

# Science Bee Round 2

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## Regulation Tossups

(1) The title of a book by Leon M. Lederman inspired one name for this entity, which was the subject of the "central problem." François Englert received the 2013 Nobel Prize for Physics for his work at CERN that was thought to involve the discovery of this entity. This entity was sought in order to prove an unexplained gap in the Standard Model, and this particle possesses even parity and lacks color, charge, and spin. Produced by its namesake's field, this is, for the point, what particle, a boson sometimes called the "God Particle?"

ANSWER: **Higgs Boson** (accept **Higgs** Particle; prompt on "Boson;" prompt on "Higgs" field by asking "What particle is associated with it?;" prompt on the "God Particle")

(2) William Derham accurately measured this quantity using the mostly displaced metric of Parisian feet. The choked velocity in a nozzle is usually less than this quantity, which is at its lowest within an ocean layer known as the SOFAR channel. Shockwaves may form when this quantity is surpassed, and, at 68 degrees Fahrenheit, the measure of this quantity is 343 meters per second. Supersonic travel is accomplished by exceeding, for the point, what quantity sometimes known as Mach 1?

ANSWER: **Speed of Sound** (accept **Mach 1** before mentioned)

(3) The developer of this concept referred to its particles as "corpuscles." Arthur Haas utilized a derivative of this concept with a single electron to determine the value of Planck's constant. This concept was superseded by Ernest Rutherford's model after students Hans Geiger and Ernest Marsden proved the existence of the nucleus using gold foil. Developed by J. J. Thomson, this is, for the point, what early atomic model exhibiting negatively charged electrons surrounded by a positively charged volume, named for a dessert?

ANSWER: **Plum Pudding** Model

(4) The "isothermal titration" form of this technique encloses samples in an adiabatic jacket. A polymer's phase change is marked by a sharp peak on a plot produced by this technique's "differential scanning" type, and the equation "Q equals MC delta-T" is used alongside this analytical technique. The constant-volume "bomb" form of this technique maintains very high pressure, though a simpler type can be performed using a thermometer and two Styrofoam cups. For the point, name this technique that measures the heat produced by a chemical reaction.

ANSWER: **Calorimetry** (accept **Calorimeter**; accept Bomb **Calorimetry**; accept Differential Scanning **Calorimetry**; accept Isothermal Titration **Calorimetry**)

(5) Up until the late 1800s, the most common means of extracting this element from the ground was the Sicilian method, which eventually came to be replaced by another method relying on superheated water. A platinum catalyst was originally used to create a compound named for, and containing, this element in the contact process. Brimstone was an ancient name for this element which, when combined with hydrogen, produces a compound with a smell resembling rotten eggs. For the point, name this yellow-colored element with chemical symbol S.

ANSWER: **Sulfur** (accept **S**)

(6) The two researchers who discovered this element erroneously thought that they had also discovered an element they called metargon, which was found to simply be contaminated argon. A commercial device that uses this element was preceded by a gas discharge tube named for Heinrich Geissler. This element, which is the first to fill up its p subshell, emits a red hue within an electrical field. For the point, identify this element and lightest of the noble gases, which is commonly used in bright electrical signs.

ANSWER: **Neon** (prompt on "Ne")

(7) The "short-path" type of this technique may use a vacuum tube called a Kugelrohr. The Fenske equation is used during this technique to calculate a minimum number of equilibrium "theoretical plates," and refluxing is used in this technique to continually re-condense solvents. Solutions of 96% ethanol in water (or other azeotropes) cannot be separated using the "fractional" form of this technique, which is used to refine petroleum. For the point, name this process of separating liquids by their boiling points.

ANSWER: **Distillation** (accept Fractional **Distillation**; accept Short-path **Distillation**)

(8) Reactions with this gas result in the cleavage of unsaturated bonds of alkenes, alkynes, and azo compounds. The odor of this gas is typically present following a lightning storm, since heated air splits nitrogen and oxygen bonds. An effort to protect this gas in the atmosphere was undertaken by the Montreal Protocol, which sought to decrease the production of chlorofluorocarbons. For the point, name this gas that is comprised of three oxygen atoms, whose stratospheric type acts as a protective shield against the sun's UV rays.

ANSWER: **Ozone** (accept **Trixygen** or **O3** before it is mentioned; accept **Ozone** Layer; accept Stratospheric **Ozone**; accept Tropospheric **Ozone**)

(9) A monotypic example of these organisms is a genus endemic to the Namib desert called *Welwitschia*. *Picea abies* was the first of these organisms to have its genome sequenced, and these organisms include cycads. The counterparts of these organisms notably enclose one of their central products, and the maidenhair tree, or *Gingko biloba*, is one of these organisms that include gnetophytes and conifers. For the point, identify these plants whose method of seed production contrasts with angiosperms.

ANSWER: **Gymnosperms** (prompt on "Plants" or "Trees" before mentioned)

(10) An isomerization reaction in this pathway is catalyzed by the iron-containing enzyme aconitase. Dehydrogenases within this pathway convert between the intermediates succinate, fumarate, and malate. In the first stage of this pathway, oxaloacetate condenses with acetyl-CoA to form citrate, which gives an alternative name to this pathway that occurs in the mitochondrial matrix. For the point, name this cycle that follows glycolysis within cellular respiration, and is sometimes named for a German biochemist.

ANSWER: **Krebs** Cycle (accept **Citric Acid** Cycle before mention of "Citrate;" accept **Tricarboxylic Acid** Cycle; accept **TCA** Cycle; prompt on "Cellular Respiration")

(11) In October 2021, the WHO endorsed the RTS,S vaccine to protect against this disease that can be prevented through using DEET or picaridin. Chinese researcher Tu Youyou investigation into this disease involved a treatment with a drug she discovered call artemisinin, which is used alongside quinine and doxycycline to treat this disease. Individuals lacking the Duffy antigen are immune to this disease that is caused by organisms from the [i]Plasmodium[/a] group. For the point, name this mosquito-borne infectious disease characterized by cyclic fevers.

ANSWER: **Malaria**

(12) A Scholander bomb is a device used to measure the water potential in this structure that likely originated from the Ordovician period. The development of this structure is split into "proto" and "meta" phases, and the Casparian strip helps regulate the entry of substances into this structure. Pressure flow and cohesion-tension theories explain water transport through this tissue that contains four types of cells, including tracheids and parenchyma. For the point, identify this vascular plant tissue that helps transport water upward, contrasted with phloem.

ANSWER: **Xylem**

(13) One class of these compounds is often co-administered with clavulanic acid as a method of suicide prevention. The enzyme DD-transpeptidase is inactivated by a class of these compounds that contain a four-membered amide ring. Resistance to these compounds can be conferred by gene cassettes that are transferred horizontally on plasmids. Beta-lactamases are often expressed by Gram-negative organisms to break down a class of these compounds that includes cephalosporin and penicillin. For the point, name these compounds that fight bacterial infections.

ANSWER: **Antibiotics** (or **Antibacterials**; accept Beta-lactam **Antibiotics**; accept **Penicillins**; accept **Cephalosporins**; prompt on "Lactams;" prompt on "Antimicrobials")

(14) This type of cloud comes in species such as *spissatus* and *fibratus*, the latter of which is the most common. This cloud type is the highest of the two that can produce a phenomena called fallstreak holes. This type of cloud occurs near the tops of stacked cumulonimbus clouds, and its low temperature usually results in the formation of ice crystals. For the point, identify this type of high, wispy cloud that takes its name from the Latin for "curl of hair," abbreviated Ci [[C-I]].

ANSWER: **Cirrus** (prompt on "Cirrostratus" or "Cirrocumulus")

(15) The strength of these phenomena are measured on the Sieberg-Ambraseys Intensity Scale. Changes in barometric pressure during extreme weather events like thunderstorms can cause the meteorological version of these events, which are characterized by entities that have abnormally high crests. One of these phenomena named for Boxing Day struck in 2004 and devastated Aceh province in Sumatra. Often caused by earthquakes centered underwater, these are, for the point, what phenomena characterized by large waves making shore?

ANSWER: **Tsunami** (prompt on Underwater "Earthquake" before mentioned)

(16) The collection of sand in one part of these entities can give rise to a knob. Ogives result in what appear to be alternating bands in these regions whose base can form chatter marks. The valley variety of these entities can undergo a form of bedrock abrasion known as plucking. Pressure from sediment underlying these entities can contribute to basal sliding. These entities are created when one form of precipitation surpasses its ablation, and the Alpine variety of these entities can form at mountaintops. For the point, name these large bodies of slow-moving ice.

ANSWER: **Glaciers** (accept Valley **Glaciers**; accept Alpine **Glaciers**)

(17) One of these objects, considered to be the least massive of its type, is sometimes referred to as Draugr. The 2019 Nobel Prize in Physics was awarded for discovery of one of these objects known as 51 Pegasi b. Changes in light during one process can help detect and predict features of these objects in the transit method. Most of these bodies can be found within the tidal locking zone, and rogue varieties of these objects do not revolve around a star. For the point, name these planets outside of the solar system.

ANSWER: **Exoplanets** (accept **Extrasolar Planets**; **Planets Outside the Solar System** or similar answers until "Outside" is mentioned and prompt after)

(18) The Cassegrain design can be employed when making one type of these objects, examples of which include IRAS and ISO. Cryogenic assembly is a characteristic of many of these objects for which a dedicated multiband photometer is used in one of these objects named for Lyman Spitzer, while the Chandra variety of these objects focuses on X-Rays. A nearly eight-foot mirror can be found on one of these objects named for Edwin Hubble. For the point, what are these objects used to observe distant stars?

ANSWER: **Telescopes** (accept Space **Telescopes**; accept Hubble Space **Telescope**)

(19) Kruskal–Szekeres coordinates are used in the study of the geometry of these entities, for which fuzzballs are said to be quantum explanations. A region around these objects caused by rotational dragging is known as the ergosphere, which is central to a theoretical mechanism by which energy is extracted from them that is named for Roger Penrose. Karl Schwarzschild lends his name to a measure of the event horizon surrounding these bodies that contain a singularity. For the point, name these astronomical bodies from which light cannot escape.

ANSWER: **Black Holes**

(20) A largely outdated variety of these structures used flat stones in its construction and was known as the clapper type. Assessments of the temporary conditions of these structures are done by calculating the live load. Like dams, these structures can be supported by abutments and they can be supported by girders. Piers can be used to support these structures, the most common varieties of which are the cantilever and suspension types. Consisting of decks often traversed by vehicles, these are, for the point, what structures that can pass over bodies of water?

ANSWER: **Bridges** (accept Suspension **Bridges**; accept Cantilever **Bridge**; accept Clapper **Bridges**)

(21) One subtype of these materials can be created in a process known as plasma etching. The cat's whisker detector was the first diode made of these materials, and that device was manufactured by the company Fairchild. These materials include gallium arsenide, and these materials can add electrical qualities through a process called doping. As temperature increases, the resistivity decreases in these materials that include transistors. For the point, name these materials that share properties of both insulators and conductors.

ANSWER: **Semiconductor** (anti-prompt on "Transistors" before mentioned; anti-prompt on "Integrated Circuits" or "Diode")

(22) The approximation of this number is the simplest application of the Babylonian method. One plus "this value" equals the limiting ratio of consecutive Pell numbers, which is called the silver ratio. Because his followers first demonstrated its irrationality through studies of a square's diagonal, this value is also called Pythagoras's constant, and this number is the length of the hypotenuse of a right triangle whose legs each have a length of one unit. For the point, name this number approximately equal to 1.414.

ANSWER: The Square **Root of 2** (or **Root 2**; or **Radical 2**; accept **Pythagoras's** Constant before mentioned)

(23) A set of axioms describing these objects was developed by Zermelo and Fraenkel. A theorem equivalent to the axiom of choice states that all of these objects can be well-ordered. A table of ordered pairs is produced by applying the Cartesian product to two of these objects, and functions that map between these objects can be classified as injective, surjective, or bijective. The "empty" type of these objects has a cardinality of zero. Union and intersection are operations that can act on, for the point, what mathematical collections of elements?

ANSWER: **Sets** (accept **Set** theory; accept Empty **Set**; accept Injective **Sets**; accept Surjective **Sets**; accept Bijective **Sets**)

(24) This scientist developed the processing program FLOW-MATIC, and their ideas inspired the creation of the programming language COBOL. This scientist created the A-0 to teach computers how to translate English into machine code. This woman who attained the rank of rear admiral was the oldest officer in the U.S. armed forces at the time of her retirement. For the point, identify this Navy programmer who made major contributions to the MARK I computer and created the first compiler.

ANSWER: Admiral Grace **Hopper** (or Grace Brewster **Murray Hopper**; accept either underlined portion)

(25) A molybdenum foil from one of these devices resulted in the first isolation of isotopes of technetium. Isochronous and spiral-sector types of these devices maximize the potential energy generated by its beams, and the first of these devices was installed at the Radiation Laboratory at the University of California, Berkeley. The synchrotron largely supplanted, for the point, what type of particle accelerator with a circular trajectory that was developed by Ernest O. Lawrence?

ANSWER: **Cyclotron** (accept Isochronous **Cyclotron**; accept Spiral-Sector **Cyclotron**)

(26) The programming language Superplan introduced a now-common one of these entities whose form was defined with an "a sub i + addend" expression. A form of space-time tradeoff that attempts to optimize the speed at which a program executes is partly named for these entities and is known as their namesake "unwinding." A count-controlled variety of these entities often employs the keyword "for" and is contrasted with the "while" variety, which occurs as long as a condition is met. For the point, name these computing statements that repeat an instruction set until satisfied.

ANSWER: **Loops** (accept for **Loop**; accept While **Loop**; accept **Loop** Unwinding)

(27) Chyle is a bodily fluid composed partially of this material that forms when fats enter capillaries of this substance called lacteals. A namesake heart of this material appears as a paired organ in amphibians and other animals. Elephantiasis can be caused by obstruction of the vessels that carry this material, which collects in small clusters of namesake organs that may swell as the result of infection. A system of the human body distributes, for the point, what fluid that accumulates in namesake nodes?

ANSWER: **Lymph** (accept **Lymph** Heart; accept **Lymph** Capillaries; accept **Lymph** Nodes)

(28) The reaction of serine and tetrahydrofolate produces this amino acid, along with 5,10-CH<sub>2</sub>-THF, and water. 5ALA is a compound produced from succinyl-CoA and this amino acid, which can be formed by the amination of MCA and ammonia. The toxin tetanospasmin inhibits GABA and this amino acid, which can act as a neurotransmitter. Notably achiral, this is the most abundant amino acid in the skin of mammals and in the triple helices of collagen. Containing a lone hydrogen atom side chain, this is, for the point, what amino acid symbolized G?

ANSWER: **Glycine** (accept **Aminoacetic Acid**; prompt on "G;" prompt on "Gly")

(29) Pyrrolysine is an alpha-amino acid involved in the synthesis of these compounds, and SH3 is a namesake domain of these compounds that can be replaced during their namesake turnover. Anfinsen's dogma hypothesizes how to determine the structure of the small, globular variety of these compounds in a physiological environment. Western blot can be used to analyze these compounds that turn into a three-dimensional structure through their namesake "folding" process. Containing a minimum of one polypeptide, these are, for the point, what compounds that include enzymes?

ANSWER: **Proteins** (accept Globular **Proteins**; accept **Protein** Folding; accept **Protein** Turnover)

(30) A model named after these particles superseded a model proposed by Shoichi Sakata, and that model was independently proposed by Murray Gell-Man and George Zweig. The anti- variety of these particles is denoted with a bar (-) above its symbol, and those types of these particles possess color charges of antired, antiblue, and antigreen. Neutrons are made up of two "down" and one "up" types of these particles, which are bonded by gluons. For the point, name these elementary particles whose six flavors include top, bottom, charm, and strange.

ANSWER: **Quarks** (accept Up **Quarks**; accept Down **Quarks**; accept Top **Quarks**; accept Bottom **Quarks**; accept Charm **Quarks**; accept Strange **Quarks**)

(31) Biomolecules are purified using a form of this process called "salting out." The "immuno-" type of this process uses a substrate-coupled antibody to collect specific proteins. Cold ethanol can be used to isolate DNA via this process, which leaves behind a liquid called the supernatant. A reaction's K<sub>sp</sub> value describes an equilibrium where the rate of dissolution equals the rate of this process, and ammonium and nitrate compounds can never undergo this process, according to the solubility rules. For the point, name this process that forms an insoluble solid product from a solution.

ANSWER: **Precipitation** (or Forming a **Precipitate**; accept **Recrystallization**; prompt on "Deposition")

(32) A study led by Gene Robinson concluded that these animals who foraged had higher levels of octopamine than those that did not. RNA viruses, such as the *Israeli acute paralysis virus*, was linked to a population collapse of these animals. A 2008 study from the University of Illinois-Champaign discovered that these animals "dance more" while under the influence of cocaine. Karl von Frisch won the Nobel Prize in 1973 for successfully translating the "waggle dance" these animals used while gathering resources. For the point, what insects, of the genus *Apis*, pollinate plants and collect nectar?

ANSWER: **bees** (accept honey **bees**)



(33) A discontinuous path is a key characteristic of the skipping variety of these phenomena, a particularly large example of which affected Gainesville in 1936. "Roping out" is the condition involving the stretching of one part of these phenomena whose namesake "families" arise from the same storm cell. The Fujita scale measures the strength of these phenomena, which are highly concentrated in states like Oklahoma that make up its namesake "Alley." For the point, identify these destructive, spinning weather phenomena.

ANSWER: **Tornado** (accept equivalents such as **Twister**s; accept **Cyclones**)

(34) They're not polymers, but the "shape memory" kind of these substances can reverse their deformation at high temperatures. The Heusler type of these substances display ferromagnetism, though their components do not. Smaller atoms substitute into a large crystal lattice in the "interstitial" type of these substances, which include austenite. Mercury-containing examples of these substances are called amalgams. For the point, name these mixtures of two or more metals, which include brass and bronze.

ANSWER: **Alloys** (accept **Intermetallics**; prompt on "Metals")

(35) One class of these objects represents a quark changing flavor via a W or Z loop and is named for a penguin. Either the t-channel or u-channel types of these objects can be used to represent a process involving the exchange of a photon between two electrons in Møller scattering. Gluons in these objects are denoted as helices, while photons are denoted as waves. For the point, name these diagrams that exhibit the interactions between subatomic particles and are named after an American physicist.

ANSWER: **Feynman** Diagrams

### Extra Questions

(1) One of these objects that is sometimes named for its use of Kjeldahl bulbs is often spherical in shape. A hose barb protrudes from the neck of these objects, which, though not burners, are sometimes named for Bunsen, but better known as the Büchner variety. Like test tubes, these objects can employ rubber stoppers, and one of these objects named for Erlenmeyer has a flat bottom and a conical shape. Often noting millimeters amounts on their exterior, these are, for the point, what pieces of laboratory glassware that hold liquids?

ANSWER: **Flasks** (accept Erlenmeyer **Flasks**; accept Büchner **Flasks**; accept Kjeldahl **Flasks**; accept Bunsen **Flasks**)

(2) Vanillin is a phenolic example of this functional group, which can be reduced by an acyl chloride in the Rosenmund reaction. A drug used to treat alcoholism known as disulfiram can inhibit the dehydrogenase of one member of this functional group, which catalyzes a reaction that converts acetic acid. The simplest member of this functional group is named for its similarity to formic acid. Containing a formyl group, this is, for the point, what functional group often contrasted with ketones whose simplest member is used to preserve bodies and other specimens?

ANSWER: **Aldehydes** (accept **Acetaldehyde**; accept **Ethanal**; accept **Formaldehyde**)