Winter Science Bee - Round 3 (M/E)

Round 3 Tossups

(1) Unique phenomena observed in this region include polar plumes and helmet streamers. Solar wind originates from namesake "holes" found in this region. During this layer's namesake "mass ejections," solar flares become more common. Spectrographic analysis of this layer, which sits above the chromosphere, led to the discovery of helium. For the point, name this outermost layer of the Sun, the name for which is Latin for "crown."

ANSWER: Stellar **Corona** (or Solar **Corona**; accept **Corona**l holes; accept **Corona**l mass ejection)

(2) Normality is defined as this quantity divided by the equivalence factor. Colligative [[koh-LIH-gah-tiv]] properties only depend on this quantity and not on the properties of the chemicals involved. This quantity for H+ [[H-PLUS]] ions determines Ph [[P-H]]. In diffusion, particles move from areas with high values for this quantity to areas with low values of it. For the point, name this quantity that can be measured in moles per liter, the abundance of a constituent divided by its total volume.

ANSWER: **Concentration** (accept Molar **Concentration**)

(3) Joseph Lister made some of the first practical applications of this theory with his antiseptics. Despite being demonstrated by Muslim doctors like Avicenna [[ah-vee-SEH-nah]], this theory was originally discounted in favor of Galen's [[GAY-lens]] miasma [[mee-AZ-muh]] theory in pre-modern Europe. Louis Pasteur is the father of, for the point, what currently accepted theory of infectious transmission, which holds that diseases are spread by pathogens?

ANSWER: **Germ** Theory of Disease

(4) This scientist's lectures were collected in the books *Six Easy Pieces* and *Six Not So Easy Pieces*. This scientist presaged the field of nanotechnology in the lecture "There's Plenty of Room at the Bottom." The title of this scientist's autobiography starts with the phrase *Surely You're Joking*. This scientist developed the path integral formulation of quantum mechanics. For the point, name this Caltech physicist, whose namesake diagrams depict particle behavior with arrows and squiggly lines.

ANSWER: Richard **Feynman** (or Richard Phillips **Feynman**; accept **Feynman** diagram; accept *Surely You're Joking, Mr. **Feynman**!*)

(5) Frictional forces in this region cause zonal and meridional [[meh-RIH-dee-uh-nal]] flow regimes. This region can be depicted with the three-cell model, which includes the Hadley Cells. This layer extends for eleven miles above sea level at the equator, ending at its "pause." Most of the Earth's weather occurs in this layer, which also has the majority of the atmosphere's mass. For the point, name this lowest layer of the atmosphere.

ANSWER: **Troposphere** (prompt on "tropopause")

(6) Due to exhibiting this phenomenon, an experiment carried out by Thomas Young helped prove the wave nature of light. The Davisson–Germer experiment used scattering and this phenomenon to demonstrate the wave-particle duality of electrons. An Airy disk is a type of this phenomenon's patterns caused by a circular aperture. For the point, identify this phenomenon in which a light beam bends after encountering a barrier or opening.

ANSWER: **Diffraction**

(7) Due to a type of heating caused by these phenomena, volcanism is possible on Jupiter's moon Io [["EYE"-oh]]. The namesake "locking" of these phenomena occurs when a body's rotation and orbit become synchronized. On Earth, these phenomena are strongest at a syzygy [[SIH-zih-jee]] and are called "springs," while the weakest types of these phenomena are called "neaps." These phenomena are caused by the gravity of the Sun and Moon on the ocean. For the point, name this regular rising and falling of ocean water.

ANSWER: Ocean **Tide**s (or **Tidal** Forces; accept **Tidal** locking; accept **Tidal** heating, working, or flexing; accept Spring **tide**; accept Neap **tide**)

(8) This scientist used the Platonic solids to defend Copernicus in his *Mysterium Cosmographicum* [[kahs-moh-GRAH-fee-kum]]. This scientist names a law that states equal area is "swept out" in equal time by an orbiting body. This assistant to Tycho Brahe [["TIE"-koh BRAH-heh]] was the first to demonstrate that a planet's orbit is an ellipse with two foci [[FOH-kai]]. For the point, name this German astronomer who names three laws of planetary motion.

ANSWER: Johannes **Kepler** (accept **Kepler**'s laws of planetary motion; accept **Kepler**'s Second law of planetary motion)

(9) Underscattering is not used with these devices as part of the dark-field method. Probe varieties of these devices use a piezoelectric [[pee-YEH-zoh-"electric"]] actuator tip to map out surfaces. Extremely sensitive varieties of these devices include the atomic force and electron tunneling varieties. Samples examined with these devices are typically placed on a glass slide. For the point, name this lab device that is used to view small things.

ANSWER: **Microscope** (accept Dark-Field **Microscope**; accept Scanning Probe **Microscope**; accept Atomic Force **Microscope**; accept Electron Tunneling **Microscope**; accept Compound **Microscope**; accept **Microscopy** in place of **Microscope**)

(10) When k equals set size, the total number of combinations can be found by dividing this function of n over this function of k times this function of the difference between n and k. Applying this function to n gives the number of permutations for n unique objects. For the point, name this function symbolized by an exclamation point, which is equal to the product of all positive integers below a certain value.

ANSWER: **Factorial**

(11) Along with adhesive forces, this phenomenon is responsible for capillary [[KAP-ih-lay-ree]] action. This phenomenon is possible when a liquid's cohesion is greater than its adhesion. This phenomenon is used by water striders to walk on the surface of lakes and ponds. This phenomenon, which gives bubbles their shape, is weakened by surfactants like detergents. For the point, name this force that holds water into droplets.

ANSWER: **Surface Tension** (prompt on "tension")

(12) The cloverleaf form of a certain macromolecule binds to the e-site of these structures. These structures are composed of "small" and "large" subunits, and can come in free and membrane-bound varieties. The biogenesis of these structures occurs in the nucleolus. Smooth and rough endoplasmic reticulum are distinguished by the presence of these structures, which serve as the site of RNA translation. For the point, name these macromolecular machines that synthesize proteins.

ANSWER: **Ribosome**s (accept Small or Large **Ribosomal** subunit; accept Free **ribosome**; accept Membrane-bound **ribosome**; accept Attached **ribosome**)

(13) This technology was first used commercially by Thomas Savery, who used it to remove water from mines. Thomas Newcomen created a version of this technology capable of giving continuous power through the use of pistons. This technology was proliferated by James Watt and is frequently held to have kicked off the industrial revolution by powering factories and trains. For the point, name this technology, a type of engine powered by boiling water.

ANSWER: **Steam** Engine (accept **Steam** pump; accept **Steam** power; prompt on "engine")

(14) Umbraphiles are people who travel around the world to observe these events. The change in the expected position of two stars during one of these events helped prove the existence of gravitational lensing. Baily's Beads are formed by light shining through the Moon's valleys during these events. For the point, name these events, whose total variety occurs when the Moon almost entirely blocks out the Sun.

ANSWER: **Solar Eclipse** (accept **Eclipse** of the **Sun**; accept Total **Solar Eclipse**; prompt on "eclipse"; do not accept or prompt on "Lunar Eclipse")

(15) A breath test for this compound can be used to assess stomach ulcer risk and the presence of *H. pylori* [[H-"pie"-LOH-ree]]. With water, this compound is the end product of the Bosch-Meiser [[BOSH-MY-zer]] process. Friedrich Wohler [[VOH-luh]] disproved vitalism by inorganically synthesizing this compound. This compound's namesake cycle forms it by combining two molecules of ammonia with one of carbon dioxide. For the point, name this compound used in nitrogen excretion, which is found in urine.

ANSWER: **Urea** (or **Carbamide**; accept **Urea** cycle)

(16) Similar to alternators, these devices can be divided into brushed and brushless varieties. Permanent magnet varieties of these devices lack field windings. An H-bridge can be used to allow the DC type of these devices to run forward or backward. These devices create torque from a rotor mounted in a stator. For the point, name this type of motor used to power the Nissan Leaf and Tesla Model 3.

ANSWER: **Electric Motor** (accept Brushed or Brushless DC **electric motor**; accept Permanent Magnet **electric motor**; accept DC **electric motor**; prompt on "motor")

(17) While in Sweden, this man published his work *Passions of the Soul*, and this man passed away after only giving Queen Cristina a few private lessons. This so-called "father of analytical geometry" lends his name to the "coordinate system," and this man's *Meditations on First Philosophy* contains the saying "cogito ergo sum" [[KOH-gee-toh EHR-goh SOOM]], or "I think, therefore I am." For the point, name this French mathematician and philosopher.

ANSWER: René **Descartes** [[day-KAHRT]] (or Renatus **Cartesius**; prompt on "Cartesian coordinates")

(18) The mineral form of this element's sulfide is the ore Galena [[gah-LEE-nah]]. This element's tetra-ethyl compound was formerly widely used as a gasoline anti-knock additive. This element is used in radiometric dating because both thorium and uranium ultimately decay into it. This element is used in radiation shields for X-rays due to its high density. For the point, name this toxic heavy metal whose atomic symbol is Pb.

ANSWER: **Lead** (accept **Pb** before mentioned)

(19) One type of this quantity named for Gibbs is equal to a heat engine variety defined as SQ over T. This quantity is conserved in microscopic reversible processes, but is monotonic [[mah-noh-TAH-nik]] in macroscopic processes. According to the Boltzmann–Planck equation, this quantity is equal to k log W. For a perfect crystal at absolute zero, this quantity equals zero. For the point, name this quantity, the measure of total disorder in a system.

ANSWER: **Entropy** (accept Gibbs **entropy**; prompt on "S")

(20) This planet's irregular moons are divided into Inuit [[IN-yoo-it]], Norse, and Gallic groups. This planet is orbited by a moon with a possible ring system, Rhea [[REH-ah]]. This planet is orbited by a moon with icy geyser structures, which were sampled by the Cassini Orbiter. Another moon orbiting this planet is the only known moon to possess its own atmosphere. For the point, name this sixth planet from the sun, which is orbited by a brilliant ring system.

ANSWER: **Saturn**

(21) Rapidly cooling liquified forms of this element can produce its amorphous "plastic" allotrope. Lapis lazuli's [[LAH-pis LAHZ-yoo-lees]] blue color comes from this element's negatively charged thiozone [["THIGH"-oh-"zone"]] ion. This element is used to strengthen rubber through vulcanization. When bonded to two hydrogen atoms, this element makes a compound that smells like rotten eggs. For the point, name this chalcogen [[KAL-soh-jen]] with atomic number 16.

ANSWER: **Sulfur** (or **S**; accept **Brimstone**; accept Plastic **sulfur**)

(22) The "shocked" variety of this mineral is used as evidence for major meteor impacts, such as the crater at Chicxulub [["CHICK"-soo-loob]]. This mineral is a seven on the Mohs hardness scale and notably exhibits piezo [[pee-YEH-zoh]]-electricity. This mineral, which is commonly found in sands, has an electric current passed through it to keep time in many watches. For the point, name this mineral whose chemical name is silicon dioxide.

ANSWER: **Quartz** (accept Shocked **quartz**; accept **Silicon Dioxide** before mentioned; prompt on "silica")

(23) The BdGPL-2 fungus causes chytridiomycosis [[kye-trih-dee-oh-my-KOH-sis]] infections and mass die-offs of members of this class. Legless members of this class are called caecilians [[kah-SEE-lee-uns]]. Like reptiles, members of this class possess a three-chambered heart. Most members of this class undergo a metamorphosis from having gills to air-breathing lungs. For the point, name this class of vertebrates that includes salamanders and frogs, whose members live on both land and water.

ANSWER: **Amphibian**s (or **Amphibia**; accept **Caecilian**s before "class")

(24) Following groundwater intrusion, these objects can release maars. When formed under an ice sheet, these objects can form tuyas. Most of the destruction caused by these objects is the result of pyroclastic flows. When releasing low viscosity material, these objects can form their "shield" variety. Commonly forming over hot spots and magma chambers, for the point, what are these mountains that can erupt and release lava?

ANSWER: **Volcano**es (accept Shield **volcano**; prompt on "mountains")

(25) The necessity of a transplant for this organ is determined using Banff classification. This organ's glomerulus [[gloh-MEHR-yoo-luss]] is composed of small tufts of capillaries and is enclosed by Bowman's capsule. This organ creates a countercurrent gradient with the loop of Henle. This organ's functional units are called nephrons, and failure of this organ can require the use of dialysis. For the point, name this bean-shaped filtration organ that comes in pairs.

ANSWER: **Kidney**s

Extra Question

(1) This process names a syndrome associated with neural crest cell function and traits such as spots and floppy ears. A team led by Dmitry Belyayev [[bel-YAH-yef]] has performed studies of this process using silver foxes. Unlike taming, this process is inheritable. For the point, name this process by which humans intentionally alter animals to be useful, which resulted in modern dogs arising from a wolf-like ancestor.

ANSWER: **Domestic**ation (accept answers referring to **domestic** animals; do not accept or prompt on "taming" or similar answers)