

(E) Science Bee Backup

Regulation Tossups

(1) Members of this bacterial genus are classified based on their ability to lyse blood cells in the Lancefield grouping. Infection by a member of this genus can cause (+) rheumatic fever if left untreated. Scarlet fever is caused by the *pyogenes* species of this genus, which leaves a white exudate on the (*) tonsils in an infection commonly detected by throat culture. For the points, name this genus of spherical bacteria that cause a namesake sore throat.

ANSWER: Streptococcus (accept Streptococcus pyogenes; accept strep throat)

(2) These structures secrete HIF-1 and VEGF to induce angiogenesis of a "leaky vasculature", and its surrounding microenvironment is commonly acidic due to the (+) Warburg effect. "Caretaker", "gatekeeper", and "landscaper" are the three categories of genes named for "suppressing" these structures which act in opposition to oncogenes. Proliferating through (*) blood vessels during metastasis, these are, for the points, what masses of cancer cells that are classified as either benign or malignant?

ANSWER: Tumors (accept Cancer Cells; accept Neoplasms; accept Tumor Suppressor Genes)

(3) Entities named for these molecules have a subtype called caveolae [[KAH-vee-OH-leh]] that are flask-shaped. Ceramides [[SEH-ruh-midez]] are an example of the "sphingo" [[SFIN-goh]] type of these molecules. (+) Microdomains enriched in cholesterol are "rafts" named for these nonpolar molecules. The cell membrane consists of a bilayer named for these hydrophobic molecules. The main components of living (*) cells include proteins, carbohydrates, and for the points, what biomolecules synonymous with fats?

ANSWER: Lipid (accept Lipid raft or Sphingolipid; prompt on "fat" or "fatty acid")

(4) The dynamic of this structure is represented by the Singer-Nicolas model, which explains how smaller (+) molecules can pass through this organelle without assistance through osmosis or diffusion. The fluid mosaic model is a representation of this organelle, which is present in both eukaryotes and (*) prokaryotes. For the points, name this organelle that surrounds the cytoplasm and protects the inner components of a cell from its environment?

ANSWER: Cell Membrane (or Plasma Membrane; or Cytoplasmic Membrane; accept Plasmalemma; do not prompt or accept "Cell Wall")

(5) This tissue is removed in a process called girdling. According to the pressure-flow hypothesis, this (+) tissue performs photosynthate partitioning by translocating carbon solutes. This tissue consists mainly of companion cells and sieve tube elements, which come from the meristem. Sap (*) is carried by, for the points, what vascular plant tissue that transports sugars and nutrients, as opposed to xylem?

ANSWER: **Phloem** (prompt on "Bark")

(6) The fork-lined method is a tactic used to solve problems presented in these diagrams. The ratio resulting from cases observing epistasis (+) are an exception to one form of these diagrams which would normally constitute a 9:3:3:1 ratio. These diagrams also outline the codominance relationship between the alleles of A and B blood types. Monohybrid and (*) dihybrid crosses are used to visualize, for the points, what diagrams that outline the allele interaction of two parents to predict the phenotypic outcomes of an offspring?

ANSWER: **Punnett** Squares

(7) This scientist proposed the parton model of hadrons and the path integral formulation of quantum mechanics. (+) Constructs named for this scientist can be used to visualize scattering processes. This scientist's *Lectures on Physics* is one of the most popular (*) science books ever written. For the points, name this Caltech physicist whose namesake "diagrams" represent the motion of particles.

ANSWER: Richard **Feynman** (accept **Feynman** Diagrams)

(8) Variations of these molecules include d5SICS and dNaM, which feature aromatic rings rather than purine rings. These molecules participate in cell signaling to create cyclic (+) guanosine [[GWAH-noh-seen]] monophosphate and cyclic adenosine [[ah-DEH-no-seen]] monophosphate. Three subunits exist within these molecules, including a five-carbon sugar and guanine, adenine, (*) cytosine, or thymine. For the points, name these organic molecules, consisting of a nucleoside and a phosphate, found in DNA and RNA.

ANSWER: **Nucleotides** (accept 5-**Nucleotides**)

(9) Eigenvalues can be found by performing this operation on the original matrix minus lambda times the identity and setting the result equal to (+) zero. This operation on a matrix is zero if and only if the matrix is noninvertible, and taking a cross product is equivalent to performing this operation on a 3 by (*) 3 matrix. For the points, identify this operation, which for a 2 by 2 matrix equals a times d minus b times c.

ANSWER: **Determinant**

(10) A spot found in a crater on Mars was dedicated to this figure during the Mars Exploration Rover mission in 2005. It was revealed in 2002 that this explorer died from overheating due to the failure of her (+) spacecraft's central R-7 sustainer, although it was first reported that this cosmonaut's death was caused by oxygen depletion. Flying into space aboard (*) Sputnik 2, this is, for the points, what Soviet cosmonaut who became the first animal to orbit Earth, also referred to as "Muttnik"?

ANSWER: Laika (prompt on "Muttnik" before mentioned)

(11) This body was termed the "little cloud" in 905 by Persian astronomer Al-Sufi. This object was the main focus of the Shapley-Curtis (+) debate, which argued whether this object was an "island universe." This body is designated 31 in the Messier catalog, and it is predicted to collide with the Milky Way in about 4.5 (*) billion years. For the points, name this closest galaxy to the Milky Way, named after the daughter of Cassiopeia.

ANSWER: Andromeda galaxy

(12) This many bonding pairs of electrons are found in molecules with a seesaw geometry. This (+) is the atomic number of the lightest element in emerald. One molecule of hydrogen peroxide contains this many total atoms. Methane contains this many (*) hydrogen atoms. For the points, how many bonds can carbon form, which is also its number of valence electrons?

ANSWER: Four

(13) A chemist from this country discovered a way of predicting reaction rates based on temperature and wrote an early acid-base definition. This country's village of (+) Ytterby was where the elements of yttrium, ytterbium, erbium, and terbium were discovered. A scientist from this country invented the smokeless powder Ballistite, as well as dynamite. Svante (*) Arrhenius was from, for the points, what country, whose native Alfred Nobel names a set of annual prizes?

ANSWER: Sweden (or Sverige; accept Kingdom of Sweden; or Konungariket Sverige)

(14) This company's TDI technology creates more power while disbursing less fuel and producing fewer emissions. This company lost half its board after the (+) CARB denied a proposed fix for vehicles with 2.0 liter engines. CEO Mark Winterkorn resigned from this company after certain vehicles produced 40 times more nitrogen oxide than during (*) emissions testing. For the points, name this German car company that produced the Beetle.

ANSWER: Volkswagen (accept VW; accept Volkswagen Beetle)

(15) Reacting this compound with copper oxide forms a bright blue salt, and a stock 98% solution of this compound has a molarity of 18.4. The 100% pure (+) version of this substance has a Hammett function of negative twelve, and was known as oil of vitriol. This substance is formed from a vanadium oxide catalyst in the contact (*) process. For the points, name this strong acid with formula H₂SO₄.

ANSWER: **Sulfuric Acid** (accept **H₂SO₄** before mentioned; prompt on "Oil of Vitriol" before mentioned)

(16) One type of these entities can be iteratively solved using Runge-Kutta methods. Guessing solutions composed of exponential functions or using (+) Euler's [[OY-lers]] method are simple methods for explicitly solving the ordinary type of these entities. Euler and Lagrange name a system for these equations, and a first step in dealing with these equations is to employ separation of (*) variables. For the points, what type of equations contain a variable and its derivatives?

ANSWER: **Differential** Equations (accept Ordinary **Differential** Equation; or **ODE**; prompt on "Derivative")

(17) Stephen Kleene [[KLAY-nee]] names a type of this symbol that returns a set of strings closed under concatenation. A forward slash and this symbol are used to delimit block comments in (+) JavaScript and CSS. In languages like C++, this symbol is used to de-reference a pointer variable. This symbol denotes required fields in web forms written in (*) HTML. For the points, name this computer programming symbol that also typically represents multiplication.

ANSWER: **asterisk** (or **star**; accept Kleene **star**)

(18) In fluorescence microscopy, this organelle is commonly stained with the dye Hoechst [[HURKST]] 33342 when imaging cells or tissues. A structure within this organelle, the karyolymph, is noted for (+) "sap"-like substance, while another structure in this organelle, continuous with the endoplasmic reticulum, is responsible for the synthesis of ribosomes. (*) Transcription occurs in this organelle, only found in eukaryotes. For the points, the "control center" of the cell is what organelle where DNA is stored?

ANSWER: Atomic **Nucleus** (accept **Nuclei**)

(19) One experiment testing this theory measured gamma rays emitted from an iron sample placed in a loudspeaker cone, and was performed by Pound and Rebka. The equivalence (+) principle relates two forms of mass in this theory, which is also described by a set of field equations that contained the cosmological constant. Gravity is explained by the curvature of (*) space-time in, for the points, what theory proposed by Einstein with a "special" counterpart?

ANSWER: general relativity (accept GR; prompt on "relativity"; do not accept or prompt on "special relativity")

(20) A value named for this scientist is the time derivative of the scale factor divided by the scale factor. An instrument named for this scientist captured high-resolution images of (+) Shoemaker-Levy 9's collision with Jupiter. This man found that an object's distance and redshift are directly proportional to each other. An astronomical (*) constant is named for, for the points, what namesake of a space telescope?

ANSWER: Edwin Powell Hubble (accept Hubble Space Telescope)

(21) This type of mixture forms at the Bancroft point, which falls within the valid ranges of the Antoine equation. Entrainers or a "pressure-swing" (+) technique using multiple columns can be used to "break" these systems, which deviate from Raoult's law. A binary example of these systems is a 96% solution of ethanol in water. Also called "constant (*) boiling point mixtures", these are, for the points, what solutions which cannot be separated by simple distillation?

ANSWER: Azeotropes (accept Constant Boiling Point Mixtures before mentioned; prompt on "Solutions"; prompt on "Non-ideal")

(22) Alfven waves travelling within these substances are modelled using MHD theory, or magnetohydrodynamics. Magnetic fields are used to confine these substances in the shape of a torus within a (+) tokamak. Solar flares are caused by magnetic reconnection within these substances because they make up the mass of the sun, as well as the discharge in (*) lightning strikes. For the points, name these ionized gases considered the "fourth state of matter".

ANSWER: plasmas

(23) A disorder that affects this organ includes a benign growth called the arytenoid granuloma, while another results in the swelling of this organ caused by a gelatinous fluid in a disorder called (+) Reinke's edema [[eh-DEH-mah]]. This organ, which is situated underneath the hyoid bone, becomes inflamed by a bacterial infection called croup, which also infects the bronchi and trachea. As the (*) epiglottis opens, air enters, for the points, what organ in the neck that houses vocal cords, also known as the voice box?

ANSWER: Larynx (prompt on "Voice Box" before mentioned)

(24) Early signs of the Fournier's type of this disease, also called necrotizing fasciitis [[fah-shee-EYE-tiss]], include (+) pain and redness surrounding an infection point. Various treatments for this disease include maggot therapy, hyperbaric oxygen therapy, and debridement. Sepsis and (*) amputation are complications of, for the points, what disease caused by a bacterial infection or inadequate blood supply that leads to tissue death, characterized by a change in skin color?

ANSWER: Gangrene (or Gangrenous Necrosis; accept Fournier's Gangrene; accept Necrotizing Fasciitis before mentioned; prompt on answers along the lines of "tissue death" before mentioned)

(25) Thales' [[THAY-LEEZ]] theorem applies when this entity is the diameter of an excircle. It's not 1, but this entity is the numerator in the cosecant [[koh-SEE-kehnt]] (+) function. The length of this entity equals the square root of two times one of its smaller counterparts in a 45-45-90 triangle. This term is represented by the "c" in the Pythagorean (*) theorem. For the points, give this term for the longest side of a right triangle.

ANSWER: Hypotenuse

Extra Questions

(1) The accumulation of this molecule by macrophages triggers the formation of foam cells seen in atherosclerosis. The Apolipo-protein (+) B100 test measures the protein of the same name that is responsible for transporting this molecule throughout the body. HDL and LDL are considered the good (*) and bad forms of, for the points, what important lipid in the body, a waxy substance found in blood that is essential to modulating the fluidity of the cell membrane?

ANSWER: **Cholesterol** (prompt on "HDL" or "LDL"; prompt on "Lipids")

(2) Milton's reagent is made by dissolving this element in nitric acid and diluting it with water. An outbreak of Minamata disease was caused by this metal, which forms alloys called (+) amalgams and is found in its +2 state in the mineral cinnabar. One atmosphere is equal to the pressure of 760mm of this element that can be found in barometers and old (*) glass thermometers. For the points, name this element with atomic number 80 and chemical symbol Hg that is liquid at room temperature.

ANSWER: **mercury** (accept "Hg" before mention)

(3) The acid-fast type of these substances is used to identify tuberculosis in patient samples. Histologists often analyze biopsies using one of these substances containing both (+) hematoxylin and eosin. One of these substances called crystal violet binds to the bacterial cell wall in a technique named for Gram. Cells (*) can be visualized using, for the points, what substances that provide contrasting colors to a biological sample?

ANSWER: **stains** (or **dyes**; accept Gram **stain**; accept H&E **stain**; accept acid-fast **stain**)