

(E) Science Bee Round 4

Regulation Tossups

(1) A program called Stockfish has been applied to analyze agents on one of these objects. This object, which can be traversed using only L-shaped jumps, is the subject of a discrete mathematics problem about arranging eight of a certain piece such that they do not attack each other. For the point, name this eight-by-eight board, the subject of the eight queens puzzle.

ANSWER: **Chessboard** (accept **Checkerboard**)

(2) Hideki Yukawa proposed that this force existed due to the pion. This force binds quarks together to form hadrons, and it also keeps hadrons together in atomic nuclei. For the point, name this fundamental force responsible for keeping protons and neutrons together in the nucleus.

ANSWER: **Strong** Force (or **Strong** Nuclear Force; accept **Strong** Interaction)

(3) Other examples of these objects were named after Hawaiian, Inuit, and Rapa Nui deities. The term for these objects was coined by Alan Stern, though the International Astronomical Union rejects the implication that the objects qualify as certain larger bodies. For the point, name this type of object, whose most famous member was demoted to its ranks in 2006.

ANSWER: **Dwarf** Planet (do not accept or prompt on "Red Dwarf" or "White Dwarf")

(4) This number is the order of the smallest non-abelian group and appears in the denominator of the solution to the Basel problem. This is the smallest perfect number, and also the number of possible handshakes among 4 people. 3 factorial is equal to, for the point, what number that gives the number of sides in a hexagon?

ANSWER: **Six**

(5) Wind forces lead these entities to move at a 90-degree angle from the direction of the surface wind in Ekman transport, and the Coriolis effect plays a large role in developing the "surface" variety of these entities. "Deep" varieties of these entities are driven by thermohaline circulation. Gyres are rotating examples of these entities, which include the Gulf Stream. For the point, name these large flows of water in the ocean.

ANSWER: Ocean **Currents** (accept **Gyres** before mentioned)

(6) Unlike their antiparticle, these particles have left-handed chirality [[KYE-rah-lih-tee]], as well as a neutron and positron. These particles are emitted during beta decay, and these fermions come in flavors that corresponds to leptons such as the electron, muon, and tau. For the point, name these nearly massless particles that interact via the weak force.

ANSWER: **Neutrino**

(7) This hormone, which regulates GLUT4 transporters, was sequenced by Frederick Sanger. Ketoacidosis is caused by a lack of this hormone, which stimulates the production of glycogen. Secreted from beta cells in the Islets of Langerhans, this is, for the point, what hormone that opposes the effects of glucagon, whose deficiency leads to type 1 diabetes?

ANSWER: **Insulin**

(8) The Abel-Ruffini theorem says it is impossible to find algebraic solutions to these objects when their degree is greater than four. The power rule can be used to differentiate these objects, which can be divided using synthetic division. For the point, name these functions consisting of sums of the powers of variables.

ANSWER: **Polynomials**

(9) Trouton's rule states that this value for liquids undergoing vaporization is fairly constant. By the second law of thermodynamics, this quantity in an isolated system must increase through spontaneous evolution to reach thermodynamic equilibrium. Changes in this quantity are denoted S. For the point, name this quantity, the measure of disorder in a system.

ANSWER: **Entropy** (accept **S** before mentioned; prompt on "chaos" or "disorder")

(10) In 2020, scientists were able to extract ancient DNA from this substance, which stabilized the organisms inside, although the extraction of dinosaur blood from this substance is not as feasible as seen in the film *Jurassic Park*. Insects are commonly preserved in, for the point, what yellow-orange resin that comes from fossilized trees?

ANSWER: **Amber** (accept Burmese **Amber**; accept **Resinite**; prompt on "Resin" before mentioned)

(11) Conflicts have arisen over whether the binary or decimal system should be used for this unit of measurement. The most common type of this unit is referred to by the Internet Protocol as an octet. For the point, name this unit of measurement for data size most commonly consisting of eight bits and expressed in kilo, mega and giga variants.

ANSWER: **Bytes** (accept kilo**byte**; accept mega**byte**; accept giga**byte**; accept tera**byte**; accept peta**byte**)

(12) Kimberlite pipes are often used to mine this mineral, which is placed at the tip of an apparatus in the Vickers test. This material, which is ranked above corundum on the Mohs scale, is a carbon allotrope consisting of a tetrahedrally bonded covalent network lattice. For the point, name this precious mineral, the hardest naturally occurring material.

ANSWER: **Diamond**

(13) Individuals with the Delta-32 mutation are resistant to infection by this pathogen due to the inactivation of the protein C-C chemokine receptor 5. This pathogen can be treated by antiretroviral drugs such as Abacavir and AZT. Helper T cells, macrophages, and dendritic cells, are attacked by, for the point, what sexually-transmitted retrovirus that leads to a weakened immune response and can cause AIDS?

ANSWER: **HIV** (or **H**uman **I**mmunodeficiency **V**irus; accept **HIV**-AIDS; do not accept or prompt on "AIDS" alone)

(14) Although humans cannot perform this ability, they are able experience it with a virtual reality device called the Tarsier Eclipse. An increased amount of high-density rod cells in the eyes allow animals to perform, for the point, what ability possessed by most nocturnal animals, such as owls, that allows them to see in the dark?

ANSWER: **Night** Vision (accept the description **see in the dark** or equivalents before mentioned)

(15) Objects that are in 1:2 orbital resonance with this planet are called "twotinos." A triangular patch of clouds on this planet is known as the "Scooter," and a former series of storms on it was called the Great Dark Spot. A moon of this planet is the largest in the solar system to exhibit retrograde orbit, Triton. For the point, name this farthest planet from the sun.

ANSWER: **Neptune**

(16) One of these devices was used to cool rubidium atoms into the first Bose-Einstein condensate. In the three-level type of these devices, pumping is used to energize the gain medium until it reaches a state of population inversion. Stimulated emission produces a coherent beam of very focused light in, for the point, what devices often found in barcode scanners and printers?

ANSWER: **Lasers** (accept **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation)

(17) This quantity was shown to be the same in both directions in the Michelson-Morley experiment, disproving the existence of "aether wind." According to special relativity, this quantity is the same in all inertial reference frames. For the point, name this quantity symbolized c , the maximum speed at which matter in the universe can travel.

ANSWER: **Speed of Light** (accept **c** until mentioned)

(18) These events can be detected by the presence of a "hook echo" pattern on a Doppler Radar. These events, examples of which include the landspout and waterspout varieties, and their intensity is measured by the TORRO and Fujita scales. A namesake "Alley" in the Central United States depicts, for the point, what meteorological events characterized by a violent funnel-shaped rotating cloud of air?

ANSWER: **Tornadoes** (accept **Tornado** Alley; prompt on "Landspout" or "Waterspout" before mentioned)

(19) These markings, which are excavated by paleontologists through the process of lithification, were discovered by a team led by Mary Leakey in Laetoli and likely belonged to the *Australopithecus afarensis* species, providing evidence of bipedalism in early hominins. For the point, name these impressions that are left on a surface when a human or animal takes a step?

ANSWER: **Footprints** (accept Laetoli **Footprints**; prompt on "Prints" or "Tracks")

(20) This author of *The Assayer* utilized the telescope to discover that the moon had craters and mountains, which was contrary to contemporary belief that the moon's surface was smooth. For the point, name this Italian astronomer that was put under house arrest by the Catholic Church for his belief in heliocentricism.

ANSWER: **Galileo Galilei** (accept either)

(21) Deuterium fuses with tritium to give an isotope of this element. Neon and this noble gas are found in a specific type of laser. The nucleus of an atom of this element is equivalent to an alpha particle, which has two protons and two neutrons. For the point, two hydrogen atoms can combine to form what noble gas, the second lightest and second most abundant element in the universe?

ANSWER: **Helium**

(22) Two oceanic plates colliding at a convergent boundary forms these landforms. The most famous example of adaptive radiation occurs in these ecosystems, which Charles Darwin investigated finches in. For the point, name these landforms surrounded completely by water, examples of which include Galapagos.

ANSWER: **Islands** (accept **Island** arc; accept Galapagos **Islands**)

(23) This element's color is explained by relativistic effects of its 5d orbitals. It's not platinum, but a combination of nitric acid and hydrochloric acid is used to dissolve this metal. A foil of this element allowed Ernest Rutherford to discover the nucleus in a namesake experiment. Electrum is the alloy of silver and, for the point, what precious elemental metal whose purity is measured in karats?

ANSWER: **Gold** (accept **Au**)

(24) Methods for detecting this disease involve the use of lateral flow strips, the RT-LAMP method, or a real-time reverse transcription PCR reaction. The first confirmed case of this disease occurred in Wuhan and resulted in widespread lockdowns in China. Delta and Omicron are variants of, for the point, what infectious disease that has caused the ongoing pandemic?

ANSWER: **COVID-19** (accept **SARS-CoV-2**; accept **Severe Acute Respiratory Syndrome Coronavirus 2**; accept **Coronavirus**; prompt on "Corona")

(25) A disease commonly named for this process is known medically as trypanosomiasis [["trip"-ah-noh-SOH-mye-AY-sis]]. Muscle paralysis often occurs during the rapid eye movement form of this process, and obstruction of breathing can lead to its namesake apnea. People with insomnia struggle to undergo, for the point, what process which can include dreaming?

ANSWER: **Sleep** (accept REM **Sleep**; accept African **Sleeping** Sickness)

Extra Questions

(1) Fibroids are smooth muscle tumors found in this organ, whose inner lining grows in the wrong location during endometriosis. A hysterectomy is the surgical removal of this internal organ, which is also cut open during a Caesarean section. The placenta forms within this organ after the embryo implants into its wall at the start of gestation. For the point, name this reproductive organ where the fetus develops.

ANSWER: **uterus** (or **womb**)

(2) Diels-Alder reactions are accelerated when this molecule is used as the solvent. The enzyme catalase breaks down its substrate into oxygen and this compound. Combustion reactions produce carbon dioxide and the gaseous form of this compound. Carbon dioxide and this compound are the inputs into photosynthesis. For the point, name this "universal solvent" with chemical formula H₂O.

ANSWER: **Water** (or **dihydrogen monoxide**; accept **H₂O** before mentioned)