(MS) Science Bee Round 8

Regulation Tossups

(1)   Enhancer trapping is a gene expression technique commonly used in this organism that only has four chromosomes. Class 2 transposable elements called P-elements were discovered in the genome of this organism that contains recessive traits such as vestigial wings and ebony bodies. Thomas Hunt Morgan discovered the white-eyed mutation in, for the point, what insect model organism whose scientific name is *Drosophila Melanogaster* [[dro-SOH-fih-luh muh-LAN-noh-gah-ster]].

ANSWER: **fruit fly** (accept **Drosophila** Melanogaster before mention)

(2)   Using previous studies from Otto Meyerhof and Edward Buchner, Gustav Embden proposed a detailed ten-step outline for this process that is parallel to the pentose phosphate pathway. This process, which is catalyzed by enzymes such as phospho-fructokinase and hexokinase, is anaerobic and involves the input of two ATP molecules. For the point, name this first step of cellular respiration, which precedes the Kreb Cycle, and in which glucose is split into two pyruvate molecules.

ANSWER: **glycolysis**

(3)   This law describes systems with a compressibility factor equal to one, which are modeled by kinetic molecular theory. This law is equivalent to setting the A and B terms equal to zero in the van der Waals equation, which disregards particle volume and intermolecular forces. It was created from a combination of Boyle's, Charles's, and Avogadro's laws. The statement "P V equals N R T" is, For the point, what law that models a hypothetical state of matter?

ANSWER: **ideal gas** law (accept **general gas** equation)

(4)   This process is regulated by the methylation of cytosines at CpG sites, and proteins such as EGR1 and ETS2. The TATAAT sequence or Pribnow Box initiates this process in prokaryotes, while for eukaryotes, it is initiated at the TATA box. Following this process, a five prime cap and poly-A tail are added to its end product. RNA polymerase is the key enzyme of, for the point, what process in which a strand of template DNA is copied into messenger RNA?

ANSWER: **transcription**

(5)   The "Ping-Pong" mechanism can be used to describe the change of these molecules into intermediate forms. Michaelis–Menten[[mih-KAY-liss MEN-ten]] kinetics help explain the activity of these molecules that can be activated or inhibited at their allosteric site. The "lock and key" model fails to explain the transition state that these molecules obtain when binding to a substrate at their active site. For the point, name these biological catalysts that help speed up chemical reactions.

ANSWER: **enzyme**s (prompt on "protein(s)"; do not accept or prompt on "catalysts")

(6)   Guanylate cyclase is activated when this molecule binds to the heme group, and this molecule is the principal propellant used in aerosol sprays. Along with a molecule with a greater number of oxygen atoms, this oxide is responsible for pollutive phenomena such as smog and acid rain. For the point, name this diatomic molecule containing one nitrogen and one oxygen atom.

ANSWER: **Nitric Oxide** (accept **Nitrogen Oxide**; accept **Nitrogen** Mon**oxide**)

(7)   Fragmentations of this organelle has been associated with Alzheimer's and Parkinson's disease. Molecules tagged with mannose-6-phosphate are directed to the lysosome from this organelle that receives COPII [[cop-two]] transported proteins at its *cis* face. Membrane-enclosed discs called cisternae are found in, for the point, what organelle that packages protein and lipid molecules into membrane-bound vesicles, often described as the "post office" of a eukaryotic cell?

ANSWER: **Golgi** Apparatus (or **Golgi** Complex; or **Golgi** Body)

(8)   The left recurrent laryngeal [[luh-RIN-jeel]] nerve loops under part of this structure. The incorrect positioning of this structure is one of the defects that make up the tetralogy of Fallot [[fuh-LOH]]. The wall of this structure often "bulges out" in people with Marfan syndrome. The ascending and descending parts of this vessel are connected by its namesake arch. The semilunar valve named for this blood vessel connects it to the left ventricle. Blood is carried away from the heart by, for the point, what largest artery in humans?

ANSWER: **Aorta** (accept Ascending **aorta**; or Descending **aorta**; accept **Aortic** arch; accept **Aortic** valve; prompt on "artery")

(9)   The surface of Mars is an example of the crescent-shape type of these topographical features known as Barchans [[bar-CANS]]. The removal of sediments cause surface depressions known as blowouts which are typically associated with the parabolic type of these topographical features, whose slip face is convex in shape. Draas are a large-scale version of, for the point, what topographical features that are mounds of sand formed by wind deposits?

ANSWER: Sand **Dune**s (accept **Dune** System; accept **Dune** Complex; accept **Dune** Field; accept Crescent **Dune**s; accept Barchan **Dune**s; accept Parabolic **Dune**s)

(10)   This structure can be classified into Piedmont and Tidewater types and cuts a U-shaped valley of surrounding bedrock to form a fjord [[FYORD]]. The retraction of these structures can result in the formation of drumlins or moraines. When these structures generally found in polar regions break apart, they form crevasses or large icebergs. Antarctica is made up of, for the point, what large moving body of dense ice?

ANSWER: **Glacier**s

(11)   This mathematical concept has a *double* type that only involves odd numbers, and a *hyper* type that form the discriminants of *Hermite polynomials*. This mathematical function increases faster than exponential growth, but slower than a double exponential function. For the point, name this mathematical function that is the product of all positive integers less than or equal to the input of the function.

ANSWER: **Factorial** (accept double **factorial**; accept hyper **factorial**)

(12)   VSEPR [[VES-purr]] theory predicts that a water molecule will exhibit a tetrahedral arrangement of the hybrid type of these entities. The spatial orientation of the simplest type of these entities is spherical. With varieties that include the s, p, d, and f types, these are, for the point, what region in an atom that describes the location and wave-like behavior of an electron?

ANSWER: Atomic **Orbital**s (accept specific orbital types such as S, P, D, or F **Orbital**s before mentioned; accept **Wavefunction**s; accept **Energy Level**s)

(13)   Description acceptable. H.K. Erben suggested that this event was caused by deformed eggshells, while another debunked theory came from L.R. Croft, who proposed that this event was caused by cataracts. S.E. Flanders suggested that this event was due to the influx of caterpillars and their tendency to eat a copious amount of plant material, leading to the animals central to this event starving. The K-T boundary was characterized by, for the point, what event that is widely believed to have been caused by an asteroid impact, killing off an entire species of large reptiles nearly 65 million years ago?

ANSWER: **Extinction** of the **Dinosaur**s (accept answers synonymous to mass **extinction** of the **dinosaurs**; accept **Cretaceous-Paleogene extinction** event; or **K-Pg extinction** event; accept **Cretaceous-Tertiary extinction** event; or **K-T Extinction** event))

(14)   The quotient of these entities can be expressed as a solution to a system of linear equations via Cramer's Rule. These entities, which come in Singleton and Jacobian varieties, are non-commutative when multiplied. The determinant of a two-by-two variety of these entities is ad minus bc. For the point, name these rectangular mathematical entities that can be arranged in rows and columns.

ANSWER: **matrix** (or **matrices**; accept Singleton **Matrix**; accept Jacobian **Matrix**)

(15)   Though not known as an economist, this scientist conducted a study on the value of money in which he discovered an early form of Gresham's law and established quantity theory. This man's seminal work, *On the Revolutions of the Celestial Spheres*, was not published until a year after his death in Poland. For the point, name this polymath who formulated the heliocentric model of the solar system.

ANSWER: Nicolaus **Copernicus** (accept **Copernican** System; or **Copernican** Revolution)

(16)   After her death in 1958, the work of this scientist was continued by Aaron Klug, which earned him the Nobel Prize in Chemistry in 1982. Raymond Gosling, one of this scientist's students at King's College in London, was responsible for taking *Photo 51*, an X-ray diffraction image of a paracrystalline gel composed of DNA fiber. For the point, name this chemist whose influence and uncredited work on the structure of DNA led to her being called the "wronged heroine."

ANSWER: Rosalind **Franklin** (Rosalind Elsie **Franklin**)

(17)   Binary types of this process are modeled on a McCabe-Thiele diagram. Refluxing is performed during this process to continually recondense vapors, and the "fractional" type of this process is often used to refine crude oil. Liquor is made by doing this process to fermented beverages. For the point, name this method of separating liquids based on their boiling points.

ANSWER: **distillation** (accept fractional **distillation**; accept pressure-swing **distillation**)

(18)   Access to these areas were limited in one location after soil samples found inside were positive for a fungus known to cause the white-nose syndrome. Within these areas are formations made of nodes of calcite, aragonite, or gypsum known as "popcorn", and another formation within these areas are made from sheets of calcium carbonates known as flowstones. The erosion of limestone forms, for the point, what natural, underground voids that contain stalactites and stalagmites, a place where spelunkers explore?

ANSWER: **Cave**s (accept **Cavern**s)

(19)   In quantum computers, this task can be accomplished by using Grover's algorithm. This task follows "pruning" in a notable solution to optimization problems. This task can be performed in depth-first or breadth-first ways in graphs, and a common demonstration of divide-and-conquer is the "binary" form of this task. For the point, name this task of finding a certain value in a given input.

ANSWER: **Search**ing (accept depth-first **search**; accept breadth-first **search**; accept binary **search**)

(20)   The soda-lime type of this material can be made through the addition of sodium and calcium carbonate, while the volcanic type is naturally occurring. Boron trioxide is a major component of one form of this material used to make laboratory equipment. This amorphous solid is non-crystalline, and can be manufactured through a process known as "blowing". For the point, name this transparent material made of silica primarily found in windows.

ANSWER: **glass** (accept soda-lime **glass**; accept volcanic **glass**; accept **glass** blowing)

(21)   This set of numbers is not bounded above in the reals by the Archimedean property. Peano's axioms are a set of rules governing these numbers. The sum of the reciprocal of these numbers is equivalent to the harmonic series. This set of numbers is the intersection of the positive numbers with the integers. For the point, what set of numbers includes 1, 2, 3, and so on?

ANSWER: **Natural** numbers (accept **Positive integer**s; accept **non-negative integer**s; accept **whole** numbers; or **counting** numbers)

(22)   This stage of a star's life involves the contraction of its helium core and the expansion of its outer hydrogen layers, and this stage precedes the white and black dwarf stages. Low and intermediate-mass stars will become this type, and our Sun is expected to engulf Venus and possibly Earth when it becomes this type of star in five billion years. For the point, name these large, highly luminous stars.

ANSWER: **Red Giant**s (prompt on "star(s)")

(23)   This force transforms charge in the tribo-electric effect, and can be depicted in Amontons Law, which states that this force is directly proportional to the applied load. The strength of this force is proportional to the normal force and can be related by a namesake coefficient symbolized mu [[MYOO]]. For the point, name this force that comes in static and kinetic forms and opposes the change in motion.

ANSWER: **Friction** (accept Static **Friction**; accept Kinetic **Friction**; accept Dry **Friction**)

(24)   The largest of these structures in the Western hemisphere is named for Jennifer Chalsty and can be found in Jersey City. Other notable American examples of these structures include the Hayden in New York and the Adler in Chicago. Archimedes is crediting with creating, for the point, what usually dome-shaped structures in which viewers can watch the projected movement of the solar system?

ANSWER: **Planetarium** (accept Jennifer Chalsty **Planetarium**; accept Hayden **Planetarium**; accept Adler **Planetarium**)

(25)   The human genome contains 54 genes of this protein in which mutations of its gene expression may cause Ichthyosis [[ik-thee-OH-sis]] bollusa of Siemens or Steatocystoma multiplex. The alpha type of this protein is characterized into two types, type I and type II, both of which make up a subunit dimer called the coiled coil. Claws, feathers, and scales are made of, for the point, what fibrous protein that also make up human fingernails and hair?

ANSWER: **Keratin** (accept Alpha-**Keratin**; prompt on "Scleroprotein")

(26)   Some animals with this property have cryoprotectants that increase the concentration of solutes inside its cells, as well as antifreeze proteins that prevents the growth of ice crystals. Animals with adaptations for this property include the African lungfish, which buries itself in the ground in preparation for hibernation. For the point, name this property in animals, such as amphibians and reptiles, that require regulation of body temperature based on its external environment.

ANSWER: **Ectotherm**s (accept **Cold-blood**ed; accept **Poikilotherm**s)

(27)   Types of this weather phenomenon include orographic, stratiform, and convective, and this weather phenomenon is measured using a udometer. According to the Thornthwaite system, the index relating to the effectiveness of this weather phenomenon in steppe vegetations ranges between 16 and 31, which classifies it as semiarid. For the point, name this weather phenomenon that formed when frozen or liquid water is released from clouds, whose subtypes include hail, rain, and snow.

ANSWER: **Precipitation** (accept Orographic **Precipitation**; accept Stratiform **Precipitation**; accept Convective **Precipitation**; accept **Hail**; accept **Rain**; accept **Sleet**; accept **Snow**)

(28)   This body's 1600-mile Aitken basin is one of the largest craters in the solar system. This body was likely formed in the "Big Splash," a collision with a Mars-sized object. This object contains a favorable landing spot called the Sea of Tranquility, and the gravitational pull of this object is responsible for tides. For the point, name this celestial body that waxes and wanes as it orbits the Earth.

ANSWER: Earth's **Moon** (or **Luna**)

(29)   The power of a test refers to the ability to correctly reject one of these statements and avoid a Type Two error. If the p-value is less than significance level alpha, the null type of this statement is rejected in favor of the alternative type. In the scientific method, these statements are often written in an "if/then" format. For the point, name these proposed statements that can be tested by experimentation.

ANSWER: **Hypothesis** (or **Hypotheses**; accept Null **Hypothesis**; accept Alternative **Hypothesis**)

(30)   One surface feature of a satellite orbiting this body was described by NASA as a "mountain sitting in a moat." This body has not made a full orbit around the Sun since its discovery due to its orbital period being over 200 years. This object was discovered by Clyde Tombaugh and it is named after the Roman god of the underworld. For the point, name this body which, in 2006, was reclassified as a dwarf planet.

ANSWER: **Pluto** (prompt on "Charon" if buzz firstline)

Extra Questions

(1)   The breaking up and recombination of molecules that contain this entity is known as their namesake "metathesis." Molecules that contain this structure between two carbon atoms are known as alkenes. Molecular oxygen contains this structure between its two oxygen atoms. For the point, name this structure, designated with two lines, where two pairs of electrons are shared between two atoms.

ANSWER: **Double bond** (accept **Olefin**; accept answers involving **Two bonds**; accept **Alkene**s before mentioned)

(2)   These are not mountains, but one type of these landforms is created due to slow convergence of tectonic plates and upward movement of the earth's crust. Another type of these landforms is formed due to the upwelling of magma and the accumulation of lava in layers. Dissected and volcanic are the two major types of, for the point, what features that are formed by thermal expansion and crustal shortening, and are elevated pieces of land with flat tops?

ANSWER: **Plateau**s (accept dissected **plateau**s; accept volcanic **plateau**s)