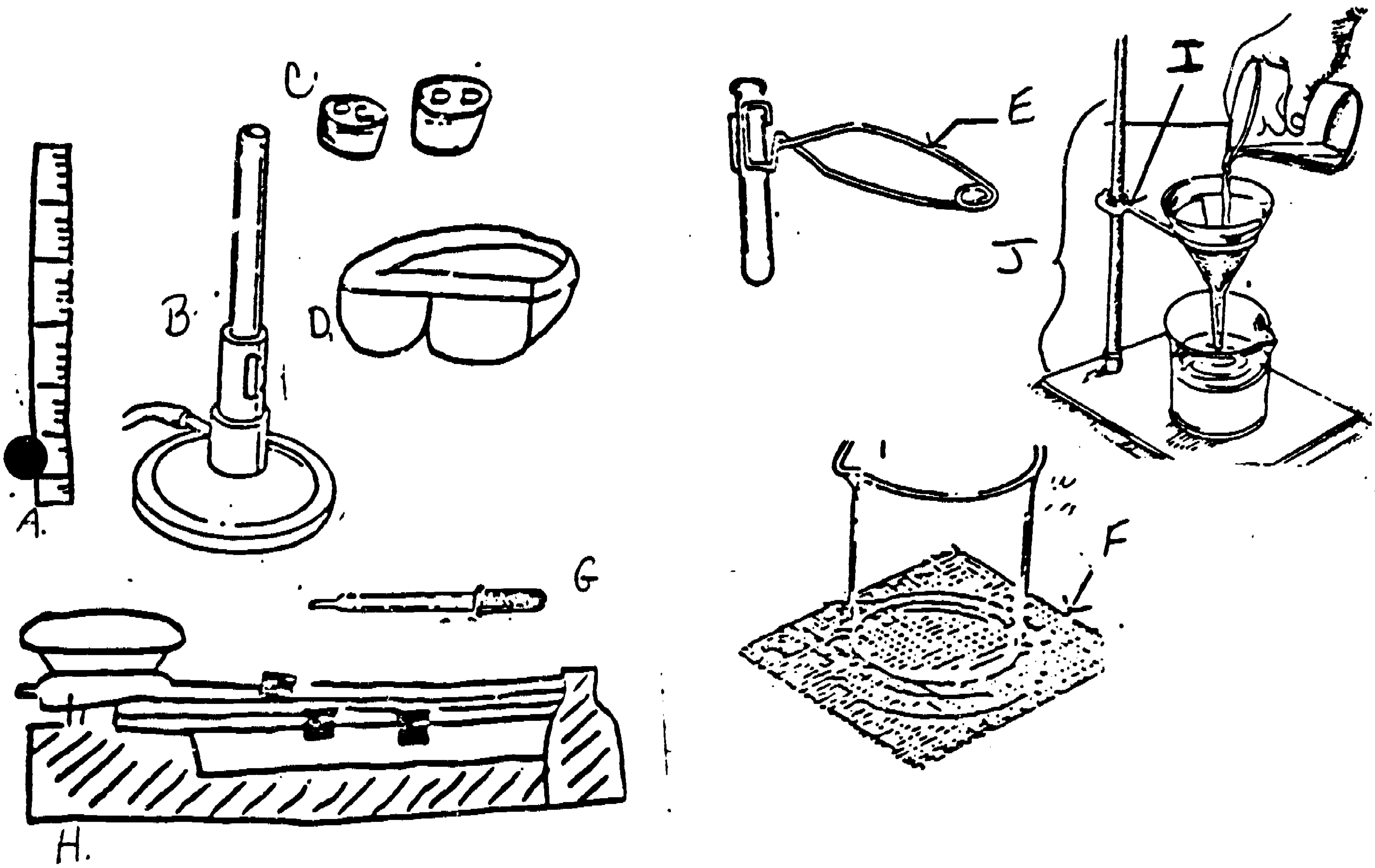

G.


H.


I.


J.

Match the picture with its name.



rubber stoppers _____

goggles _____

ruler _____

laboratory burner _____

eye dropper _____

test tube holder _____

wire gauze _____

balance _____

ring stand _____

ring clamp _____

Match what you need to do with the equipment that will help you do it.

Measure exactly 20 milliliters of water	mortar & pestle
Look closely at a plant cell	eyedropper
Find out how hot a solution is	goggles
Protect your eyes	graduated cylinder
Grind something into a powder	balance
Count out three drops of a liquid	thermometer
Measure how long a spring is	laboratory burner
Heat a solution in a test tube	funnel
Weigh blocks used in an experiment	microscope
Pour a solution into a test tube	ruler

There are several types of glass containers used in experiments. Sometimes you can use any of the types. But often there is one type of container that would be most useful for that experiment. A beaker, an Erlenmeyer flask, and a test tube are all glass containers.

Beakers come in many sizes, from small to very large. They usually have a wide opening, like a cup. Beakers also hold a specific volume of liquid (like a "250 ml beaker"). Beakers are useful when the contents are going to be stirred or other apparatus (like a test tube or another beaker) is going to be put inside the first beaker.

An Erlenmeyer flask is a large container with a wide base and a small opening at the top. It may or may not have a volume measurement marked on it. An Erlenmeyer flask is good for swirling or mixing solutions because it is difficult for the liquid to splash out of the small opening. However, the small opening makes it a bad choice in an experiment where other containers will be inserted into the flask.

A test tube is a small, long container. It cannot stand, but needs to be placed in a rack to hold it upright. Test tubes do not have volume measurement markings. They hold small amounts of material. Test tubes are often used when you perform a series of tests. (For example, if you have ten substances and you plan to add acid to each one and see how each reacts, you could line up 10 test tubes, each with 1 substance, and add acid to each.)

Read the experiment descriptions below. At each numbered step decide what piece of equipment would be used. Choose your answers from the list below. You may use a piece of equipment more than once. Read the entire experiment before deciding on the equipment.

A.
1) Label a small container.
2) Find the mass of the container and record.
3) Measure 25ml of water and pour it into the container.
4) Find the mass of the container and the water.
Find the density of the water.

EQUIPMENT
1) ____________________
2) ____________________
3) ____________________
4) ____________________

balance	pestle
beaker	test tube
eye dropper	test tube holder
graduated cylinder	watch glass

B.
1) Fill a large container with ice.
2) Measure 250 grams of salt and sprinkle over the ice.
3) Measure out 5ml of water.
4) Add water to a small container which will fit inside the large container.
5) Stire the ice-salt mixture slowly.
6) Measure and record the temperature of the ice-salt mixture and the water in the small container at the end of every minute. Do this until the temperatures are equal.

1) ____________________
2) ____________________
3) ____________________
4) ____________________
5) ____________________
6) ____________________

balance	graduated cylinder
beaker	laboratory burner
Erlenmeyer flask	petri dish
eye dropper	test tube
funnel	thermometer
glass rod	wire gauze

C.

1) Using tweezers, place a few crystals of cobalt chloride in a small container.
2) Heat the container and record any color change.
3) Set the container aside to cool.
4) Add a few drops of water to the cooled container.
5) Place 3ml of nickel sulfate in the container.

Record any changes you observe.

1) ______________________________
2) ______________________________
3) ______________________________
4) ______________________________
5) ______________________________

balance	test tube
Erlenmeyer flask	test tube holder
eye dropper	test tube rack
graduated cylinder	thermometer
laboratory burner	wire gauze
ring clamp	

> Read the following experiment. Fill in the blank with the correct piece of equipment.

Using a ________________, measure 4ml of water. Add the water to an empty ________________. Using the ________________, measure out 1 gram of table salt and add it to the water. What happens? Now, using an ________________, add 4 drops of mineral oil to the solution. Close the tube with a ________________ and shake. Record what happens.

List all the equipment needed for the following experiments.

1. Dissolve 3 grams of powdered copper sulfate in 18ml of water in a glass container. Place a strip of zinc in the water and watch for a reaction.

2. Place 1 gram of iron filings and 1 gram of sulfur together in a small glass container. Hold the container over a flame for 1 minute. Let it cool. Record any changes you observe.

C. CHEMICAL SYMBOLS

Listen to the name of each chemical expression and identify its symbolic representation.

EXAMPLE:

Your partner says: Nitrous Oxide"
You circle: N_2O NO N_2O_3

Tutor says	Circle the correct formula		
1. nitrogen (I) oxide	N_2O	NO_2	NO
2. dinitrogen trioxide	N_2O_2	NO_3	N_2O_3
3. water	HO	HO_2	H_2O
4. helium	Hu	He	H
5. ammonium phosphate	$(NH_4)_3PO_4$	$(NH)PO_4$	$(NH_4)PO_4$
6. ozone	H_2O	H_3O	HO_3
7. silica	SiO_2	SiO	Si_2O_2
8. rust	FeO_3	FeO	Fe_2O_3
9. ethane	CH_4	C_2H_6	C_2H
10. butane	C_4H	C_4H_{10}	CH_{10}

Listen to the chemical formulas and identify their names.

STUDENT: Your partner will say each chemical form out loud. Circle the correct answer.

EXAMPLE:

Your partner says: "H-2-O"

You circle: water ozone hydrogen dioxide

Tutor says		Student circles		
11.	H_2SO_4	sulfuric acid	hydrogen sulfate	sulfurous acid
12.	KNO_3	nitrous potassium	potassium oxide	potassium nitrate
13.	CO_2	calcium oxide	carbon dioxide	carbonic oxide
14.	$AgNO_3$	silver nitrous oxide	silver nitrate	silver nitrogen oxide
15.	MgO	magnesium oxide	manganese oxide	magnesium oxygen
16.	$2KClO_3(c)$	potassium chloride	chloric oxide	potassium chlorate
17.	2Kcl(c)	potassium chloride	potassium chloride	potassium chlorate
18.	$NaHCO_3$	salt	baking soda	sodium hydrogen oxide
19.	$CuSO_4(aq)$	carbon sulphate	copper sulphide	copper (II) sulphate
20.	NaOH	sodium hydroxide	nobelium hydroxide	sodium hydrate

21. Match each chemical formula with its correct written form.

N_2O	sodium hydroxide
H_2O	baking soda
$(NH_4)_3PO_4$	magnesium oxide
SiO_2	carbon dioxide
C_2H_6	sulfuric acid
H_2SO_4	nitrogen oxide
CO_2	ethane
MgO	silica
$NaHCO_3$	ammonium phosphate
$NaOH$	dihydrogen oxide

Write the written forms of the following chemical elements and compounds.

EXAMPLE: H_2O water

22. NO ______________

23. C ______________

24. $Al(OH)_3$ ______________

25. Ag ______________

26. $NaHCO_3$ ______________

27. NH_4^+ ______________

28. CO_2 ______________

29. $FeCl_3$ ______________

30. MnO_2 ______________

31. $CH_3COOC_6H_4COOH$ ______________

Listen to the names of each element or compound and write down the corresponding chemical formula.

STUDENT: Your partner will say each expression to you. Repeat the expressions and then write the corresponding chemical formulas.

EXAMPLE:

Your partner says: "silver"

You say: "silver"

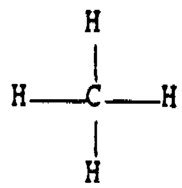
You write: Ag

32. carbon ______
33. fluorine ______
34. zirconium ______
35. rubidium ______
36. nickel ______
37. ozone ______
38. table salt ______
39. methane ______
40. chloroform ______
41. methanol ______

Interpreting formulas for organic compounds.

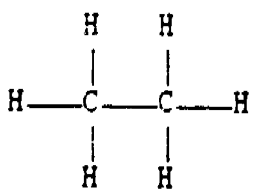
STUDENT: Your partner will say each expression to you. Repeat the expressions and then write the corresponding chemical formulas.

EXAMPLE:



Tutor asks: "What does 'H' represent?"
You say: "Hydrogen."
Tutor asks: "What does 'C' represent?"
You says: "Carbon."
Tutor asks: "How many hydrogen atoms are there?"
You say: "Four."
Tutor asks: "How many carbon atoms are there?"
You say: "One."
Tutor asks: "Can you write the chemical formula?"
You write/say: CH_4 / C-H-four
Tutor asks: "Can you say that another way?"
You say: "Methane."

42.



What does 'H' represent? ________

What does 'C' represent? ________

How many hydrogen atoms are there? ________

How many carbon atoms are there? ________

Can you write the chemical formula? ________

Can you say that another way? ________

Classify the elements according to their position on the Periodic Table of the Elements.

STUDENT: Your partner will help you classify the elements according to their positions on the Periodic Table of the Elements. Your partner will ask questions and give advice as shown in the example.

EXAMPLE: You read "Er."

Tutor asks:	Student replies:
What does "Er" represent?	Erbium
What group does Erbium belong to?	It's a rare earth element in Group 3B.
Is it solid, liquid or gas?	It's a solid.
What's its atomic number?	Its number is 68.
What's its atomic weight?	Its atomic weight is 167.
How many electrons does it have in its outer electron shell?	It has 2 electrons in its outer shell.
Which period is Erbium in?	It's in period 6.
Can you name some other elements in period 6?	Yes, Barium, Tantalum,...
Can you name some other rare earth elements?	Yes, Lanthanum, Cerium,...

Student reads:

43. B
44. F
45. Rn
46. Fm
47. Xe
48. H
49. V
50. Co
51. He
52. Zr

ALPHABETICAL LISTING OF GLOSSARY TERMS

TERM	PAGE
absolute zero	17
accelerate	3
acceleration	3
action force	3
alpha particle	17
alternating current	17
amplitude	3
anode	17
atom	3
atomic mass number	17
atomic mass unit	17
atomic number	17
balance	26
bar graph	21
barometer	26
base unit	3
beaker	26
beta particle	17
boiling	3
boiling point	3
Boyle's Law	12
calorimeter	26
catalyst	3
cathode	17
Celsius	17
centimeter	17
centripetal Force	3
Charles's Law	12
chemical change	3
chemical formula	3
chemical reactivity	4
circle graph	21
cloud chamber	26
coefficient	4
compression	4
computer	26
concave mirror	26
conclusion	15
condensation	4
conduction	4
conservation of momentum	12
control	15
convection	4
convex lens	26
convex mirror	26
corrosion	4
coulomb	26
covalent bond	26

TERM	PAGE
decelerate	4
deceleration	4
density	4,17
diffraction	4
direct current	17
displacement reaction	5
distillation	5
Doppler effect	12
double displacement reaction	5
efficiency	5
effort	5
electricity	5
electrolysis	5
electromagnet	26
electron	5
endo-	24
endothermic reaction	5
energy	5
Erlenmeyer flask	26
evaporation	5
exo-	24
exothermic reaction	5
experiment	15
experimental	15
eye dropper	26
filter paper	26
flame test	12
flourescent	5
force	5
freezing	5
friction	5
fulcrum	5
funnel	26
galvanometer	26
gamma ray	17
gas	6
Geiger counter	26
goggles	26
graduated cylinder	26
gram	17
gravitational force	6
gravity	6
heat	6
heat of condensation	6
heat of fusion	6
heat of vaporization	6
hertz	18
hydronium ion	18
hypothesis	15
inertia	6

TERM	PAGE
parallel circuit	27
pascal	18
petri dish	27
pH	18
photo-	24
photoelectric cell	27
photoelectric effect	13
physical change	8
physical property	8
plane mirror	27
potential energy	8
power	8
pressure	8
prism	27
product	8
pulley	8
radioactivity	8
radiation	8
rarefaction	8
rate	8
react	8
reaction force	8
reflection	8
refraction	8
reflecting telescope	27
refracting telescope	27
resistance	9
results	15
ripple tank	27
series circuit	27
simple machine	9
solid	9
solubility	9
specific heat	9
speed	9
stable	9
standard	9
standard temperature and pressure	19
-stat	24
structural formula	9
sublimation	9
subscript	19
synthesis reaction	9
tele-	24
temperature	9
test tube	27
theory	15
therm-	24
thermometer	27
thermostat	27

Read the problem. Circle the letter of the closest paraphrase of the underlined part or parts.

71. Over eighty percent of all known compounds contain carbon. What percent of all known compounds do not contain carbon?
    A. At least eighty percent of all known compounds have carbon in them. What percent don't?
    B. If greater than 80% of all known compounds have carbon, then what percent don't?
    C. If no fewer than 80 compounds have carbon in them, how many don't?

72. Radium melts at 700 Celsius. Barium melts at 850 Celsius. Which element has the greatest tolerance to heat?
    A. Barium has a lower boiling point than radium, which boils at 700 C.
    B. The temperature at which barium melts is 150 C higher than that of radium.
    C. The temperature at which barium melts is 150 C less than that of radium.

73. One newton of force is required to cause a one kilogram mass to be accelerated at the rate of one meter per second each second. How many are needed to accelerate a two kilogram mass?
    A. How many meters per second each second are accelerated by a two kilogram mass?
    B. What is the acceleration of a two kilogram mass?
    C. What number of newtons are needed to accelerate a two kilogram mass at one meter per second each second?