1. This compound is turned into xanthate (ZAN-thate) before being rebuilt through a spinneret in the process to create viscose rayon. This compound has beta-1,4 glycosidic (gly-co-SID-ic) linkages; those linkages are the only difference between this compound and starches, which are likewise made up of repeating chains of glucose. This most abundant organic compound on earth is indigestible by humans; however, it can be broken down by microorganisms that live in cows and termites. For 10 points, name this compound that makes up the majority of a plant's cell wall.
ANSWER: **cellulose**

2. Old rubber tires often "crack" when exposed to this compound, whose concentration is reported in Dobson units. The Chapman cycle describes the production and degradation of this compound, which at low temperatures forms a dark blue liquid. It takes its name from the Greek "to smell," and its odor can be observed during lightning strikes. In the atmosphere, this compound is broken down by compounds called chlorofluorocarbons (KLOR-oh-FLOOR-oh-CAR-buns). For 10 points, name this compound that forms a namesake layer in the atmosphere that shields the Earth from ultraviolet light, with formula O_3.
ANSWER: **ozone** [accept **O3** before mentioned]

3. This language's arguments dot callee gives extra power to anonymous functions. Like Python, it has a for in construction. Commonly used libraries for this language includes Ext, YUI, and Dojo. Primitive types in this language include undefined and null. Instead of using classes, this language like its Self predecessor uses prototypes. Local variables can be declared by the keyword var. For 10 points, name this programming language often used in webpages.
ANSWER: **JavaScript** [or **ECMAScript**; or **JScript**]

4. The Shankland team supported the outcome of this experiment by finding fundamental flaws in Daisy Miller's observations. A version of this experiment looking for seasonal variation was carried out by Kennedy and Thorndike. It used a half-silvered mirror to split coherent light and attempted to detect a certain "wind" by measuring fringe shift with an interferometer. Its results were explained by the Lorenz-FitzGerald hypothesis concerning length contraction. For 10 points, what experiment, named for two physicists at Case Western, disproved the existence of luminiferous (loo-min-IF-er-us) aether (EE-ther)?
ANSWER: **Michelson-Morley** experiment

5. A form of these substances that marks a shift to a specific electric potential is known as the redox type. The most notable type of these substances includes chemicals like cresol (KREE-sol) red and bromothymol (BRO-mo-THY-moll) blue and demonstrates the endpoint of an acid-base titration. For 10 points, name these chemicals that reversibly change color at a certain chemical point and include acid-base examples like phenolphthalein (FEE-nolf-THALE-een).
ANSWER: **indicator** [or pH **indicator**; or acid-base **indicator**]

6. This element, whose most stable form is the rhombic (ROM-bick) allotrope (AL-oh-trope), is extracted by pumping superheated steam into deposits in the Frasch (FRASH) process. Thiols (THY-olls) are alcohol analogs with oxygen replaced by this element. A platinum or vanadium (vuh-NAY-dee-um) catalyst is used in the contact process, which synthesizes a compound consisting of oxygen, hydrogen, and this element. Although blue in flame test, it is yellow as a solid and a liquid. This element forms cross-links in rubber vulcanization. For 10 points, name this element with atomic number 16.
ANSWER: **sulfur** [or **S**]

7. Under some conditions, an ICE table must be use to compute this property, and a device used to measure this property is named for Arnold Beckman. The Henderson-Hasselbalch (HEN-der-sun HOSS-el-bock) equation relates this quantity to the pK_a of a compound, and it is kept constant by buffer solutions. It is defined as the negative of the base ten log of the concentration of hydronium ("high"-DRO-nee-um) ions. For 10 points, give this quantity that measures how acidic or basic a solution is, which is seven for water.
ANSWER: **pH**

8. Along with mollusks, this grouping is defined by the existence of a cavity for blood circulation known as the hemocoel (HEE-moh-"SEAL"). This phylum takes in oxygen through stacks of plates filled with blood known as book lungs. One extinct member of this phylum was the most common animal of the Cambrian Explosion. That animal was a three lobed marine creature known as the trilobite (TRY-lo-bite). Members of this phylum have exoskeletons made of chitin (KYE-tin). For 10 points, name this phylum that includes crustaceans (crus-TAY-"shins") and insects.
ANSWER: **Arthropoda** [or **arthropod**s]

9. Historically, it was believed that these objects could be modeled as a cavity with equally likely modes that increased with frequency. The fourth power of temperature is proportional to the flux emitted by one of these according to the Stefan-Boltzmann (STEF-on BOLTS-mon) law. They have a wavelength of maximum intensity described by Wien's (VEENZ) displacement law. The ultraviolet catastrophe describes the breakdown of the Rayleigh-Jeans Law governing radiation from these entities. For 10 points, name these objects that absorb all incoming energy.
ANSWER: **blackbody**

10. For a black hole, this quantity is given by the product of the area of that black hole with Boltzmann's constant, divided by four times the Planck length squared. Taking the negative derivative with respect to temperature of the Helmholtz free energy yields this quantity, which can be defined as Boltzmann's constant times the logarithm of the number of microstates of a system. This quantity goes to a minimum as temperature approaches absolute zero. For 10 points, the second law of thermodynamics holds that, over time for isolated systems, there is an increase in what measure of disorder, symbolized S?
ANSWER: **entropy** [prompt on **S** before it is read]

11. These can be treated as a collection of stream processors. They often use z-buffers and they make use of framebuffers. These devices must deal with transformations, clipping, and shaders. Two popular ways of writing software that use them are OpenGL and DirectX. These devices use many small computing units to operate on vertices and pixels. For 10 points, name these components of a computer that accelerate the rendering and display of visual output.
ANSWER: **GPU** [or **graphics processing unit**; or **video card**; or **graphics card**]

12. A disease related to this organelle is caused by a lack of hexosaminidase (HEX-ose-am-IN-ih-dace) A, characterized by a red spot in the iris, and called Tay-Sachs disease. Mannose-6-phosphate tags proteins destined for this organelle. This organelle contains namesake hydrolases and can absorb material via autophagy. This organelle's V-class proton pumps create an acidic environment to carry out its main function. For 10 points, name this organelle that breaks down macromolecules and cellular waste.
ANSWER: **lysosome**

13. This process can be reversed in a pathway involving urokinase ("YOUR"-oh-KINE-ase), and it is downregulated by prostacyclin (PROS-tuh-"SIGH"-klin). Christmas disease results from a lack of Factor IX involved in this process. During this process, the serine protease (PRO-tee-ase) thrombin (THROM-bin) converts fibrinogen (fie-BRIN-oh-jen) into fibrin (FIE-brin), which forms a mesh polymer. Platelets have several important roles in this process. For 10 points, name this process by which by which the blood congeals after injury, which is impaired in hemophilia (HEE-mo-FILL-ee-uh).
ANSWER: **coagulation** [or **clotting**]

14. When these landforms lie parallel to one another, they create raised and lowered areas called horsts and grabens. Flat irons form from scarps, which are located along these features. These features divide a surface into a hanging wall and a footwall. At lower depths, they are called shear zones. If the movement of one of these features has both strike and dip components, it is known as an oblique-slip one. They also come in transform and strike-slip types. For 10 points, name these cracks in the Earth's surface, the movement of which causes earthquakes.
ANSWER: **fault**s

15. One class of these are circuit gateways and they can be used to make a DMZ. An example of a stateful one is iptables and NAT can be configured to act like a very basic one. Application-Layer ones use knowledge about the content to make decisions. They protect against things like denial of service attacks. Common techniques include port blocking and packet filtering. Usually they must be configured to allow new trusted programs and services to access the internet. For 10 points, name these pieces of software or hardware that protect computers from network based attacks.
ANSWER: **firewall**s

16. They are the subject of Wagstaff's Conjecture. The Lucas-Lehmer test is used to find these numbers. The programs GIMPS searches for new examples of these numbers. Every even perfect number is the product of one of these numbers and a corresponding power of two. The first four of these numbers are three, seven, thirty-one, and one hundred and twenty-seven. For 10 points, identify these prime numbers of the form two to the n minus one, named for a medieval French mathematician.
ANSWER: **Mersenne** prime numbers [prompt on **prime** before mentioned]

17. On the station model, this phenomenon is plotted using a barb that contains flags which show its magnitude. On a map, this phenomenon's direction is held constant along an isogon, while its speed is constant along an isotach. Near the ocean, this phenomenon changes direction at night, when the land cools faster than water. The lack of this phenomenon defines the "horse latitudes." The Beaufort Scale measures the strength of this phenomenon, the speed of which is related to damage on the Saffir-Simpson and Fujita scales. For 10 points, name this phenomenon, the movement of air on the earth's surface.
ANSWER: **wind**

18. Spirochetes (SPY-ro-KEATS) have modified versions of these structures known as axial filaments. In bacteria, the hook, or base of this organelle, is covered. This organelle is attached to a basal body. In eukaryotes, they are the longer of two types of structures that are composed of a "nine plus two" arrangement of microtubules. Unlike that other structure, cilia, these structures work by rotating in a clockwise or counterclockwise manner. For 10 points, name these whiplike projections that are the main method of cell motility in *Euglena* and sperm cells.
ANSWER: **flagella** [or **flagellum**]

19. Along with rural agenesis (ay-JEN-uh-sis), this disease accounts for a majority of the occurrences of congenital absence of the vas deferens (VOSS DEF-er-enz). This disease is most commonly caused by a deletion of three nucleotides, starting with the phenylalanine (fen-il-AL-uh-neen) at position 508, of a namesake chloride channel. This disease is diagnosed in early childhood via the noninvasive sweat test. It was first described by Dorothy Andersen, who described its characteristic pancreatic scarring. For 10 points, name this autosomal recessive genetic disease that causes a buildup of mucus in the lungs.
ANSWER: **cystic fibrosis** [or **mucoviscidosis**; prompt on "CF"]

20. The earliest definition of this term involved the use of tens to the seventh and negative seventh and was named for John Napier. Numbers of this type are made up of an integer called the characteristic and a fraction called the mantissa. Taking this operation to the multiplication of two components is equivalent to adding the values of this operation to those components individually. The derivative of one type of this function is equal to one over x. That type is taken in the base of e and is called the natural type of this. For 10 points, name this function that is the inverse of an exponent.
ANSWER: **log**arithms [or Napierian **log**arithms; or natural **log**arithms]

21. This element forms a namesake cycle with sulfur whose net reactant is water and net products are hydrogen gas and oxygen gas. A hormone that includes this element is thyroxine (thy-ROX-een), which loses one atom of this element to yield its active form. Preparations of this element include Lugol's solution, and its presence in the diet prevents goiter. For 10 points, name this halogen often used as a test for starch and in a disinfecting agent, which on the periodic table appears below bromine but above astatine.
ANSWER: **iodine**

22. In Minkowski space, this quantity equals the rate of change above the four-momentum vector with respect to proper time. The total amount of this quantity imparted on a charged particle by both the magnetic and electric fields is named for Lorentz. This quantity is equal to the time derivative of the body's momentum by Newton's Second Law. Work is equal to this quantity times distance. For 10 points, name this vector quantity measured in newtons, which equals mass times acceleration.
ANSWER: **force** [or **net force**]

23. In the MIPS ("mips") architecture, many ALU ("A"-"L"-"U") operations, such as add, have this as their opcode. In "one's complement" notation there are two of these. In Unix, slash dev slash null has a counterpart that produces these. In C++ this is equivalent to false. Arrays usually start with this index. In digital circuits, this number corresponds to a low voltage. A common programming error, or exception, is dividing by this number. For 10 points, name this value, which is contrasted with "one" in the binary system used by computers.
ANSWER: **zero**

24. Wolff's Law governs the circumstances that cause density of this tissue to increase or decrease. Precursors to this tissue are generated at the epiphyseal (EPP-ih-FIZZ-ee-uhl) plate. Since estrogen causes cells that resorb this tissue to undergo apoptosis, this tissue becomes noticeably weaker in post-menopausal (men-oh-"PAWS"-uhl) women. Blood is supplied to this tissue through Haversian (huh-VER-zee-uhn) canals, and the hydroxyapatite ("high"-DROX-ee-APP-uh-tite) in this tissue's matrix is a major site of calcium storage. For 10 points, name this tissue that comprises the majority of the skeleton.
ANSWER: **bone**

25. An outdated model for the structure of this entity was proposed by Davson and Danielli. Enzymes such as flippases ("FLIP"-"aces") move molecules within this structure. It contains glycolipids (GLY-ko-LIP-idz) such as gangliosides (GANG-lee-oh-"sides"). The fluidity of this structure is regulated by the amount of cholesterol within it. The fluid mosaic model of this structure holds that proteins and lipid rafts are embedded in a freely moving phospholipid (FOSS-fo-LIP-id) bilayer. For 10 points, name this structure that encloses the cell and separates it from the outside environment.
ANSWER: cell **membrane**

26. The Sylvester-Gallai theorem gives a requirement that all items in question are upon only one of these. These objects are replaced by the idea of a geodesic on a general metric; specifically, in spherical geometry, these objects are replaced by "great circles." In coordinate geometry, these objects can be specified in slope-intercept form. Perpendicular ones intersect at an angle of ninety degrees. For 10 points, name this geometric construct defined by two points.
ANSWER: **line**s

27. This man proved the theorem of quadratic reciprocity. He used his formulation of least squares to accurately predict the orbit of Ceres. This mathematician discovered a compass and ruler construction for the heptadecagon. This man devised an improved proof of the fundamental theorem of arithmetic. According to a popular legend, while still in school he devised a simple formula for the sum of one through n. His name is also attached to a statistical distribution about a mean, also called the normal distribution or bell curve. For 10 points, name this German mathematician.
ANSWER: Carl Friedrich **Gauss**

28. Along with sodium carbonate, this substance's chloride is a byproduct of the Solvay Process. This element can be made through the reaction of its oxide with aluminum. This element's oxide is known as quicklime. Lime is a heated form of this element's carbonate. Marble is a crystalline form of this element's carbonate that is also known as limestone. This element has an electron configuration of [Ar]4s2 ("Argon Four S Two"). For 10 points, name this alkaline earth metal with symbol Ca.
ANSWER: **calcium** [or **Ca** before it is read]

29. Methods of measuring the magnitude of this effect often include the use of a platinum probe, such as a DuNouy ring or Wilhelmy plate. This phenomenon is no longer changed once the critical micelle concentration is reached. Those micelles are formed by substances that lower the strength of this effect, which are called surfactants. This effect limits the height in a container of a meniscus caused by capillary action. Bubbles form spheres according to this effect. For 10 points, name this cohesive attraction that causes a film to be created at the top of liquids, which allows some insects to walk on water.
ANSWER: **surface tension**

30. This body releases cytochrome ("SIGH"-tow-krome) c to trigger apoptosis (AY-pop-TOW-sis). The DNA found in these organelles (OR-guh-NELLZ) is passed down matrilineally (MAT-ruh-LIN-ee-uh-lee), and along with its double membrane, may be evidence for its endosymbiotic (EN-"dough"-sim-by-OTT-ick) origin. Its inner folds are called cristae (KRIS-tay), and its matrix is home to respiration reactions like glycolysis (GLY-"CALL"-ih-sis). For 10 points, name this organelle, the "powerhouse" of the cell.
ANSWER: **mitochondria** [or **mitochondrion**]

31. The enzyme that produces this compound has segments called F_0 and F_1 connected by a rotating axle. This compound is converted into a cyclic signal transduction second messenger called cAMP ("camp"). The Embden-Meyerhof pathway produces two molecules of NADH and two molecules of this compound. Hydrogen ions are pumped across a gradient to produce this compound in oxidative phosphorylation (OX-ih-DAY-tive FOSS-FOR-ill-AY-shun). For 10 points, name this "energy transfer currency" of the cell, a compound that contains three phosphate groups and goes by a three-letter acronym.
ANSWER: **ATP** [or **adenosine triphosphate**; or **adenosine 5'** (five-prime) **triphosphate**]

32. Monomitic systems occur when only the generative type of these structures is present. Other types of them include the elongated and thick walled skeletal type and the multi-branching binding variety. Their tips are sometimes the site of haustoria (how-STOR-ee-uh) in parasites. Those tips are the source of their expansion through an organelle known as the spitzenkorper (SPIT-zen-kor-per). Most of them are divided into cells by barriers called septa. A collection of these structures is known as a mycelium (my-SEEL-ee-um). For 10 points, name these structures that make up most of a fungus.
ANSWER: **hypha**e

33. Drugs containing a compound called artemisinin (AR-tuh-mih-SINE-in) are used to treat this disease, whose severity is lessened in individuals with thalassaemias (THAL-uh-SEEM-ee-uhs). Those who completely lack receptor proteins called Duffy antigens are immune to one form of this disease. Individuals who are heterozygous for the mutated allele for sickle cell anemia are at far less risk for this disease. Its longtime treatment was derived from Cinchona (sin-CHO-nuh) bark. For 10 points, the parasite *Plasmodium* causes what disease that was once treated by quinine (KWY-nine) and is spread by mosquitoes?
ANSWER: **malaria**

34. One species of these creatures, *Mycocepurus smithii* (MY-coh-seh-"PURE"-us "SMITH"-"e"), is cultivated by the Attini and is entirely female. The presence of a metapleural (MET-uh-PLOOR-uhl) gland, which secretes phenylacetic acid (FEN-il-uh-SEE-tic), differentiates most species of these creatures from other members of order Hymenoptera (hi-men-OP-ter-uh). These organisms of family Formicidae (for-MISS-uh-dee) often herd aphids for food and include "driver," "carpenter," and "army" varieties. For 10 points, name these insects which form underground hives occupied by soldiers, workers, and the queen.
ANSWER: **ant**s [or **Formicidae** until it is read]

35. The movement of one type of these objects at high altitudes can create cracks called bergschrunds (BEARG-schrundts). These objects are split by the firn limit into two zones, called the zones of accumulation and ablation. When two of these objects are near each other on a mountain, they can cause the formation of an arête (ar-RET). The movement of these objects caused the formation of such geographic features as moraines. Types of them include cirque, alpine, valley, and continental. For 10 points, name these large moving masses of ice.
ANSWER: **glacier**s [accept **alpine glacier** or **cirque glacier** or **valley glacier** until "moraines;" do not accept or prompt on specific types of glaciers after "moraines"]

36. The product of one type of this process is recycled in the Cori Cycle after it is transported to the liver. This biochemical process is preferred over oxidative phosphorylation by organisms like yeast, and it is essential to such diverse phenomena as muscle soreness and the brewing of beer. For 10 points, name this alternative pathway to cellular respiration, in which cells anaerobically break pyruvate into products like ethanol or lactic acid instead of oxidizing it to carbon dioxide.
ANSWER: **fermentation**

37. The Hoffman modulation contrast type of these devices enhances phase gradients. A component named after Nomarski (no-MAR-skee) is used in the differential interference contrast type of these devices. Abbe (AH-BAY) condensers are attached to these devices. Confocal ones remove light that is out of focues. They have objective and ocular pieces. The multiplication of the strengths of two of their pieces gives the total magnification. For 10 points, name these laboratory devices that magnify images of cells and other structures.
ANSWER: optical **microscope**s

38. These compounds form Weinreb amides by the Wittig reaction, and varieties of these substances with alpha-hydrogen centers participate in a type of tautomerism named for these compounds and enols. Examples of these compounds include a compound with abbreviated formula Ph2CO ("P-H-TWO-C-O"), benzophenone, which like other members of this family features a carbonyl group. For 10 points, name this functional group which consists of a carbon double bonded to an oxygen and to two other carbon atoms.
ANSWER: **ketone**s

39. A thermal inversion can cause rays to wrap around the earth in the infinite form of this phenomenon. That difference in temperature can also allow sound to travel farther due to this effect, such as sound traveling over a lake. This phenomenon is no longer observed once an angle of incidence reaches a critical angle and causes total internal reflection. One is the minimum value for the index associated with this effect; that index, denoted n, is equated with angles of incidence via Snell's Law. For 10 points, name this phenomenon in which a wave changes velocity upon entering a different medium.
ANSWER: **refraction**

40. These devices are typically used in traffic light sensors, and their impedance is proportional to angular frequency. Like resistors, when these devices are arranged in series or in parallel their strength is combined. The energy stored by these devices is proportional to one half times the current squared. The L in RLC circuits refers to these devices. These devices, which include solenoids and toroids, are represented in circuit diagrams by a coil. For 10 points, name these electrical devices that can store energy in a magnetic field.
ANSWER: **inductor**s

41. The gene "mothers against decapentaplegic" (DECK-uh-PEN-tuh-PLEE-jick) was discovered in this model organism. Genes such as bicoid (BI-coyd), oscar, and hunchback are important for its early development, which takes place in a syncytium. One mutant of it is eyeless. Polytene (PAHL-ee-teen) chromosomes can be found in this organism, as can P elements. Features of this organism includes bristles, ommatidia (OM-muh-TID-ee-uh), and wings. Thomas Hunt Morgan did his primary genetic research on this organism. For 10 points, name this insect model organism.
ANSWER: ***Drosophila*** *melanogaster* [or **fruit fly**]

42. Though it is not the kidneys, the tissue surrounding arteries in this organ is called a Malpighian (mal-PEE-gee-uhn) body. One type of tissue in this organ is made up of Cords of Billroth. Along with the liver and bone marrow, the body stores ferritin (FAIR-it-in) bound iron in this organ. The two main types of tissue in this organ meet at the "marginal zone." Along with the thymus, this part of the lymphatic system is the only organ that contains efferent lymphatic vessels. This organ is made up of red pulp and white pulp. For 10 points, name this organ that removes old red blood cells from the blood.
ANSWER: **spleen**

43. One model for the formation of these regions was proposed by John T. Wilson. One of these regions, nicknamed the "Great Meteor," may be responsible for diamond-containing kimberlite deposits. Rhyolites (RYE-oh-lites) are formed when basaltic magma from these regions bubbles under a continental crust. One of them created the Galapagos island chain. A currently active one resulted in the formation of the Hawaiian island chain. For 10 points, name these areas on the earth's crust where very hot plumes of magma result in unusually high levels of volcanic activity.
ANSWER: **hotspot**s [or **mantle plume**s]

44. An alternate name for this type of reaction is "metathesis" (muh-TATH-uh-sis). If one of the products of this kind of reaction breaks down to release a gas, it is an effervescent reaction. This type of reaction is also undergone when acids and bases are neutralized to form salts. This type of reaction differs from a redox reaction in that no reactant changes oxidation states. In the most common form of this kind of reaction, two ionic solutions are added to each other to form a precipitate. For 10 points, name this type of reaction in which portions of two reactants swap positions with each other.
ANSWER: **double displacement** reactions [or **double replacement** reactions]

45. This material completely surrounds lands known as "kipuka." A landform called a tuya results when this substance is found beneath a glacier. This substance interacts with water to form the "pillow" type of it. When this substance is very liquid, it is known as pahoehoe (pa-HOY-hoy). When this material takes on a chunky consistency, it is known as aa (AH-ah). Composite, or "strato" cones, alternate between this emitting this material and expelling tephra and ash. For 10 points, name this type of molten rock, the above-ground counterpart of magma.
ANSWER: **lava** [do not accept "magma"]

46. This organ is calcified in a condition named for its resemblance to porcelain, and a condition caused by an excess of cholesterol is named for this organ's resemblance to a strawberry. Like the pancreas, it is emptied through the action of the hormone cholecystokinin (COAL-uh-sis-toe-KINE-in). Its cystic duct connects with the common hepatic duct; that connection forms a duct named for a substance the liver produces but this organ stores. For 10 points, name this organ found just above the liver, whose main function is to store bile.
ANSWER: **gallbladder**

47. Data serialization and restoring serialized data requires these objects to be "swizzled" and "unswizzled." Nonstatic methods implement one of these called "this." Each node of a doubly linked list includes two of these, often called "next" and "previous;" the head and tail nodes have one each of these set to NULL. These objects are "dereferenced" to obtain the value at the address they indicate. For 10 points, name these variables present in many programming languages, notably C and C++, that store a memory address.
ANSWER: **pointer**s

48. Cajal (kuh-HALL) bodies in this structure contain scaRNAs, which direct post-transcriptional modifications of another type of RNA unique to this structure. Transport into and out of this organelle is dependent on a GTPase called Ran. Importins and exportins move proteins across this organelle's membrane. A smaller organelle within this one is the site of ribosome (RYE-bo-some) production. This organelle is surrounded by a membrane known as its "envelope," which breaks down and disintegrates during prophase. For 10 points, name this organelle that contains much of a cell's genetic material.
ANSWER: cell **nucleus**

49. In complete metric spaces, Cauchy sequences always have one of these. Those of a function can be found using the sandwich theorem and a typical definition is that for some delta region around x, f(x) will be within some epsilon region. A technique for finding indeterminate ones of functions of form f(x)/g(x) c uses the ratio of the respective derivatives and is better known as L’Hôpital’s rule. These are often used to give define derivatives. For 10 points, name this concept often given as the value of a function as it approaches a certain point.
ANSWER: **limit**

50. One problem concerning the substances is solved using the Sackur-Tetrode equation and is presented in the Gibbs paradox. The law named for these substances is not effective when dealing with high pressures or low temperatures. That law is a combination of laws named for Charles and Boyle. These substances are assumed to have no attractions between themselves, and have completely elastic collisions. For 10 points, name this hypothetical form of a phase of matter, which is modeled by its same named equation of PV=nRT ("P-V equals N-R-T").
ANSWER: **ideal gas**es [prompt on **gas**es]

51. The Harris Matrix makes use of the laws of this scientific field. This field was advanced by the laws of Nicholas Steno, who theorized that assuming original horizontality and lateral continuity were important in this field. Terms in this field include "anticline" and "sincline." The first work in this field was the Law of Superposition, which assumed that the oldest material was on the bottom and the youngest material was on top. The iridium-rich K-T boundary was discovered using this discipline. For 10 points, name this branch of geology, the study of layers of rock.
ANSWER: **stratigraphy** [prompt on **geology**]

52. Free radicals act as messengers in the namesake "signaling" of these reactions. Disproportionation (DIS-pro-por-shun-AY-shun) reactions occur when different atoms of the same element undergo both half-reactions of this class of reactions. The two half-reactions which make up these reactions take place in the two half-cells of an electrochemical (ee-LECK-tro-KEM-ih-kul) cell. For 10 points, name this class of reactions which involve a change in oxidation number, named for the fact that they consist of reduction and oxidation.
ANSWER: **redox** reactions [or **oxidation-reduction** reactions before "reduction"; or **reduction-oxidation** reactions before "reduction"]

53. When these materials interface with other materials, Andreev (ahn DREE yev) reflection can occur. A phenomenological theory of these was developed by Lev Landau and Vitaly Ginzberg. They expel magnetic fields from their interior in the Meissner Effect. Coming in Type I and Type II varieties, these materials are described as the result of electrons condensing into Cooper pairs by BCS theory. For 10 points, name these materials, which have zero resistance at low temperatures.
ANSWER: **superconductor**s [prompt on **superconductivity**]

54. Python employs the "duck" way of determining these constructs. C++ can use RTTI to determine these at runtime as a form of introspection, and C++ uses templates in a similar fashion to "generic" ones. Programming languages can be classified by having static, dynamic, strong, or weak systems of these. If built into a language they can be called "primitive," while object-oriented programming allows the programmer to implement new ones. For 10 points, name these programming constructs which include characters, bools, integers, floats, and strings.
ANSWER: data **type**s

55. One formulation of this value uses Slater's rules to find a effective nuclear charge, which is then divided by the covalent radius. The Allred-Rochow (ROSH-ow) formulation of it does not account for the d-block elements. Allen suggested that this value is related to the average energy of a certain particle, and Mulliken defined it as the mean of first ionization energy and electron affinity. Fluorine possesses the highest value for, for 10 points, what quantity proposed by Pauling as a measure of an atom's ability to attract electrons to itself?
ANSWER: **electronegativity**

56. The Czochralski (cho-KROLL-skee) technique is a way of synthetically making these. The intercepts of the axes of the structure of these can be used to determine their Miller indices, and fourteen structures named for Bravais (bruh-VAY) can be used to describe these. The packing factor of these indicates the percent of space used by matter. Their structure can be classified using terms like orthorhombic (OR-tho-ROM-bick), monoclinic, and face-centered cubic. For 10 points, name these solids made of repeating patterns of atoms or molecules, examples of which include ice and quartz.
ANSWER: **crystal**s [prompt on **lattice**s; accept **crystal lattice**s]

57. The sequence KDEL marks proteins for retention in this structure. Chaperone proteins located in this structure fold newly created proteins. A specialized variety of this structure stores calcium ions and is found in smooth and striated muscle. That "sarcoplasmic" (sar-co-PLAZZ-mic) type of this organelle is in turn a subset of a type of this structure which is the location of carbohydrate and steroid metabolism. That type is known as "transitional" or "smooth." For 10 points, name this organelle, which also has a "rough" type that contains ribosomes (RYE-bo-soams).
ANSWER: **endoplasmic reticulum** [or **ER**; or smooth **endoplasmic reticulum**; or rough **endoplasmic reticulum**; prompt on sarcoplasmic **reticulum**; prompt on **SR**]

58. One class of this phylum is distinguished by the presence of a pharynx that opens into the gastrovascular (GAS-tro-VAS-kyoo-lurr) cavity and is known as the actinopharynx (ack-TIN-o-FAIR-inks). One member of this phylum, *Chironex fleckeri* (KY-ro-nex FLECK-er-eye), is in the class Cubozoa (CUBE-oh-ZO-uh). Its class Anthozoa (AN-tho-ZO-uh) contains corals. Organisms in this phylum are characterized by stinging cells known as nematocytes (nuh-MAT-oh-sites) and grow from a polyp to a medusa. For 10 points, what marine phylum includes sea anemone, hydra, and jellyfish?
ANSWER: **Cnidaria** (ni-DARE-ee-uh)

59. This statement is invoked in the Born-Haber (BORN HAW-ber) cycle. This statement follows from the fact that the quantity it concerns is a state function, and therefore its value is independent of the system's trajectory. This statement is often framed in terms of the heats of formation of reactants and products. For 10 points, name this statement of thermodynamics that suggests that a reaction's enthalpy change is equal to the sum of the enthalpy changes of each step.
ANSWER: **Hess**'s Law

60. "Low barrier" types of these entities occur in the catalytic triad of serine proteases. A unique form of these is present in borane-ammonia complexes. In RNA and proteins, they are chiefly responsible for secondary structure. Water expands upon freezing because these entities become ordered. They usually involve fluorine, nitrogen, or oxygen and their namesake element. For 10 points, name these exceptionally strong dipole-dipole interactions.
ANSWER: **hydrogen bond**s

61. Sputnik is the name given to an infection that targets the unusually complex Mimi one of these agents. They can be classified under the Baltimore scheme. One class of them is responsible for the E6 and E7 oncogenes, and some of them have gag genes. Their reproductive cycle can be classified as lysogenic or lytic. Their central component is a protein capsid which encloses their genetic material, which can be RNA in the "retro" type. For 10 points, name these infectious agents that require a host cell to replicate.
ANSWER: **virus**

62. An open question about these is whether those that exploit randomness such as those related to languages in BPP are more powerful than deterministic ones. Models on which the behavior of these evaluated include the cell probe, decision tree, and PRAM. If they exploit optimal substructure and memoization they can be considered "dynamic" and if they recursively breakup a problem they are "divide and conquer". Examples include the Bellman-Ford, Euclid's, and Dijkstra (DIKE stra)'s. For 10 points, name these methods of solving a problem in a finite number of steps, some of which are "sort" and "search" ones.
ANSWER: **algorithm** [or **computation**; accept **Turing machine** before cell probe]

63. This substance is assumed to have vertical equipotential lines in order to simplify solutions to an equation for its movement. That assumption named for Dupoit is invoked along with Darcy's law to explain this substance's movement. Pockets of air are found alongside it in the vadose zone. It is present in any bedrock pore in the phreatic zone. Structures that contain it can emit it spontaneously if its namesake "table" is above ground level. This substance flows freely from artesian wells. For 10 points, name this substance, which is found in porous rock in aquifers.
ANSWER: **water** [accept **groundwater**; or underground **water**; or **H_2O**; or other reasonable equivalents]

64. Early development of some of these cells are guided by netrin (NET-rin) and semaphorin (SEM-uh-FOR-in) proteins. Historically, reticular (RET-ick-YU-lar) theory contrasted with these cells' namesake doctrine. Examples of these cells include pyramidal cells and Purkinje (pur-KIN-jee) cells. The cell body of one of these cells is known as the soma, and a "hillock" in these cells generates an action potential, which is propagated down the axon. For 10 points, name these cells of the nervous system.
ANSWER: **neuron**s

65. The Havel-Hakimi theorem gives the conditions for a sequence to correspond to one of these. Ramsey's theorem deals with the coloring of complete ones. They can occur in undirected and directed forms, the latter of which gives a direction to one of their components. Hamilton and Euler (OY-ler) name cycles in these; Euler's is used in the Seven Bridges of Konigsberg Problem, which launched the study of them. For 10 points, name these mathematical objects made of vertices and edges.
ANSWER: **graph**s

66. Nickel is purified in the Mond process by reacting it with this compound. This compound can react with chlorine gas to form phosgene (FOSS-jeen), which was once used as a chemical weapon. A mixture of it with hydrogen gas is called syngas. It is referred to as carbonyl (CAR-bo-neel) when it functions as a ligand. In the body, hemoglobin (HEE-mo-glo-bin) is about two hundred times more likely to bond to this compound than oxygen. It is formed in incomplete but not complete combustion reactions. For 10 points, name this odorless, colorless gas that is often called "the silent killer," which has the formula CO.
ANSWER: **carbon monoxide** [or **CO** before mentioned]

67. Some models of this process have a LS factor, and the most common model for it is the revised USLE. This process comes in sheet, rill, and gully forms. It opposes orogeny and loosens the ped structure. The products of this process can undergo deposition. Fluvial, aeolian, and glacial processes cause this process, which can be increased by a lack of vegetation. It is similar to, but not the same as, the related concept of weathering. For 10 points, name this process by which materials such as soil are moved, such as when a stream wears down its banks.
ANSWER: **erosion**

68. A recently developed one of these with a good proven competitive ratio is called tango. One of these that operates on a restricted key set with log log n performance is named after van Emde Boas (vahn EM-dah BOH-az). The zig-zag step is one of the steps which can be used in creating the splay type of these. A set of coloration rules are used in the red-black type, which is an example of the balanced binary search class of these. Their topmost nodes are known as root nodes. For 10 points, name these data structures whose terminal nodes are called leaves.
ANSWER: **tree**s

69. One section of this organ contains a mass of lymphoid (LIM-foid) tissue called Peyer's (PAY-erz) Patches. Another section of this organ receives a material from the pylorus known as chyme. Like the esophagus, this organ uses a contractile motion known as peristalsis (PAIR-ee-STALL-sis). This organ receives the enzymes trypsin (TRIP-sin), lipase (LYE-"pace"), and amylase (AMM-ill-ase), which break down proteins, lipids, and starches, respectively. For 10 points, name this organ divided into the jejunum, ileum, and duodenum, whose main function is to digest food before it passes into the large intestine.
ANSWER: **small intestine** [accept **ileum** before "chyme" is read]

70. This function's Taylor series approximation begins 1 - $X^2/2!$ + $X^4/4!$ ("One minus X squared over two factorial plus X to the fourth over four factorial"). In Euler's Formula, this function added to i(sin(x)) ("I times the sine of X") is equal to e^{ix} ("E to the I X"). This function is also equal to the square root of $1-\sin^2$ (theta) ("One minus sine squared of theta") and approaches zero as theta approaches p/2 ("pi over two"). Name this function equal to a triangle's adjacent side over its hypotenuse.
ANSWER: **cosine**

71. This law's integral and differential forms can be related by the Kelvin-Stokes Theorem. The original formulation of this law broke the rule that the divergence of a curl must be zero; that flaw was corrected with the addition of a displacement current by James Maxwell. In cases with the requisite symmetry, this law is used in place of the more cumbersome Biot-Savart (BEE-oh suh-VAR) Law. For 10 points, name this law that states that the line integral of the magnetic field around a closed loop is proportional to the current passing through it.
ANSWER: **Ampere**'s Law

72. This is the number of variables that the Ackermann function takes. Euler's formula states that the number of vertices, minus the number of edges, plus the number of faces of any convex polyhedron is equal to this number. This is the only number for which the reciprocals of its powers sum to the number itself. This is the highest number x at which a to the x plus b to the x can equal c to the x, according to Fermat's Last Theorem. It is the third number in the Fibonacci series. For 10 points, name this number, the only even prime.
ANSWER: **two**

1. [10] This is a 20-second calculation question. What is the perimeter of a rectangle whose area is 10 and whose length is 1.6 times longer than its width.
ANSWER: **13**
[10] This is a 10-second calculation question. If a rectangular coordinate is 2,sqrt(3), what is it in polar form?
ANSWER: **(sqrt(7), pi/6)** [or **(2.646, 0.524)**]
[10]This is a 10-second calculation question. What is (2x+2sqrt(3))*(2x-2sqrt(3))?
ANSWER: **$4x^2-12$**
[10] This is a 20-second calculation question. What is 13.916724 divided by 3.49?
ANSWER: **3.9876**
[10] This is a 30-second calculation question. If Ermes puts $340 in a bank account that pays 3 percent annual interest compounded every quarter, how much is in his bank account after four years?
ANSWER: **383.18**
[10] This is a 30-second calculation question. What is the harmonic mean of 1 through 6 in reduced fractions? The harmonic mean is the reciprocal of the average of the reciprocals of the values.
ANSWER: **120/49**

2. [10] This is a 30-second calculation question. What is $8x^5 + 6x^4 + 42x^3+29x^2+55x+35$ divided by $2x^2+5$?
ANSWER: **$4x^3+3x^2+11x+7$**
[10] This is a 30-second calculation question. Suppose you have 256 meters of rope. What is the largest rectangular area that you can enclose with the rope?
ANSWER: **4,096** square meters
[10] This is a 10-second calculation question. What is 9.5*7.23?
ANSWER: **68.685**
[10] This is a 10-second calculation question. If Ludmilla has three different pairs of shoes, seven scarves, and eleven different hats, how many different outfits can she make from those items?
ANSWER: **231**
[10]This is a 20-second calculation question. If a triangle has two angles of 30 and 105 degrees, a side length of 2*squareroot(2-squareroot(2)) opposite the unknown angle, and another side of length 2, what is the length of the unknown side?
ANSWER: **2**
[10]This is a 20-second calculation question. What is 3.7^4?
ANSWER: **187.4161**

3. [10] This is a 20-second calculation question. If Professor Persikov has has an initial population of four frogs and the population doubles every 4 weeks, how many frogs does he have after a year? You may assume that there are 52 weeks in a year.
ANSWER: **32,768**
[10] This is a 10-second calculation question. What is the value of w if 3w=7w+11? Give your answer in decimal form.
ANSWER: **-2.75**
[10] This is a 10-second calculation question. What is 7/3 divided 2/9?
ANSWER: **21/2** [or **10.5**]
[10] This is a 20-second calculation question. What is 3.567*9.877?
ANSWER: **35.231259**
[10] This is a 30-second calculation question. Consider a cone of height h and radius r. If 14h=336 and 3r+3=h and we approximate pi by 3.14, what is the surface area of the cone?
ANSWER: **703.36**

[10] This is a 30-second calculation question. What are the roots of $x^3 - 5.5x^2 - 17.5x + 49$?
ANSWER: x=**-3.5, 2, 7** [accept in any order]

4. [10] This is a 10-second calculation question. Add eight and six-sevenths plus thirty-four and one-quarter.
ANSWER: **1207/28** [or **43 3/28**]
[10] This is a 10-second calculation question. Find 32 percent of 73.
ANSWER: **23.36**
[10] This is a 20-second calculation question. Every domino in a set of dominoes is two inches long, three-quarters of an inch wide, and one-quarter of an inch thick. How many of these dominoes can fit in a box that is four and a half inches wide, four inches long, and two and three-quarters inches high?
ANSWER: **132**
[10] This is a 20-second calculation question. A company finds that demand for its widgets follows the equation 100 minus 2p, if p is the price they charge for each widget; and the amount of money earned by the company is the product of the price and the quantity sold. What price earns the largest revenue?
ANSWER: $**25**
[10] This is a 30-second calculation question. You have a coin that lands heads-up 75% of the time when it is flipped. If you flip this coin four times, find the probability of getting exactly three heads.
ANSWER: **27/64**

[10] This is a 30-second calculation question. Find $\cos(\sin^{-1} -6/13)$ ("cosine of the arcsine of negative six-thirteenths").
ANSWER: **(square root 133)/13**

5. This is a 20-second calculation question. Divide 9.4624 by 7.09.
ANSWER: **1.36**
This is a 10-second calculation question. A banner is placed on a 12-foot wall. If the banner covers 35% of the length of the wall, what is the length of the banner in feet and inches?
ANSWER: **4 feet, 2.4 inches**
This is a 30-second calculation question. Solve the system of equations -8x+2y-4z = -40; 3y-8z = -12; -8x+9y-4z=-68.
ANSWER: **(4, -4, 0)**

This is a 10-second calculation question. Evaluate $3x^2 - 7x + 9$ when x = -3.
ANSWER: **57**
This is a 20-second calculation question. Three of the corners of a rectangle are at the points (10, 10), (5,0), and (2, 4). Find the location of the fourth corner.
ANSWER: **(13, 6)**
This is a 30-second calculation question. According to a recent census, a certain town has 590 households with no children, 1826 households with one child, 1574 households with two children, 153 households with three children, and 26 households with four children. In this town, to the nearest tenth, what is the average number of children per household?
ANSWER: **1.3**

6. This is a 20-second calculation question. Evaluate $(2/15)^2$ times 25 plus 3 times 4/7.
ANSWER: **136/63** [or **2 10/63**]
This is a 10-second calculation question. Find the least common multiple of 6, 12, 15, and 40.
ANSWER: **120**

This is a 10-second calculation question. Find the center and radius of the circle with equation $x^2 - 12x + y^2 + 4y = 41$.
ANSWER: center **(6, -2)** and radius **9**

This is a 20-second calculation question. Simplify the expression $(x^2+11x+24)/(x^2-9)$.
ANSWER: **(x+8)/(x-3)**
This is a 30-second calculation question. Using 3.14 as the value for pi, give the volume of a cylinder with radius 7 inches and height 4 inches.
ANSWER: **615.44 cubic inches**
This is a 30-second calculation question. In a population with a mean height of 67 inches and a standard deviation of 2.5 inches, find the standard score (or z-score) of a person with a height of 71 inches.
ANSWER: **1.6**

7. This is a 10-second calculation question. Multiply 7.55 times 3.8.
ANSWER: **28.69**
This is a 10-second calculation question. Give the prime factorization of 16,200.

ANSWER: $\mathbf{2^3 3^4 5^2}$

This is a 20-second calculation question. Factor: $8x^2 + 78x + 85$.
ANSWER: **(4x+5)(2x+17)** [order of factors does not matter]

This is a 20-second calculation question. Find the foci of the hyperbola with equation $5(x-2)^2 - 3(y+1)^2 = 30$.
ANSWER: **(-2, -1) and (6, -1)**
This is a 30-second calculation question. Find the surface area of a cylinder that has a radius of 9 inches and a height of 13 inches. Use 3.14 as an approximation for pi.
ANSWER: **1243.44 square inches**
This is a 30-second calculation question. A coin is weighted to land heads 60% of the time. If you flip this coin three times, what is the probability that you will get at least two heads?
ANSWER: **81/125** [or **0.648**]

8. [10] This is a 20-second calculation question. Suppose 20% of the books on your bookshelf have covers and the rest do not. Furthermore, you have not read 70% of the books with covers and 60% of the books without covers. Given a random book off of your shelf that you have read, what is the probability in lowest terms that it has a cover?
ANSWER: **3/19**
[10] This is a 10-second calculation question. Add 4/11 and 5/7.
ANSWER: **83/77**

[10] This is a 10-second calculation question. Evaluate $3x^4 + 2y$ when x =3 and y=7.
ANSWER: **257**

[10] This is a 30-second calculation question. Factor $16z^2 - y^2 - 6y - 9$.
ANSWER: **(4z-y-3) (4z+y+3)**
[10] This is a 30-second calculation question. Using 3.14 for pi find the area of the ellipse whose foci are (2squareroot(10), 0) and (-2squareroot(10)), and whose eccentricity is (2squareroot(10))/11.
ANSWER: **310.86**
[10] This is a 20-second calculation question. Guglielmo wants to make as many pizzas as he can for $200. Sauce costs $1.50 a can and there is enough sauce per can for 2 pizzas. Cheese costs $2 a pack and has enough for one pizza. Dough costs $3 a can and is enough for 1.5 pizzas. Assuming he can only make an integer number of pizzas, if he makes the maximum number of pizzas, how much money will he have left?
ANSWER: **50 cents**