

(MS) Science Bee Round 7

Regulation Tossups

(1) This biological order has four of five species as members of the *Tachyglossidae* genus. That genus of this order is divided into short-beaked and long-beaked species, with those animals being called echidnas or spiny anteaters. This order is the smallest of the three that form its class, alongside placentals and marsupials, and all extant species are native to Australia. For the point, name this smallest order of mammals, which includes the platypus and has egg-laying members.

ANSWER: **Monotremes** (or **Monotremata**)

(2) Many moon rocks have a large concentration of one type of these minerals called anorthite. Alkali types of these minerals have lower specific gravity than their plagioclase and orthoclase types. A subclass of these minerals constitutes the continuous branch of Bowen's reaction series, and a subclass of these minerals defines six on the Mohs hardness scale. For the point, name this most abundant class of minerals in Earth's crust.

ANSWER: **Feldspars** (accept Plagioclase **Feldspars**; accept Orthoclase **Feldspars**; accept Alkali **Feldspars**)

(3) Like arthropods, members of this phylum utilize copper-based hemocyanins to transport oxygen in the body. Members of this phylum possess a mantle that contains a large cavity for feeding and excretion. Many members of this phylum possess a tongue-like structure called a radula. Cephalopods, gastropods, and bivalves belong to, for the point, what largest marine phylum of invertebrates that includes clams and snails?

ANSWER: **Mollusca** (or **Molluscs**)

(4) X-bracing has been used for some of these structures in Chicago, while the trussed tube concept was applied to examples of these structures like the Onterie Center. Tube framing superseded the steel frame design of these structures, which were pioneered by Fazlur Rahman Khan. These structures often make use of sky lobbies to expand service core via elevators. For the point, name these towering buildings that include the Burj Khalifa.

ANSWER: **Skyscrapers** (accept **Supertalls**; prompt on "High-rises"; prompt on "Buildings")

(5) Common types of these things use the molecule Tris along with EDTA, and include the TAE and TBE varieties, which are often used during gel electrophoresis. In the human body, a mixture of carbonic acid and bicarbonate form a system used to maintain the quality of blood that acts as one of these entities. The pH of these solutions can be estimated via the Henderson-Hasselbach equation. A weak acid and its conjugate base make up, for the point, what solutions that can resist changes in pH level?

ANSWER: **buffers** (or **buffer** solution/agent)

(6) This software's original name was Freax, a portmanteau of "free", "freak", and "x". Debian and Ubuntu are popular distributions of this software. This software originally employed the EXT File System, though most modern distributions use EXT4. For the point, name this Open-Source operating system, originally developed by Linus Torvalds, whose mascot is a penguin named Tux.

ANSWER: **Linux** (accept GNU/**Linux**; prompt on "Unix")

(7) Individuals infected with this disease may exhibit Bannwarth syndrome. The bacterium that causes this disease come from the genus *Borrelia*, and those spirochete [{"SPY"-roh-keet}] class bacteria makes this disease hard to treat by creating a biofilm that allows it to hide within many areas of the body. A bull's-eye pattern rash is a common symptom of, for the point, what vector-borne disease that is contracted from the bite of a deer tick?

ANSWER: **Lyme** Disease (accept **Lyme Borreliosis**; accept **Lyme** Neuroborreliosis; prompt on "*Borrelia*" before mentioned; do not accept or prompt on "Rocky Mountain Spotted Fever")

(8) A relation named for a letter describing this quantity and sigma describes black holes. Luminosity is proportional to this quantity to the 3.5 power for main-sequence stars. Low values of this quantity for a star never enter the asymptotic giant branch of stellar evolution. Units for this quantity are often expressed in terms of the Sun. For the point, name this quantity of how much matter a star contains.

ANSWER: Stellar **mass** (prompt on "M" or "M-sigma relation")

(9) Manhattan plots can represent "association studies" named for these things, which link nucleotide variation to disease traits. The first complete map of one of these things for a eukaryote was created for Baker's yeast. James Watson led a project that used high-throughput sequencing to map these things for *Homo sapiens*. For the point, what term refers to the entire genetic sequence of an organism?

ANSWER: **Genome** (accept Human **Genome** Project; accept **Genome**-wide Association Studies; prompt on "genes" or "DNA")

(10) This operation describes the runtime for the fastest known algorithm that solves the traveling salesman problem. This operation is performed on " $\cos(x) + i \sin(x)$ " in De Moivre's [{"deh MWAHVS}] formula. This operation's second input is *nt* in the compound interest formula. When this operation has a base of two, it is the same as doubling. For the point, name this operation that multiplies a number by itself.

ANSWER: **Exponent**iation (or **Exponential**; accept **Power**)

(11) In Conway's Game of Life, the boat, long tail, and glider occupy this number of cells. This Wilson prime is also the third Catalan number and the fifth of the Fibonacci numbers. This number appears under the square root in the numerator of the golden number, and this number is also the value of the hypotenuse of the smallest Pythagorean triple. For the point, identify this number, the atomic number of boron, as well as the total sides in a pentagon.

ANSWER: **Five**

(12) Objects from this region are disrupted by a dwarf star every 27 million years, according to the Nemesis hypothesis. The inner part of this location is sometimes called the Hills cloud, and the dwarf planet Sedna is located in this region beyond the Kuiper [[KY-per]] Belt. For the point, name this proposed location for the source of long-period comets, named for a Dutch astronomer.

ANSWER: Öpik-**Oort Cloud**

(13) The transition between minerals rich in sodium and minerals rich in this element make up the continuous branch of Bowen's reaction series. Along with magnesium, this metal is present in dolomite, and it is also found in aragonite and calcite. This element's carbonate makes up the shells of many marine animals. A metal found in limestone, this is, for the point, what element, the main constituent of bone?

ANSWER: **Calcium** (or **Ca**)

(14) This scientist failed to determine the shape of DNA by proposing a triple-helical model. In 1954, this scientist won a Nobel Peace Prize for his opposition to weapons of mass destruction. To treat heart disease and prevent colds, this scientist controversially advocated for megadoses of vitamin C. Electronegativity is measured within a range from 0.7 to 4 on a scale named after, for the point, what American chemist who wrote *The Nature of the Chemical Bond*?

ANSWER: Linus **Pauling** (or Linus Carl **Pauling**; accept **Pauling** Scale)

(15) Laura Ingalls Wilder wrote *The Long Winter* detailing her and her family's efforts to survive during one of these events. The Storm of the Century caused one of these natural events to occur in March 1993. The National Weather Service states wind speeds must be greater than or equal to 35 miles per hour in order to be, for the point, what type of severe, prolonged snowstorm?

ANSWER: **Blizzard** (accept Ground **Blizzard**; prompt on "Snow" or "Snowstorm")

(16) The Ukok Plateau is one of the last remnants of this animal's namesake steppe, and resources from this animal were used to make the Venus of Brassempouy and Lion-Man statues. A handful of isolated populations of this animal on St. Paul Island and Wrangel Island survived until 4,000 years ago, and a frozen specimen of this animal was discovered at Yukagir. For the point, name this tusked, furry creature that roamed the earth during the last Ice Age.

ANSWER: **Woolly Mammoths** (accept *Mammuthus primigenius*; prompt on partial answers; do not accept or prompt on answers mentioning elephants)

(17) Under D'Alembert's [[dah-lem-BARES]] paradox, this force disappears within an incompressible and inviscid flow. At very low Reynolds numbers, the magnitude of this force on a spherical object is proportional to fluid velocity according to Stokes' law. Gravity balances this upward-acting force when a falling object reaches terminal velocity. For the point, name this force that opposes the motion of an object through a fluid.

ANSWER: **drag** force (accept **air resistance**; or fluid **resistance**; prompt on "friction")

(18) The Dongfanghong I was the first of this kind of object launched by China as part of its "Two Bombs, One [this object]" campaign. Celestial bodies like Europa and Ganymede are considered the "natural" kind of this object and surround Jupiter. Artificial examples of these objects include the Soviet Sputnik 1. For the point, name these objects that orbit larger bodies.

ANSWER: **Satellites** (accept natural **satellites**; or artificial **satellites**)

(19) Increases in the frequency of this phenomenon can be used to predict microbursts. The Miller-Urey experiment tested whether this phenomenon led to the first organic compounds on earth. St. Elmo's fire can be produced by this phenomenon, whose "ball" variety may be explained by the soliton hypothesis. This phenomenon occurs when the atmospheric field strength exceeds three million volts per meter. For the point, name this phenomenon seen during thunderstorms.

ANSWER: **Lightning** (accept ball **lightning**)

(20) This scale's namesake worked with James Joule to discover an effect regarding the throttling of a non-ideal gas. In 2019, this scale was recalibrated around Boltzmann's constant. A constant term of about 273 is used to convert this scale's measures to Celsius, and this scale is named for the title held by physicist William Thompson. For the point, name this temperature scale that starts at absolute zero.

ANSWER: **Kelvin** Scale

(21) This effect disagrees with classical electromagnetism and, in practical experimentation, this effect illustrates that the removal of negatively charged particles from a material surface occurs only when incident rays of light exceed a certain frequency regardless of change in intensity. Albert Einstein used this effect to explain the particle nature of light. For the point, name this phenomenon in which light emits electrons when hitting certain materials.

ANSWER: **Photoelectric** Effect

(22) The length of this quantity over two is the minimum distance between antipodal points. Arc length can be calculated by multiplying this quantity by theta over 360. The constant tau is equal to the ratio between this quantity and the radius, and this quantity can be estimated by multiplying the diameter by 22 over 7. For the point, give this term for the distance around a circle.

ANSWER: **Circumference**

(23) Ronald Fisher analyzed this man's data using statistics and determined that it was "too good to be true." One law named after this man states that alleles for separate traits are passed independently of one another. This scientist coined the terms "dominant" and "recessive" for the expression of traits and developed the laws of segregation and independent assortment. For the point, name this scientist whose experiments on pea plants provided the foundation of genetics.

ANSWER: Gregor **Mendel** (or Gregor Johann **Mendel**)

(24) The dorsal face of this joint contains a triangular depression called the anatomical snuff box. The scaphoid, pisiform, and hamate are among the eight bones found in this ellipsoid joint, which attaches to both the ulnar and radial collateral ligaments. Repeated compression of the median nerve that passes through this joint causes carpal tunnel syndrome. For the point, name this joint that connects the arm to the hand.

ANSWER: **Wrist** (accept **Radiocarpal** Joint before "carpal" is mentioned)

(25) Solvents in this phase of matter are used to partition solutes in the most common form of extraction. The HPLC type of chromatography uses a pressurized solvent in this phase, which also names the crystalline materials used in TV displays. This phase is bypassed by substances that undergo deposition and sublimation. At room temperature, bromine and mercury exist as, for the point, what state of matter?

ANSWER: **Liquid** (accept **Liquid** Crystals; accept **Liquid**-liquid Extraction)

(26) The location of this body's orbital resonances corresponds to Kirkwood gaps. A system on this planet found between two jet streams was found to move in an anticyclonic manner in time-lapse photos from *Voyager 1*. A massive storm called the Great Red Spot is found on this planet, whose moons include Ganymede and Europa. Most asteroids are found between Mars and, for the point, what largest planet in the Solar System?

ANSWER: **Jupiter**

(27) One of these entities named for its wheel-like shape contains the surface proteins VP4 and VP7 which induce the neutralization of antibodies. The Baltimore system is used to classify these entities, which typically replicate using the lytic [[lih-tik]] or lysogenic cycle. Reverse transcriptase is used by the “retro” type of these infectious agents, which require host cells to reproduce. Bacteriophages [[bak-TEE-ree-oh-FAY-juz]] are a type of, for the point, what pathogens that can cause Ebola, chicken pox, and the flu?

ANSWER: **Viruses** (accept **Retroviruses**; accept **Rotaviruses**; accept either Bacteri**phages** or **Phages** before “Bacteriophages” is mentioned)

(28) Along with the disease called flacherie, this man found that Nosema parasites afflicted silkworms eggs in a disease called pébrine. This scientist found that nothing would grow in nutrient broth unless it was exposed to the air, thereby rejecting the theory of spontaneous generation and providing evidence for germ theory. For the point, name this French chemist and microbiologist, who developed a namesake process of heating certain foods and beverages to destroy pathogens.

ANSWER: Louis **Pasteur** (accept **Pasteurization**)

(29) This is the heaviest particle created in beta-plus decay. “Thermal” and “slow” types of these particles are produced in nuclear reactors. Isotopes of elements are caused by differing amounts of these particles. These baryons are composed of one up quark and two down quarks. For the point, name these particles found with protons in atomic nuclei and which possess no electric charge.

ANSWER: **Neutrons**

(30) Scientists studying this phenomenon rely on the Doppler shift in Platform Transmitter Terminals as well as using other methods such as radio-tracking collars. The “great” [this phenomenon] is exhibited by wildebeests, and the Sierra Madre Mountains in Mexico is the target destination of monarch butterflies after performing this 3,000-mile phenomenon from Canada. For the point, name this phenomenon animals exhibit when they move to another location in response to a change in their environment.

ANSWER: **Migration** (accept Great **Migration**)

Extra Questions

(1) Some plants in this biome have adapted to utilizing CAM photosynthesis or C4 carbon fixation to minimize the rate of transpiration. Features like ergs and oases can be found in this biome that can be formed by the rain shadow effect or weathering processes. The Gobi and Sahara are examples of, for the point, what type of biome characterized by little precipitation and arid climate?

ANSWER: **deserts**

(2) Simon Baron-Cohen conducted the "Sally-Anne test" on children with this condition and proposed that people with it have "extreme male brain." Researchers have mostly rejected the theory that this condition is caused by "broken" mirror neurons. People with this disorder often struggle to respond to cues for joint attention and can be non-verbal. For the point, name this disorder characterized by difficulty in communication, whose forms include Asperger's.

ANSWER: **Autism** spectrum disorder (accept **ASD**; accept Kanner **Autism**; or Classic **Autism**; prompt on "Asperger's")