

Science Bee Round 3

Regulation Tossups

(1) The limit of this concept is being tested in the VIP2 experiment by a laboratory below the Gran Sasso Mountain. A quantum number in this concept must be opposite half-integers of either $+1/2$ or $-1/2$. The application of Hund's rule to this concept dictates that all orbitals must be filled with electrons with parallel spins before being paired with an opposite spin, while the Aufbau [[OWF-bow]] principle states that electrons occupy subshells with lowest available energy first. For the point, name this principle that states that no two electrons in an atom can have identical quantum numbers.

ANSWER: **Pauli Exclusion** Principle

(2) This dimensionless value is plotted against the Hersey number on the y-axis of a Stribeck curve. One form of this value is calculated as the arctangent of the angle of repose, and this value can be empirically measured as the ratio between a hanging and a resting mass in a tribometer. Lubricants lower this value for a surface, which is multiplied by the normal force to give the magnitude of a force with both static and kinetic types. For the point, name this scalar value that describes the force between two objects rubbing together, symbolized as "mu."

ANSWER: **Coefficient** of **Friction** (accept **Mu** before mentioned; accept **Coefficient** of Static **Friction**; accept **Coefficient** of Kinetic **Friction**; prompt on "Friction" or "Static Friction" or "Kinetic Friction")

(3) An effect involving atomic nuclei within a solid that are subject to this phenomenon without recoil is known as the Mössbauer effect. That effect is named after the scientist who created a spectroscopy technique in which this phenomenon is generated when Cobalt-57 decays to Iron-57. This phenomenon is a byproduct of the alpha decay of Americium-241 to Neptunium-237, and the most intense form of this phenomenon in the universe is released in "bursts" that are formed when a supernova or superluminous supernova implodes. For the point, name this massless, high-energy radiation with the shortest wavelength.

ANSWER: **Gamma** Radiation (accept **Gamma** Rays; accept **Gamma** Ray Bursts; prompt on "Radiation" before mentioned)

(4) The Richardson number is used to determine if this process is natural or forced, and neither type of this process is negligible if the value lies between 0.1 and 10. This process creates hexagonal patterns known as Rayleigh-Bénard cells, and the ratio of this process to conductive heat transfer is known as the Nusselt number. Heating water demonstrates this process because less dense, hotter molecules rise as the more dense, cooler water molecules sink. For the point, name this mode of heat transfer that occurs by the movement of a liquid or gas.

ANSWER: **Convection** (accept Natural **Convection** or Forced **Convection** before mentioned)

(5) In one method for calculating this quantity, little g is multiplied by the difference in the mass of two objects, all divided by the sum of the masses. In Torricelli's formula, a coefficient is multiplied by both this quantity and the change in displacement. Jerk is the time derivative of this quantity that has a value of zero for an inertial reference frame. For the point, what is this quantity given by " Δv " over " Δt ," a measure of the rate of change in velocity?

ANSWER: **Acceleration**

(6) A 1,2-diaryl [[DI-AYR-ull]] one of these compounds is formed in the Fritsch-Buttenberg-Wiechell rearrangement. Aldehydes are converted into these compounds in that aforementioned rearrangement, which is the second step in a type of substitution reaction. The Sonogashira reaction creates a bond between an aryl halide and one of these compounds that are created in the Corey-Fuchs reaction. The simplest form of these compounds with formula C_2H_2 acetylene. For the point, name these hydrocarbons characterized by at least one carbon-carbon triple bond.

ANSWER: **Alkynes**

(7) Dissolved electrons in liquid ammonia attack this molecule in the simplest form of the Birch reduction. Functional groups are added to this molecule in most EAS reactions, such as the Friedel-Crafts alkylation. The methylation of this molecule produces toluene. When it serves as a functional group, this molecule is called "phenyl," and August Kekule proposed the structure for this molecule, whose aromaticity is represented using a hexagon containing a circle. For the point, name this organic molecule with formula C_6H_6 .

ANSWER: **Benzene** (accept **C6H6** before mentioned)

(8) One type of this reaction proceeds via the Cossee-Arlman mechanism. Telechelic molecules are both produced by, and can serve as, reactants for one of these reactions, which are called "living" if they cannot terminate. The RAFT type of this reaction transfers free radicals during its propagation steps. Terminal alkenes bind to a Ziegler-Natta catalyst in one type of this reaction, which can come in "step-growth" and "chain-growth" subtypes. For the point, name these reactions that assemble individual subunits called monomers into long chains.

ANSWER: **Polymerization** reaction (accept Making **Polymers**; accept RAFT **Polymerization**; such as Radical **Polymerization**; accept Living Polymerization[/a]; accept Step-growth or Chain-growth ; accept Step-growth or Chain-growth **Polymerization**)

(9) Common mistakes made while using one device that measures this quantity include pushing down to the "second stop" while collecting a sample or not switching tips. The "serological" or "Mohr" types of a device that measures this quantity often use a rubber bulb as a vacuum source. Titration is also referred to a type of analysis named for this quantity, which is measured using a burette, and this quantity is accurately assessed by reading the point at the bottom of the meniscus. For the point, name this quantity measured in milliliters using a graduated cylinder.

ANSWER: **Volume** (accept **Volumetric** Analysis)

(10) According to Bredt's rule, these interactions cannot occur at the bridgehead of a ring system. Lindlar's catalyst selectively forms these interactions between carbon atoms, and these interactions alternate in the simplest conjugated systems, such as butadiene. E-Z notation describes the orientation of atoms around these interactions, which also link the carbon and oxygen atoms in a carbonyl [[car-bo-NEEL]] group. These interactions consist of one sigma bond and one pi bond. Alkenes contain, for the point, what covalent bonds that share four electrons?

ANSWER: **Double Bonds** (accept **Alkenes** before Carbonyl; prompt on "Covalent Bonds;" prompt on "Pi Bonds")

(11) This element has the highest atomic number among the three elements in a popular reducing agent discovered by Finholt, Bond and Schlesinger. That reducing agent is a hydride consisting of this element and lithium, and it's not gallium, but the ore bauxite provides large quantities of this element, which is extracted in the Bayer Process. This metal is present along with silicon in all feldspars, and the 27 isotope is the only stable isotope of this element with atomic number 13. For the point, name this element used in little league bats and soda cans with the chemical symbol Al.

ANSWER: **Aluminum** (accept **Aluminium**; accept **Al** before mentioned)

(12) This quantity is plotted on the X-axis of a Pourbaix diagram. During the first step of 2D gel electrophoresis, isoelectric focusing is used to separate proteins along a gradient of this quantity. Both glass electrodes and Hydrion paper are used to measure this quantity, which mediates the color change of phenolphthalein. The Henderson-Hasselbalch equation relates a system's pKa to this quantity, which is found by taking the negative log of H-plus concentration. A scale ranging from 0 to 14 gauges, for the point, what measure of relative acidity?

ANSWER: **pH** (accept **Power** of **Hydrogen**)

(13) An outbreak of this organism linked to organic fenugreek sprouts killed 53 people in 2011 due to the acquisition of the Stx2 gene. Laboratory strains of these organisms include B and K-12 types, which were the subject of Richard Lenski's evolution studies and were used in the Messelsohn-Stahl experiments. Several strains of this bacterium used to study the *lac* operon can cause serious food poisoning. For the point, name this rod-shaped bacterium, an important model organism of molecular genetics found in the human gut.

ANSWER: **Escherichia coli**

(14) A technique named for this substance uses formaldehyde to crosslink proteins, which are then immunoprecipitated with antibodies. HDAC enzymes remove acetyl groups from this substance to form its more tightly-packed "hetero-" form. The 30 nanometer fiber of this substance resembles coiled "beads on a string," with each consisting of a nucleosome containing eight histone proteins and wound-up nucleic acid. For the point, name this macromolecular complex of DNA and proteins that condenses into chromosomes.

ANSWER: **Chromatin** (or Hetero**chromatin**; or Eu**chromatin**; accept **Chromatin** Immunoprecipitation; prompt on "DNA" or "Histones")

(15) Cancer of this structure often involves a mutation of the KRAS gene and can be identified through the tumor marker CA19-9. A structure known as the ampulla of Vater is formed when the sphincter of Boyden helps join this organ to the gallbladder via their common bile ducts. This organ is divided into endocrine and exocrine portions, and Delta cells found in the Islets of Langerhans help this organ to secrete the hormone somatostatin. Blood sugar levels are regulated by, for the point, what digestive organ that secretes glucagon and insulin?

ANSWER: **Pancreas**

(16) The Trofile assay identifies the cell types infected by this virus, which expresses the glycoprotein gp120 on its envelope. A deletion of 32 base pairs on chromosome 3 confers resistance to this virus by stopping the expression of CCR5 receptors on white blood cells. Patients infected with this virus often develop Kaposi's sarcoma, and the drug AZT inhibits the activity of reverse transcriptase in this virus, which attacks CD4 helper T-cells to weaken the immune system. For the point, name this virus that causes AIDS.

ANSWER: **HIV** (or **Human Immunodeficiency Virus**; do not accept or prompt on "AIDS")

(17) While working on the Hubbard Brook Ecosystem Study, Gene Likens discovered this phenomenon for the first time in North America and linked it to a certain human-created cause. Numerous studies have connected the increased prevalence of this phenomenon in certain ecosystems with the decline in sugar maple populations. Nitrogen oxide emissions can cause this form of precipitation that causes steel buildings to corrode. Containing increased quantities of hydrogen ions, this is, for the point, what form of precipitation characterized by a low pH?

ANSWER: **Acid Rain** (prompt on "Rain;" prompt on "Snow;" prompt on "Hail;" prompt on "Precipitation" before mentioned)

(18) Gas flows in a radial fashion across a region of these features in the Evershed effect. The cyclical decline in latitude of these features is described by a law named for Gustav Spörer, and a period beginning in 1645 exhibited a significantly lower amount of observations of these features than normal. The Maunder Minimum was a period of low observance for these features that vary within 11 cycles and can be caused by reductions in convection. For the point, identify these low temperature regions of a solar body that appear as dark marks on the solar system's largest star.

ANSWER: **Sunspots**

(19) Michael Brown discovered the second-largest known object in this region that is named after a god from the mythology of the Easter Islanders. Predictions have failed to explain the lack of large objects beyond this region's 1:2 resonance, and Methane and ammonia are among the "ices" that make up bodies in this region which is closer than the Oort Cloud to the sun. Other bodies within this region include Haumea and Makemake, as well as a reclassified body discovered by Clyde Tombaugh. Pluto can be found within, for the point, what disc-shaped region of the Solar System named for a Dutch astronomer

ANSWER: Edgeworth-**Kuiper** Belt

(20) The originator of this theory used a point-coincidence argument to answer his own paradox of theoretical "hole transformations." Arthur Eddington led expeditions to observe a solar eclipse to test this theory, and the central equation of this theory sets an expression involving the stress-energy tensor equal to a curvature term plus the metric tensor times the cosmological constant. A thought experiment describing a man dropping a ball in an elevator illustrates this theory's equivalence principle. For the point, name this theory that equates the curvature of space-time with gravity, which was formulated by Albert Einstein after a "Special" counterpart.

ANSWER: **General Relativity** (or **GR**; prompt on "Relativity;" do not accept or prompt on "Special Relativity")

(21) One class of these structures is named for the fact that its post is hollowed to make way for the drive shaft. The Zaan district was known for its heavy concentration of these structures, a variety of which Daniel Halladay designed in America to pump water. These sail-containing structures that were historically associated with the Netherlands have largely been phased out in favor of similar turbines that generate electricity. For the point, name these structures that create rotational energy with their blades.

ANSWER: **Windmills** (accept **Wind Engine**; do not accept or prompt on "Turbine" or "Wind Turbine")

(22) Any function that is differentiable over these numbers at every point along its domain is called holomorphic. Raising these numbers to an exponent "n" using de Moivre's formula can generate roots of unity. These numbers are added together like vectors on an Argand diagram, and the quaternion system generalizes these numbers, which give a real product when multiplied by their namesake conjugate. A quadratic equation with a negative discriminant has two roots with, for the point, what property of numbers that have a real and an imaginary part?

ANSWER: **Complex** Numbers (prompt on "Imaginary" before mentioned)

(23) These shapes are used to construct a fractal called the Apollonian gasket. Brahmagupta's formula is used to calculate the area of quadrilaterals that can be inscribed in these shapes. In polar coordinates, the equation "R equals a constant A" produces one of these shapes, and the Cartesian product of two of these two-dimensional shapes gives a torus. These shapes have an eccentricity of zero, making them the simplest conic sections. For the point, name this shape consisting of all points in a plane equidistant from a given center whose boundaries are described by the circumference.

ANSWER: **Circles** (do not accept or prompt on "Sphere")

(24) This man developed a motto translating to "Let no man belong to another who can belong to himself." The microcosm-macrocosm analogy was furthered by this man who was heavily supported by the Rosicrucians. This man claimed that "the sickbed is your study" in his rebuke of emphasis on medical titles, and this man often burned copies of works by Galen during lectures he held in Basel. The modern name for zinc may have originated with this man who conflated sulfur with the soul and salt with the body. Living during the German Renaissance, this is, for the point, what 16th-century alchemist?

ANSWER: **Paracelsus** (Theophrastus von **Hohenheim**; accept Philippus Aureolus Theophrastus Bombastus von **Hohenheim**)

(25) Ferdinando II was the dedicatee of a work by this man which labels one character as Sagredo. Robert Bellarmine questioned the accuracy of the findings of this man who names a spacecraft launched in 1989 that studied Gaspra and other asteroids near Jupiter. The quotation "Eppur si muove," meaning "And yet, it moves" is often attributed to this man who lived in Pisa and earned the ire of Pope Urban VIII [[THE EIGHTH]]. For the point, name this Italian scientist who was tried in the 17th century for expounding the theory of heliocentrism.

ANSWER: **Galileo** [di Vincenzo Bonaiuti de'] **Galilei** (accept either underlined answer)

(26) A prior version of this programming language divided it into Transitional and Strict varieties, the latter of which was created for more common usage. WHATWG is a group involved in the development of this programming language that utilizes tags with text like "p" to represent paragraph and "img" to represent image. Cascading Style Sheets, or CSS, is a language often used in conjunction with this language whose namesake documents are displayed by internet browsers. For the point, name this markup language used on webpages.

ANSWER: **HTML** (accept **HyperText Markup Language**)

(27) The film *The Magnificent Seven* inspired the name of an isolated neutron star within this constellation named Calvera. One star in this constellation was, along with another constellation's star of Mizar, referred to as one of the so-called Indestructibles. Pherkad can be found in this constellation whose beta star is Kochab, and this constellation is located east of Draco and contains the smaller of two features made up of seven stars that appear as a ladle. Containing the Little Dipper, this is, for the point, what constellation that contains the North Star with a name translating as "Little Bear?"

ANSWER: **Ursa Minor** (prompt on "Little Bear;" prompt on "Lesser Bear;" prompt on "Ursa;" do not accept or prompt on "Ursa Major")

(28) A 2005 study linked the occurrence of this disorder with mutations in the SLITRK1 gene. PANDAS is a syndrome that bears many similarities to this disorder that was named for an intern of Jean-Marie Charcot. Premonitory urges can precede central occurrences associated with this disorder that often co-occur with ADHD or OCD. Often beginning in adolescence, this nervous disorder is characterized by the occurrence of motor tics. For the point, name this disorder characterized by sudden twitching movements.

ANSWER: **Tourette's** Syndrome (accept Tourette's **TS**; or **Tourette's**)

(29) The absence of these objects has been referred to by researchers as the “immigration delay disease,” which is caused by the improper expression of the protein SMARCAD1. A detection of these objects produces a dye called “Ruhemann’s purple” when that dye’s amino acids interact with a white organic compound called ninhydrin. The Henry Classification System is used to sort characteristics of these objects, common patterns of which include loops, whorls, and arches. For the point, name these unique human identifiers that are found at the ends of a person’s digits.

ANSWER: **Fingerprints**

(30) Ophthalmologists utilize the A-scan biometry of this technique during routine exams to determine a person’s eye length. The damping block and matching layer are parts of the transducer, a hand-held probe that converts electrical energy into mechanical energy during this technique. This technique is used during a fetal echocardiography which provides an image to determine if a baby has a heart defect. For the point, name this form of imaging technique that uses high frequency sound waves and its echoes to produce pictures inside a body.

ANSWER: **Ultrasounds** (or **Sonography**; accept **Ultrasonography**)

(31) [USED FOR ASIA SPRING] A 1979 study found that the measles virus mutated when it became infected with these types of cells. These cells were found to multiply faster in zero gravity while on board the Korabl-Sputnik-2 satellite. The National Foundation for Infantile Paralysis wanted a mass-production of these cells after it proved essential in the production of the polio vaccine. First successfully replicated by Theodore Puck and Philip I. Marcus, for the point, what “immortal” cells originated from a cancer patient named Henrietta Lacks?

ANSWER: **HeLa** cells

(32) A 1928 paper published by Kiyoo Wadati inspired this one-time research assistant of Robert Millikan to develop his most famous innovation. Beno Gutenberg helped this man develop that innovation, which aimed to eliminate the subjectivity of a similar system named for Giuseppe Mercalli. The system developed by this man is notably logarithmic and measures phenomena that begin below the epicenter. For the point, identify this seismologist best known for his namesake scale for measuring the intensity of an earthquake.

ANSWER: Charles Francis **Richter**

(33) A version of this phenomenon described by the Japanese word "Modoki" affects the central portion of one region. A transitional period brought by this phenomenon can contribute to the increase in tornadoes in the Midwest. A decrease or complete halting of Walker circulation can lead to this phenomenon, which results in declines in fish populations due to the upwelling of cold water. Variations in air pressure occur in different regions of the Pacific during this phase of the ENSO. For the point, name this period of warm temperatures off the coast of South America whose Spanish name means "the boy."

ANSWER: **El Niño**

(34) One form of this technique capitalizes on the use of osmotic flow and is occasionally combined with mass spectroscopy. In order to maintain a constant pH value, buffers like TAE or TBE are used in this technique that occurs before a Western blot. DNA can be stained using ethidium bromide to visualize results from this technique that involves the migration of particles from electrodes. Agarose and PAGE are forms of, for the point, what technique used to separate molecules based on their size and charge by applying an electric field to a gel?

ANSWER: Gel **Electrophoresis** (accept **SDS-PAGE**; accept Agarose **Electrophoresis**; accept PAGE **Electrophoresis**)

(35) The regressive typed of these features can be formed at the terminus of a gut, and differences in channel slopes can lead to avulsions, a type of switching that occurs along these features. The bird's foot is a variety of these features where fisheries often thrive, and the Ganges is home to the largest of these features, which can degrade due to a lack of sediment being deposited into them. Often forming where a sea and river meet, these are, for the point, what triangular-shaped hydrological features?

ANSWER: River **Delta**

Extra Questions

(1) In organophosphorus chemistry, Kabachnik parameters can represent this quantity for functional groups. Germanium's heightened value for this quantity relative to silicon can be explained by d-block contraction. A type of this quantity that focuses on the surface of certain entities is named for A. Louis Allred and Eugene G. Rochow. Symbolized chi, this quantity's strength is heavily correlated with ionization energy and can be measured in Pauling units. Fluorine has the highest value of, for the point, what measure of an atom's ability to attract a certain negatively charged particle?

ANSWER: **Electronegativity** (accept word forms; prompt on "Chi" before mentioned)

(2) IgG depositions are found at one junction in this disease's namesake band test, which is used in its diagnosis. Hydralazine and/or procainamide use are the most common causes of the drug-induced form of this disease, which can be treated by belimumab. This disease is nearly ten times more common in women of childbearing age than in men, and a butterfly-shaped mark is the most common and identifiable symptom of this rheumatic disease. For the point, name this disease characterized by a red rash that was thought to resemble a wolf's bite.

ANSWER: Systemic **Lupus** erythematosus (accept **SLE**; accept Drug-induced **Lupus** Erythematosus; accept **DIL**; accept **DILE**)