Semifinals - Elementary

Round 4 Tossups

(1) **By firing a gun into the ballistic variety of these devices, the momentum of a bullet can be found. A classical example of a chaotic system is the double variety of these devices. The (+) ideal form of these devices consists of a weighted bob at the end of a massless rod. Swinging to keep time in (*)** grandfather clocks, for the point, what are these devices?

ANSWER: **Pendulum**s (accept Double **pendulum**)

(2) **The influence of this quantity causes the integrated Sachs-Wolfe effect. The existence of an increasing variety of this quantity, known as its phantom type, would cause the "big rip" end of the (+) universe. Driving the expansion of the universe and making up the bulk of the universe's mass-energy (*)**, for the point, what is this unobserved quantity which is more than twice as prevalent as dark matter?

ANSWER: **Dark energy** (do not accept or prompt on "dark matter")

(3) **Faraday's constant equals the charge of an electron times this quantity, which is also multiplied by Boltzmann's constant to give the ideal gas constant. This constant equals the number of atoms in (+) 12 grams of carbon-12, which is approximately 6.022 times 10 to the 23rd power. Defining the number of particles in a mole (*)**, for the point, what is this constant which is named for an Italian scientist?

ANSWER: **Avogadro**'s number (or **Avogadro**'s constant)

(4) **Common systems of a disorder caused by this hormone include crowded teeth and enlarged hands and feet. Excessive levels of this hormone can cause pituitary tumors and acromegaly [[ak-roh-MEH-gah-lee]]. (+) Deficiencies of this hormone are the primary cause of human dwarfism. A peptide hormone responsible for stimulating cell division, (*)** for the point, what is this common performance-enhancing drug?

ANSWER: Human **Growth Hormone** (or H**GH**; accept **Somatropin** or **Somatotropin**)

(5)   **This rock, the intrusive counterpart of rhyolite, is the most common material found in Bornhardts. This rock forms its namesake domes at landmarks such as Sugarloaf Mountain and Yosemite's Half Dome. (+) This rock contains crystals of feldspar and quartz and predominantly makes up the continental crust. A coarse-grained igneous rock, (*)** for the point, what is this material commonly used to make high end countertops?

ANSWER: **Granite**

(6)   **Along with ambient visible light, this is the primary radiation converted into electrons in night vision goggles. This radiation names a form of spectroscopy that measures a (+)** molecule's vibrational transition. This radiation has wavelengths from 700 millimeters to 1 centimeter. Including wavelengths longer than that of visible light, (*) for the point, what is this radiation range?

ANSWER: **Infrared** light (or **IR**)

(7)   **This scientist's paper "Experiments on Plant Hybridization" led to the introduction of the laws of segregation and independent assortment. This scientist's studies of (+)** *Pisum sativum* **[[PEE-sum sah-TEE-vum]] led him to coin the terms "dominant" and "recessive." A 19th century friar, (*)** for the point, who was this man who studied inheritance among pea plants?

ANSWER: Gregor Johann **Mendel**

(8)   **Common causes of these events, the largest of which occurred in Washington in 1980, include increases in pore pressure and hydrostatic pressure in surface cracks. The field of predicting these events is called (+) slope stability analysis. These events, which are a form of mass wasting, are often preceded by heavy rains destabilizing the (*)** surface layer. For the point, name these potentially catastrophic movements of rock and sediment down a slope.

ANSWER: **Mudslide**s (accept **Landslide**s; accept **Mudflow**s; accept **Rockslide**s; accept **Flow Slide**s; prompt on "mass wasting" before mentioned)

(9)   **Up-regulation of cytochrome P450 conveys resistance to this organo-chlorine compound, which prevents sodium channels from closing. This chemical was implicated in declining peregrine falcon and (+) bald eagle populations as it accumulated in their prey. Responsible for thinning eggshells, (*)** for the point, what is this pesticide that was highlighted in Rachel Carson's *Silent Spring*?

ANSWER: **DDT** (or **Dichlorodiphenyltrichloroethane**)

(10)   **Each atom in this material shares three sp2 hybridized orbitals, making it the strongest of all currently known materials. Andre Geim [[GIME]] employed micromechanical exfoliation and a silicon wafer to isolate layers of this (+)** material using Scotch tape and the primary component of pencil lead. Arranged in a single-layered hexagonal lattice, **(*)** for the point, what is this 2D carbon allotrope?

ANSWER: **Graphene** (do not accept or prompt on "graphite")

(11)   **This law is extended to the enthalpy of a chemical reaction by Hess's law. This law, which is often notated as "delta U equals Q minus W," is equivalent to stating that first kind (+)** perpetual motion machines are impossible. Stating that the total amount of mass-energy in a system is constant, **(*)** for the point, what is this law?

ANSWER: **First Law** of **Thermodynamics** (prompt on "Conservation of Energy"; prompt on partial answers)

(12)   **One controversial method for carrying out this task involves depositing a certain substance into a subduction zone. (+)** The primary method for carrying out this task is called deep geological **(*)** repository. For the point, identify this task of safely dealing with the waste products of fusion and fission.

ANSWER: **Radioactive waste disposal** (accept any answer indicating the disposal, storage, or management of waste products from nuclear power plants or weapons)

(13)   **This value represents the Turing degree of the partial computable functions. This value represents the bottom element of a bound lattice and is the (+)** cardinality of the empty set. Creating an undefined **(*)** expression as the denominator of a fraction, for the point, what is this number?

ANSWER: **Zero** (accept **Naught** or **Nil**)

(14)   **Lenski et al.'s ongoing evolution experiment with this species observed them spontaneously developing the ability to metabolize citrate [[SIT-"rate"]]. In (+)** humans, beneficial strains of this species are involved in producing vitamin K in the intestines. A common model organism, **(*)** for the point, what is this rod-shaped, gram negative gut bacteria?

ANSWER: **E. coli** (or **E**scherichia **coli**)

(15)   **This location is the origin of toxic dust storms that spread tuberculosis and cause cancer in former fishing towns such as Mo'ynoq [[MOY-nok]]. Desertification of this location was driven by agricultural diversion of the (+)** Syr Darya and Amu Darya rivers. Formerly located on the border of Kazakhstan and **(*)** Uzbekistan, for the point, what is this now mostly dried up Central Asian lake?

ANSWER: **Aral** Seabed (or **Aral** Sea; accept **Aralkum** Desert)

(16)   **This field was founded and developed by the father-son pair D.D. and B.J. Palmer. This field was founded on pseudo-scientific claims of the existence of (+) lesions not visible on X-rays, termed vertebral subluxations [[sub-luk-SAY-shuns]]. (*)** For the point, name this field of alternative medicine based around performing spinal "alignments."

ANSWER: **Chiropractic** (accept word forms like **Chiropractor**)

(17)   **Scientists from this country include the author of *Systema Naturae* [[NAH-tyoo-ray]]. A village in this country is the namesake of four chemical elements, (+) including Ytterbium [[ee-TER-bee-um]]. The home country of Svante Arrhenius [[SVAHN-teh ah-REE-nee-us]] and Arvid Carlsson, (*)** for the point, what is this country in which the presentation ceremonies of all three science Nobel Prizes are held?

ANSWER: Kingdom of **Sweden** (or Konungariket **Sverige**)

(18)   **This scientist described cultural features that are passed down in a way analogous to genes with the coined term "meme." This scientist popularized the gene-centered view of evolution in books such as (+)** *River Out of Eden* and *The Selfish Gene.* **Known for his criticisms of religion in his book** *The God Delusion*, **(*)** for the point, who is this British evolutionary biologist?

ANSWER: Richard **Dawkins**

(19)   **This organ can be affected by cholesterolosis [[koh-leh-steh-RAH-loh-sis]], which is also known as "strawberry" [this organ]. This organ can be (+) removed when it accumulates painful amounts of calcium salts and cholesterol, forming this organ's namesake (*)** stones. For the point, name this organ that receives and stores bile from the liver.

ANSWER: **Gallbladder** (accept **Cholecyst**; prompt on "gallstone")

(20)   **Bartlett's test, a type of F-test, compares two values for this quantity, which is also analyzed by a set of models developed by Ronald Fisher called ANOVA [[ah-NO-vah]]. (+) The parameter lambda for a Poisson [[pwa-SAHN]] distribution symbolizes both the expected value and this quantity, which is the square of the standard deviation. (*)** For the point, name this measure of how spread out a data set is.

ANSWER: **Variance** (accept Analysis of **variance**)

(21)   **This scientist controversially refused to give her subjects numbers, instead opting for names like "Goliath." This scientist observed one animal population using twigs and grass to "fish" for termites. (+) This scientist observed a nonhuman "war" between the Kasakela and Kahama communities of Gombe [[GOHM-beh]] National Park. Best known for studying Tanzanian (*)** chimpanzees, for the point, who is this English anthropologist and primatologist?

ANSWER: Jane **Goodall** (or Valerie Jane Morris-**Goodall**; or Baroness Jane van Lawick-**Goodall**)

(22)   **Since 2019, Huawei [[HWAH-WAY]] has been banned from implementing this technology in the U.S. due to espionage claims. Protestors in the UK who believed this technology was responsible for (+) Covid-19 set fire to cell towers. The Samsung Galaxy S20 was the first smartphone (*)** compatible with this technology. For the point, name this latest broadband cellular standard.

ANSWER: **5G** NR (or **5G** New Radio]

(23)   **As part of Project Nekton, this feature was explored by the Auguste Piccard designed *Trieste* [[tree-ESS-teh]] vessel. One portion of this feature was explored by the *Kaiko* and *Nereus* unmanned (+) submarines. This feature's southern end contains its deepest point, the Challenger Deep. (*)** Located near an American-controlled Pacific island group, for the point, what is this deepest point in the ocean?

ANSWER: **Mariana Trench** (or **Marianas Trench**; accept **Challenger Deep** before mentioned)

(24)   **These data structures connect all vertices of a graph with minimum edge weights. The red-black variety of this data structure is self-balancing, differentiating it from the binary search (+) variety, and the first node of this structure is known as the root node. With terminal nodes referred to as leaf nodes rather than (*)** branches, for the point, what is this type of data structure?

ANSWER: **Tree** (accept Binary Search **Tree** before mentioned; accept Binary **tree**; prompt on "graph" before mentioned)

(25)   **The most common methods for detecting these objects include the radial velocity method and the transit method. When found in the habitable (+) zone, these objects are said to be in the "goldilocks" zone. Examples of these objects include super-Earths and (*)** hot Jupiters. For the point, name these rocky or gaseous bodies that orbit stars other than our Sun.

ANSWER: **Exoplanet**s (accept any answer indicating extrasolar planets; accept answers such as planets outside our solar system; prompt on "planet"s)

Extra Question

(1)   **This man's final book was a discourse on the study of motion and the study of materials titled** *Two New Sciences.* **The publication of this man's (+)** *Dialogue Concerning the Two Chief World Systems* **led to him being (*)** condemned by the inquisition for his heliocentrism. For the point, name this scientist who observed a group of namesake moons of Jupiter.

ANSWER: **Galileo** Galilei (or Galileo **Galilei**)