

Science Bee Round 1

Regulation Tossups

(1) This property is observed in materials without inversion symmetry. A sharp tip with this property is attached to a cantilever and dragged along the surface of a sample in atomic force microscopy. Ceramic capacitors often contain lead zirconate titanate, which exhibits a strong form of this property. Studies of Rochelle salts led Jacques and Pierre Curie to discover this property that is possessed by quartz. For the point, identify this property of materials that generate an electric voltage in response to applied mechanical stress.

ANSWER: **Piezoelectricity** (or **Piezoelectric** Effect)

(2) In a theory concerning this force, David Gross and Frank Wilczek discovered asymptotic freedom, which, in one context, can be explained by pion exchanges. Referred to as residual in one capacity, this force explains why free particles are required to have a color charge value of zero. Gluons experience this force, which is responsible for the confinement of quarks and is the subject of quantum chromodynamics, or QCD. For the point, name this force which binds together the atomic nucleus, contrasted with a weak counterpart.

ANSWER: **Strong** Force (accept **Strong** Interaction; accept **Strong** Nuclear Force)

(3) This region of the electromagnetic spectrum partly names a situation in which a blackbody emits boundless energy in a namesake "catastrophe." Hydrogen emits a spectral Lyman-alpha line that falls within this region of the electromagnetic spectrum. Exposure to radiation in this part of the electromagnetic spectrum can lead to conditions such as photokeratitis of the eye. With a shorter wavelength than visible light, this is, for the point, what type of radiation, excessive exposure to which can cause skin cancer?

ANSWER: **Ultraviolet** Radiation (or **Ultraviolet** Light)

(4) Most researchers agree that these entities require exotic matter in order to stabilize themselves. According to "Polchinski's paradox," a billiard ball traveling through these entities can knock itself off course. The Schwarzschild type of these entities are thought to contain an "Einstein-Rosen bridge," which is a tube connecting two exterior regions together. For the point, name these theoretical structures that connect two points of the universe, whose existence may prove the feasibility of time travel.

ANSWER: **Wormholes** (or Einstein-Rosen [wormhole]; accept Wormhole; accept s; accept **Einstein-Rosen Bridges**)

(5) One laboratory method used to measure this quantity packs the sample into a thin capillary tube, which is then viewed through a lens while it is heated in a heating block. A mixture's lowest possible value for this quantity occurs at the eutectic point, and ethylene glycol is added to car engines to lower this quantity whose namesake "depression" is dependent on size. For the point, name this temperature at which a solid turns into a liquid, which is zero degrees Celsius for water.

ANSWER: **Melting Point** (or **Freezing Point**; or **Melting Temperature**; or **Freezing Temperature**)

(6) Yttrium barium copper oxide was the first material discovered that could superconduct above the boiling point of this substance at nearly 92 Kelvin. The handling of this substance requires it to be slowly boiled to 77 Kelvin and stored and transported in vacuum flasks. This substance's low boiling point is caused by the weak van der Waals interaction between its diatomic molecules. For the point, name this incredibly cold liquid used in cryotherapy and cryogenics.

ANSWER: Liquid **Nitrogen** (accept **LN2**; accept Liquid **N2**)

(7) A test named for a chloride of this element is used to detect phenols in a sample compound. This element combines with a cyanide compound to form the pigment Prussian blue. After magnesium, this element has the most abundant isotope of any other metal in the solar system. One of this element's primary ores is magnetite, and another ore of this element is hematite. For the point, identify this element whose "pig" type is a byproduct of steel production.

ANSWER: **Iron** (or **Fe**)

(8) According to this theory, the arrangement of nitrosonium octafluoroxenate(VI) [[SIX]] is square antiprismatic. Notations used for this theory denote "A" as the central atom, "X" as bonding pairs, and "E" as lone pairs in the convention known as the AXE method. Strontium fluoride is an exception to this theory, as its structure angles are 120 degrees between each bond instead of 180 degrees. Methane is a tetrahedral molecule according to, for the point, what theory that suggests the geometry of molecules is based on its number of electron pairs?

ANSWER: **VSEPR** [[VES-purr]] (or **V**alence **S**hell **E**lectron **P**air **R**epulsion)

(9) The development of this principle was introduced in a 1916 article titled *The Atom and the Molecule*. Because they possess a d-orbital, transition metals are an exception to this principle, while elements such as hydrogen and helium are exceptions, since both only need to fill their s² orbitals. The electron dot diagram is used to illustrate this principle by using lines to represent the bonding of atoms. Developed by Gilbert N. Lewis, this is, for the point, what rule that states that a chemical element is most stable when there are eight electrons in its valence shell?

ANSWER: **Octet** Rule

(10) A mutation on chromosome 15 in Prader-Willi syndrome can disrupt the function of this structure, which is also impacted in Kallmann syndrome. The ventromedial nucleus is a feature in this structure that is responsible for thermoregulation and food intake. This organ's parvocellular cells stimulate prolactin release, while its magnocellular cells synthesize vasopressin and oxytocin. It's not the pituitary gland, but the endocrine and nervous system is linked by , for the point, what small organ located below the thalamus?

ANSWER: **Hypothalamus** (do not accept or prompt on "Thalamus")

(11) Anthropologists at Tel-Aviv University determined humans were these types of animals based on farming data from the Stone Age. The world's largest living reptile fits into this category of animals, as do nearly all shark species. The *Anomalocaris* was one of the earliest known examples of these creatures, which occupy the highest trophic level in any ecosystem. No other organisms can prey upon, for the point, what biological organism at the top of the food chain?

ANSWER: **Apex Predators**

(12) The stomach slips through this structure in a condition known as a hiatal hernia. The phrenic nerve innervates this muscle, whose strength is tested by measuring the vital capacity in both the upright and supine positions. The flattening of this muscle on an X-ray can help diagnose COPD, and involuntary spasms of this muscle produce hiccups. The volume of the thoracic cavity is increased by, for the point, what sheet of skeletal muscle that contracts to draw air into the lungs during respiration and is used by professional singers to produce powerful notes?

ANSWER: Thoracic **Diaphragm**

(13) Both males and females of this species are born with ankle spurs, but only the males are able to use these structures to distribute venom. Another biological strength these prototherian mammals possess is a sense of electroreception that allows members of this species to find their prey by detecting electric fields. Along with the echidna, this animal is one of the five remaining species of monotreme, which are a type of mammal that lays eggs. For the point, name this semiaquatic, duck-billed mammal native to Australia.

ANSWER: Duck-billed **Platypus**

(14) The efficiency of this process is increased by a trimeric sliding clamp protein, and the rolling-circle type of this process begins at sites labeled "ori." Obstacles to this process can cause fork reversal and restart, which requires enzymes like topoisomerases that relieve supercoiling and helicases that separate the hybridized strands. Okazaki fragments are synthesized on the lagging strand during this process, which occurs during S phase. For the point, name this process that creates a copy of the cell's genome.

ANSWER: **DNA Replication** (accept **DNA Synthesis**; prompt on "Replication")

(15) It's not Alzheimer's, but the Braak staging method describes the progression of this disease, and it's not dementia, but cells affected by this exhibit aggregation of protein alpha-synuclein that forms spherical masses called Lewy bodies. Most cell-based therapies for this disease transplant tissue into the substantia nigra, and the drug L-dopa treats this disorder, which is caused by the death of neurons that produce dopamine. For the point, identify this neurodegenerative disorder whose symptoms include a shuffling gait and involuntary tremors.

ANSWER: **Parkinson's Disease** (or **PD**; accept **Shaking Palsy**)

(16) Among the incohesive types of rock that form at these regions are its namesake breccia and gouge. The collapse of calderas can lead to the creation of the ring type of these features, which are the subject of a theory developed by Ernest Anderson. One type of these regions that occurs underwater can form a characteristic zigzag pattern and terminate at a subduction zone. These planar regions can undergo a type of displacement called creep in the absence of seismic activity. For the point, name these regions that can cause earthquakes, such as one named for San Andreas.

ANSWER: **Faults** (accept **Fault** Line; accept **Fault** Trace; accept **Fault** Zone)

(17) A period of these events that affected Australia during 2009 came to be referred to as Black Saturday. Low-lying debris can cause the crawling variety of these events which can undergo a wind-induced phenomenon called "jumping." Distinguished from a controlled variety that are used to manage their central environments, these events can be caused by lightning strikes and by the availability of combustible vegetation. For the point, name these events characterized by heavy smoke and widespread burning.

ANSWER: Forest **Fires** (accept Wild**fires**; accept **Bushfire**; accept Wildland **Fire**; accept Rural **Fire**)

(18) A British chart that lists these phenomena is divided into three columns of thirteen rows that are marked by diamonds. Often occurring in a semi-diurnal fashion, the range of these entities is a measure of their peak-to-peak amplitude, or the difference between two varieties. Though the term quadrature can be used to characterize when these phenomena are at their lowest, the better known term is neap. Central to coast management, these are, for the point, what variations in sea level that can be "High" or "Low?"

ANSWER: **Tides** (accept **Tidal** Forces; accept **Spring Tides**; accept Neap **Tides** before mentioned; accept High or Low **Tides** before mentioned))

(19) A rare, naturally occurring form of this substance is called prasiolite. One variation of this crystalline mineral is uniquely composed of colloidal ferric hydroxide impurities, and this variation is called a citrine. This mineral is naturally made of a continuous framework of tetrahedra, and this mineral defines the value of seven on the Mohs scale of hardness. For the point, identify this second-most abundant mineral in the Earth's crust after feldspar, a mineral composed of silicon dioxide?

ANSWER: **Quartz**

(20) This scientist's predictions regarding the motion of Mars came to be known as the Vicarious Hypothesis. This scientist developed a model in which Platonic solids circumscribed and inscribed by orbs could characterize the relationships between planets in the solar system. This scientist collected a set of data to help compute planetary positions known as the *Rudolphine Tables* and found that the length of the semimajor axis is proportional to planetary orbital period. For the point, name this German astronomer who developed three laws of planetary motion.

ANSWER: Johannes **Kepler**

(21) Larger objects that make use of these objects often use service structures as a starting point, where they are eventually severed from an umbilical tower prior to one process. An equation dealing with these objects relates specific impulse to delta-v, and these objects come in multistage varieties. The namesake exhaust of one component of these objects is created by its propellant, which is hydrogen peroxide for those used in jet packs. Gaining thrust from its namesake engine, this is, for the point, what type of object commonly used to power spacecraft?

ANSWER: **Rocket** Engine (prompt on "Spacecraft" or "Space Shuttle" or similar answer)

(22) William Lassell discovered this planet's largest orbiting body just a little over two weeks after this planet's discovery. Despina is a satellite of this planet whose existence was predicted in part by Urbain Le Verrier's calculations. Features of this planet include the Adams Ring, as well as a series of anticyclonic storms within its Great Dark Spot. Triton is the largest moon of, for the point, what planet whose astronomical symbol resembles a trident, the eighth planet from the sun?

ANSWER: **Neptune**

(23) Two lines that are central to these items intersect at the pitch point. The herringbone variety of these items consist of a duo of side-by-side helical types of these items. Depicted on the logo of Citroën, these components comprise sets whose mechanical advantage can be defined by a namesake ratio, and ,when two of these items are meshed, they can form a transmission. Often containing teeth, these items create speed from torque and are alternatively known as cogs. For the point, name these circular components that one can shift when driving a car.

ANSWER: **Gears** (accept **Gear**box; accept Herringbone **Gear**; accept Double Helical **Gear**; accept **Gear** Transmission; accept **Cogs** before mentioned)

(24) A porous material known as coke is an example of a type of fuel that undergoes this process' destructive variety. One type of this process is necessary for converting crude oil into a form that can be stored in atmospheric tanks, and that variety of this technique is known as stabilization. This process can follow fermentation in a technique in which alcoholic beverages become liquor. Coming in partial and fractional forms, this is, for the point, what laboratory process that separates components of a liquid mixture?

ANSWER: **Distillation** (accept Fractional **Distillation**; accept Partial **Distillation**; accept Destructive **Distillation**)

(25) Variants of this statement are applied in the Art Gallery problem and the proof of the Pumping Lemma for Regular Languages. According to this principle, two people will share the same birthday in any given room of at least 367 people. Commonly known as Dirichlet's box principle, this mathematical statement explains that when n items are put into m containers if n is greater than m , then at least one container will have more than one item. For the point, name this combinatorial principle inspired by the roosts of a certain urban bird.

ANSWER: **Pigeonhole** Principle (accept **Dirichlet**'s Box Principle before mention)

(26) This function names a modified form of the Klein-Gordon wave equation. This function appears in the imaginary parts of both Demoivre's [[de-MWAHV]] and Euler's formulas. The terms in this function's Taylor series contain odd exponents divided by odd factorials. This function is positive in the first and second quadrants because it gives the y-coordinate on the unit circle. Cosecant is the reciprocal of, for the point, what trigonometric function, which, in a right triangle, equals the opposite side over the hypotenuse?

ANSWER: **Sine** (or **Sin X**)

(27) Peter Singer criticized the 80% number given during this effort as a potentially dishonest claim, and this event was followed a month later by a similar one involving Philip Blaiberg. The overseer of this effort was helped by his brother, Marius, in providing a Lithuanian-born grocer named Louis Washkansky with the central entity at Groote Schuur Hospital. Taking place in Cape Town in 1967, this is for the point, what event in which Christiaan Barnard surgically provided a certain organ to a patient with congestive failure?

ANSWER: **First Heart Transplant** from Human to Human (accept **Heart Transplant** of Christiaan Neethling **Barnard**; prompt on partial answers)

(28) The Banker's algorithm that aims to prevent deadlock was developed for one of these entities named for the Eindhoven University of Technology, where its developer, Edsger Dijkstra, served as professor. Hypervisors can be used to run guest versions of these entities on top of a host system through the process of virtualization. Prioritization of I/O operations can be accomplished by the schedulers in these entities, which contain a kernel. For the point, name these low-level computer programs that include Linux and Windows.

ANSWER: **Operating Systems** (accept **OS**; accept THE **Operation System**)

(29) This substance may have been inspired by one of the same name that appeared 28 years earlier in Malcolm Jameson's story "Devil's Powder." Kenji Oyama created a bonding process with this substance, which was employed by his daughter, Lady Deathstrike. Apocalypse extracts this substance from Sabretooth in one story and gives it to a character who first appeared in *The Incredible Hulk* and sometimes goes by the name Logan. Found in both the skeleton and claws of Wolverine, this is, for the point, what metal alloy from the X-Men universe known for its hardness?

ANSWER: **Adamantium**

(30) During one hearing, Claire McCaskill said that a certain community "is almost monolithic against" this man who co-founded a company with Jeff Arnold that ran the RealAge Test. Following the death of a man from brain injury, this man assisted Eric Rose with providing baseball player Frank Torre with heart transplant. The son of immigrants from Turkey, this holder of both an MD and MBA hosted a namesake show co-produced by Oprah Winfrey. Currently running for Senator in Pennsylvania, this is, for the point, what celebrity doctor known for promoting dubious therapies?

ANSWER: Mehmet **Oz** (accept Doctor **Oz**)

(31) Event occurrences on the view of one of these constructs can lead to their namesake trigger. Amazon Aurora is an engine on which these constructs can run, and Redis is used within these constructs whose desktop variety can be created by Microsoft Access. Codd's 12 rules govern these constructs that can take the form of lakes or warehouses. Coming in relational and non-relational varieties, these constructs often make use of SQL. For the point, identify this structures collection of data in which files are often stored data.

ANSWER: **Databases** (accept Relational **Databases**; accept Non-relational **Databases**)

(32) The solid-state type of these devices use crystalline or glass rods that are bombarded with ions of ytterbium, holmium, or thulium. Components of these devices typically consist of a gain medium, a high reflector, and an output coupler. These devices are triggered when an electron drops to a lower energy level after being hit with a photon in a process called stimulated emission. For the point, name these devices that emit a beam of light and are used in corrective eye surgery and handheld pointers.

ANSWER: **Lasers** (or **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation; accept **LASIK**)

(33) "For his services in the investigation of the structure of atoms," this man won a Nobel Prize in Physics in 1922 and subsequently gave a lecture about the correspondence principle he formulated. This protégé of J. J. Thomson founded an institute at the University of Copenhagen, which now bears his name. This scientist who names a synthetic element with the atomic number 107 co-names an atomic model with Ernest Rutherford. For the point, name this Danish theoretical physicist

ANSWER: Niels Henrik David **Bohr**

(34) One form of this technique uses a reflectron to measure a sample's time-of-flight. In this technique, fragmented benzyl groups rearrange to form stable tropylium cations. "Soft" ionization techniques such as ESI and MALDI prepare samples for this process, which is often coupled with gas chromatography. On spectra produced by this technique, the "base peak" represents the most abundant ion. For the point, name this analytic technique that separates fragments based on their mass-to-charge ratio.

ANSWER: **Mass Spectrometry** (or **Mass Spectroscopy**; or **MS**; accept Time-of-flight **Mass Spectrometry**; accept GC-**MS**)

(35) The James Webb Space Telescope contains 18 gold-layered fixtures of this element that serve as mirrors. This element forms an alloy with copper that is prominent in metalworking contexts, and two nuclei react to form an unstable version of this element before the creation of carbon in the triple-alpha process. Aquamarine and emerald are both varieties of a mineral that lends its name to this element that lies above magnesium on the periodic table. For the point, name this element with atomic number 4 and symbol Be.

ANSWER: **Beryllium** (accept **Be** before mentioned)

Extra Questions

(1) This phenomenon was first published in a treatise titled *On the coloured light of the binary stars and some other stars of the heavens*. Joseph Petzval challenged this effect because he thought the equations were too basic to explain any natural phenomena. Buys Ballots tested this phenomenon by having a group of musicians play the same note while on a moving train. Developed by a 19th century Austrian physicist, this is, for the point, what phenomenon that explains why a sound is heard louder as its source approaches an observer?

ANSWER: **Doppler** Effect (or **Doppler** Shift)

(2) Lazzaro Spallanzani originally discovered these organelles, which he labelled as "stars." Cell sap can be found within this organelle where ions of cobalt 2+ and strontium 2+ are often sent. These organelles can facilitate increased germination speed by expanding, and osmoregulation takes place within one variety that can undergo expansions, while its other variety completes the opposite process. The contractile variety compartmentalizes enzymes in, for the point, what water-filled organelles involved in storage.

ANSWER: **Vacuole** (accept Contractile **Vacuole**)