

## Round 4

### Regulation

(Tossup 1) In the process of making one type of this food, *Propionibacterium freudenreichii* is used to generate carbon dioxide. An enzyme called rennet is used in the production of this food, though rennet's derivation from ruminant stomachs is troubling for many vegetarians. Molds may be purposefully added to some varieties of this food for flavor and ripening. The primary component of this food is the protein casein, which coagulates and separates from the liquid whey in the presence of lactic acid. For the point, name this food made from the curds of milk.

ANSWER: cheese (accept Swiss cheese before "molds")

(Tossup 2) Terry Welch improved on one method of this process by taking advantage of high-usage patterns organized around a translation table or extended dictionary. This process is the subject of four algorithms developed by Abraham Lempel and Jacob Ziv. Huffman coding is one method of performing the lossless variant of this process. The extensions .rar [dot "rawr"] and .zip [dot zip] are used for files that have undergone this process. For the point, name this process of decreasing the amount of storage space needed for a file.

ANSWER: compression (accept lossless compression; prompt on LZW; prompt on Lempel-Ziv-Welch)

(Tossup 3) This quantity lowers the surface barrier in transistors, increasing the rate of thermionic emission. The Stark effect describes how spectral lines split when this quantity is non-zero. The cross product of this quantity with the H-field gives the Poynting vector. Maxwell replaced the e-m-f in Faraday's law with the curl of this quantity. For a single static point charge, the force over charge gives this quantity. This field varies perpendicular to magnetic field. For the point, name this field that applies a force to a charged particle, symbolized E.

ANSWER: (external) electric field (prompt on "E-field"; prompt on "E")

(Tossup 4) Palisade cells and mesophyll cells are part of these structures. Monocots and dicots are named due to their embryos having differing numbers of cotyledons, which are the proto form of these structures. Transpiration occurs through the stomata of these structures, which are attached to the rest of the organism by a petiole. The fronds of ferns are examples of these structures, some of which change color in the autumn on deciduous trees. For the point, name these green plant organs, the main site of photosynthesis.

ANSWER: leaf (accept leaves)

(Tossup 5) Simple, strong bulky bases can be formed by combining this element with n-butyl ["n" - bew - till] or diisopropylamide [di - "iso" - pro - pill - am - ide]. Esters and carboxylic acids can be reduced to alcohols using this element's aluminum hydride. A salt containing this element is used as a treatment for bipolar disorder. This element's ions can be moved between anode and cathode making it useful in rechargeable batteries. For the point, name this lightest alkali metal, atomic number 3, with symbol Li.

ANSWER: lithium (prompt on Li)

(Tossup 6) This process sometimes results in the formation of bright patches called Herbig-Haro objects. Jeans instability marks the radius where interstellar gas clouds collapse at the start of this process. Bok globules are a common location for this process to occur. The Pillars of Creation are named for undergoing this process, which typically also includes the formation of a proto-planetary disk. For the point, name this process where dense regions of molecular clouds collapse and form bright objects like the Sun.

ANSWER: star formation (or anything indicating the creation of stars; accept protostar in place of star)

(Tossup 7) The GMFCS is a system for measuring the impact of this condition on motor function. This condition's athetoid subtype is thought to be related to hypoxia or the accumulation of bilirubin in the basal ganglia. Botulinum toxin can be used to reduce spasms in this condition's most common spastic type. For the point, name this neuromuscular condition in which damage to the white or grey matter can cause problems with movement and muscle development, named for the part of the brain usually affected.

ANSWER: cerebral palsy (accept CP)

(Tossup 8) Cloths soaked in brine separated the copper and zinc disks in an early type of this device. Carl Gassner created the first "dry" version of this device with a solid electrolyte, while Gaston Plante's rechargeable design used lead and sulfuric acid. Originally composed of multiple cells joined together, these devices were named by Benjamin Franklin for their resemblance to a group of artillery. Lithium-ion and alkaline are the two most common types of, for the point, what electrical devices that store energy for later use?

ANSWER: battery (accept batteries; accept voltaic pile until "Gassner"; prompt on electrochemical cell)

(Tossup 9) Emergency shutdown of these devices is commonly referred to by the acronym SCRAM. Graphene and water typically serve as moderators in these devices to slow down neutron flux. When these devices produce more material than they consume, they are called "breeders." Control rods can be employed in these devices to shut them down in the case of runaway reactions. These devices typically use uranium as a fuel source. For the point, name this device which produces energy through nuclear fission.

ANSWER: nuclear reactors (accept equivalents like nuclear power plant or nuclear pile; prompt on reactor)

(Tossup 10) The Rouse number and Exner equation measure the speed and amount of this type of substance in a flow, respectively. Consisting of compaction followed by cementation, lithification is the process by which this type of substance becomes rock. Moraines are deposits of this type of substance by glaciers, while beaches consist of this type of substance transported by water. For the point, name this type of substance which consists of pieces of weathered and eroded minerals.

ANSWER: sediments

(Tossup 11) A point on one of these objects and the normal vector can be used to define the position of one of these objects in three-dimensional space. Stereographic projections assign points on a sphere to points on one of these mathematical objects. While real numbers can be modeled using a line, the complex numbers require one of these other objects with two axes. One of these objects can be defined by three non-collinear points or by two parallel lines. For the point, name this two-dimensional surface in geometry.

ANSWER: plane

(Tossup 12) A sudden increase in the severity of this phenomenon is called a squall. Barbs with flags are used to indicate measurements of this phenomenon on weather maps using station models. Caused by the atmosphere's equalization of pressure differences, this phenomenon is noticeable on beaches due to differential heating of the land versus the water. This phenomenon's speed can be measured using an anemometer, and its direction using a vane. For the point, name this phenomenon of moving air.

ANSWER: wind (accept wind speed until "direction")

(Tossup 13) Theodor Svedberg's 'ultra' type of this device allowed him to study the structure of colloidal proteins. One of these devices named for Zippe is used to purify uranium-235 gas for use in nuclear reactors. One of these devices is used in medical laboratories to run hematocrit tests, which determine the proportion of blood volume made of red blood cells. Human-scale versions of, for the point, what devices are used to train astronauts by rapidly rotating to simulate strong g forces?

ANSWER: centrifuges (accept ultracentrifuge until "Zippe")

(Tossup 14) A structure consisting of four of these things was first synthesized in the compound chromium(II) acetate [chromium two ass-ih-tate]. The induction effect causes polarization by drawing charge through these things. When three of these things form a triangle, they bend; that "banana"-named variety of these things can be seen in cyclopropane. The sigma type of these is stronger than the pi type. For the point, name these things which come in covalent and ionic types, tying up electrons between atoms.

ANSWER: bonds (accept specific types like pi bond; sigma bond; banana bond; delta bond)

(Tossup 15) The so-called "Armada" sent to study this object included *Sakigake*, the first Japanese spacecraft to leave Earth's orbit, and the ESA's *Giotto* probe. This object was the first non-planet proven to orbit the sun. Debris from this object produces the Orionid meteor shower, and images from its last visitation in 1986 confirmed the "dirty snowball" hypothesis. For the point, identify this comet, named for an English astronomer, due to return to Earth's vicinity in 2061.

ANSWER: Halley's comet (accept 1P/Halley)

(Tossup 16) One subject of this field of study, Mokele-mbembe, has been used to explain the lack of hippos in Lake Bangweulu. The now defunct International Society of this field used the okapi as its emblem. The surgeon's photograph and Patterson film were once considered key evidence in this field, whose researchers were embarrassed when the Mongolian death worm was proven to be a common sand snake. For the point, name this pseudoscience which seeks to prove the existence of creatures like Bigfoot and the Loch Ness Monster.

ANSWER: cryptozoology (prompt on zoology; prompt on folklore before "okapi")

(Tossup 17) John Wheeler proposed that all of these particles were actually the same particle moving backwards and forward in time in a phone call to Richard Feynman. The Davisson-Germer experiment determined that this particle has wave-like behavior. This fermion is lighter than its tau and muon counterparts. The Millikan oil drop experiment was the first to experimentally determine the charge of this particle that was discovered by J.J. Thomson. For the point, name this fundamental particle whose antiparticle is the positron.

ANSWER: electrons

(Tossup 18) The regulation of hyperactivation in these cells is done through CatSper ion channels. These cells have their histones replaced with protamines late in development. Sertoli cells provide support to these cells during their development. These cells contain a special organelle called the acrosome designed to break down the zona pellucida. They are stored in the epididymis and contain a long flagellum for motility. For the point, name these eukaryotic male gametes which fertilize egg cells.

ANSWER: spermatozoa (or sperm cells; accept spermatozoon or spermatium or spermatids)

(Tossup 19) The Laschamp event was an excursion of this phenomenon which dropped it to about 5% of its current strength. The Van Allen belts are held in place by this phenomenon, which creates a bowshock where it meets the solar wind. The declination of this phenomenon has varied and even reversed over time, though it is currently tilted about 11 degrees from the axis. The result of the geodynamo is, for the point, what phenomenon generated by convection of iron in the Earth's core?

ANSWER: geomagnetic field (accept Earth's magnetic field; prompt on magnetic field)

(Tossup 20) Royal Crown was among the first companies to use Eral Frazee's design for the opening of these containers, later supplanted by the "Sta-Tab" [stay tab] model which reduced litter from these containers. Proteins present in beer trap oxygen, meaning that these containers may not need an internal coating as is usually present when these containers are filled with heavily acidic and corrosive liquids such as colas. Many sodas and other beverages are packaged in, for the point, what metal containers that are stereotypically twelve ounces with a pop top?

ANSWER: aluminum cans (prompt on can, soda can, or beer can, by asking "Made of what material?")

(Tossup 21) This compound and water are the products of the Sabatier reaction. The “burp” hypothesis uses release of this compound from clathrates to explain a sudden climate shift at the end of the Paleocene epoch. Many archaeans generate this compound in the form of marsh gas, and about 25 percent of it in the atmosphere comes from ruminants like cows. It is thirty times more potent a greenhouse gas than carbon dioxide. The main component of natural gas is, for the point, what simplest hydrocarbon with formula  $\text{CH}_4$ ?

ANSWER: methane (accept  $\text{CH}_4$  before it is mentioned)

(Tossup 22) De Broglie wavelength is equal to Planck’s constant divided by this quantity. Symmetry under translations imply the conservation of this quantity by Noether’s theorem. Newton’s second law can be written as “force equals the rate of change of this quantity.” In metric units, this quantity is measured as kilogram-meters per second. This quantity and kinetic energy are conserved in a perfectly elastic collision. For the point, name this measure of how difficult it is to stop something, equal to mass times velocity.

ANSWER: linear momentum (do not accept or prompt on angular momentum)

(Tossup 23) An apparent alignment of this phenomenon with the plane of the Solar System has been dubbed the “Axis of Evil.” The WMAP mission detected anisotropies in this phenomenon, while the COBE satellite measurements of it produced a near perfect black body spectrum. Arno Penzias and Robert Wilson discovered this phenomenon by accident in 1964, and its temperature is about 2.7 kelvins. For the point, name this faint radiation detectable throughout space, a residual effect of the Big Bang.

ANSWER: cosmic microwave background radiation (accept CMB or CMBR; do not accept or prompt on any other order of the words)

(Tossup 24) In statistics, the phrase “of freedom” may follow this word to describe the number of data points that may vary in a set of data. For a given polynomial, this word is used to classify the polynomial by the highest exponent on its variables, such as quadratic or cubic. The unit with this name is equivalent to pi over 180 radians in trigonometry. For the point, give this word which is commonly used in math for a unit used to measure an angle, of which there are 360 in a full circle.

ANSWER: degrees

(Tossup 25) This class of compounds can be modelled as a collection of N Kuhn segments with equal Kuhn length. Florry Huggins solution theory models the solubility of this class of compounds which can be formed using a Ziegler-Natta catalyst. This class of compounds can be formed with a chain reaction where the active site is regenerated after each growth step. Synthetic and plastic examples of this class of compounds include nylon and Teflon. For the point, name these chains of repeated monomers.

ANSWER: polymers (accept polymerization; accept synthetic polymers; prompt on plastic)

(Tossup 26) In 1919, Steve Benner announced an analogue of this molecule that doubles the storage capacity described as “hachimoji.” Linus Pauling believed that this molecule had neutral phosphate groups. Maurice Wilkins questionably won part of a 1962 Nobel Prize for his x-ray diffraction work on this molecule. Rosalind Franklin’s Photo 51 of this molecule was used with Chargaff’s rules to determine its structure by Watson and Crick. For the point, name this molecule which uses base pairs of GC and AT to store biological information.

ANSWER: **DNA** (or **deoxyribonucleic acid**; accept hachimoji **DNA**; prompt on hachimoji before read)

(Tossup 27) Salt printing was invented by a man with this first name, and another man with this first name discovered hydrogen and famously measured the density of the Earth. A prince whose name is usually translated to this name in English led the development of the caravel sailing ship. A man with this last name is the namesake of the SI unit for inductance. For the point, give this name, the first name of the man who popularized the assembly line at his automobile factory.

ANSWER: **Henry**

(Tossup 28) This star’s companion is the closest white dwarf to Earth and was discovered by Alvin Clark on observations of this star’s orbit made by Friedrich Bessel. The Winter Triangle is formed by Betgeuse [“beetle juice”], Procyon [PRO-see-on] and this star. This star’s heliacal [heely-uh-cool] rising was used in Ancient Egypt to predict the flooding of the Nile. This star has the lowest apparent magnitude at -1.46. For the point, name this alpha star of Canis Major, the brightest star in the night sky, nicknamed the dog star.

ANSWER: **Sirius** A (prompt on Canis Major Alpha; prompt on Dog Star)

(Tossup 29) This disease was targeted by the ZMapp vaccine, which relies on a serum made in fast-growing tobacco plants. The 2018 Kivu outbreak of this disease struck the Congo last August. Controversially, in 2014, health workers in Liberia with this disease were flown to U.S. hospitals for treatment. The first known outbreak of this disease was a 1976 case in Zaire near a river sharing its name. For the point, name this viral hemorrhagic disease that struck West Africa in a 2013-2016 outbreak.

ANSWER: **Ebola** virus disease (accept **EBOV** or **Ebola** hemorrhagic fever or **EHF** or **EVD**)

(Tossup 30) The speed of light divided by this quantity, all times Planck’s constant, provides the energy for a quanta, according to Planck’s equation. Fraunhofer lines are dark lines seen when solar radiation is plotted for this quantity. This quantity is measured by looking for corresponding points on the same phase, such as two crests. This quantity is usually symbolized by the Greek letter lambda and is measured in nanometers. For the point, name this quantity which is the inverse of frequency in electromagnetic radiation.

ANSWER: **wavelength** (do not accept or prompt on frequency)

## Backup

(Tossup 31) This scientist discovered a staining technique known as the “black reaction” which stained neurons. Even though he and Ramon y Cajal came to different conclusions on how the nervous system worked, they were jointly awarded the 1906 Nobel Prize in Physiology or Medicine. This scientist is the namesake of an entity that is folded into cisternae and is responsible for dispatching protein received from the endoplasmic reticulum. For the point, name this Italian scientist, the namesake of an organelle apparatus.

ANSWER: Camillo Golgi (accept Golgi method or staining; accept Golgi apparatus or body)

(Tossup 32) Basement rocks are exposed in zones given this geologic name, such as the Canadian or the Fennoscandian, which have been tectonically stable since the Precambrian. Rift zones may develop on a type of volcano described by this adjective, which is built from a series of non-explosive eruptions of very fluid lava that spread out, giving this type of volcano its descriptive name. For the point, give this word that describes a geologic object that resembles a piece of protective armor.

ANSWER: shield