

Round 3

Regulation

(Tossup 1) In 2019, this state's legislature voted to make *Streptomyces griseus*, the source of streptomycin antibiotic, its official microbe. Einstein tried to unify field theory at this state's Institute for Advanced Study. UNIX, C++, the laser, and the transistor were invented at this state's Bell Labs. The Wizard of Menlo Park, Thomas Edison, worked in this state, where John Nash developed his equilibrium at its Princeton University. For the point, name this state where Willis Carrier invented air conditioning in Newark.

ANSWER: New Jersey

(Tossup 2) SNEWS detects neutrinos as the result of one of these events in our galaxy, the last one of which detected in 1987. Kepler names one of these events that occurred in 1604; that instance of this event was classified as type 1a [one - "a"] occurring between a white dwarf and a red giant. One common mechanism by which these events occur is from sudden gravitational collapse in the core of a massive star. For the point, name these late stellar events that result in a massive explosion.

ANSWER: supernovas (or supernovae; accept specific types such as 1a, 1b, 1c, 2-P, 2-L, 2-N, or 2b supernovae)

(Tossup 3) Andrew Taylor Still founded a branch of medicine whose name begins with this Greek prefix. Loss of estrogen after menopause increases calcium levels in the blood in a condition beginning with this prefix which can lead to fractures in the elderly. A cancer common in young people is a sarcoma named with this prefix which may be found in the tibia. For the point, name this Greek prefix meaning "bone," which appears before "arthritis" in a condition abbreviated OA.

ANSWER: osteo- (accept osteopathic medicine or osteopathy until "prefix")

(Tossup 4) The quality of this process is controlled with a "pioneer round" involving the cap-binding complex. In bacteria, the Shine-Dalgarno sequence helps initiate this process. Wobble base pairing helps explain some of the redundancy in the 20 base units used in this process. A, P, and E sites in ribosomes are occupied by tRNAs during this process. AUG is typically the start codon for this process which terminates when a stop codon is read. For the point, name this process of producing protein from an RNA sequence.

ANSWER: RNA translation (prompt on answers indicating protein synthesis)

(Tossup 5) The Brinnell test can be used to determine the value of this property using a ball, while the more accurate Vickers test uses a pyramid. CBN and some borides have very high levels of this property. A sclerometer is used to measure the 'scratch' version of this property from the width of the deformity left by a diamond under constant pressure. For the point, name this property of a mineral which can be ranked on the Mohs scale and which is a measure of the resistance of a material to being deformed.

ANSWER: hardness (accept indentation hardness until "sclerometer")

(Tossup 6) The cuprate YBCO is one type of this material that can maintain the namesake property above 77 Kelvin. Electrons pair up to form boson-like Cooper pairs in these materials according to BCS theory. These materials expel their magnetic field in the Meissner effect. These materials were first discovered by Heike Onnes and form below a critical temperature, where they suddenly have a persisting current. For the point, name these materials characterized by zero electrical resistance.

ANSWER: superconductors (accept superconductivity; accept word forms like superconduction)

(Tossup 7) The “poverty of the stimulus” is an argument from this scientific field, sometimes defended by reference to binding theory or anaphora. In this field, formants may be analyzed using a spectrogram of the generated frequencies. Philology is a subfield of this field which attempts to trace historical patterns in etymology such as by using cognates. Noam Chomsky put forth the theory of a universal grammar in, for the point, what scientific field that studies the sounds, symbols, and rules of language?

ANSWER: linguistics (accept developmental linguistics or language learning until “formants”)

(Tossup 8) For a parabola, this word names the only point lying on the axis of symmetry, and on a curve, this word can name any place where the first derivative is zero. The ‘two ears theorem’ states that at least two of these points can be removed from a polygon without introducing a crossing. The Euler characteristic of a polyhedron is the number of these points, minus the number of edges, plus the number of faces. For the point, name these points in geometry where two lines meet, such as at an angle.

ANSWER: vertex (accept vertices or vertexes)

(Tossup 9) It’s not *Chironomus*, but the term “polytene” was coined for the large chromosomes observed in this organism’s salivary glands. Thomas Hunt Morgan noted sex-linked traits in this organism’s mutant white-eyed variant. This organism with four pairs of chromosomes has genetic linkage for curly and short wings. For the point, name this model organism, an insect whose scientific genus is *Drosophila*.

ANSWER: fruit fly (accept Drosophila Melanogaster; accept Drosophila before mentioned; prompt on fly; do not accept or prompt on other flies like house fly)

(Tossup 10) Relying on Planck’s constant, a Kibble one of these devices was used to redefine the unit it measures in 2019. A Roberval one of these devices has six pivot points arranged in a parallelogram, while an ancient one of these, the steelyard, requires a movable counterweight. A traditional school lab might use a double pan or triple beam one of these devices, and modern electronic ones can be precise to one microgram. For the point, name this device used to measure the mass of an object.

ANSWER: balance (accept scale)

(Tossup 11) This region is the outer limit of the sun’s Hill sphere, where the sun’s gravity can attract satellites. The inner part of this region is sometimes named for Jack G. Hills, and this region was first proposed by Ernst Öpik. Long-period comets are thought to originate in this region, and the material in this region may have shifted outward from the scattered disc. For the point, name this region of space, named for a Dutch astronomer, where the furthest solar system objects lie.

ANSWER: Öpik-Oort cloud

(Tossup 12) This quantity is displayed on two axes of a psychrometric chart, and the ratio of the two measures of quantity can be used to determine humidity. This quantity is plotted on the vertical axis of the “hockey stick” graph, so-called due to this quantity’s recent increase as shown by past reconstructions of this quantity. This quantity decreases with altitude in the troposphere, but not in the stratosphere, leading to its namesake inversion. For the point, name this quantity which can be measured using a thermometer.

ANSWER: air temperature

(Tossup 13) As bubbles form within this substance, scoria may be produced or amygdules may fill the gaps. Small blocky rocks within this substance are called clinker, while smoother “pillow” formations of this substance are common underwater. A coulee [koo-lee] may be formed when this substance forms a dome and then continues to slowly flow. This substance can be classified into pahoehoe [pa-howay-howay] and a’a [ah-ah] types based on its flow. For the point, name this substance, which is formed when molten rock called magma reaches the Earth’s surface.

ANSWER: lava

(Tossup 14) In 2008, this pathogen was declared cured in the “Berlin patient.”. Opportunistic infections like *Pneumocystis* pneumonia often follow infection by this pathogen. Truvada is a drug designed to prevent infection by this pathogen. The drug Selzentry blocks it by binding to CCR5 receptors, while AZT therapy inhibits this pathogen’s reverse transcriptase enzyme. Helper T-cells are the primary target of this virus, resulting in collapse of the immune system. For the point, identify this retrovirus, which may lead to AIDS.

ANSWER: HIV (accept human immunodeficiency virus; prompt on AIDS)

(Tossup 15) Due to osmium tetroxide’s ability to bind to alkenes in this vitamin, Sharpless dihydroxylation was widely replaced with Upjohn dihydroxylation. An extended conjugated chain of alkenes makes up this vitamin that isomerizes from cis- to trans- form in the presence of light. Golden rice is genetically engineered rice that contains a precursor to this vitamin. Rhodopsin makes use of this vitamin, of which beta-carotene and retinol are common sources. For the point, name this fat-soluble vitamin important for healthy eyesight.

ANSWER: Vitamin A (prompt on retinol or retinal or retinoic acid; prompt on beta-carotene)

(Tossup 16) The Strecker synthesis forms these organic compounds by the reaction of an aldehyde and ammonium chloride. These compounds are zwitterions at biological pH. A carboxylic [car-box-sill-ic] acid and an amine group are on opposite ends of these organic compounds. The sequence of these compounds is responsible for the formation of beta sheets and alpha helices. For the point, name these organic compounds that include arginine and tryptophan, the basic building blocks of proteins.

ANSWER: amino acids

(Tossup 17) The ATTZ near a river has an ecology based on the “pulse” of these events. Statistical measurements of recurrence of these events have led the biggest ones to be dubbed “100-year” events. Slow infiltration rates may cause these events, such as where asphalt or concrete makes soil impermeable. Arroyos are susceptible to the “flash” type of these events. Levees are built to protect areas from, for the point, what hydrological events in which water rises far above normal levels?

ANSWER: floods (accept word forms)

(Tossup 18) Annual meetings of those who have achieved this honor are held at Lindau. Nazi policy forbade the acceptance of this honor by German scientists such as Richard Kuhn and Adolf Butenandt. The premature publication of an obituary led to the founding of this honor by the inventor of dynamite. Chemist Linus Pauling has won two of these honors in different categories. Awarded by various Swedish and Norwegian committees, for the point, name this prestigious annual prize awarded to laureates in fields such as medicine, physics, and peace.

ANSWER: Nobel prizes

(Tossup 19) The ratio of the rate of this process for two different gases is equal to the square root of their molar masses, according to Graham’s Law of [this process]. William Sutherland derived a result commonly named for Einstein where a coefficient of this process is equal to “mobility times Boltzmann’s constant times absolute temperature”; that coefficient first appeared in Adolf Fick’s 1855 treatment of this process. Water undergoes osmosis, a special case of this form of passive transport. For the point, name this process of particles moving from high concentrations to low concentrations.

ANSWER: diffusion (accept effusion – a special case of diffusion described by Graham’s Law)

(Tossup 20) Goldreich and Tremaine demonstrated the chaotic orbits of one of these things was due to “shepherding” between the moons Pandora and Prometheus. A major theory for the creation of these things is a satellite falling into the Roche limit of its parent body. A prominent gap between these things known as the Cassini Division is caused by the moon Mimas. The one named for Phoebe is tilted 27 degrees to the other icy ones that orbit the 6th planet from the sun. For the point, name these collections of icy dust which orbit around Saturn.

ANSWER: planetary rings (or ring systems; accept rings of Saturn)

(Tossup 21) Ebonite is the result of this process when prolonged over an extended time and was originally used in bowling balls and some clarinets. Allylic hydrogen bonds are replaced in this process, often at around 130 degrees Celsius using an accelerator. Lower temperatures often create polysulfide links of around 6 atoms, with shorter links appearing at higher temperatures. For the point, name this process of heating and adding sulfur to rubber in order to strengthen and harden it, such as for making car tires.

ANSWER: vulcanization (accept word forms)

(Tossup 22) In this author's essay "General Scholium" he claimed to "feign no hypothesis" centering around the second edition of his most famous work. After the Glorious Revolution, this scientist was appointed Master of the Royal Mint. Edmund Halley convinced this scientist to publish his *Principia Mathematica* after discovering that this man had solved Kepler's laws of planetary motion. For the point, name this mathematician who feuded with Leibniz over the discovery of calculus.

ANSWER: Sir Isaac Newton

(Tossup 23) This phenomenon occurs when stepped leaders connect with upward streamers, and it may create fulgurites in the soil. Collisions between ice crystals and graupel, which then separate to different parts of a cloud, are thought to provide the charge for this phenomenon. Rapid expansion of surrounding air due to heat creates the sound that often accompanies this phenomenon. For the point, name this weather phenomenon, a visible flash of electrical current between the ground and a cloud.

ANSWER: lightning

(Tossup 24) Biomedical values of pressure are typically reported in millimeters of this element. Plastic-laminated gloves are now required to handle this element's dimethyl variant after the tragic death of Dartmouth chemist, Karen Wetterhahn. Touching an iron nail to this element's surface causes it to oscillate wildly in its namesake "beating heart" experiment. This metal causes erethism, which is better known as "mad hatter disease." For the point, name this metal, known to alchemists as quicksilver and symbolized Hg.

ANSWER: mercury (prompt on Hg)

(Tossup 25) The net value of this quantity is equal to the area under a process curve on a PV diagram. This quantity for an object is equal to the path integral of the force field. By the first law of thermodynamics, the change in internal energy is equal to heat added to the system minus this quantity. This quantity is equal to the change in kinetic energy. This quantity is zero for a tray carried perpendicular to the floor by a walking waitress. For the point, name this quantity equal to force times distance, commonly symbolized W.

ANSWER: work (done by a system)

(Tossup 26) Variations in this planet's celestial movement over time are the cause of the Milankovitch cycles. This planet is the densest in the solar system. Some believe that an object called Theia collided with this planet, forming this planet's only natural satellite. On this planet, the acceleration from gravity measures about 9.8 meters per second squared. This planet is the subject of a photo known as the *Pale Blue Dot*. For the point, name this planet, the only one known for sure to harbor life.

ANSWER: Earth

(Tossup 27) A continued fraction must terminate if it is in this set of numbers. The real numbers can be constructed from these numbers using Dedekind cuts. These numbers are symbolized by a bold Q. According to legend, Pythagoras sentenced Hippasus to death by drowning for finding a number *not* of this type. Fractional examples of these numbers include $4/7$ [4 over 7] and $7/2$ [7 over 2]. For the point, name this subset of the real numbers which either repeat or terminate after a finite number of decimal places, *unlike* pi or the square root of 2.

ANSWER: **rational** numbers (prompt on Q; prompt on fractions; do not accept or prompt on irrational)

(Tossup 28) Tamarack and larch are common pioneer species in this ecosystem, where climate change can result in drunken trees. Most peat bogs are located within this biome. A well-documented predator-prey relationship in this biome involves lynx and snowshoe hares, and its largest mammals include the moose and Siberian tiger. Scandinavia, Russia and Canada are covered by, for the point, which biome marked by heavy snowfall and evergreen trees like pine and spruce?

ANSWER: **taiga** (accept **boreal forest** or **northern coniferous forest**)

(Tossup 29) At 573 degrees Celsius, this mineral abruptly increases in volume as it changes into its beta form. When mixed with its polymorph moganite, this mineral forms the rock chalcedony. This mineral occupies the lowest positions in both Goldich's dissolution series and Bowen's reaction series. This naturally-transparent material has specific colored variants such as citrine and amethyst. Made of a tetrahedral structure of silicon and oxygen, for the point, name this common mineral whose crystals are often used in clocks and watches.

ANSWER: **quartz**

(Tossup 30) This single letter symbolizes the amino acid that replaces glutamic acid in sickle-cell hemoglobin. It is not N, but this letter appears squared in one term of the van der Waals equation. A theory whose name begins with this letter predicts trigonal pyramidal geometry for ammonia. As a Roman numeral, this letter represents the most common oxidation state of niobium, such as in the compound niobium pentoxide. For the point, name this letter, the symbol of element 23, vanadium.

ANSWER: **V**

Backup

(Tossup 31) The lungs secrete DPPC and other lipid components to increase pulmonary compliance and lower this quantity. This quantity is a linear function of temperature according to Eotvos's [airt-varsh's] rule. A gradient in this quantity causes mass transfer due to the Marangoni effect, which causes the "tears of wine" phenomenon. Surfactants lower this property of a liquid which is responsible for the meniscus seen when a liquid is held in a tube. For the point, name this property caused by the cohesive forces between molecules, which water striders take advantage of to stay afloat.

ANSWER: **surface tension** (prompt on tension)

(Tossup 32) Based on how they react to shearing forces, these substances can be described as rheopectic or thixotropic. These substances are described by an equation whose smooth solutions are the subject of a Millennium Prize problem. The Navier-Stokes equations describe these substances that are non-Newtonian if they disobey Newton's law of viscosity. For large Reynolds numbers, flow in these substances can transition from laminar to turbulent. For the point, name these substances which can exist as a gas or a liquid and are characterized by their ability to fill a vessel.

ANSWER: fluids (do not accept or prompt on liquid or gas)