2021 ACF Regionals

This physicist proposed that all particles have non-constant positive mass, which allowed for his theory that photons consist of neutrino-antineutrino pairs. This physicist, who studied the photoelectric effect with his brother Maurice, spearheaded the proposal that led to the establishment of CERN. This non-American physicist proposed the existence of a nonlocal guiding equation in the first hidden-variable theory, which was later elaborated upon by David Bohm as pilot wave theory. A hypothesis proposed by this physicist was tested by an experiment that found a maximum intensity of 54 volts at 50 degrees for an electron beam reflected off of a nickel crystal. The Davisson–Germer corroborated the namesake hypothesis of, for 10 points, what French physicist who proposed that all matter has wave-like properties?
ANSWER: Louis (Victor Pierre Raymond) **de Broglie**
<David Bass>

Via an "exchange property" named for this type of set, a set larger than a preexisting one of these sets can be made into one of these sets by replacing one of its elements. Adding an element to this type of set for a matroid can yield a circuit of the matroid. Any polynomial system can be transformed, via Buchberger's algorithm, into one of these sets named for Gröbner. In addition to curvature and torsion, a Frenet–Serret apparatus contains the elements of one of these sets. One of these sets for a subspace can be orthonormalized by the Gram–Schmidt process. The "elementary" one of these sets contains e-sub-one through e-sub-n and can be represented as an n-by-n identity matrix. The cardinality of these sets for a vector space defines its dimensionality. By definition, these sets contain linearly independent vectors that span a given vector space. For 10 points, name these sets that define a coordinate system.
ANSWER: **basis** [or **bases**; prompt on maximal independent sets]
<David Bass>

Alfred Werner became the first inorganic chemist to win the Nobel prize when he showed that coordination compounds like hexamminecobalt(III) chloride can exhibit this geometric configuration. For 10 points each:
[10] Name this geometry of a molecule with coordination number six.
ANSWER: **octahedral** molecular geometry
[10] Octahedral coordination compounds with two triplets of identical ligands exhibit this type of isomerism, in which identical ligands can either form a right triangle or an equilateral triangle. One configuration of this isomerism contains only *cis* pairs of identical ligands, while the other has both *cis* and *trans* pairs.
ANSWER: **fac**ial-**mer**idional isomerism
[10] These symbols are drawn around diagrams of hexamminecobalt(III) chloride in order to distinguish the main molecule from its free chloride ions. Placing these symbols around a chemical formula denotes its concentration.
ANSWER: square **bracket**s
<David Bass>

Aguiar *et al*. simulated this feature by rotating shear layers of water in a drum with a rotating center. This feature's wavenumber of six was found to occur over a wide parameter range, subject to initial conditions. For 10 points each:
[10] Name this feature that was first observed by the *Voyager* mission in 1981, but was not imaged in visible light again until its planet's summer in 2009. This feature changed colors from blue in 2013 to gold in 2016.
ANSWER: **Saturn**'s North Polar **hexagon**
[10] An early theory proposed by Allison *et al*. in 1990 suggested that Saturn's hexagon is a stationary example of this type of wave. These planetary-scale waves are caused by the change in Coriolis force with latitude. On Earth, these waves occur in "atmospheric" and "oceanic" varieties and cause meanders in the jet stream.
ANSWER: **Rossby** waves
[10] Another notable feature of Saturn are these collections of ice and rock particles that orbit Saturn's equator.
ANSWER: Saturn's **ring**s
<David Bass>

Reid Miles designed one work of this type features the text "'it's time!'" in quotes followed by ellipses and ten lines of exclamation marks. One work of this type features the text "Una Mas (One More Time)" being held by Kenny Dorham, who was photographed by Francis Wolff. They're not related to books, but S. Neil Fujita created abstract paintings for his designs of these works. One work of this type features a burning flower and two hugging African women melting into clouds above an ocean. An orange man wearing a *kple kple* mask and playing the keyboard is central to another one of these works. One of these works created for *'Round About Midnight* features a red photograph of Miles Davis. Blue Note Records released many notable designs of, for 10 points, what works of visual art designed to accompany works like *Head Hunters* and *Bitches Brew*?
ANSWER: jazz **album cover**s [accept **album art** or **record art**]
<David Bass>

During this doubly-eponymous fight, both teams' Shens neglected to use their ultimates. For 10 points each:
[10] Name this legendary 2013 fight that was won by the well-timed usage of quicksilver sash's active ability. Because LCK used to make the fifth game of a series blind pick, this fight was a mirror matchup of Zed versus Zed.
ANSWER: SKT T1 **Faker** versus KT Bullets **Ryu** [prompt on partial answer with "who was the other player?"]
[10] The Faker versus Ryu fight occured in a competitive match of this largest esport in the world. This Riot Games-developed esport is massively popular in Korea, whose teams have won 6 of its 10 World Championships.
ANSWER: ***League of Legends*** [or ***LoL***; prompt on *League*; reject "*League of Legends: Wild Rift*"]
[10] Another famous moment in competitive *League of Legends* is when xPeke performed a "backdoor" to destroy this structure in a 2012 match against SK Gaming by using Kassadin's Riftwalk to repeatedly teleport around this structure. This structure shares its name with the central base structure of the Protoss in *Starcraft* games.
ANSWER: **Nexus**
<David Bass>

2020 ACF Winter

HIVE-CUT is a database of usage tables for these structures. The degree to which selection has affected these structures is factored into their namesake adaptation index. Organisms with high growth rates generally have more optimized usage bias for these structures, which can affect elongation rate. These structures are sequentially fed through A, P, and E sites. Synonymous mutations are a result of these structures' "degeneracy," which refers to how different types of these structures can perform nearly identical functions because there are sixty-four possible types of these structures, but only twenty translated amino acids. UAA, UAG, and UGA are the "stop" type of, for 10 points, what sets of three mRNA nucleotides that "code" for certain amino acids?
ANSWER: **codon**s [do not accept or prompt on anticodons; accept **stop codon**s or **codon usage tables** or **codon adaptation index**]
<DB>

The construction of a tourist attraction in Pingtang County near one of these devices followed China's rejected proposal to host one of these devices, the Square Kilometer Array. Because it has a coefficient of thermal expansion lower than that of borosilicate glass, Zerodur is used in the construction of examples of these devices that include Keck 1 and Keck 2. One of these devices named for Green Bank has an off-axis feed arm and, along with another one of these devices that is located in a Karst sinkhole in Arecibo, Puerto Rico, collects data for SETI@home. Protests have blocked the construction of the "Thirty Meter" one of these devices on Mauna Kea. "First light" is taken by new examples of, for 10 points, what devices that detect electromagnetic radiation from space?
ANSWER: **telescope**s [prompt on observatories or Arecibo Observatory or W. M. Keck Observatory or telescope mirrors; accept **radio telescope**s or **visible-light telescope**s or **FAST** or **Five-hundred-meter Aperture Spherical radio Telescope** or **Tianyan** or **Green Bank Telescope** or **Thirty Meter Telescope**]
<DB>

Transition metals described by this term are especially resistant to oxidation and corrosion due to their full d-subshells. For 10 points each:
[10] Name term that is used describe the gases in group 18 of the periodic table due to their low reactivity.
ANSWER: **noble** [accept **noble metal**s or **noble gas**es]
[10] Neil Bartlett produced the first noble gas compound in 1962 by combining this noble gas with platinum and fluorine to form a yellow solid. Ramsay and Travers realized their discovery of this element by its blue glow when distilled into a vacuum tube.
ANSWER: **xenon** [or **Xe**]
[10] Despite being unreactive noble gases, helium and neon are used to construct a gain medium for one type of these devices in which excited helium atoms collide with neon atoms in order to generate a population inversion.
ANSWER: **laser**s [accept **helium-neon laser**s or **He-Ne lasers** or **gas laser**s]
<DB>

For the sheer scientific thrill of it, you have placed a box at the top of an inclined plane with an angle of inclination, *theta*. For 10 points each, answer these questions about what will happen next.
[10] While sliding down the incline plane, your box could experience drag from this force, which is equal to the product of normal force and its namesake coefficient, symbolized *mu*.
ANSWER: **friction** force [do not accept **coefficient of friction**]
[10] Luckily, you live in an ideal world without friction. When friction force is set equal to zero, the force on your box parallel to the inclined plane is proportional to this function of theta. The torque acting on the simple pendulum in your nearby clock is also proportional to this function of its angle from the vertical.
ANSWER: **sin**e of theta
[10] Oh no, the physics student's worst nightmare has come true: you must account for air resistance. To do this, you use the drag equation, which describes drag force as proportional to velocity to this power.
ANSWER: **2** [accept **squared**]
<DB>

Jerzy Neyman introduced the modern frequentist interpretation of these statistical objects with his namesake "construction." For 10 points each:
[10] Name these ranges of values that have a namesake probability of containing a certain parameter value. One way to construct a "95%" one these ranges is to add plus-or-minus two times the standard error to the sample mean.
ANSWER: 95% **confidence interval**s
[10] The aforementioned method of creating a confidence interval requires the assumption that the data is normally distributed. This field of statistics describes data *without* making any assumptions about its underlying distribution.
ANSWER: **nonparametric** statistics [prompt on **flexible** statistics]
[10] A common nonparametric technique is bootstrapping, which involves performing this action many times in order to generate a distribution for a statistic. This action's "stratified" form involves partitioning the population.
ANSWER: **sampling** [accept anything mentioning taking a **sample**]
<DB>

This work describes its titular entity as "a Commonwealth … which is but an artificial man." For 10 points each:
[10] Name this work whose introduction popularized the term "body politic" and states that "life is but a motion of the limbs."
ANSWER: ***Leviathan*** *or The Matter, Forme and Power of a Commonwealth Ecclesiasticall and Civil*
[10] *Leviathan* describes man as having a "perpetual and restless desire for" this faculty, which it divides into "natural" and "instrumental" types. Macchiavelli argued that there does not exist a moral basis for judging the uses of this faculty.
ANSWER: **power** [accept **natural power** or **instrumental power**]

[10] *Leviathan* contains one of the first descriptions of this concept, in which it asserts the benefits of creating covenants with an authority. Jean-Jacques Rousseau's magnum opus is named for this concept.
ANSWER: **social contract** [accept *The* ***Social Contract*** or **social contract theory**]
<DB>

They're not schools, but Philip Yenawine and Abigail Housen developed the VTS curriculum for use in these places. Metadata in three different languages has been found at the earliest one of these places, which was founded by the priestess Ennigaldi-Nanna. While doing research for one of these places, Franz Boas opposed these places' commitment to ethnology and championed cultural relativism with his design of the Hall of the Pacific Northwest Coat. The "British" one of these places controversially houses the Elgin Marbles, which have been a primary target of ongoing efforts for the repatriation of these places' artifacts. For 10 points, name these places where curators design exhibitions, exemplified by the Met and the Louvre.
ANSWER: **museum**s [accept **exhibit**s or **exhibition**s or art **galleries**, accept any specific type of museum like **art museum** or **museum of natural history**]
<DB>

In one song, this artist reflects on a breakup with the lines, "What a thing to be human / Made her more of a woman." Kid Cudi sings, "As I fantasize / So much to see, I'm in paradise," in a feature on a song by this artist that describes "Red lips, french kiss my worries all away." This artist sings about a girl who "was too young to be the Hollywood type" and drinks "Tequila before sunrise" in the autobiographical song "She." This artist sings of "Burning toast in the toaster" in a song that opens, "Baby, you've been so distant from me lately." In one song, this artist alternatively sings, "I needed to hate you" and "I needed to lose you to love me." For 10 points, name this artist who included the song "Look at Her Now" on her 2020 album *Rare*.
ANSWER: Selena (Marie) **Gomez**
<DB>

2020 ACF Fall

Dozens of 350-foot long sand pits outside of Orlando, Florida generate this substance by acting as RIBs. This substance saturates the phreatic zone, which lies below the vadose zone, where this substance is at atmospheric pressure. This substance, which can ascend via base flow, is naturally generated by infiltration followed by percolation. Darcy's law is most commonly applied to describe the movement of this substance, which ascends naturally at "artesian" sites. Human extraction of this substance leads to land subsidence as aquifers are depleted. For 10 points, name this potable substance that can be extracted from a well.
ANSWER: **groundwater** [prompt on water or H_2O with "Where does it come from?"; accept any answer mentioning **water** that is in the **ground**]
<DB>

In special relativity, beta is a ratio of two values for this quantity. The Tsiolkovsky rocket equation uses this quantity's "effective exhaust" form as a coefficient to solve for the maximum possible change in this quantity. This is the only squared quantity in Bernoulli's equation, which multiplies this quantity by one-half times density. The change in the square of this quantity is two times acceleration times distance. The square root of the projected area of a falling object is inversely proportional to the "terminal" type of this quantity. For 10 points, name the derivative of position with respect to time, a quantity that can be expressed in meters per second.
ANSWER: **velocity** [accept **v**; prompt on speed]
<DB>

This process produces an effluent stream whose contents are separated in a fractionator. For 10 points each:
[10] Name this process that is used to increase the octane content of gasoline by breaking up larger hydrocarbons.

ANSWER: fluid catalytic **cracking** [accept thermal **cracking**]
[10] The catalyst in fluid catalytic cracking must be periodically injected with heat and air in a regenerator in order to remove this substance that destructively adheres to the catalyst. This carbon-rich fuel can be produced via destructive distillation by heating coal in the absence of air.
ANSWER: catalyst **coke** [accept petroleum **coke** or coal **coke**]
[10] Gasoline produced with fluid catalytic cracking has this element removed from it in order to reduce emissions of this element's toxic dioxide. Many of this element's compounds smell like rotten eggs.
ANSWER: **sulfur** [or **S**]
<DB>

A common example in topology involves showing that a coffee cup is homeomorphic to this solid because it only has one hole. For 10 points each:
[10] Name this donut-shaped solid that can be generated by revolving a circle around a coplanar axis.
ANSWER: **torus**
[10] A topology is said to be first-countable if it has a countable basis for every one of these sets in the topology. This type of set for a point contains at least one open set around the point.
ANSWER: **neighborhood**
[10] An open set on a manifold necessarily contains at least one of these objects surrounding each of its points. In Euclidean 3-space, this type of object is defined as the volume bounded by a sphere.
ANSWER: 3-**ball** [accept n-**ball**]
<DB>

In one work from this country, villagers escape punishment by testifying that "Fuenteovejuna did it." A character in a work from this country laments, "What is life? a tale that is told; / What is life? a frenzy extreme" while imprisoned by Clotaldo on orders from his father, the king of Poland. In addition to *Life is a Dream*, a play from this country features Adela, who commits suicide after hearing her mother shoot at Pepe el Romano. That play from this country is set during an eight-year period of mourning for the husband of Bernarda Alba. For 10 points, name this country that was home to Golden Age playwright Pedro Calderón de la Barca and Federico García Lorca.
ANSWER: Kingdom of **Spain** [or Reino de **España**]
<DB>

This author urged that "we must widen our common literary world to include many more voices from beyond our comfort zones of the elite first world cultures" in his Nobel Prize acceptance speech. For 10 points each:
[10] Name this author of *The Buried Giant* who discussed his racial identity in "My Twentieth Century Evening – and Other Small Breakthroughs."
ANSWER: (Sir) Kazuo **Ishiguro**
[10] Students in this novel by Ishiguro are expected to make art so that Madame can prove that they have souls. In this novel, Kathy H. works as a "carer" for her friends Ruth and Tommy, who are clones created for organ donation.
ANSWER: ***Never Let Me Go***
[10] Kazuo Ishiguro has lived in this country since leaving Japan at the age of five. Another recent Nobel laureate from this country is the playwright Harold Pinter, whose plays are described as "comedy of menace."
ANSWER: the **United Kingdom** of Great Britain and Northern Ireland [or the **U.K.**]
<DB>

Arthur Wesley Dow inspired this artist to experiment with abstraction while at the University of Virginia, where this artist depicted its architecture in a series of watercolors. This artist depicted a black column surrounded in curtain-like fabric on either side in a painting subtitled *Red, White and Blue*. This artist included her husband's name in a red bar in a painting of the Radiator Building. This artist of *Ram's Head, Blue Morning Glory* created multiple

paintings titled *Red Canna*. For 10 points, name this artist who spent much of her career in New Mexico and is best known for her paintings of animal skulls and suggestive flowers.
ANSWER: Georgia Totto **O'Keeffe**
<DB>

This pioneer of surrealist photography depicted a baby armadillo in *Père Ubu*. For 10 points each:
[10] Name this French artist who used photomontage techniques to create a photograph of a pair of legs being held over a bridge and a photograph of a human hand coming out of a conch shell. She is also known for her street photography, including the photograph *Man looking inside of a sidewalk inspection door*.
ANSWER: Dora **Maar** [or Henriette Theodora **Markovitch**]
[10] Dora Maar received illegal electroshock therapy after leaving an abusive relationship with this artist. Maar captured a series of photographs depicting this Spanish artist of *Les Demoiselles d'Avignon* painting *Guernica*.
ANSWER: Pablo Ruiz **Picasso**
[10] Dora Maar was famously photographed by this Dadaist, who depicted a woman's back as a violin in *Le Violon d'Ingres*. This photographer depicted Marcel Duchamp dressed as his female alter ego, Rrose Sélavy.
ANSWER: Man **Ray** [or Emmanuel **Radnitzky**]
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