

# Round 1

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## Round 1 Tossups

(1) This quantity is plotted versus orbital binding energy on a Walsh diagram. The reaction of a nucleophile with a carbonyl group is defined by one form of this quantity named for Bürgi [[BOOR-gee]] and Dunitz [[DUN-itz]]. The combination of torsional strain and small values for this quantity leads to significant ring strain in cyclopropane. Because of greater repulsive forces, replacing a substituent with a lone pair decreases this quantity according to VSEPR [[VES-per]] theory. For the point, name this quantity that is 120 degrees for trigonal planar molecules and 109.5 degrees for methane.

ANSWER: **Bond Angle** (accept **Angle of Attack**; prompt on "angle")

(2) This theory was first proposed by Alan Guth to explain the non-existence of magnetic monopoles. This theory proposes that the early universe underwent a rapid cooling on the order of 100 thousand times prior to its thermalization. This theory's namesake epoch occurred from ten to the negative 36 to ten to the negative 32 seconds after the universal singularity. For the point, name this theory that states the size of the universe rapidly increased shortly after the Big Bang.

ANSWER: Cosmic **inflation** (or Cosmological **inflation**; accept **Inflationary** epoch)

(3) The Grotthuss [[GROHT-hooss]] mechanism is a minor consequence of this effect, which names a technique developed by Binnig and Rohrer which can image individual atoms. In addition to that form of microscopy, this effect was used by George Gamow to explain alpha decay. This effect is illustrated with a non-zero wave function outside a finite potential well. For the point, name this phenomenon in which an atom passes through a normally impassable barrier, unexplainable by classical mechanics.

ANSWER: Quantum **Tunneling**

(4) Two phenol [[FEE-nahl]] groups are found in a brominated example of these substances used to track the progression of gel electrophoresis [[ee-lek-tro-foh-REE-sis]]. Urine or saliva tests may use a type of Hydriion paper blotted with these substances, one example of which is called bromothymol [[bro-moh-"THIGH"-mol]] blue. One of these substances called phenolphthalein [[fee-nolf-THAY-leen]] turns pink at the equivalence point of a titration. For the point, name these substances that change color at different pH levels, which include red cabbage juice and litmus.

ANSWER: pH **Indicators** (or acid-base **Indicators**; accept **Color Markers**; prompt on "dye"; prompt on "litmus")

(5) Molecules with this property attract each other via "pi-pi stacking" interactions. The Friedel-Crafts reaction attaches functional groups to molecules with this property, which must have a conjugated system and " $4n + 2$ " electrons according to Huckel's rule. Any cyclic planar molecule with delocalized electrons is defined as having, for the point, what stabilizing property possessed by benzene and originally named for its pleasant odor?

ANSWER: **Aromaticity** (prompt on "Cyclic"; prompt on "Planar")

(6) For some metal alloys, exposure to hydrogen can cause the environmental stress type of this process. In the fatigue form of this process, repeated application of force causes the spread of striations. For ductile materials, this process occurs after strain hardening and necking at the end point of a stress-strain curve. In highly brittle materials, this process occurs without plastic deformation. This process occurs with the propagation of cracks. For the point, name this process that occurs when stress causes solid objects to break in two.

ANSWER: **Fracture** (accept word forms; accept Environmental Stress **Fracture**; accept **Cracking** or Fatigue **Crack** before mentioned)

(7) Grignard [[green-YARD]] reagents are commonly stored in a ring-shaped solvent with this functional group called THF. This functional group is made by reacting an alkyl halide with an alcohol in a synthesis reaction named for Williamson. Three-atom cyclic examples of these molecules are called epoxides. For the point, name this functional group consisting of two carbon chains bonded to a single oxygen atom, whose "diethyl" type was formerly a common anesthetic.

ANSWER: **Ethers** (accept Diethyl **Ether**)

(8) Lewis Binford promulgated the "new" form of this field in a book that said this field is "anthropology or it is nothing." The study of seemingly unimportant features in this field was popularized by *In Small Things Forgotten* by James Deetz. Popular methodologies of this field include remote sensing and analysis of physical culture. For the point, name this social science field that involves excavating old human settlements.

ANSWER: **Archaeology** (accept word forms)

(9) An ion in its lowest possible energy state is produced in a type of ionization process with this property. The heat capacity ratio is often known as this property's index. This property is usually only possible in insulated systems, because it only occurs when the change in internal energy equals work. Along with reversibility, isentropic processes possess this property. For the point, name this property of processes that have zero heat transfer.

ANSWER: **Adiabatic** (accept **Adiabatic** index)

(10) An organism's field metabolic rate is commonly measured by treatment with this molecule, a type of DLW. The CANDU reactor uses this molecule as a neutron moderator to avoid the need for enriched uranium. This common NMR solvent has a mass of 20 daltons because of its two extra neutrons. For the point, name this molecule that contains two deuterium atoms bonded to an oxygen atom and has a larger mass than a similar universal solvent.

ANSWER: **Heavy Water** (or **Deuterium Oxide**; or **D2O** or **2H2O**; prompt on "Deuterium"; do not accept or prompt on "water" or "H2O")

(11) This mountain range is home to the only extant short faced bear, the spectacled bear. This range is home to a genus of high altitude hummingbirds known as hillstars. This range's northern end is home to the Mountain Tapir, and this mountain range is the natural habitat of chinchillas and guinea pigs. Wild camelids found in this mountain range include the vicuña [[vih-KOO-nyah]] and guanaco [[gwah-NAH-koh]]. For the point, name this South American mountain range home to alpacas and llamas.

ANSWER: **Andes** Mountains (or Cordillera de los **Andes**; accept **Andean** Mountains; prompt on "Altiplano")

(12) The Torino or Palermo scales are used to assess the risks posed by some of these objects. Some of these objects that orbit in the L4 and L6 points of Jupiter and Neptune are known as Trojans. The largest and first-discovered example of these objects was predicted to exist by the debunked Bode's [[BOADS]] Law and is named Ceres [[SEE-rees]]. For the point, name these large, rocky masses that orbit the sun in a namesake "belt."

ANSWER: **Asteroids** (accept **Asteroid** belt; prompt on "minor planet" or "planetoid")

(13) This compound form is divided into driving and driven varieties based on whether it has the potential to condense out of the atmosphere. This compound form is the most abundant and potent greenhouse gas in Earth's atmosphere. Suddenly exceeding the saturation point of this compound form in the atmosphere can lead to cloudburst precipitation. Concentration of this compound form is measured as humidity. For the point, name this greenhouse gas which condensates to form clouds.

ANSWER: **Water Vapor** (accept **Aqueous vapor**; prompt on "water"; prompt on "H2O"; do not accept or prompt on "Steam")

(14) These hormones are notably produced in the zona fasciculata [[fah-sih-kyoo-LAH-tah]] and zona reticularis [[reh-tih-kyoo-LAY-riss]]. Aspirin and ibuprofen are part of a class of painkillers named for the fact that they do not act on these hormones. Examples of these hormones include the androgen and estrogen sex hormones. Cholesterol is in a class of precursors for these hormones, which include stress hormones like cortisol. For the point, name these hormones, whose anabolic variety are illegally used to grow muscle mass.

ANSWER: **Steroids** (accept Anabolic **steroids**; prompt on "Corticoids")

(15) The kinetic energy of the output of this effect is equal to the work function subtracted from Planck's constant times frequency. A coil with a spark gap was used to observe this effect by Heinrich Hertz. Robert Millikan verified that this effect's output is related to frequency but not intensity. Albert Einstein's 1921 Nobel Prize in Physics was for his work on this effect. For the point, name this effect in which electrons are emitted under light.

ANSWER: **Photoelectric** Effect

(16) It's not five, but this many up-arrows represents the pentation operator. Graham's number uses this integer as a base for a hyperoperation, and there are this many Frenet-Serret [[freh-NEH-seh-REH]] formulas, which in total concern this many vectors. Apéry's [[ah-PEH-rees]] constant is the value of the Riemann zeta function with this integer as an input. The area of a polygon with this many sides can be calculated using Heron's formula. For the point, what number is the degree of a cubic polynomial?

ANSWER: **Three**

(17) The bites of these animals spread the malaria-like disease *Babesiosis* [[bah-bee-see-OH-sis]] to humans and those who are infected are unable to donate for blood transfusions. One disease spread by these animals can be diagnosed by a bullseye rash. These animals are the primary vector for human infections of *Rickettsia rickettsii* [[rih-KET-see-uh rih-KET-see-"eye"]], the causative agent of Rocky Mountain Spotted Fever. For the point, name these parasitic arachnids, the primary carriers of Lyme disease.

ANSWER: **Ticks** (or **Ixodida**; accept American dog **ticks**; accept Rocky Mountain Wood **Ticks**; accept Brown dog **ticks**; accept Black-legged **ticks**; accept Bear **ticks**; accept Deer **ticks**; prompt on "arachnids" before mentioned)

(18) The citrate of this element can be used to prevent kidney stones and is used as a laxative to prepare for colonoscopies. Calcined dolomite can be used to purify this element. Grignard [[green-YARD]] reagents are characterized by containing this element. This element's sulfate is often used for anti-inflammatory soaks and is called epsom salt. In a flame test, this element emits bright white light. For the point, name this alkali earth metal with number 12.

ANSWER: **Magnesium** (accept **Mg**; accept **Magnesium** citrate)

(19) This man falsely claimed to have executed a controlled landing after crashing with a parachute near a peasant man and his daughter. This man died along with Colonel Vladimir Seryogin [[seh-ree-OH-gin]] while piloting an experimental MiG-15 aircraft near the town of Novosyolovo [[no-vo-syo-LO-vo]]. During his most significant mission, this man allegedly said, "I don't see any God up here." The pilot of Vostok I, for the point, who was this Soviet cosmonaut, the first human to reach space?

ANSWER: Yuri **Gagarin**

(20) A technique developed in these organisms uses "Bait" and "Prey" domains to detect protein-protein interactions in a "two-hybrid assay." One of these organisms with both "a" and "alpha" mating types was the first eukaryote [[yoo-KAY-ree-oat]] to have its genome entirely sequenced. These organisms include *Candida albicans* and members of the genus *Saccharomyces* [[sah-kah-roh-"MY"-sees]], which can release carbon dioxide and ethanol during fermentation. For the point, name these single-celled fungi used during beer and bread making.

ANSWER: **Yeasts** (accept **Saccharomyces** before mentioned; accept **Saccharomyces cerevisiae**; prompt on "fungi")

(21) In the Earth's atmosphere, the Birkeland currents are carried by these substances. These substances are confined with magnetic fields in a *tokamak* [[TOH-kah-mak]]. As in electrolyte solutions, the range of a particle's electrostatic effect in this state is given as the Debye [[deh-"BYE"]] length. Nuclear fusion is only possible if matter is in this state. For the point, name this fourth state of matter, a collection of highly energized gas atoms found in stars.

ANSWER: **Plasma**

(22) The presence of a three-body scatter spike on a radar map is indicative of the presence of these objects. These objects maintain a liquid core due to releasing latent heat during formation. These objects begin to form when supercooled water comes into contact with dust nucleation sites. These objects form after repeated passing through updrafts in cumulonimbus clouds during severe storms. For the point, name these icy objects that fall as precipitation.

ANSWER: **Hail** stones

(23) This scientist inverted his benefactor's temperature scale to create the modern Celsius system. This scientist's major work popularized a scientific racist theory of classifying humans into four groups based on skin tone and alleged personality. This scientist's *Systema Naturae* is credited with standardizing binomial nomenclature and modern taxonomy. For the point, name this taxonomist who invented the modern Latin naming convention for organisms.

ANSWER: Carl **Linnaeus** (or Carl von **Linné**; or Carolus **Linnaeus**; prompt on "Linnaean system" or "Linnaean taxonomy")

(24) Three times this quantity cubed makes up the denominator of the Larmor [[LAR-mor]] formula. Exceeding this quantity in a certain medium results in the emission of Cherenkov [[che-REN-kof]] radiation. Particles that can hypothetically exceed this quantity in a vacuum are known as tachyons [[TAK-ee-ons]]. Mass energy equivalence is established by a formula that sets energy equal to mass times this quantity squared. Represented as "c" in Einstein's formula "e equals mc squared," for the point, what is this rate at which photons move?

ANSWER: **Speed of Light** (or **Lightspeed**; prompt on "c")

(25) Western people may be more susceptible to the Sander type of these phenomena due to living in more regularly-shaped homes. One of these phenomena caused by lateral neural inhibition is named for Ernst Mach [[MOCK]]. Many of these phenomena originate from a confused figure-ground distinction. The autokinetic effect is one of these phenomena that suggests movement. For the point, name these phenomena, which trick the brain into processing visual data incorrectly.

ANSWER: Optical **illusions** (accept Visual **illusions**)

(26) The application of this substance was first scientifically studied by University of Illinois bioethicist Arthur Galston. This substance is composed of equal parts dichlorophenoxyacetic ["die"-klo-ro-feh-NAHK-see-ah-SEH-tik] acid and trichlorophenoxyacetic ["try"-klo-ro-feh-NAHK-see-ah-SET-tik] acid. The first use of this substance occurred during the Malaysian Emergency. This substance is the best known of the so-called Rainbow Herbicides. For the point, name this defoliant used to clear out forests during the Vietnam War.

ANSWER: **Agent orange**

(27) This region is home to terrigenous sediment that forms Calcareous [[kal-KAY-ree-us]] and Siliceous [[sih-LIH-see-us]] oozes. The most remote portions of this region are primarily covered in hematite [[HEE-mah-"tight"]] rich "red clay." This region is home to formations such as black and white smokers. Cold seeps along this region can result in the formation of brine pools. Organisms that live near this region are collectively known as benthos, which often cluster around hydrothermal vents. For the point, name this rocky region at the bottom of the ocean.

ANSWER: **Sea floor** (or **Ocean floor**; accept **Bed** in place of **Floor**; accept **Bottom** in place of **Floor** before mentioned)

(28) The production of this molecule in plant seeds is the primary mechanism for removing ammonia. This molecule's receptors are activated by a class of hallucinogenic drugs that includes psilocin ["SIGH"-loh-sin] and LSD. When prepared for gastrointestinal use, this molecule is synthesized and secreted by enterochromaffin [[en-teh-roh-KROH-mah-fin]] cells, which synthesize it from tryptophan [[TRIP-toh-fan]]. Lexapro, Zoloft, and Prozac are name brand examples of this neurotransmitter's selective re-uptake inhibitors. For the point, name this appetite and mood-regulating neurotransmitter.

ANSWER: **Serotonin** [[seh-roh-TOH-nin]] (accept **5-hydroxytryptamine**; or **5-HT**)

(29) A basis of unit vectors with this property is generated by the Gram-Schmidt process. The transpose of a matrix with this property always equals its inverse. A triangle's circumcenter lies at the intersection of lines named for this property, which is also possessed by two vectors whose dot product equals zero. Two lines with opposite reciprocal slopes have this relative property. For the point, name this property of lines that meet at 90 degree angles.

ANSWER: **Perpendicularity** (accept **Orthogonality**; accept **Normal**; accept **Orthonormal**; accept **Right angles** or **90 degree angles** before mentioned; prompt on "bisector" or "bisecting")

(30) Most members of this classification are part of the Olfactores [[ohl-fac-TOH-res]] clade [[KLAYD]], which is named for possessing specialized smell organs. Along with Echinodermata [[ee-kai-no-der-MAH-tah]] and acorn worms, members of this phylum are deuterostomes [[doo-TEH-roh-stohms]], meaning they have a separate mouth and anus. Members of this phylum possess either pharyngeal [{"fair"-en-JEE-ahl}] pouches or pharyngeal slits while in their embryonic state. For the point, name this animal phylum named for possessing a namesake cartilage tube or backbone.

ANSWER: **Chordata** (or **Chordates**)

(31) The Faber-Jackson and Tully-Fisher equations relate the stellar velocity dispersion of these entities to their luminosity, and Hubble's tuning fork diagram is used to classify these entities. In approximately four billion years, two of these will collide, creating an entity named "Milkomeda" [{"milk"-AH-meh-dah}]. Coming in irregular, spiral, and elliptical varieties, for the point, what are these large collections of dust, dark matter, and stars, of which Andromeda is one?

ANSWER: **Galaxy** (accept **Galaxies**; accept Milkomeda **galaxy** or Milkdromeda **galaxy**; accept Andromeda **galaxy**; accept Irregular, Spiral, or Elliptical **galaxy**)

(32) Variations in the upper and lower portions of these systems are described by Bradshaw's model. Biospheres located along these systems are classified as crenon, rhithron, and potamon [[poh-TAH-mun]]. Studies of these systems introduced Strahler [[STRAY-ler]] numbers for describing branch order. Riparian [{"rye"-PAIR"-ee-an}] zones form buffer areas around these systems. Cutting off sections of these bodies of water forms oxbow lakes. For the point, name these bodies of water that flow into the sea at deltas.

ANSWER: **Rivers** (accept more narrow synonyms such as **Stream**, **Brook**, **Creek**, or **Rivulet**)

(33) The cold molding method of making these objects involves binding thin pieces of wood together with epoxy to produce rigidity. The transom supports of these devices connect to the sterndrive. These devices are divided into inboard and outboard motor varieties based on the placement of their propeller. These devices can be steered by redirecting fluid with a rudder. For the point, name these vehicles, examples of which include canoes.

ANSWER: **Boat** (or **Ship**; accept Motor **Boat** before "canoe" is mentioned)

(34) These entities can be described using only mass, angular momentum, and charge, rendering them “hairless”, and energy can be extracted from one of these entities via the Penrose process. An object approaching one of these entities will become increasingly redshifted and eventually stop moving, and the boundary of that occurrence with these objects is known as the event horizon. For the point, name these gravitational singularities from which even light cannot escape.

ANSWER: **Black holes**

(35) During the winter in South Korea, frozen sausages are often used to interact with this technology. Extended use of this technology without rest can lead to a repetitive motion injury commonly known as "gorilla arm." Mobile devices often employ haptics to improve user experience with this technology. Pinches and multi-finger swipes are common gestures used with this technology. For the point, name this technology used to give inputs when using smartphones.

ANSWER: **Touch screen** (accept descriptive answers involving **screens** which are operated by **touch**)

**Extra Question**

(1) With people, these animals title a pseudo-scientific intelligent design textbook written by Percival Davis. A grip-assisting extension of this animal's sesamoid [[SEH-sah-moyd]] bone was used as an example of a spandrel in a Stephen Jay Gould essay titled for this animal's "thumb." Due to their lack of interest in mating in captivity, a method of artificial insemination using liquid nitrogen was developed. For the point, name these black and white bamboo-eating bears from China.

ANSWER: Giant **Pandas** (or *Ailuropoda melanoleuca*; accept **Panda** bears)