Science Bee 2 - Round 4

Round 4 Tossups

(1) Known in the 19th century as Heine-Medin disease, this disease remains active in the wild only in Afghanistan and Pakistan. Drinker and Shaw developed a negative pressure ventilator in 1928 in response to pervasive outbreaks of this disease. In 1921, Franklin Delano Roosevelt was diagnosed with this disease, leaving him confined to a wheelchair. For the point, name this disease, whose first vaccine was developed by Jonas Salk.

ANSWER: **Polio**myelitis

(2) This is the simplest non-aldehyde molecule that can form an enol through a tautomerization reaction. A cooling bath at negative 78 degrees Celsius is created by mixing dry ice with this polar aprotic solvent, which consists of a carbonyl group bonded to two methyl groups. This three-carbon compound is commonly used to clean laboratory glassware. For the point, name this simplest ketone often found in nail polish remover.

ANSWER: **Acetone** (or **Propanone**)

(3) The hypothetical object Nemesis is said to pass by this region once every 26 million years, and the inner part of this region is named after Jack G. Hills. This region may be as much as four thousand times farther from Earth than the Kuiper [[KAI-per]] belt and is postulated to be the outermost edge of the solar system. For the point, name this region which is named after a Dutch astronomer, from which comets are thought to originate.

ANSWER: Öpik–**Oort cloud**

(4) The WKB method can be applied to this man's namesake equation, which governs the wave function of a quantum-mechanical system. This man designed a thought experiment to ridicule the Copenhagen interpretation of quantum mechanics. This man's theoretical experiment involved a Geiger counter, poison, and an animal inside a box. For the point, name this Austrian physician who demonstrated superposition using his namesake cat.

ANSWER: Erwin **Schrödinger** [[SHRER-ding-uh]] (be lenient on pronunciation; accept **Schrödinger**'s equation; accept **Schrödinger**'s cat)

(5) The hyperbolic form of this function defines a catenary curve. A law named for this function states that "c squared equals a squared plus b squared minus two times a times b times this function of angle C." This function of "x" is the reciprocal of secant of "x." This function of "x squared plus sine of x squared" is always equal to one. For a triangle, this function is equal to adjacent over hypotenuse. For the point, name this trigonometric function contrasted with sine of "x."

ANSWER: **Cos**ine of x

(6) Some protists engage in this process in a transversal or longitudinal fashion. When this process occurs in some higher organisms like tapeworms, it is called strobilation. Enzymes begin this process at the origin of replication. Once this process has begun, the cell will begin to elongate to make room for the duplicated material. This process is completed after that duplicated material separates. For the point, identify this type of cell division which takes place in most bacteria?

ANSWER: **Binary fission**

(7) This scientist's namesake law states that an increase in acid leads to an increase in air temperature and concerns the greenhouse effect. The Eyring [[EYE-ring]] equation modifies this scientist's namesake equation, which contains the pre-exponential factor symbolized "A." This man defined acids as species that form hydronium in solution. For the point, name this Swedish chemist whose namesake equation relates activation energy to reaction rate.

ANSWER: Svante **Arrhenius** [[ah-RAY-nyuss]] (accept **Arrhenius**'s law; accept **Arrhenius**'s equation)

(8) The surface of a location where this process occurs is an arc-trench complex. A shallow angle is present in the "flat slab" form of this process. Earthquakes are generated in Wadati-Benioff zones, in which this process is frequent. Many regions in which this process occurs are found in the Pacific Ocean's Ring of Fire. For the point, name this process which happens when one tectonic plate goes below another at a namesake "zone."

ANSWER: **Subduction** (accept Flat slab **subduction**; accept **Subduction** zone(s))

(9) This feature is located off the western edge of the Tharsis plateau, part of the Valles [[VAH-less]] Marineris canyon. This feature's name was changed after the Mariner 9 spacecraft imaged it. In 2011, Rheasilvia [[ray-ah-SILL-vyah]] on the asteroid Vesta was found to be of similar height to this mountain, thus competing with it as the highest mountain in the solar system. For the point, name this shield volcano on Mars with a height of over 20 kilometers.

ANSWER: **Olympus Mons**

(10) Centipede Serum contains Extremis virus and this type of energy, emitted by all inmates of The Cube on Earth-8096. In one film, the Tesseract can be tracked because it generates this form of energy, to which all Agents of S.M.A.S.H. were exposed. Samuel Sterns and Emil Blonsky became the Leader and the Abomination, respectively, after absorbing, for the point, what type of radiation from the radioactive decay of the atomic nucleus which transformed Bruce Banner into the Incredible Hulk?

ANSWER: **Gamma** radiation (accept **Gamma** rays; accept **Gamma** energy)

(11) **This principle is represented by an inequality in which the product of the variance of position and momentum must be equal or more than the reduced Planck constant divided by two. According to this principle, it is impossible to (*)** simultaneously measure a particle's position and momentum. This principle is often confused with the related observer effect. For the point, name this principle in quantum mechanics, sometimes named after a German physicist.

ANSWER: Heisenberg('s) **uncertainty** principle

(12) Inclusion-cell disease is a namesake "storage disease" of this organelle which stems from phosphotransferase's inability to transfer phosphate to mannose. After their creation, parts of the cytoplasm are delivered by the autophagosome [[aw-toh-FAY-joh-sohm]] to this organelle which carries out its central function via hydrolytic enzymes. For the point, name this organelle which disposes of waste.

ANSWER: **Lysosome**s

(13) This constant multiplied by the charge of an electron equals Faraday's constant. This constant is sometimes called the Loschmidt [[LOH-shmit]] constant. Silicon is used to determine the value of this constant, and the gas constant "R" is equal to Boltzmann's constant times this constant. For the point, name this constant which is approximately equal to 6.022 times 10 to the 23rd, the number of molecules in a mole of substance.

ANSWER: **Avogadro**'s number (accept "constant" in place of "number")

(14) In analysis, this man found a creative solution by equating the power series expansion of the sine function to its factored form, allowing him to state that the sum of reciprocals of squares was "pi squared over 6." This man proved that there was no solution to a problem involving the Pregel River and the seven bridges of Königsberg [[KER-nigs-burg]]. This man created the notation for the constant "e." For the point, name this prolific Swiss mathematician.

ANSWER: Leonhard **Euler** [[OY-lehr]]

(15) This writer explored the danger of implanting neurostimulators in his second novel, *The Terminal Man*. This author was criticized when his novel *State of Fear* seemed to deny climate change, though his story of a silicon pathogen from space, *The Andromeda Strain*, is considered a modern sci-fi classic. An island of cloned dinosaurs was invented by, for the point, which author of *Jurassic Park*?

ANSWER: Michael **Crichton**

(16) The ILLIAC I computer studied this object, as did Donald B. Gillies. The GURVO, or R7, Rocket was planned to be used with this object which was first envisioned as "Object D." The creation of this object was proposed from plans that Dimitri Ustinov and Sergei Korolev created. In Operation Moonwatch, observers sited this satellite. Prompting the Space Race, for the point, what was this Soviet Satellite launched in 1957?

ANSWER: Prosteyshiy **Sputnik**-1 (prompt on "Satellite 1," "Elementary Satellite 1," or "PS-1")

(17) A book written by this person was the subject of H.F. van Emden and David Peakall's 1996 *Beyond* that book. This scientist's breakthrough publication was the nonfiction book *The Sea Around Us*. This scientist's best known book argued for calling chemical pesticides "biocides" due to their damage to the environment. For the point, name this American biologist and environmentalist, who described the effects of DDT in the book *Silent Spring*.

ANSWER: Rachel **Carson**

(18) This quantity divided by surface area is used to calculate surface tension. This quantity can be calculated as enthalpy minus the product of temperature and entropy. When the change in this quantity is less than zero for a reaction, the reaction will be spontaneous. For the point, name this thermodynamic quantity which at constant temperature and pressure, represents maximum reversible work that can be done, symbolized "G."

ANSWER: **Gibbs free energy**

(19) The 89 version of this language is ANSI supported, and unlike an update of this language which uses "new" and "delete," this language allocates and frees memory through "malloc" and "free." GCC compiles this language which was developed by Dennis Ritchie at Bell Labs as a way to implement utilities and the kernel of Unix [[YOO-niks]]. For the point, name this programming language which was updated with objects in a "Plus Plus" version.

ANSWER: **C**

(20) This scientist expanded upon Henri Becquerel's work on uranium salts emitting rays, and to do so, used the electrometer, which was invented by her husband. While investigating ore pitchblende, this scientist discovered an element, polonium, which she named after her country of birth. This woman also discovered radium with her husband, Pierre. For the point, name this Polish scientist who coined the term "radioactivity."

ANSWER: **M**arie **Curie**

(21) Muscled appendages in these organisms include pedicellaria [[peh-deh-ceh-LAH-ree-uh]]. Ophiuroidea [[oh-fee-yoo-ROY-dee-ah]] is a class in this phylum named for being "brittle." Tube feet allow organisms in this phylum to attach to surfaces, and one organism in this phylum uses Aristotle's lantern to feed. Sand dollars belong to this phylum, some of whose organisms have five-fold radial symmetry. For the point, name this marine phylum which includes sea cucumbers, sea urchins, and starfish.

ANSWER: **Echinoderm**ata (or **Echinoderm**s)

(22) Because they use these interactions, alpha helices and beta sheets are secondary structures. These interactions are found between pyrimidines [[pih-RIH-mih-deen]] and purines [[PYOO-reens]] in DNA, such as three of them formed between cytosine [[SAI-toh-seen]] and guanine [[GWAH-neen]]. These interactions are responsible for the structure of water and its high surface tension and cohesion. For the point, name these interactions which form between fluorine, oxygen, or nitrogen and its namesake element with atomic number one.

ANSWER: **H**ydrogen **bond**s

(23) Luhman 16 is a binary system of two of these objects, the closest-known of these objects to Earth. M, L, T, and Y are spectral classifications of these objects, and the spectroscopic lithium test is used to characterize these objects. These objects have masses of about 13 to 80 times the mass of Jupiter. For the point, name these so-called "failed stars" which do not have enough mass to perform hydrogen fusion.

ANSWER: **Brown dwarf**s (prompt on "star(s)")

(24) At this university's Cavendish Laboratory, Max Perutz used x-ray crystallography to find the structure of hemoglobin. J. J. Thomson's cathode ray experiments at this institution led to the discovery of the electron. Lucasian Professors of Mathematics at this university have included Stephen Hawking and Isaac Newton. Second only to Harvard in number of Nobel laureates, for the point, what is this British university, the longtime rival of Oxford?

ANSWER: University of **Cambridge** (accept **Cambridge** University)

(25) The formation of these molecules from alpha-olefins is facilitated by Ziegler-Natta catalysts. The "dispersity" of these molecules describes their mass distribution. These molecules can be formed by step-growth or chain growth, and common examples of these molecules include rubber and plastic. For the point, name these macromolecules formed by repeating units called monomers.

ANSWER: **Polymer**s

(26) Some members of this phylum utilize an operculum [[oh-PER-kyoo-lum]] to close off a calcified structure. Most members of this phylum possess a tongue-like feeding structure called a radula [[RAD-yoo-luh]]. Members of this phylum possess a body mantle, which secretes calcium carbonate and conchiolin [[kon-KAI-oh-lin]] to form a hard shell. Major groups within this phylum include bivalves and cephalopods. For the point, name this phylum of invertebrate animals which includes squids, octopuses, and snails.

ANSWER: **Mollusca** (or **Mollusk**s)

(27) This language was used to compose the medieval textbook *The Canon of Medicine* by Avicenna [[ah-vee-SEH-nah]]. A treatise on mechanical inventions, *The Book of Ingenious Devices*, was written in this language at the House of Wisdom. Terms like "alcohol" and "algebra" are derived from this language, as are Rigel [[RYE-jel]], Deneb, and most other star names. The ten digits used by the West were transmitted from India via, for the point, which language of many historical Islamic scholars?

ANSWER: **Arabic** (or al-**arabiy**yah)

(28) This concept was incorrectly understood by Aristotle, but the Chinese philosopher Mozi showed a better understanding of this concept in the same time period. Islamic scientists demonstrated an understanding of this concept five centuries before Galileo and Copernicus began to describe it in relation to planetary motion. Kepler first used this term, but Newton never used the term even though he is most associated with this concept. For the point, what is this resistance to change in an object's motion, often explained as "An object in motion will stay in motion."

ANSWER: **Inertia**

(29) This mineral is found at the bottom of the Goldich dissolution series, because it has high stability on Earth's surface. The shocked type of this mineral that has a varied microstructure is formed from meteor impacts. A crystal of this mineral is found in watches, because it is piezoelectric [[pee-eh-zoh-ee-LEK-trik]]. This mineral has a value of seven on the Mohs hardness scale. For the point, name this mineral composed of silicon dioxide, which is found in sand.

ANSWER: **Quartz** (accept Shocked **quartz**)

(30) The conductivity of these cells is improved by being coated in myelin by Schwann cells. These cells are supported by glial [[GLEE-ull]] cells, which include oligodendrocytes and astrocytes. These cells demonstrate "plasticity" through pruning and long-term potentiation. These cells connect to each other through axons and dendrites and communicate with chemicals such as dopamine and serotonin across their synapses. For the point, name these cells which make up the nervous system.

ANSWER: **Neuron**s (accept **Nerve** cell before "nervous system")

Extra Question

(1) This particle names a technique for which the 2017 Nobel Prize in Chemistry was awarded. Photons cause the emission of these particles in the photoelectric effect. The charge of these subatomic particles was determined by the Millikan oil drop experiment. J.J. Thomson described these particles floating in a positively-charged medium in his "plum pudding" model of the atom. For the point, name these negatively charged particles which orbit the nucleus.

ANSWER: **Electron**s (accept Cryo-**electron** microscopy)