

## (MS) Science Bee Round 2

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### Regulation Tossups

(1) This disease ravaged European forces active in the Caribbean, and France's effort to reconquer Haiti was thwarted in part by this disease. This disease, also known as "Bronze John", is mentioned on the tombstone of Walter Reed, a U.S. Army physician who confirmed the theory, proposed by a Cuban physician named Carlos Finlay, that this disease was transmitted through *Aedes aegypti* [[eh-DEEZ eh-GIP-tee]]. For the point, name this viral disease that is transmitted through mosquitos, named for the jaundice it causes.

ANSWER: **Yellow Fever** (or **Yellow Jack**; or **Yellow Plague**; accept **Bronze John** before mentioned)

(2) John Waterston's 1845 paper expanded on this law by unearthing Daniel Bernoulli's earlier application of Newton's laws of motion to this law at a molecular level. That application to this law would prompt the future establishment of the kinetic theory of gases. Though this gas law was published in London by a namesake Anglo-Irish physicist in 1662, Edme Mariotte independently rediscovered this law. For the point, name this gas law that examines how the pressure of a gas often decreases as the volume of its container increases.

ANSWER: **Boyle's Law** (or **Boyle-Mariotte Law**; accept **Mariotte's Law** before mentioned)

(3) An early manifestation of this disease is seen in many newborns in what is known as *meconium ileus* in which a child suffers from bowel obstruction. Among the methods used to diagnose this disease is a sweat test that measures the concentration of chloride in an individual's sweat and a carrier screening that can help detect a mutation of the *CFTR* gene. For the point, name this genetic condition in which scar tissue forms on the pancreas and mucus clogs the lungs.

ANSWER: **Cystic Fibrosis** (accept **CF**)

(4) The value for this quantity in an isolated conducting sphere is equal to  $4\pi$  times epsilon naught times its radius. This quantity can be increased by the presence of a dielectric, and unlike resistance, this quantity sums linearly for its circuit components in parallel. Charge is equal to this quantity times voltage. Self and mutual are two types of, for the point, what quantity, the ratio of charge stored to electric potential?

ANSWER: **Capacitance** (accept **Capacitor**)

(5) Scientists believe that one organism's ability to live in these environments is due to the thermal insulation provided by bacteria living on its back. Those bacteria are among the various microbes that take up methane and sulfides found on the ground in these environments, which in turn, supports other organisms such as limpets and giant tube worms. Chemosynthesis drives, for the point, what mineral-rich environments that include the "white smoker" types and is found on the seafloor?

ANSWER: **Hydrothermal Vents** (accept **Black Smokers**; accept **White Smokers** before mentioned; prompt on "Vents"; prompt on "Seafloor"; prompt on "Extreme" or "Extremophile")

(6) Early implementations of this computational concept include one researched by C. Chapin Cutler at Bell Labs in 1950, known as the Differential Pulse-Code Modulation. This process is often dubbed "lossy" or "lossless" depending on how much information is lost. For the point, identify this computational process that reduces the size of transmissions or files, such as .MP3 and .MPEG, by encoding information using fewer bits than the original representation.

ANSWER: Data **Compression** (accept **Source Coding**; accept **Bit-Rate Reduction**

(7) One of these objects is the entity behind the Einstein cross, which arises due to gravitational lensing. The distinction between these entities and blazars is the direction of emission of a relativistic jet, and these objects are often categorized as radio-loud or radio-quiet. For the point, name these active galactic nuclei, the most luminous objects in the universe.

ANSWER: **Quasars** (accept **Quasi-Stellar** Object; or **QSO**; prompt on "Active Galactic Nucleus" before mentioned)

(8) An enzyme precursor required for this process is called Christmas factor. Collagen binding activates proteins such as kallikrein and von Willebrand factor during this process's namesake "cascade." The drug Warfarin inhibits this process by reducing Vitamin K. Thrombin triggers the formation of a fibrin network during this process, which is impaired in hemophiliacs. Platelets aggregate at the site of a wound in, for the point, what process that stops blood loss?

ANSWER: Blood **Clotting** (or **Coagulation**; accept **Thrombosis**)

(9) The export of protons leads cells surrounding these structures to uptake potassium ions. Root-produced abscisic acid causes the closure of these structures, which are inactive during the day in CAM plants. These structures are surrounded by two guard cells and are located mainly on the bottom of leaves to take in carbon dioxide. For the point, name these pores that regulate gas exchange in plants.

ANSWER: **Stomata** (accept **Stomates**; accept **Guard Cells** before mentioned)

(10) The liquid form of this element is used in experiments such as DarkSide and other dark matter detection surveys. An isotope of potassium decays to this element in a radiometric dating technique named for the two elements. This noble gas is the third-most abundant element in Earth's atmosphere after nitrogen and oxygen. For the point, identify this noble gas named for the Greek for "lazy" whose atomic number is 18.

ANSWER: **Argon** (or **Ar**; accept **K-Ar** dating)

(11) Healthy examples of this tissue exclusively have chondrocyte [[KON-dro-site]] cells. The amount of proteoglycan and collagen in this tissue determines if it is hyaline, fibro, or elastic. Along with bone tissue, this tissue is destroyed in osteoarthritis. This tissue makes up the skeletons of skates, rays, and sharks. For the point, name this flexible structural tissue that lines joints and makes up the nose and ear.

ANSWER: **Cartilage** (accept **Cartilaginous** tissue)

(12) The North Sea is an epeiric sea on one of these entities. This entity ends at the point of an increasing slope called a 'break', before which lie the regions called the slope and rise. The pelagic environment of these entities comprise the neritic zone, while the benthic zone is its seafloor region. For the point, name these portions of a continent submerged under an area of shallow water that can be exposed when sea levels drop.

ANSWER: **Continental shelf**

(13) Although not indicative of HSV-1 encephalitis, high levels of this substance in cerebrospinal fluid are indicative of bacterial meningitis. This substance is produced in the Cori Cycle from pyruvate and then converted back to pyruvate in the liver, leading to gluconeogenesis. A byproduct of anaerobic metabolism is, for the point, what compound that is the cause of muscle soreness after a person undergoes intense exercise?

ANSWER: **Lactic** Acid (or **Lactate** or **CH<sub>3</sub>CH(OH)COOH**)

(14) Electrically-powered types of these objects operate when the object's magnetic field and its electric current in a wire generate torque to be applied on the object's shaft. Mechanically, these objects typically consist of a stator, commutator, windings, and a rotor supported by bearings. For the point, name this family of machines designed to convert forms of energy into mechanical energy.

ANSWER: **Motor** (or **Engine**)

(15) The *opposite* of this word names a type of "deep scattering" that gave evidence for the existence of quarks. Young's modulus is also named for this property of a material. According to kinetic molecular theory, gas particles undergo collisions described by this term where the total kinetic energy remains the same. For the point, what term describes materials like rubber that return to their original shape after a deformation?

ANSWER: **elastic** (or **elasticity**; accept **elastic** collisions; accept **elastic** modulus; do not accept or prompt on "inelastic")

(16) The dot product of two vectors multiplies their magnitudes by this function of the angle between them. This function names a law that is a generalized form of the Pythagorean theorem. This trigonometric function is obtained by dividing the adjacent side of a right triangle by its hypotenuse. The secant function is the reciprocal of, for the point, what mathematical function, the co-function of sine?

ANSWER: **Cosine** (accept Law of **Cosines**)

(17) These entities are classified based on their thermal stratification into either holomictic or meromictic. These bodies of water become enriched with nutrients during eutrophication. When a river meander is cut off, the "oxbow" varieties of these bodies of water can form. For the point, name these bodies of water that come in glacial and fluvial varieties, examples of which include Michigan and Superior.

ANSWER: **Lakes** (accept Oxbow **Lakes**; accept glacial **lakes**; accept fluvial **lakes**)

(18) Diatomaceous earth is frequently used in swimming pools as a medium for this process due to its high porosity. This process is the final step of hot recrystallization, which is sped up using a vacuum flask and a device named for Ernst Büchner. This physical process is used to separate sand and water. For the point, name this method of physical separation that isolates solids from liquids, which can use porous paper and a funnel.

ANSWER: **filtration** (or **filtering**)

(19) One of these devices found in San Diego utilized large aluminum-coated "honeycomb" Pyrex mirrors and is supported by a "horseshoe" mount. These devices, which can be classified into reflecting and refracting varieties, were used to capture images of the Double Helix Nebula and the Pillars of Creation. For the point, name these optical devices used to observe stars, examples of which include the James Webb and Hubble.

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

(20) This person was presented with one gram of a certain element by Warren Harding during a tour in the United States. Two countries declared 2011 to be the year of this person, who analyzed samples of pitchblende and torbernite in experiments that led her to win the Nobel Prize in Chemistry in 1911. Also the winner of the 1903 Nobel Prize in Physics, this is, for the point, what Polish-French scientist who discovered polonium and radium, and conducted research on radioactivity with her husband, Pierre?

ANSWER: **Marie Curie** (or **Marie Salomea Skłodowska-Curie**; or Maria Salomea **Skłodowska**; prompt on "Curie")

(21) The V-2 rocket took the first two images of this celestial body between 1946 and 1947. This celestial body was in the background when Alexei Leonov performed a 12-minute spacewalk outside Voskhod 2, and this celestial body was the subject of an impromptu image taken by Voyager 1 which was dubbed by Carl Sagan as the *Pale Blue Dot*. During the Gemini 12 mission, Buzz Aldrin took the first "space selfie" with, for the point, what celestial body that is the third planet from the sun?

ANSWER: **Earth**

(22) Along with Procyon and Betelgeuse, this star forms one of the angles of the Winter Triangle. This star is part of a binary system with a white dwarf with a diameter approximately the same size as Earth, and this star's apparent magnitude is approximately twice as great as Canopus. For the point, identify this star in Canis Major, the brightest in the night sky.

ANSWER: **Sirius A** (or The **Dog Star**; accept **Alpha Canis Majoris**; do not accept or prompt on "Sirius B")

(23) This set of numbers can be constructed from the rationals using Dedekind cuts. This set of numbers was shown to be uncountable by Cantor's diagonalization argument. The rational numbers are dense in this set of numbers, which also includes the irrational numbers. For the point, what set contains any number that can be expressed on a number line, contrasted with complex numbers?

ANSWER: **Real** numbers (prompt on "R")

(24) A compound containing this element is created in the Chapman cycle and can be measured in Dobson units. This element can be added to an alkene to form an epoxide. This element is the final electron acceptor in the electron transport chain, and the diatomic form of this element is a product of photosynthesis. For the point, name this element with atomic number 8 that combines with iron to form rust.

ANSWER: **Oxygen** (or **O**; accept Ozone-**Oxygen** Cycle; accept **O2**; accept **Ozone** or **O3** before "alkene" is mentioned)

(25) Levinthal's paradox concerns this class of compounds, and the assembly of this compound is facilitated by chaperonins. Those chaperonins assist the folding of these compounds into secondary, tertiary, and quaternary structures, which are undone by the process of denaturation. In the ribosome, translation converts messenger RNA into, for the point, what macromolecules that are made up of amino acid monomers and whose subtypes include antibodies and enzymes?

ANSWER: **Proteins** (or **Polypeptides**, prompt on "Amino Acids" before mentioned)

(26) These structures that can produce tephra were observed by the *Voyager 2* spacecraft on Triton. The Pacific Ring of Fire is home to many of these structures that can be found at convergent and divergent tectonic plate boundaries, examples of which include Krakatoa and Mauna Loa. Cinder cone, submarine, and shield are all types of, for the point, what type of structure from which lava erupts?

ANSWER: **volcano** (accept cinder cone **volcano**; accept submarine **volcano**; accept shield **volcano**)

(27) A form of this process involves the use of PEP carboxylase to produce oxaloacetic [[aak-sa-low-AH-suh-tayt]] acid. The most abundant enzyme in the world, RuBisCO, is used in this process alongside ATP and NADPH to produce the three-carbon molecule G3P during the Calvin cycle. The chloroplast is the site of, for the point, what process in which plants use light energy from the sun to convert carbon dioxide and water into glucose?

ANSWER: **Photosynthesis** (accept C4 **Photosynthesis**)

(28) Alpha-1 anti-trypsin is an inherited genetic disease that degrades the elasticity of this organ, which is surrounded by a pleural membrane. A spirometer can be used to measure the function of this organ, which receives deoxygenated blood via the pulmonary artery from the heart. Alveoli can be found in, for the point, what primary organ of the respiratory system that facilitates gas exchange and helps us breathe?

ANSWER: **lungs** (do not accept or prompt on "alveoli")

(29) One phenomena associated with these events is subject to Omori's law, which describes how the frequency of those events decreases reciprocal to the amount of time elapsing from its cause. These events are concentrated at their hypocenter, or focus, and these events can be followed by aftershocks. For the point, identify this type of seismic event whose magnitude is measured on the Richter scale.

ANSWER: **Earthquakes** (accept **Tremors**; prompt on "Aftershock" before mentioned; prompt on "Seismic Event" or synonymous answers before mentioned)

(30) A method named for Euler repeats this operation to find the limit of a series. This operation is applied to trapezoids in a method for approximating integrals. Doing this operation on two vectors applies the parallelogram law by aligning them, and, with multiplication, this is the only commutative arithmetic operation. Zero is the identity of, for the point, what operation represented by a plus sign?

ANSWER: **Addition** (or **Adding**; accept **Sum**; or **Summation**; accept **Plus** before mentioned)

### Extra Questions

(1) The first case of the current outbreak of this disease was reported by the Center for Disease Control to have been contracted by an inmate in Colorado in 2022. There are three subtypes of this disease that have been detected in the United States, one of which is a reassortment of the Eurasian H5 and the North American N2 viruses. The double crested cormorant helped spread, for the point, what virus that spreads through contact with infected animals in the same family as chickens or geese?

ANSWER: **Avian Influenza** (both underlined portions required) (or **Bird Flu**; accept **H5N1 Virus**; accept **HPAI**)

(2) The gravitational definition of this quantity states it is the equivalent of an object's mass multiplied by its gravitational acceleration, whereas the operational definition states this quantity is equivalent to the amount of force exerted by an object. The newton is the SI unit that measures, for the point, what quantity, commonly measured in the U.S. in pounds?

ANSWER: **Weight**