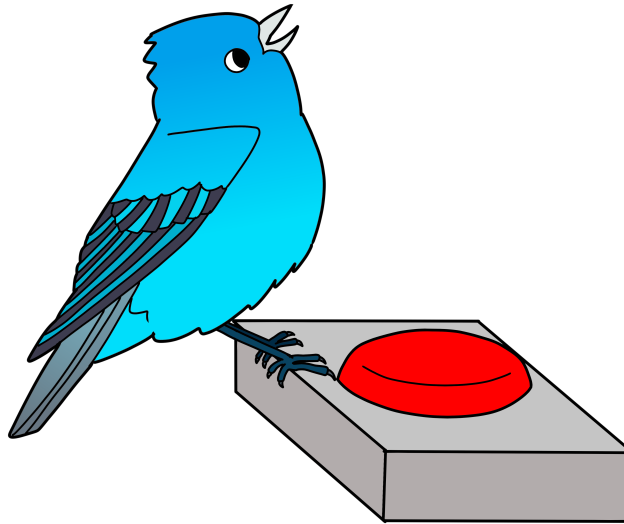


# Science Quiz Bowl C BUZZER ROUND

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**Coordinated By:**

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1. **One example of this type of enzyme activates protein synthesis via mTOR by activating Akt. This type of enzyme, which converts D-glucose to glucose-6-phosphate (\*), can act on proteins, lipids, carbohydrates and other molecules. One example of this type of enzyme is also activated when it binds to cyclin during the cell cycle., For 10 points, name the type of enzyme that catalyzes phosphorylation.**

**ANSWER: KINASE** (Biology)

2. **Increasing levels of this cellular structure in a wee1-Cdc25 mutant will not affect CDK activation during the cell cycle. About 25% of Diamond Blackfan anemia patients (\*) have a mutation for this organelle's protein S19. This organelle is composed of four different RNAs and its subunits are also characterized by Svedberg units. For 10 points, name the organelle responsible for translating mRNA to protein.**

**ANSWER: RIBOSOME** (Biology)

3. **The PCP theorem in complexity theory roughly states that in this type of optimization problems, an approximate solution, checked probabilistically, is no easier than computing exact solutions. (\*)** The discrete logarithm problem is shown to be in, at least, this set of problems in computer science. Minesweeper is an example of a game that is proven to be in this complexity class. For ten points, name this complexity class, whose relationship to P is questioned in a famous Millenium Problem that roughly states that every computationally difficult problem may be solved in polynomial time.

**ANSWER: NP** (anti-prompt on NP-complete), Misc. - Computer Science)

4. **The term for this phenomenon was coined by Sir James Alfred Ewing from an Ancient Greek word meaning "lagging behind". The curve describing the relationship between field strength and magnetization in a (\*) ferromagnetic material is described as a loop of this phenomenon. Soft iron has a smaller energy loss associated with this phenomenon than does hard iron. This phenomenon is most widely associated with changes in size or number of ferromagnetic or ferroelectric domains, although it also occurs in elastic and various other materials. For ten points, name this term for a system whose state depends on its history.**

**ANSWER: HYSTERESIS** (Physics)

5. **In 1986, residents and livestock near Lake Nyros suffered from asphyxia partially due to a lack of regularity of this hydrological process. Where this process occurs once each year, whether it occurs in the summer or winter depends on latitude and elevation (\*).** The term dimictic is used to describe its occurrence twice each year. This process is usually possible when a plot of depth versus temperature is vertical, analogous to when the thermocline is not present in the ocean. This lacustrine process occurs in the absence of stratification and is responsible for bringing nutrients to the surface and oxygen to lower depths. For ten points, name this phenomenon that mixes the lake water column.

**ANSWER: LAKE OVERTURNING** (Earth/Space Science)

6. **The discovery of the first high-temperature example of this type of material was awarded the 1987 Nobel Prize in Physics. Perfect diamagnetism occurs in these materials not due to the orientation of electron spins (\*) but due to the flow of screening currents within the materials. These materials are divided into type-I and type-II categories based on the way in which the Meissner effect breaks down in the material in very strong magnetic fields. For ten points, name this general term for a material in which electrical resistance drops abruptly to zero below a specific critical temperature.**

**ANSWER: SUPERCONDUCTOR** (Physics)

7. **In the Wegener–Bergeron–Findeisen process, the properties of these particles affect the ratio of droplets to ice crystals required for the process to proceed. When these particles have radii less than 0.2 micrometers, they are referred to as the Aitken variety (\*).** Examples include soot, sulfate, kaolinite, and salt. The existence of these particles drastically reduces the relative humidity required for cloud formation to begin. For ten points, name these small particles on which water vapor condenses.

**ANSWER: CLOUD CONDENSATION NUCLEI** (prompt on aerosol or nuclei) (Earth/Space Science)

8. **The driving force of this phenomenon is an interaction of the mean flow with wave averaged flows of the surface waves. The components of this phenomenon align in the direction of the wind and rarely have an effect below the pycnocline (\*).** It was first explained in 1938 after the phenomenon's namesake scientist crossed the calm Sargasso Sea. This phenomenon is characterized by alternating regions of upwelling and downwelling between the individual rotating cells. For ten points, name this process that consists of long sets of twisting vortices in the surface water.
- ANSWER: LANGMUIR CIRCULATION** (Earth/Space Science)
9. **This molecule is a competitive inhibitor that hyperactivates PKA, desensitizing both the beta-adrenergic receptor and glucagon receptor. This molecule, which also functions as an adenosine antagonist (\*),** is a central nervous system stimulant that can be used to treat infantile bronchopulmonary dysplasia and helps enhance pain relievers. Charles the II of England tried to ban a popular drink containing this compound in 1676, as did Frederick II of Prussia in 1777. For 10 points, name the stimulant compound often found in coffee and tea.
- ANSWER: CAFFEINE** (Biology)
10. **In complex analysis, a theorem named for this person provides values for a holomorphic function within a disk given the values on the boundary of the disk. This mathematician's functional equation, which over the rational numbers has linear solutions (\*),** is  $f(x) + f(y) = f(x+y)$  ("f of x plus f of y equals f of the quantity x plus y"). Given a positive distance, a sequence with property named for this mathematician will have only a finite number of terms greater than that distance apart from each other. For ten points, name this French mathematician, whose inequality shares its namesake with Hermann Schwarz and, in the real numbers, roughly states that the square of the sum of products is less than the product of the sum of squares.
- ANSWER: AUGUSTIN-LOUIS CAUCHY** (Misc. - Mathematics)
11. **The mathematical expression, the Slater determinant, changes its sign when the space and spin coordinates of a pair of these particles are exchanged. According to Huckel's Rule (\*),** an aromatic molecule must possess  $4n+2$ , where n is 0 or any positive integer, of a certain type of this particle. These particles, which can be confined in extremely small CMOS transistors maintained at cryogenic temperatures, experience Coulomb force interactions with protons in atomic nuclei. For 10 points, name the subatomic particle whose electric charge is -1 elementary charge.
- ANSWER: ELECTRON** (Accept fermion before mention of Huckel's Rule) (Chemistry)
12. **This experiment is considered in Wheeler's delayed choice experiment, which questions whether this experiment's inputs can sense its output. An analog of this experiment for the electron was conducted by Davisson and Germer, and yielded similar results. One phenomenon displayed in this experiment results from a (\*)** path difference that is an integer multiple of wavelength. That phenomenon's general form is represented by alternating light and dark bands displayed on a screen, or interference rings. The principle of complementarity was demonstrated when this experiment demonstrated light's wave-particle duality. For ten points, name this experiment, named for a set of openings, conducted by Thomas Young.
- ANSWER: YOUNG's DOUBLE-SLIT EXPERIMENT** (Physics)
13. **In the year 2000, Robert Solovay was presenting a talk on one of his novel algorithms which had to do with circuits with only one of these when he was interrupted by a fire alarm. DiVencenzo's criteria says that for a specific type of computer to be constructed, it must have the ability to initialize the state of these (\*)** to a simple fiducial state. One of these can be represented with a Bloch sphere, where each point on its surface maps to a state of this unit of information. In 2001, IBM used Shor's algorithm to factor the number 15 with only 7 of these. For ten points, name the quantum counterpart to a classical bit.
- ANSWER: QUBIT** (Misc. - Computer Science)
14. **In algebra, this word refers to a ring element that has an inverse. A matrix with property given by this word is the identity element of the general linear group. Dividing by the magnitude of a vector produces a new vector with property characterized by (\*)** this word. The astronomical variety of this word is defined as the distance between the Earth and the Sun. Trigonometric functions are often defined with respect to a circle of radius 1, which is usually described as a "circle" preceded by this word. For ten points, scientists usually collect measurements using the International System of what word, abbreviated SI?
- ANSWER: UNIT** (Misc. - Other/Mathematics)

15. **Description acceptable. The theory of one member of this collection was verified experimentally in only about three years by Jean Baptiste Perrin. Another member of this collection identifies two key postulates, one of which roughly asserts that if physical laws hold in one system of coordinates, then (\*) the same laws hold for any other system. One member of this set provided an explanation to the photoelectric effect; at the same time it asserted a description of light quanta, better known as photons. For ten points, name this set of papers, one of which famously asserted a relationship between a change in mass of a body and a change in energy, often summed up more simply as "E = mc squared".** **ANSWER:** ANNUS MIRABILIS PAPERS (Accept any description that mentions "Einstein" and "1905" as well) (Physics)
16. **This mass unit in this system of units describes the theoretical minimum possible mass of a Schwarzschild black hole. Similar to the Stoney units, this particular system of measurements can be described as natural units. However this system relies only on the properties of free space rather than any arbitrary particle. (\*)** First proposed in 1899, this system of measurement is commonly used in particle physics and physical cosmology. When expressed in these units, the speed of light in a vacuum, the gravitational constant, and the Boltzmann constant all have a numerical value of 1. For ten points, name this system of measurement named after a German physicist who won the Nobel Prize in physics for his discovery of energy quanta.  
**ANSWER:** PLANCK UNITS (Physics)
17. **In organic chemistry, many sugars are produced when molecules with this functional group undergo an addition with an alcohol. Molecules with this functional group can undergo oxidation. (\*)** When reduced, molecules with this group will form a primary alcohol. Compounds with this group tend to have systematic names ending in -al. For ten points, name this functional group which contains a carbonyl center bonded to a hydrogen atom and a side chain R.  
**ANSWER:** ALDEHYDE (Chemistry)
18. **The Legendre Transform of the Hamiltonian, this quantity is central to a reformulation of mechanics in 1788 built on the principle of stationary action. This perspective focuses on (\*)** minimizing the action, which is the time integral of this quantity. Therefore, if this quantity has no explicit time dependence, it follows that the action is also time invariant and energy is conserved. For each symmetry (to first order) of this quantity, Noether's theorem states that there exists a conserved momenta. This framework was proposed by the individual who identified points of equilibrium in the 3-body problem. For ten points, name this quantity often used in classical mechanics, where it is defined as the difference between the kinetic and potential energies of a system.  
**ANSWER:** LAGRANGIAN (Physics)
19. **Below 2.17 K, helium-4 behaves as though it contains a superfluid component in which this property is zero. Setting this property to zero in the Navier-Stokes equations reduces to the Euler Equations. A large (\*)** Reynolds number indicates that forces due to this property are not dominant at large scales in a fluid flow. This property is defined as the proportionality constant between shear stress and the gradient of velocity. For ten points, name this property of fluids, a measure of their resistance to deformation due to internal friction.  
**ANSWER:** VISCOSITY (Physics)
20. **One member of this set of elements was first isolated in 1895, after a Scottish chemist treated the mineral cleveite with acids. Ionization of the gas form of another one of this set of elements results in a bright orange light. Another member of this group of elements' natural radioactivity (\*)** makes it the second leading cause of lung cancer after smoking. The inertness of one of this group's members makes it useful for suppressing unintended reactions in chemical reactions and industrial processes. One of this group's members shares its name with a fictional planet which is the home of Superman. For ten points, give the common name for the members of Group 18 within the periodic table.  
**ANSWER:** NOBLE GASES (Accept "Group 18" before mentioned) (Chemistry)
21. **This plant region, which is nonexistent in wheat embryos, grows asymmetrically during apical hook formation. (\*)** The fungus *Rhizoctonia solani* affects this part of the plant, where resistance correlates with the thickness of this plant part. The plumule of a plant consists of this region, young leaves, and the shoot apical meristem. For 10 points, identify the embryonic shoot above cotyledons in plants.  
**ANSWER:** EPICOTYL (Biology)

22. **Fibonacci, Leftist, Brodal:** in computer science, these are all variants of this data structure. Insertion into the leftist variant of this data structure, which was invented by Clark Allan Crane, takes amortized (“AH-mortized”) constant time. In binary exploitation, a “double free” vulnerability can be used to perform this kind of overflow. (\*) Priority queues are primarily represented with this data structure of the same name, which itself is represented with a tree. In the C programming language, the malloc (“ma-LOCK”) keyword can be used to allocate memory to this section of memory. For ten points, name this area of dynamically allocated memory present in running programs.

**ANSWER: HEAP** (Misc. - Computer Science)

23. **One of these statements asserts the existence of the Lebesgue number in compact metric spaces given an open cover. A different one of these statements, famous in set theory, concerns upper bounds on chains and maximums and is named for Zorn. A “lifting” variety of these concerns the  $p$ -adic valuation of differences of powers (\*)** and is related to Hansel’s one of these. In number theory, one of these states that the greatest common divisor of two integers can be written as a linear combination of those two integers and is named after Bézout. For ten points, name this kind of mathematical proposition, the handshaking one of which asserts that the sum of the degrees of the vertices of a finite simple graph is even.

**ANSWER: LEMMA** (Misc. - Mathematics)

24. **In chemistry, this type of reaction requires a nucleophile to attack an electrophile, commonly accompanied by a leaving group leaving. These electrophile-nucleophile reactions can differ in their transition state energies; however, a similar type of reaction will typically have (\*)** a lower transition state energy. This type of reaction can also be viewed as a neutralization reaction. For ten points, name the reaction that will cause a protonation and deprotonation of the reactants or an exchange of the H<sup>+</sup> ion.

**ANSWER: ACID-BASE REACTION** (Chemistry)

25. **Albert Einstein’s predicted gravitational lens effect was confirmed observationally for the first time with a twin variant of these objects. The optically violent variable type of these objects can change its visible light output by 50% in a day (\*)** and are similar in appearance to BL Lacertae objects. The first of these objects appeared about 13 billion years ago and their peak epoch occurred nearly 1 billion years later. Approximately 10 to 15 percent of these objects are particularly loud at radio wavelengths. In 1984, Edwin Salpeter and Yakov Zel’dovich suggested that these objects are powered by accreting material into supermassive black holes at the centers of galaxies. For ten points, name these very luminous and seemingly star-like active galactic nuclei.

**ANSWER: QUASARS** (Earth/Space Science)

26. **A number of experiments are actively searching for a theorized form of this decay process without the emission of neutrinos, which if observed would mean neutrinos are Majorana particles. Parity violation was first experimentally demonstrated through this decay process in cobalt-60. The Fermi theory of this decay process involved the interaction of four fermions at a single vertex, which in the modern (\*)** electroweak theory is replaced by the exchange of a W or Z boson. This decay process connects isobaric nuclides. For ten points, name this form of radioactive decay, characterized by the emission of an electron or positron.

**ANSWER: BETA DECAY** (Physics)

27. **This molecule can be used to treat KRAS oncogenic mutations by targeting deregulated cellular energetics through GLUT1 transporters. This molecule, produced by the Reichstein process (\*)** cannot be synthesized in humans because our form of L-gulonolactone oxidase is highly mutated. In the 1700s, James Lind began treating pirates with scurvy with citrus fruit, which are rich with this molecule. For 10 points, name the vitamin also known as ascorbic acid, commonly found in citrus fruits, broccoli, strawberries, and other foods.

**ANSWER: VITAMIN C** (Also accept ascorbate; accept ascorbic acid before mentioned) (Biology)

28. **All chemical reactions will have transition states where the energy level of the reaction reaches its highest point. When this molecule is added, (\*)** there will be no effect on the Keq (read letter by letter) reaction. This molecule can be used in most reactions regardless of whether the Gibbs Free Energy of the reaction is net positive or negative. This kind of molecule is not consumed and not modified after its usage. For ten points, please name the generic enzyme that will change a reaction’s activation energy.

**ANSWER: CATALYST** (Chemistry)

29. **The gross structure of line spectra of hydrogen-like atoms is derived by ignoring the coupling of orbital angular momentum to this property. Helicity is the projection of this vector onto the direction of momentum (\*).** The magnetic moment of an electron is parallel to this property. Particles with an integer value of this property obey Bose-Einstein statistics. For ten points, name this form of angular momentum, which is quantized in half integer values.

**ANSWER: SPIN** (Physics)

30. **A diagram named after a winged insect illustrates the latitudinal variation of this phenomenon over time. Around the 17th century, the Maunder minimum, a period of a relatively low occurrence of these noticed by Gustav Spörer, has been proposed to be the cause of the Little Ice Age. They occur in cycles, of which the present is 25 (\*).** Each of their cycles marks a change in polarity of their parent body's magnetic field. Solar cycles were first observed by counting the number of these. For ten points, name these dark regions of the Sun's surface.

**ANSWER: SUNSPOT** (Earth/Space Science)

31. **Reasoning about this structure dates back to the fifth century BCE, when Greek philosophers (incorrectly) suggested that the shape of these structures may contribute to the flavor of certain foods. But by the 19th century, scientists had understood through a set of mathematical laws that these structures must act in proportions given their mass and size (\*).** English chemist Frederick Soddy defied the age-old description of this structure by suggesting that chemically similar types of these structures may possess different physical properties. (modern wave description over the Bohr model). For ten points, name this smallest unit of matter which constitutes a chemical element.

**ANSWER: ATOM** (Chemistry)

32. **Abstract machines can be described as being either stack machines or machines of this kind. Compilers often include an allocator for these. (\*)** In one type of exploit, control over the program is gained by writing an arbitrary value into one of these. SP ("S P") is an example of this, as is the 64-bit RAX ("R A X"). These are often used by processors as targets for arithmetic operations. For ten points, name this word, whose "cash" version goes "ka-ching!" when a cashier opens its box.

**ANSWER: REGISTER** (Misc. - Computer Science)

33. **This type of rock is the most common igneous rock in Earth's crust, produced by submarine volcanism at mid-ocean ridges and make up much of the ocean crust. This type of basaltic magma is initially generated as partial melts of peridotite (olivine and pyroxene) (\*).** produced by decompression melting of the Earth's mantle. This type of basalt constituting the oceanic crust is termed MORB: mid-ocean-ridge basalt. It describes the evolution of a mafic magma into a more evolved, silica rich end member. Rock types of this series include this type of basalt, ferro-basalt, this type of basaltic andesite, this type of andesite, dacite and rhyolite. For ten points, name the series which is one of two main series in subalkaline igneous rocks.

**ANSWER: THOLEIITIC** (Earth/Space Science)

34. **Chemical bonds are formed by the interaction of electrons, whether that be sharing electrons, stealing or giving electrons, etc. Electrons within each atom are in orbitals that estimate their electron cloud shape and are the result of this certain process. (\*)** When a molecule is capable of resonance, at least one atom within that molecule will have a more reactive, higher energy orbital as the result of this combination. For ten points, name the concept of mixing of atomic orbitals to form new hybrid orbitals that are more suitable for the pairing of electrons in chemical bonds according to the valence bond theory.

**ANSWER: HYBRIDIZATION** (Chemistry)

35. **This mineral is associated with volcanic structures that are formed by the sudden expansion of volatiles. Lamproites and another igneous rock that is found exclusively in Archaean cratons sometimes contain this mineral (\*).** Owing to the conditions this mineral forms under, it is often used in experiments that simulate the high pressures of Earth's interior. Experiments indicate that abundant amounts of this mineral condense from methane on Uranus and Neptune. For ten points, name this mineral that has a hardness of 10 on the Mohs scale.

**ANSWER: DIAMOND** (Earth/Space Science)

36. The approximate arterial reference range of this ion, important for acid-base homeostasis, is about 22 to 28 mmol/L. Salt of hartshorn is the traditional name for a salt consisting of an ammonium cation and this anion. This ion is the dominant form of (\*) dissolved inorganic carbon in seawater. For ten points, name this anion, with the empirical formula  $\text{HCO}_3^-$ .

**ANSWER: BICARBONATE** (Accept Hydrogen Carbonate) (Chemistry)

37. The "fossil" variety of this object has its original material largely replaced by terrestrial secondary mineralization but retains grains of relict spinel. The event associated with this object may form glassy, gravel sized objects completely lacking microlites or phenocrysts. (\*) The modern classification scheme groups this type of object based on structure, chemical and isotopic composition. When this object is large enough to create an impact crater, geologists refer to it as referred to as a bolide. For ten points, name this piece of debris from space that survives its passage through the atmosphere to reach the surface of a planet or moon.

**ANSWER: METEORITE** (do not accept meteoroid) (Earth/Space Science)

38. This series of genes, typically in bacteria, will be transcribed together to make enzymes that will all assist to complete the same task. In 1961, a paper was published by (\*) Jacob and Monod detailing their discovery of enzyme induction in *E. coli* as the result of this certain unit of genes. They discovered a negatively regulated system prominent in enteric bacteria. This group of genes turns on and off in response to its Catabolite activator protein and a certain repressor. For ten points, name the operon that controls the expression of genes that regulate the breakdown of lactose.

**ANSWER: LAC OPERON** (accept Lactose operon) (Biology)

39. Stirling's Approximation uses Laplace's method, which approximates integrals of this number raised to a constant times a function. This number appears in a limiting case of Bernoulli's Inequality. The Lindemann-Weierstrass Theorem establishes that any power of this constant is (\*) transcendental. Euler initially proved the irrationality of this constant using a continued fraction. For ten points, name this famous mathematical constant that is equal to the sum of the reciprocals of factorials and is represented by the fifth letter of the alphabet.

**ANSWER: EULER'S NUMBER** (Accept e, prompt on Euler's constant) (Misc. - Mathematics)

40. This question has two acceptable answers, and each clue describes only one of these answers. You may answer with either one of the answers. In computer science, this structure is used in the Huffman compression algorithm to construct lowest-frequency trees. In mathematics, this letter represents a set of numbers, which can be constructed as the equivalence classes of an ordered pair of integers. (\*) This data type is used in most implementations of the breadth-first search graph algorithm. This letter represents a set of numbers that is famously dense over the set of reals, and can be expressed as the quotient of two relatively prime integers. For ten points, name the 17th letter of the alphabet representing the set of rationals, which when pronounced, sounds like a first-in-first-out data structure.

**ANSWER: Q or QUEUE** (Misc. - Other)

41. This event was partly caused by the breakup of the Weddellian Isthmus. Prior to this event, Arecaceae, Fagus, and Pinophyta were common taxa on a continent which shares its name with this event. This event primarily began in the southern hemisphere, while its defining characteristic would not spread to the northern hemisphere for nearly 30 million years, after the Isthmus of Panama was closed. Beginning around 22 million years after the (\*) PETM, atmospheric carbon dioxide levels were around 750 ppm. This event's namesake continent would be covered by its namesake characteristic by around 28 million years ago. The Great American Interchange occurred 9.5 million years ago during this event. This event is still ongoing, although it is currently an interstadial period. For ten points, name the current period of worldwide cooler temperatures which saw the rise of many hominid species, mastodons, and smilodons.

**ANSWER: ANTARCTIC GLACIATION or LATE CENOZOIC GLACIATION** [Accept Ice Age in place of glaciation; prompt on Late Cenozoic or Cenozoic; anti-prompt on Pleistocene/Quaternary Glaciation/Ice Age; do NOT prompt on solely glaciation or ice age] (Earth/Space Science)

42. The chorioallantoic membrane assay has been used as a cheaper model to study this process, first recorded by Scottish surgeon John Hunter to follow Aristotle's basic law of nature "form follows function". This process presents itself in two types, sprouting and intussusceptive (\*), both of which occur in essentially all tissues and organs. This process is induced in hypoxic tumor cells by excreting growth factors such as VEGF. For 10 points, name the process of growing new blood vessels from pre existing vessels.

**ANSWER: ANGIOGENESIS** (Biology)

43. This molecule can appear in three main conformations, A, B, and Z. The topology of this polymer can be described with three values, describing the way it is coiled and packaged within the cell. (\*) This essential molecule is composed of two long strands which form major and minor grooves in its double helical structure. For ten points, name this biomolecule found in the nucleus which contains genetic instructions in the form of the four nitrogenous bases A, G, C and T.

**ANSWER: DNA** (prompt on "nucleic acid") (Biology)

44. This laboratory technique, invented in 1983 by Kary Mullis, has been modified to detect CpG islands in genomic DNA. It is also an important technique that can be used to detect adaptive mutations in cancer patients by detecting ctDNA levels (\*), and often uses Taq polymerase from the bacterium *Thermus aquaticus*. Mullis used Sanger sequencing as the basis for this technique, adding a second primer and repeatedly using DNA polymerase. For 10 points, name the laboratory technique that allows scientists to amplify a very small sample of DNA by using thermal cycling, primers, and DNA polymerase.

**ANSWER: PCR or POLYMERASE CHAIN REACTION** (Biology)

45. At temperatures above 600 K and pressures above 17 gigapascals, this element forms an allotrope with a deep red color and monoclinic C2/m structure. Vienna Standard Mean Ocean Water contains two isotopes of this element in a ratio of approximately 2005 parts per million. (\*) The modern term for this element was coined by Antoine Lavoisier, replacing the previous name "dephlogisticated air". For ten points, name this chemical element with the atomic weight 15.999.

**ANSWER: OXYGEN** (Chemistry)

46. Lipschitz functions with finite constant K on a bounded interval satisfy this property. Thomae's function satisfies this property on some bounded interval (\*), but Dirichlet's function does not satisfy this property. Continuous functions satisfy this property if the set of discontinuous points has measure zero. A function satisfies this property if the supremum of the set of lower Riemann sums given any partition P is equal to the infimum of the upper Riemann sums given any partition P. For ten points, name this property of a function, which is implied from anti-differentiability, although the converse is not true.

**ANSWER: INTEGRABILITY** (Misc. - Mathematics)

47. This organic compound is formed when benzo(a)pyrene is oxidized by cytochrome P450, and is specifically known to cause oncogenic mutations. This compound, which can be synthesized with a Williamson ether synthesis (\*), can isomerize in the presence of transition metal catalysts. This organic compound, which can form a trans diol through an SN2 reaction, may undergo ring expansion when reacting with different compounds. For 10 points, name the very reactive 3-membered cyclic ether also known as an oxirane.

**ANSWER: EPOXIDE** (Chemistry) (Accept oxirane before mentioned)

48. In cryptography, the "LadderLeak" attack is a novel side-channel attack that breaks this version of a signature scheme. The Montgomery ladder is a method of scalar point multiplication on a certain algebraic group, which these cryptosystems are based on. (\*) These three letters also stand for an encoding scheme, which implements an algorithm that adds redundancy to data. A popular version of this three-letter encoding scheme is named after the mathematician Richard Hamming. For ten points, what are these three letters, which can represent both a type of algebraic curve and an encoding scheme used to reduce errors in data transmission over a noisy channel?

**ANSWER: ECC** (Accept Elliptic Curve or Elliptic Curve Cryptography before power) (Misc. - Computer Science)



49. **SBDD is a disease affecting a certain part of the body due to long-term non-steroidal anti-inflammatory use, causing gastrointestinal tract bleeding and intestinal obstruction. This word is both a muscle in the human body and a form of female birth control (\*),** and contains three major openings at T8, T10, and T12. This large, dome-shaped muscle separates the chest and abdomen into two large, distinct cavities. For ten points, name this muscle that sits below the ribcage and helps with respiration by creating a vacuum-like effect in the lungs.

**ANSWER: DIAPHRAGM** (Biology)

50. **In 1951, a classified project conducted at this institution was named after a hotel in the city where this institution is located. This institution is known for its residential system, which includes buildings such as “Fleming” and “Page.” This institution has a history of conducting elaborate pranks (\*),** among the most famous of which is nicknamed “The Great Rose Bowl Hoax”. This year’s National Science Olympiad Tournament Director and Southern California Science Olympiad State Director is an alumnus of this university. For ten points, name this university located in Pasadena, California, notable as the host of the 2022 National Science Olympiad Tournament.

**ANSWER: CALIFORNIA INSTITUTE OF TECHNOLOGY** (Accept Caltech) (Misc. - Other)