Winter Science Bee - Final Round

Final Round Tossups

(1) Skywave propagation involves the reflection of radio waves off this region, allowing AM broadcasts to travel long distances. Interactions between the magnetosphere and this region cause the aurora borealis. This region contains the entire thermosphere and portions of the mesosphere and exosphere. For the point, name this layer of the atmosphere named for containing a high concentration of charged particles.

ANSWER: **Ionosphere** (prompt on "Thermosphere" before mentioned)

(2) One form of this sense is activated when glutamic [[gloo-TAM-ik]] acid binds to a "G" protein-coupled receptor. Another form of this sense is activated with the presence of alkali metals and may have evolved to detect toxins. The lack of this sense is called hypogeusia [["high"-poh-JYOOS-yah]]. This sense's receptors are contained in the papillae [[pah-PIH-lay]], which detect umami [[oo-MAH-mee]], sweet, and sour. For the point, name this sense detected by the tongue.

ANSWER: Sense of **Taste** (accept **Gustatory** sense or **Gustatory** system)

(3) On the eastern edges of this "sea" is the Sinus Concordiae [[kon-KOR-dee-ay]], while the Rupes Cauchy [[ROO-pes koh-SHEE]] crater lies in the northeastern portion of this sea. A metallic placard was left in this sea including the text "We Came in Peace for all Mankind." This sea's namesake "Base" is the location at which Buzz Aldrin and his colleagues landed the *Eagle* module. For the point, name this "Sea" on the Moon in which American astronauts first landed.

ANSWER: Sea of **Tranquility** (or Mare **Tranquillitatis**)

(4) Climate change is contributing to increasing the size of the active layer of this substance, increasing instability due to solifluction [[soh-lih-FLUK-shun]]. Collapse-scar bogs and thermokarst lakes form where this substance has broken down. Palsas and pingos are notable examples of the patterned ground created from this feature of the tundra. For the point, name this type of soil which remains below 32 degrees Fahrenheit year-round.

ANSWER: **Permafrost** (prompt on "soil" before mentioned)

(5) In computer languages, this property determines how operators with equal precedence are grouped. When a function has this property, the placement of parentheses does not impact output. Like commutativity, this property is lacking for subtraction and division. For the point, name this property of addition and multiplication, in which the grouping of operations does not change the outcome.

ANSWER: **Associative** Property (or **Associativity**)

(6) One member of this order produces ambergris [[AM-ber-gree]] as a byproduct of their digestion. Filter-feeding members of this order possess keratin plates called baleen [[BAY-leen]]. Many members of this order contain a structure called a melon, which houses the spermaceti [[sper-mah-SEH-tee]] organ used in echolocation. Members of this order breathe through a specialized nostril on their backs called a blowhole. For the point, name this order of marine mammals that includes porpoises, dolphins, and whales.

ANSWER: **Cetacea**ns [[see-TAY-shuns]] (accept **Whale**s before mentioned; prompt on "dolphin" or "porpoise" before mentioned)

(7) Thomas Kuhn [[KYOON]] argued that these periods involve paradigm shifts in a book about *The Structure of* [this sort of period]. Along with the Renaissance, one of these periods is held to have not been a radical break from the Middle Ages in the "continuity thesis." The publication of Copernicus's theories is considered the beginning of one of, for the point, what type of social era, which included the development of modern biology and chemistry?

ANSWER: **Scientific Revolution**s (prompt on "Copernican Revolution")

(8) For an ideal block and tackle setup, this quantity is equal to the number of rope sections supporting the block. For a wedge, this quantity is inversely proportional to the wedge's slope. This quantity is demonstrated by the law of the lever, which relates opposing weights and arm length. For the point, name this ratio of output force to input force, used to measure the effectiveness of a simple machine.

ANSWER: **Mechanical Advantage**

(9) Chiral [[KY-rull]] symmetry breaking and asymptotic [[AY-simp-TAH-tik]] freedom are among the properties of the quantum chromodynamics theory of this force, which confines smaller particles into hadrons. This force, whose magnitude increases with distance, is mediated by gluons. Binding together neutrons and protons in the nucleus, for the point, what is this fundamental force which is much more powerful than the weak force?

ANSWER: **Strong** Nuclear Force (or **Strong** Interaction; or **Color** Force; prompt on "quantum chromodynamics" before mentioned)

(10) These phenomena, which can be visualized with a butterfly diagram, were less frequent during the Spörer and Maunder Minima. The position of these phenomena predicts the location of coronal loops and solar flares. The frequency of these phenomena varies on an eleven-year cycle which corresponds to the reversal of a magnetic field. For the point, name these darker regions found on the surface of the Sun.

ANSWER: **Sunspot**s

(11) This scientist argued that ionic and covalent [[koh-VAY-lent]] bonds existed on a single continuum. In his book *How to Live Longer and Feel Better*, this scientist advocated for taking megadoses of vitamin C to prevent the common cold. This scientist outlined the modern understanding of an atom's tendency to attract shared electrons in his book *The Nature of the Chemical Bond*. For the point, name this American scientist who won Nobel Prizes in both Peace and Chemistry.

ANSWER: Linus **Pauling** (or Linus Carl **Pauling**)

(12) This region's outer boundary is sometimes called the Lehmann-Bullen discontinuity. Due to having temperatures near the surface of the sun, this region passes the Curie temperature and is not ferromagnetic. This layer, whose existence is demonstrated by PKiKP waves, is composed of a solid iron-nickel alloy. For the point, name this solid metal layer of the Earth, which is surrounded by the liquid outer core.

ANSWER: **Inner Core** (prompt on "core"; do not accept or prompt on "outer core")

(13) This scientist, who discovered iron oxide's use as an arsenic antidote, discovered the elements cesium [[SEE-zee-um]] and rubidium [[roo-BIH-dee-um]] with Gustav Kirchhoff [[KEER-kof]]. This scientist lends his name to a device that manipulates airflow at the top and fuel supply at the bottom to control combustion rate. For the point, name this German chemist, who lends his name to a common type of open-flame burner used in lab experiments.

ANSWER: Robert **Bunsen** (or Robert Wilhelm Eberhard **Bunsen**; accept **Bunsen** Burner)

(14) For an object to be in static equilibrium, this force's metacenter must be above the center of gravity. This force, which equals density times gravity times volume, is opposed by the hydrostatic pressure gradient. This force equals the weight of the fluid that is displaced according to the Archimedes principle. For the point, identify this force that allows objects to float in a liquid.

ANSWER: **Buoyant** force (or **Buoyancy**; accept **Upthrust**)

(15) In his *De Architectura*, Vitruvius [[vih-TROO-vee-us]] said that these devices were invented by Anaximander [[ah-naks-ih-MAN-der]]. In their simplest form, these devices possess a vertical portion, the gnomon [[NOH-mon]], and a horizontal portion, the style. Along with specialized candles and water drip clocks, these were among the earliest devices to mark the time of day. For the point, name these devices that determine the time from the position of a shadow.

ANSWER: **Sundial**

(16) Large circular holes in these objects are called moulins [[MOO-lins]], which can drain lakes named for these objects. Deposits created by these objects include eskers and drumlins. Fjords, cirques [[SIRKS]], and moraines were created by the retreat of these objects which break down at the coast via calving [[KAV-ing]], forming icebergs. For the point, name these massive ice flows that cover Greenland and Antarctica.

ANSWER: **Glacier**s (prompt on "glacial lake")

(17) In marsupials, this structure's function is fulfilled by the anterior commissure. Patients who fail to develop this structure may develop Probst bundles to compensate. Damage to this structure can result in alien hand syndrome or Dr. Strangelove syndrome. This structure has a Latin name meaning "tough body." This structure is severed in patients who undergo a split brain procedure, which is sometimes used to treat epilepsy. For the point, name this structure that links the two hemispheres of the brain.

ANSWER: **Corpus Callosum** (or **Callosal Commissure**)

(18) These objects are known as "potato stones" when recovered from England's Mendip Hills. These objects can form when an empty cavity, such as a gas bubble, is filled with groundwater that deposits crystalline minerals. These objects are smaller analogs to vugs and crystal caves. For the point, name these hollow rocks containing crystals, whose name comes from the Greek for "Earth-like."

ANSWER: **Geode**

(19) A type of scattering found in these substances can give a blue appearance to motorcycle smoke or flour mixed into water. These substances, which exhibit the Tyndall effect, include emulsions and aerosols. Common examples of these substances include milk, fog, and foam. For the point, identify this type of substance, in which small particles of one substance are suspended within another.

ANSWER: **Colloid** (accept **Colloid**al Suspension; prompt on "suspension")

(20) In the most widely accepted hypothesis, this phylum is considered the sister taxon to bilateria [["by"-lah-TEE-ree-ah]]. One sessile [[SESS-ile]] clade [[KLAYD]] in this phylum has a symbiotic relationship with clownfish, providing shelter in exchange for cleaning. This phylum is characterized by a specialized type of cell that releases stinging (*) toxins on contact. For the point, name this animal phylum that includes sea anemones, corals, and jellyfish.

ANSWER: **Cnidaria**ns [["nigh"-"DARE"-ee-uns]] (prompt on "Jellies"; be lenient on pronunciation)

(21) A sensitive magnetometer [[mag-neh-TAH-mee-ter]] called a SQUID [["SQUID"]] consists of two of these materials separated by a thin layer. A loop example of these materials is called a Josephson junction. Through the Meissner effect, these materials expel magnetic field lines. The BCS theory of these materials posits that phonons mediate the binding of electrons into Cooper pairs. For the point, name these materials which have no electrical resistance.

ANSWER: **Superconductor** (accept **Superconductivity**; prompt on "conductor")

(22) When oxygen is present in its substrate, this protein produces phosphoglycolate [[foss-foh-gly-KOH-"late"]] and 3-phosphoglycerate [["three" foss-foh-GLIH-seh-"rate"]]. In C4 plants, this protein has reduced specificity and is located in the bundle sheath cells. This protein is the most abundant enzyme on Earth and catalyzes the start of the Calvin cycle. For the point, name this major enzyme important for the carboxylation of RuBP in photosynthesis.

ANSWER: **RuBisCO** [[roo-BIH-skoh]] (or **RuBPCase**; or **RuBPco**; accept **Ribulose-1,5-bisphosphate carboxylase/oxygenase**)

(23) For heat and moisture-sensitive materials, ethylene oxide gas can be used to perform this task by inhibiting metabolism. An autoclave uses "wet-heat" to leverage hydrolysis [["high"-DRAH-lih-siss]] to perform this task on glassware, rendering it aseptic. 70 percent is the most effective concentration of isopropyl [["eye"-soh-PROH-pil]] alcohol for performing this task. For the point, identify this task of killing microorganisms on lab equipment and other surfaces.

ANSWER: **Sterilization** (accept word forms and answers such as "making **sterile**; accept answers indicating "killing microorganism" before mentioned; prompt on answers such as "cleaning")

(24) Abnormalities in the millisecond variety of these objects provide indirect evidence of gravitational waves. When originally discovered, these objects were nicknamed "LGM," or little green men. These bodies are only detectable if one of their poles points toward the Earth. For the point, name these rapidly rotating neutron stars that are named for periodically emitting bursts of radio waves.

ANSWER: **Pulsar** (accept **Pulsating Radio** Source; prompt on "Little Green Men" or "LGM" before mentioned; prompt on "Neutron Star" before mentioned)

(25) Range contraction can cause the centrifugal [[sen-TRIH-foo-gul]] type of this process. The Theory of Punctuated Equilibrium posits that this process occurs in rapid bursts. When this process occurs over a single geographic range, it is termed "sympatric." Geographic isolation causes the allopatric type of this process to occur, and new branches on phylogenetic [[FY-loh-"genetic"]] trees are formed by this process. For the point, name this process which results in two populations being unable to breed with one another.

ANSWER: **Speciation** (accept Centrifugal **Speciation**; accept Sympatric **Speciation**; accept Allopatric **Speciation**; accept Peripatric **Speciation**; accept Parapatric **Speciation**; prompt on "Evolution")

(26) The centripetal [[sen-TRIH-peh-tal]] form of this quantity is always directed inward. Torque is equal to the moment of inertia multiplied by the tangential form of this quantity. In general relativity, it is impossible to distinguish between forces caused by gravity and this quantity. For the point, name this quantity measuring rate of change in velocity, which can have units of meters per second squared.

ANSWER: **Acceleration** (accept Centripetal **acceleration**; accept Tangential **acceleration**)

(27) A statistically determinate type of these objects will bend uniformly when a uniform weight is applied. The cantilevered type of these objects are supported only from one end. One common type of these objects has two horizontal flanges [[FLAN-jeez]] connected by a vertical web, known as the "I" type of these objects. For the point, name these fundamental structural components, which have much greater lengths than widths.

ANSWER: **Beam** (accept Cantilevered **beam**; accept I-**beam**)

(28) Highly inefficient algorithms for this task are given the prefix "bogo." One algorithm for this task that uses paired comparisons is named after garden gnomes. Exchange-based algorithms for this task have a worst-case runtime of "Big O [[OH]] of n squared." Common algorithms for this task include ones named bubble, quick, and merge. For the point, name this task of organizing an array or list into the desired order.

ANSWER: **Sort**ing (or **Sort**ing algorithm; accept Bogo, Gnome, Exchange, Bubble, Quick, or Merge **Sort**)

(29) Cylinders have a value of zero, and spheres have a negative value for this man's namesake curvature. This man's proof of the fundamental theorem of algebra was created to refute D'Alembert's [[dah-lem-BEHRS]] false proof. This man names a theorem relating the electric field to the charge distribution, and this man also names a distribution shaped like a bell curve. For the point, name this German mathematician who names the normal distribution.

ANSWER: Johann Carl Friedrich **Gauss** (accept **Gauss**ian curve or curvature; accept **Gauss**'s law or flux theorem; accept **Gauss**ian distribution or **Gauss**'s distribution; accept Laplace-**Gauss** distribution)

(30) This constellation names the closest known moving group to Earth, being part of the Local Bubble. This constellation contains a notable binary system made of Mizar [["MY"-zar]] and Alcor. Major stars in this constellation include Dubhe [[DOO-beh]] and Merak [[MEE-rak]], which can be used to locate Polaris in another constellation. For the point, name this northern hemisphere constellation that contains the Big Dipper.

ANSWER: **Ursa Major** (or **Great Bear**; accept **Ursa Major** Moving Group or **Ursa Major** Association; prompt on the "Big Dipper" before read; prompt on "the Plough")

Extra Question

(1) Due to this phenomenon, changes in wind velocity can cause a hook echo on weather radar. This phenomenon's namesake radar is used by police radar guns to determine a car's velocity. This phenomenon is visualized with the bunching of waves in front of a moving source. Redshift is caused by, for the point, what phenomenon in which a pitch shifts with movement, as with a siren driving by?

ANSWER: **Doppler** effect (or **Doppler** shift; accept **Doppler** radar; prompt on "red shift" or "blue shift" before mentioned)