

### Tossups:

Applying the beta plane approximation when modeling these confined systems causes their streamlines to pack densely along one boundary. Henry Stommel justified the existence of AABW by using his two-box model to infer motion in the interior of these systems, and was the first to describe the process of western intensification. The Sverdrup balance states that the curl of wind stress on these systems is proportional to the net (\*) Ekman transport. The raised center of these systems produces the outward pressure gradient that defines geostrophic flows. There is significant upwelling along the eastern edges of these systems, whose surfaces circulate in large gyres directed by the Coriolis force. For 10 points, name these systems, the largest bodies of water on Earth. ANSWER: Earth's oceans [or the sea; accept ocean basins, ocean gyres, the ocean surface, the sea surface, or specific oceans; prompt on currents or gyres by asking "what systems are those found in?"]

<DB, Other Science>

The Bedside Schwartz equation uses a child's height to assess this organ's function by estimating a quantity whose gold standard is found using inulin. The CKD-EPI and MDRD formulas controversially added race as a factor to the Cockcroft–Gault equation, which was the first to consider the role of sex when measuring the amount of creatinine passing through this organ. Approximated clearance rates are routinely up to 20 percent over the true value of this organ's (\*) GFR, which measures the rate of flow into the Bowman's capsule.

Countercurrent multiplication in this organ facilitates the passive reabsorption of salts in the descending limb of the loop of Henle. For 10 points, nephrons are the functional unit of what paired organ, which filters blood to produce urine?

ANSWER: kidneys

<DB, Biology>

One sculpture made of this material uses the letters "H.H." to represent the Grand Hyatt in Union Square. In addition to *Ruth Asawa's San Francisco Fountain*, this material was used by Glenna Goodacre to depict a woman looking up while another woman holds a blindfolded soldier in the Vietnam Women's Memorial. This material was used by Kristen Visbal in a controversial sculpture of a girl with her hands on her (\*) hips. That sculpture faces down an Arturo Di Modica sculpture made of this material that depicts an animal on Wall Street. For 10 points, *Fearless Girl* and *Charging Bull* were sculpted using what material often used by Camille Claudel and her lover, Auguste Rodin?

ANSWER: bronze

<DB, Visual Arts>

This technique can be applied to ill-posed problems by adding the Lagrange multiplier of the constraints to every element of the principal diagonal. One form of this technique acts on the outputs of the logit ("lo-JIT") function, which are exponentiated in the final result. The product of the normal matrix  $X$ -transpose  $X$  and the moment matrix is the BLUE for one form of this technique by the (\*) Gauss–Markov theorem. While assessing this technique, one can correct for the effect of degrees of freedom on the coefficient of determination. The sum of the square of the residuals is minimized in the least-squares variety of, for 10 points, what statistical technique that can describe the relationship between variables as a best-fit line?

ANSWER: regression analysis [accept linear regression, ordinary least-squares regression, logistic regression, or ridge regression]

<DB, Other Science>

A character in this play asks to be plucked like a “creeping vine” and thrown “over your shoulder like an old shoe” in a monologue that notes, “we take our tears, and we put ’em in the ice box, in the goddamn ice trays.” After accusing someone of “rearranging the chromozones,” a man in this play calls himself an “ABMAPHID.” One character in this play shoots a gun that fires a parasol before (\*) arguing about the color of his son’s eyes. A “hysterical pregnancy” is discussed with a couple who have an imaginary son in this play. This play’s third act, “The Exorcism,” follows “Walpurgisnacht,” in which Honey leaves to vomit in the bathroom. For 10 points, name this play in which George and Martha ask the title “bland, intellectual” question, by Edward Albee.

ANSWER: Who’s Afraid of Virginia Woolf?

<DB, American Literature>

A syndrome can be uniquely defined for bursts of these phenomena with arbitrary shifts if they lie in distinct cosets of a Galois (“gal-WAH”) field. Elwyn Berlekamp applied his work on polynomial factoring to finding these phenomena in cyclic examples of Reed and Solomon’s approach. If these phenomena have an incidence below two in seven, then a seven by four generator matrix is sufficient to eliminate them. Codes can use selectively-overlapping XOR (“ex-or”) (\*) operations to detect these phenomena with more robustness than a simple parity check. A non-zero Hamming distance indicates the presence of these phenomena in a message, and can be corrected for by including redundant data or a checksum. For 10 points, noisy channels are defined by what phenomena that cause bits to take on the wrong value?

ANSWER: errors [accept error correcting, error detecting, error-correcting codes, burst errors, transpositions, or deletions; accept bit flips until “bit” is read; prompt on noise, interference, distortions, mistakes, or data changes]

<DB, Other Science>

The Fueter–Pólya theorem states that the only quadratic polynomial pairing function is the one named for this mathematician. Points in this mathematician’s namesake space are infinitely long sequences of binary digits. In one proof, this mathematician merged ordered pairs by alternating between their digits, then described the resulting irrationals as unique continued fractions, to construct a (\*) bijection between the unit interval and the unit square. This mathematician introduced the Hebrew letter “aleph” to denote infinite cardinals, and posited that there is no set with cardinality between aleph-0 (“aleph-null”) and aleph-1 (“aleph-one”), which is known as the continuum hypothesis. For 10 points, name this pioneer of set theory who proved the uncountability of the real numbers in a namesake diagonalization argument.

ANSWER: Georg (Ferdinand Ludwig Philipp) Cantor [accept Cantor space, Cantor ternary set, or Cantor diagonalization argument]

<DB, Other Science>

Schlieren photography visualizes variations in this quantity using variations in refractive index. Differences in this quantity across an interface cause the formation of “mushroom spikes” that increase in size, eventually leading to a layer of turbulent mixing. The time derivative of this quantity equals the negative divergence of this quantity times the flow velocity field according to the (\*) continuity equation of fluid dynamics. This quantity is the ratio of dynamic to kinematic viscosity. Hydrometers measure this quantity using the fact that the buoyant force equals the product of volume, gravitational acceleration, and this quantity. Specific gravity is the ratio of this quantity for a substance to that of water. For 10 points, name this quantity that, for water, is approximately one gram per milliliter.

ANSWER: density [accept specific kinds of density such as mass density; prompt on rho]

<DB, Physics>

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**Bonuses:**

In this novel, the protagonist befriends the “prison charlie” while convicted in Staja 84. For 10 points each:  
[10e] Name this Anthony Burgess novel narrated by the delinquent Alex, who uses words like “devotchka,” “cut-throat britva,” and “droog” as part of a Russian-influenced dialect called Nadsat.

ANSWER: *A **Clockwork Orange***

[10m] This character in *A Clockwork Orange* helps Alex recover from being beaten by the police before realizing that Alex had earlier killed his wife. This fictional author writes a manuscript titled *A Clockwork Orange*.

ANSWER: **F. Alexander** [prompt on partial answer; do not accept or prompt on “Alex”]

[10h] The “prison charlie” asks this seven-word question before saying, “Is it going to be in and out and in and out of institutions like this?” This existential question is asked at the beginning of each part of *A Clockwork Orange*.

ANSWER: “**What’s it going to be then, eh?**” [do not accept or prompt on partial answer]

<DB, British Literature>

The ChemCam laser-induced breakdown spectrometer was designed to analyze this region, where it has measured high levels of silicon, aluminum, and iron oxides. For 10 points each:

[10m] Name this region covered in a perchlorate-rich regolith. Hundreds of prominent rocks were named things like Jake and Big Joe after being studied for many sols in parts of this region like the Bradbury Landing.

ANSWER: surface of **Mars**

[10e] These robots serve as mobile laboratories on Mars and include *Spirit*, *Opportunity*, and *Curiosity*.

ANSWER: Mars **rovers** [accept **Mars Exploration Rover**]

[10h] On [this element.com], Materion Inc. advertises that alloys of this element with aluminum were used in hundreds of fittings in the Mars Exploration Rovers. This element’s combination of strength and toxicity means that it is frequently found in space-based projects, like the hexagonal mirrors of the James Webb telescope.

ANSWER: **beryllium** [or **Be**; accept **beryllium.com**]

<DB, Other Science>

These entities contain convective systems that are sustained by the latent heat released by condensation. For 10 points each:

[10m] Name these tall entities that evolve from shorter *congestus* relatives in the presence of sustained updrafts.

ANSWER: **cumulonimbus** clouds [accept **cumulonimbuses** or **cumulonimbi**; prompt on **clouds**, **thunderstorms**, or **storm clouds**]

[10h] A reversal in this quantity at the tropopause makes cumulonimbi spread out instead of rising further. The atmosphere is stable when the adiabatic value of this quantity is less than the environmental value, preventing air parcels from expanding indefinitely.

ANSWER: **lapse rate** [accept dry adiabatic, moist adiabatic, or environmental **lapse rate**; prompt on **gamma**; prompt on **DALR**, **MALR**, or **ELR**]

[10e] Orographic lift forces air upwards, causing adiabatic cooling that produces rainfall on the windward sides of these landforms. The rain shadows of these landforms created deserts like the Mojave and the Chihuahuas.

ANSWER: **mountains**

<DB, Other Science>

In April 2020, Bartolomei et al. reported using a namesake “tiny” collider filled with fractional quantum hall liquid to observe the behavior of the Abelian type of these quasiparticles for the first time. For 10 points each:

[10h] Name these particles that obey fractional statistics and carry fractional multiples of the elementary charge.

ANSWER: **anyons** (“EN-ee-ons”) [do not accept or prompt on “anions” (“ANN-ions”); ask teams to spell their answer if you are unsure]

[10e] In the tiny anyon collider, anyons exhibited “minor clumping,” indicating that they behave both like bosons and like these particles. These particles obey statistics partially named for Dirac and have half-integer spin.

ANSWER: **fermions**

[10m] Due to the unique topology of [*this number*]-dimensional space, anyons can only exist in systems with this many dimensions. The Pauli exclusion principle results from the fact that the wavefunction of a system with this many identical fermions equals zero.

ANSWER: 2 dimensions [or 2-dimensional; accept 2-particle system]

<DB, Physics>

This technique may optimize its hyperparameter to avoid oversensitivity to local structure. For 10 points each:

[10m] Name this statistical technique that predicts the output at a point by averaging the output of a subset of the training set. Outliers can be removed from this technique by increasing its namesake constant.

ANSWER: k-nearest neighbors [or k-NN; accept k-nearest neighbors algorithm, regression, or classification]

[10e] The k-nearest neighbors method chooses the neighborhood for a point by minimizing this quantity, whose Euclidean definition is the length of a straight line between two points.

ANSWER: Euclidean distance [accept Lp metric or p-norm]

[10h] Reducing large datasets to prototype values allows this most efficient variety of k-nearest neighbors to be used without losing too much information. Cover and Hart showed that this variety has minimal error as part of their proof that bounds the error rate of k-nearest neighbors.

ANSWER: 1-nearest neighbors [or 1-NN; accept k-nearest neighbors when k is one, nearest neighbor, or NN]

<DB, Other Science>

In these objects, grid fingers carry current to perpendicular busbars. For 10 points each:

[10h] Name these objects that are connected in series by tab wires, then in parallel by bus wires. The simplest type of these devices consists of a thin n-type-doped layer placed on top of a thicker p-type-doped layer.

ANSWER: solar cells [accept photovoltaic cells or PV cells or solar panels]

[10e] Off-grid solar systems generally deposit charge into the “deep cycle” type of these electrical storage devices, since they can undergo a high depth of discharge at night.

ANSWER: batteries [accept deep-cycle battery]

[10m] The most common deep-cycle battery is the “flooded” type of this type of battery. This type of battery, the first rechargeable battery to be invented, generally provides the current to start a car engine.

ANSWER: flooded lead-acid battery [prompt on lead battery]

<DB, Physics>

This poet began an epic poem with “‘It’s a beautiful country,’ / Toscanelli had told Columbus.” For 10 points each:

[10h] Name this Nicaraguan poet who wrote about Central American history in the poems *The Doubtful Straight* and *Zero Hour*. This poet founded a primitivist commune of peasants and artists on the Solentiname Islands.

ANSWER: Ernesto Cardenal (Martínez)

[10e] Until his death in March 2020, Ernesto Cardenal was a priest of this dominant religion in Nicaragua. Cardenal reconciled his belief in both this religion and evolution in his poem “The Origin of the Species.”

ANSWER: Catholicism [or Roman Catholic Church; prompt on Christianity]

[10m] This Mexican nun wrote about the spread of Catholicism in the Americas in the play *Loa to Divine Narcissus*. This poet described a “Pyramidal / death-born shadow of earth / aimed at Heaven” in the long poem “First Dream.”

ANSWER: Sor Juana (Inés de la Cruz)

<DB, World Literature>

In a story by this author, “four idiot sons” kill their sister like the title animal. For 10 points each:

[10h] Name this author who wrote about the beheading of Bertita in “The Decapitated Chicken.” A bloodsucking monster kills Alicia on her honeymoon in this author’s short story “The Feather Pillow.”

ANSWER: Horacio (Silvestre) Quiroga (Forteza)

[10m] Another reference to chickens occurs in this short story by Gabriel García Márquez. The title character is kept in a chicken coop by Elisenda and Pelayo, who charge visitors five cents to see him in this story.

ANSWER: “A **Very Old Man with Enormous Wings**” [or “Un **señor muy viejo con unas alas enormes**”]

[10e] This author of “The Cask of Amontillado” and “The Tell-Tale Heart” influenced Latin American authors like Quiroga and García Márquez, to the point that Quiroga is often called “the [this author] of South America.”

ANSWER: Edgar Allan **Poe**

<DB, World Literature>