

(MS) Science Bee Round 5

Regulation Tossups

(1) Zosimus of Panopolis, who advanced the idea of chrysopoeia [[kry-soh-poh-EH-uh]], was an early adherent of this practice. "Internal" and "external" types of this early practice were included in Daoist texts. Despite devising his namesake law, Robert Boyle practiced this discipline, believing that salt, sulfur, and mercury are the true "principles of things." For the point, name this protoscientific practice, the goals of which included creating the philosophers' stone.

ANSWER: **Alchemy** (accept descriptive answers including **turning objects into Gold**)

(2) Edwin Chadwick supported one of these systems with a velocity-augmenting design. The Metropolitan Board of Works oversaw the construction of one of these structures in London. The effluent type of these systems, often abbreviated STEG, have small diameter pipes, and items are transported through these systems to namesake treatment centers to remove contaminants. Septic Tank Effluent Pumping and Septic Tank Effluent Gravity are types of, for the point, what typically underground structures that carry wastewater?

ANSWER: **Sewers** (accept **Sewer** Systems; accept Sanitary **Sewers**; accept **Septic Tank Effluent Pumping** before mentioned; accept **Septic Tank Effluent Gravity** before mentioned)

(3) This mathematician is the first namesake of a constant also known as gamma and equal to about 0.577. This mathematician solved the Basel problem by utilizing a power series. This man names a formula relating the exponential of complex numbers to trigonometric functions. The base of the natural logarithm is, for the point, a number named for which mathematician, symbolized e ?

ANSWER: Leonhard **Euler** (accept **Euler's** Formula; prompt on "E")

(4) Components within this cellular structure include two calcium ion release channels inositol 1,4,5-triphosphate receptors and ryanodine receptors. One form of these cellular structures is connected by helical sheets called Terasaki ramps, and these structures are composed of flatted sacs called cisternae. Connected with the nuclear envelope, this is, for the point, what organelle that is responsible for the regulation of protein synthesis, whose "smooth" type is characterized by its lack of ribosomes?

ANSWER: **Endoplasmic Reticulum** (or **ER**; accept **Rough Endoplasmic Reticulum**; accept **Smooth Endoplasmic Reticulum**; accept **Sarcoplasmic Reticulum**)

(5) Proofs of this formula include the "dissection and rearrangement" method or the use of trapezoids, which was developed by President James Garfield. The distance formula in Cartesian coordinates is derived from this formula, solutions for which include namesake triples such as 6, 8, and 10. The hypotenuse of a triangle can be computed by, for the point, what formula named for a Greek mathematician that states that a-squared plus b-squared equals c-squared?

ANSWER: **Pythagorean** Theorem

(6) The molecule IPTG mimics this sugar by releasing a DNA-bound repressor. The metabolism of this sugar is induced by cyclic AMP binding to the catabolite activator protein, and this sugar is broken down by the enzyme beta-gal, which is expressed by a polycistronic system with Z, Y, and A structural genes. In *E. coli*, the metabolism of this sugar is controlled by a namesake operon that cleaves it into glucose and galactose. For the point, name this sugar found in milk.

ANSWER: **Lactose** (accept **Lac** Operon; accept **Allo****lactose**)

(7) This shape's namesake numbers are generated by the formula "n times 3n minus 1 all over 2." This shape contains as many diagonals as it does sides. Each internal angle of a regular one of this polygon measures 108 degrees. For the point, name this type of polygon which has five sides.

ANSWER: **Pentagon**

(8) Some of these natural structures in Rotomahana field were destroyed by the eruption of New Zealand's Mount Tarawera. An example of these natural formations is located beside the Hvítá River of Iceland. That formation of this type, known as the Strokkur, has a clear conduit and has been erupting constantly since 1969. For the point, name this type of spring that intermittently ejects steam and boiling water.

ANSWER: **Geyser**

(9) The Moho discontinuity forms the boundary between this region and what lies below it, and the brittle-ductile transition zone divides this region's upper and lower areas. This region forms the uppermost boundary of the lithosphere, and isostatic equilibrium is the process by which this region floats over the mantle. For the point, name this outermost layer of the Earth.

ANSWER: Earth's **Crust**

(10) The sum of all values of this quantity in a circuit is governed by Kirchhoff's loop rule. This quantity is produced across a conductor in the Hall effect. Power equals this quantity times current. For a capacitor, charge is equal to capacitance times this quantity, and it is equal to current times resistance in Ohm's law. For the point, name this quantity, the difference in electric potential between two points, symbolized V.

ANSWER: **Voltage** (accept **electric pressure**; accept **electric tension**; accept **electric potential difference** before mentioned)

(11) This adjective and the word "cold" refers to an entity that may be explained by particles called WIMPs. Fritz Zwicky proposed an entity named for this adjective after observing the Coma Cluster. Phantom energy, a type of one quantity named for this adjective, may explain the Big Rip hypothesis. About 68 percent of the universe may be made of an "energy" described by this word. For the point, name this word that describes an unobservable form of matter.

ANSWER: **Dark** (accept **Dark** energy; accept **Dark** matter; accept Cold **Dark** Matter)

(12) A "meso" type of these entities range in size from mesoscale beta to microscale. Polar lows and nor'easters are examples of these entities, which can also be found on other planets, such as the Great Red Spot on Jupiter. Depending on their location, these entities can be known as hurricanes and typhoons. For the point, name these air masses that rotate around a center of low atmospheric pressure called the eye.

ANSWER: **Cyclones** (accept Mesocyclone; prompt on "hurricane" or "typhoon")

(13) This man discussed the area of a parabola and the volume of a sphere in a letter to Eratosthenes called *The Method of Mechanical Theorems*. This man tried to calculate the number of sand grains that could fit in the universe in *The Sand Reckoner*. His namesake principle states that the weight displaced by an object in a fluid equals the buoyant force on it. For the point, name this Greek mathematician from Syracuse notable for shouting "Eureka!"

ANSWER: **Archimedes** of Syracuse

(14) A super variant of this entity created by Samy Kankar could track even anonymous TOR users, and their risk is mitigated by the Public Suffix List. Lou Montoulli coined this term to describe entities that can record browsing histories of users and store passwords and usernames on their devices. For the point, name these small blocks of data created by a web server while browsing the web, named after a popular baked snack.

ANSWER: **Cookies** (accept Web **Cookies**; or HTTP **Cookies**; or Internet **Cookies**; or Browser **Cookie**s; or Authentication **Cookies**; or Tracking **Cookies**; or Super **Cookies**)

(15) A hydrogen-based type of this phenomenon is used in a common "ionization detector" for gas chromatography. The simplest type of emission spectroscopy observes the color given off by samples exposed to this phenomenon, which produces yellow for sodium and bright white for magnesium. This phenomenon is produced in laboratory settings using a Bunsen burner. For the point, name this phenomenon given off by combustion reactions.

ANSWER: **flames** (or **fire**; accept **flame test**; accept **flame** ionization detector; prompt on "heat")

(16) This element was first isolated by Henri Moissan through electrolysis. This element's existence was first theorized by André-Marie Ampère in 1810, and this halogen exists by itself as a diatomic element. This element is the most electronegative and therefore reacts strongly to all elements, except argon, neon, and xenon. Commonly found in toothpaste, this is, for the point, what element used as an additive in tap water with the atomic symbol F?

ANSWER: **Fluorine** (accept **F** before mentioned)

(17) This disease and frontotemporal dementia are both caused by the *CHCHD10*, *SQSTM1*, and *TBK1* genes, and are linked with the abnormal presence of the *TDP-43* protein. One moniker of this disease is derived from its discoverer, Jean-Martin Charcot, while a more common moniker derives its name from a New York Yankees first baseman who died in 1941. Stephen Hawking suffered from, for the point, what progressive neurodegenerative muscle disorder also known as Lou Gehrig's Disease?

ANSWER: **ALS** (or **Amyotrophic Lateral Sclerosis**; accept **Motor Neuron** Disease; accept **Charcot's** Disease; accept **Lou Gehrig's** Disease before mentioned)

(18) Medical knowledge was mixed with spells in documents from this civilization named for Ebers, Edwin Smith, and London Medical. Hippocrates and Galen studied this civilization's early medicine, including fruit-derived ointments, at the temple of one of its rulers. Despite advances in dental technology, this civilization's Queen Hatsheput died from an abscess following a tooth extraction. For the point, name this ancient civilization whose early science was advanced thanks to the patronage of the pharaohs.

ANSWER: Ancient **Egypt** (accept **Kemet**; or **km.t**; prompt on "Black Land")

(19) In this process, Okazaki fragments are joined by ligase to synthesize the lagging strand, and this process occurs during the S phase of the cell cycle. The Meselson-Stahl experiment proved that this process was semi-conservative, and PCR is an example of this process occurring on a massive scale. For the point, name this process in which DNA is copied onto a new strand.

ANSWER: DNA **Replication**

(20) Examples of these objects include the North America type and the Westerhout Five, the latter of which is often paired with the neighboring Heart type of these objects as the "Heart and Soul." Subclasses of these objects include the emission and reflection types, and the Crab type found in Taurus is an example of the supernova remnant subclass of these objects. For the point, name these massive cosmic clouds primarily made of gas and dust.

ANSWER: **Nebulae** (accept Emission **Nebulae**; accept Reflection **Nebulae**; accept Dark **Nebulae**; accept Planetary **Nebulae**; accept **Supernova Remnant** before mentioned)

(21) A type of chromatography named after this material separates colored chemicals. A wooden frame called a "deckle" is used in the manufacturing of this material. Machines that produce this material have sections termed "wet end" and "dry end." Litmus stains this material in a common acid-base indicator. For the point, name this material made of pulp, which comes in sizes like legal and A4.

ANSWER: **Paper** (accept **paper** chromatography; accept litmus **paper**; accept copy **paper**)

(22) This body moves in the direction of the Cygnus constellation and contains features that can be predicted by Spörer's law. NASA's Pioneer program engineered the first satellites for long-term observation of this object, which caused a geomagnetic storm during the Carrington Event. This entity, which is classified as G-type main-sequence, contains an outermost layer made of plasma known as the corona. For the point, name this star at the center of our solar system.

ANSWER: **Sun** (accept **Sol**)

(23) One form of this quantity can be calculated from enthalpy and temperature by the Clausius-Clapeyron equation, that is the "vapor" form. Amonton's law correlates this quantity with temperature. Dalton's law equates the sum of the "partial" forms of this quantity to the "total" form in a system. For the point, name this quantity measured in pascals, the force per unit area.

ANSWER: **Pressure** (accept Vapor **Pressure**; accept Partial **Pressure**)

(24) Homology-directed repair via CRISPR can be used to introduce these phenomena into a target sequence that can be prevented by Wobble-base pairing. Substitution of valine for glutamic acid is caused by one of these events and results in sickle cell anemia, while another type has no effect on phenotype. Point and frameshift are examples of, for the point, what process that results in the change of DNA sequence in an organism?

ANSWER: **mutation** (accept word forms)

(25) This scientist co-names the second law of photochemistry with Johannes Stark. One quantity introduced by this scientist is symbolized lambda and represents the expansion of the universe, though he later deemed it his “biggest blunder.” Gravitational lensing is explained by a “general” form of a theory proposed by this scientist. For the point, name this German-born physicist who originated two theories of relativity.

ANSWER: Albert **Einstein** (accept **Einstein**-Stark Law)

(26) This organ’s sinoatrial node is located near the superior vena cava, and its activity is recorded by an EKG. Purkinje fibers conduct action potentials in this organ, which is affected by myocardial infarctions. Atria and ventricles make up the four chambers of this organ in humans. For the point, name this central organ whose namesake “beat” is essential to human life.

ANSWER: **Heart** (accept **Heart**beat)

(27) This organelle in eukaryotic cells contains cytochrome c oxidase, which participates in the electron transport chain. The Krebs cycle occurs in the matrix of this organelle. Cristae are folds in the inner membrane of this organelle, where a proton gradient helps synthesize ATP, the cell’s main energy currency. For the point, name this so-called “powerhouse of the cell.”

ANSWER: **Mitochondria** (or **Mitochondrion**)

(28) Electrorceptors in the pores of these animals are known as Ampullae of Lorenzini. Cladoselache was a genus of early predecessors to these animals, which contain multiple rows of replaceable teeth. The “whale” variety of these animals is the largest extant fish species. For the point, name these animals that include “hammerhead” and “great white” varieties.

ANSWER: **Sharks** (accept Whale **Sharks**; accept Hammerhead **Sharks**; accept Great White **Sharks**; prompt on "Fish")

(29) Ernest Rutherford was the first to apply the current name to this particle. This baryon is a fermion with a half-integer spin composed of three valence quarks, two up quarks and one down quark. While this nucleon is commonly bound to another subatomic particle, the most common isotope of hydrogen’s nucleus is a lone one of these particles. For the point, name this positively-charged subatomic particle that composes an atom’s nucleus with the neutron.

ANSWER: **Proton**

(30) The very low Bond albedo of this planet's rings explain why they are so dark in color. This planet was originally called the "Georgian Star" by its discoverer, who also was the first to spy its moons Titania and Oberon. This planet's extreme seasonal variance has been explained by its almost ninety degree sideways tilt. William Herschel discovered, for the point, what seventh planet from the Sun that lies between Saturn and Neptune?

ANSWER: **Uranus**

Extra Questions

(1) These organisms contain the transcription factor Gal4, which is used in their namesake "two-hybrid screening" assay to detect protein interactions. The most common form of thrush is caused by infection with one of these organisms, *Candida albicans*. Both "a" and "alpha" mating types are found in the "baker's" type of these organisms. For the point, name these unicellular fungi used in making bread and beer.

ANSWER: **yeasts** (accept **Saccharomyces**; accept **Saccharomyces cerevisiae**; accept **Candida albicans**; prompt on "fungi")

(2) The SI unit for this quantity was redefined in terms of the Boltzmann constant in 2019. The inputs of Planck's Law are frequency and this quantity. According to Charles' law, this quantity varies directly with volume in a gas. Materials lose superconductivity above this quantity's critical value. This quantity is measured on the Rankine scale, which starts at absolute zero but uses Fahrenheit units. For the point, name this quantity measured by a thermometer.

ANSWER: **temperature** (prompt on "degrees")