

ROUND ROBIN 1

TOSS-UP

- 1) Chemistry - *Short Answer* What type of particle is released when an unstable uranium-238 nucleus decays to form thorium-234?

ANSWER: Alpha particle (ACCEPT: Alpha)

BONUS

- 1) Chemistry - *Multiple Choice* A reaction with positive values for both ΔH [delta H] and ΔS [delta S] best fits which of the following descriptions?

- W) Only spontaneous at high temperatures
- X) Only spontaneous at low temperatures
- Y) Spontaneous at all temperatures
- Z) Not spontaneous at all temperatures

ANSWER: W) Only spontaneous at high temperatures

TOSS-UP

2) Math - *Short Answer* The interior angle of a regular n -gon is 168 degrees. What is the value of n ?

ANSWER: 30

BONUS

2) Math - *Short Answer* Compute the sum of the infinite geometric series with first term 1 and second term $-\frac{1}{3}$.

ANSWER: $\frac{3}{4}$ (ACCEPT: 0.75)

TOSS-UP

3) Earth and Space - *Short Answer* What is the term for a reverse fault with a relatively small dip angle?

ANSWER: Thrust fault

BONUS

3) Earth and Space - *Multiple Choice* A geologist stumbles across three rock layers A, B, and C. They observe that fragments of B are present in A and that B is located above C. In which of the following orders did these rock layers form?

- W) A, B, C
- X) B, A, C
- Y) C, A, B
- Z) C, B, A

ANSWER: Z) C, B, A

TOSS-UP

4) Physics - *Multiple Choice* A student is sitting in a boat floating in Lake Lagunita with a rock in hand. She throws the rock overboard, where it sinks to the floor of the lake. To an outside observer, what happens to the water level of Lake Lagunita as a result?

- W) The water level falls
- X) The water level stays the same
- Y) The water level rises
- Z) Depends on the density of the rock

ANSWER: W) The water level falls

BONUS

4) Physics - *Short Answer* Identify all of the following three circuit elements whose associated quantities add linearly in series: 1) Resistor; 2) Capacitor; 3) Inductor.

ANSWER: 1 and 3

TOSS-UP

5) Chemistry - *Short Answer* What is the name of the law that only states that the pressure exerted by a given mass of an ideal gas is inversely proportional to the volume it occupies given constant temperature?

ANSWER: Boyle's law

BONUS

5) Chemistry - *Short Answer* Identify all of the following three intermolecular interactions that are present in an aqueous solution of HF: 1) Ion-dipole interactions; 2) Hydrogen bonding; 3) London dispersion forces.

ANSWER: All

TOSS-UP

6) Biology - *Multiple Choice* Which of the following correctly identifies the normal pancreatic response to high blood sugar levels?

- W) Alpha cells release glucagon **[GLUE-cuh-gon]**
- X) Alpha cells release insulin
- Y) Beta cells release glucagon
- Z) Beta cells release insulin

ANSWER: Z) Beta cells release insulin

BONUS

6) Biology - *Short Answer* Identify all of the following three features that would be present in jellyfish: 1) Gastrovascular cavity; 2) Radula **[RAH-joo-luh]**; 3) Notochord.

ANSWER: 1 only

TOSS-UP

7) Math - *Short Answer* A triangle and circle are placed in the plane so that they intersect at n points. How many possible values for n are there?

ANSWER: 7

BONUS

7) Math - *Short Answer* Calculate the shortest distance from the origin to the line $8x + 15y = 120$.

ANSWER: $\frac{120}{17}$

TOSS-UP

8) Energy - *Short Answer* Researchers in the Jaramillo [**har-uh-MEE-yo**] group at Stanford are studying how black carbon released by wildfires impacts climate change. Black carbon affects climate because its deposition decreases what quantity, which refers to the amount of radiation reflected by Earth?

ANSWER: Albedo [**al-BEE-doh**]

BONUS

8) Energy - *Short Answer* Scientists at the Stanford Genome Technology Center are studying the Epstein-Barr virus using high-throughput sequencing. What laboratory technique must they use to make billions of copies of specific genes for analysis?

ANSWER: Polymerase [**puh-LIM-er-ase**] chain reaction (ACCEPT: PCR)

TOSS-UP

9) Biology - *Multiple Choice* Blades and petioles [**PEH-tee-ohls**] are associated with which of the following parts of a plant?

- W) Flowers
- X) Stems
- Y) Leaves
- Z) Roots

ANSWER: Y) Leaves

BONUS

9) Biology - *Short Answer* The parasympathetic nervous system does not directly control digestive activity in the gastrointestinal tract. Instead, it mainly relays signals to what other division of the autonomic nervous system, controlling food movement and enzyme secretion?

ANSWER: Enteric [**en-TAIR-ik**] nervous system

TOSS-UP

10) Earth and Space - *Short Answer* Order the following three layers of the Sun from lowest to highest average temperature: 1) Radiative zone; 2) Photosphere; 3) Corona.

ANSWER: 2, 3, 1

BONUS

10) Earth and Space - *Multiple Choice* Which of the following statements best compares large main-sequence stars compared to small main-sequence stars?

- W) Older and hotter
- X) Older and colder
- Y) Younger and hotter
- Z) Younger and colder

ANSWER: Y) Younger and hotter

TOSS-UP

11) Physics - *Short Answer* A cubic wooden block is four times less dense than water. If the block is placed in a tub of water, what fraction of the block will be submerged below the water's surface?

ANSWER: $\frac{1}{4}$

BONUS

11) Physics - *Short Answer* A Carnot [car-NOH] engine with hot reservoir at 200 kelvins and cold reservoir at 50 kelvins takes in 50 joules of heat from the hot reservoir. How much heat is transferred to the cold reservoir, in joules?

ANSWER: $\frac{25}{2}$ (ACCEPT: 12.5)

TOSS-UP

12) Chemistry - *Multiple Choice* Which of the following descriptions best characterizes a nitrogen-oxygen bond?

- W) Nonpolar covalent
- X) Polar covalent
- Y) Ionic
- Z) Metallic

ANSWER: X) Polar covalent

BONUS

12) Chemistry - *Short Answer* Rank the following four atoms from smallest to largest by atomic or ionic radius: 1) Mg^{2+} ; 2) Na^+ ; 3) F^- ; 4) O^{2-} .

ANSWER: 1, 2, 3, 4

TOSS-UP

13) Energy - *Short Answer* Researchers at SLAC are developing new designs for quantum computers. This process involves creating new architectures for what basic unit of quantum computing, equivalent to the bit in normal computers?

ANSWER: Qubit (ACCEPT: Quantum bit)

BONUS

13) Energy - *Multiple Choice* Scientists at the Stanford Nanofabrication Facility are using xenon difluoride to create silicon wafers. Which of the following describes both the molecular geometry and electron pair geometry, respectively, of xenon difluoride?

- W) Linear, trigonal bipyramidal
- X) Linear, octahedral
- Y) Bent, trigonal bipyramidal
- Z) Bent, octahedral

ANSWER: W) Linear, trigonal bipyramidal

TOSS-UP

14) Math - *Multiple Choice* In 2014, January 31st fell on a Friday. On which of the following dates did the first Friday of March take place in 2014?

- W) March 1st
- X) March 4th
- Y) March 6th
- Z) March 7th

ANSWER: Z) March 7th

BONUS

14) Math - *Short Answer* The Lucas sequence is defined similarly to the Fibonacci sequence but with different initial numbers. Specifically, the first Lucas number is 2, the second Lucas number is 1, and each successive Lucas number is the sum of the previous two Lucas numbers. What is the ninth Lucas number?

ANSWER: 47

TOSS-UP

15) Biology - *Short Answer* Two species of shrimp have dispersed into a new pond. What ecological principle predicts that eventually only one species will remain?

ANSWER: Principle of competitive exclusion (ACCEPT: Gause's law)

BONUS

15) Biology - *Multiple Choice* The smooth endoplasmic reticulum detoxifies drugs and other harmful compounds primarily through the addition of what functional group?

- W) Hydroxyl [hy-DROX-ul]
- X) Sulfhydryl [sulf-HY-drul]
- Y) Carboxyl [car-BOX-ul]
- Z) Carbonyl [CAR-buh-neel]

ANSWER: W) Hydroxyl

TOSS-UP

16) Physics - *Short Answer* A boat is crossing a river of width 40 meters. It sails at a speed of 4 meters per second directly across the river with a 3 meters per second current perpendicular to the boat's intended direction of travel. How long, in meters, is the boat's actual path across the river?

ANSWER: 50

BONUS

16) Physics - *Short Answer* Order the following three types of radiation by increasing penetrative power: 1) Alpha; 2) Beta; 3) Gamma.

ANSWER: 1, 2, 3

TOSS-UP

17) Earth and Space - *Multiple Choice* Which of the following stream channel types would you be most likely to find at the terminus of a glacier?

- W) Braided
- X) Straight
- Y) Meandering
- Z) Anastamosing [**uh-NAS-tuh-moh-sing**]

ANSWER: W) Braided

BONUS

17) Earth and Space - *Multiple Choice* Which of the following features is typically found directly above a slump?

- W) Bajada [**buh-HAW-duh**]
- X) Cuesta [**KWES-tuh**]
- Y) Scarp
- Z) Talus [**TAL-is**]

ANSWER: Y) Scarp

TOSS-UP

18) Math - *Short Answer* Daniel has a cube of chocolate. He uses a plane to slice off and eat a small piece from each corner of the cube. How many edges does the resulting polyhedron have?

ANSWER: 36

BONUS

18) Math - *Short Answer* What is the greatest multiple of 3 that can be formed using any combination of the digits 3, 1, 4, 1, 5, 9?

ANSWER: 94311

TOSS-UP

19) Chemistry - *Short Answer* When exposed to the atmosphere, the decomposition of hydrogen peroxide has a half-life of one day. Edwin prepares container A with 2 molar hydrogen peroxide and container B with 1 molar hydrogen peroxide. After three days pass, what is the ratio of the hydrogen peroxide concentration of container A to that of container B?

ANSWER: 2 (ACCEPT: 2 to 1)

BONUS

19) Chemistry - *Short Answer* According to VSEPR [VES-per] theory, what is the molecular geometry around the central carbon in formaldehyde, a compound with chemical formula CH₂O?

ANSWER: Trigonal planar

TOSS-UP

20) Physics - *Short Answer* The potential of a region immediately surrounding a charged particle is proportional to the distance from the particle raised to what power?

ANSWER: -1

BONUS

20) Physics - *Short Answer* Anthony is attempting to use a 20 centimeter long pinhole camera to take an image of his favorite lamp, which is 2 meters tall. If he holds the camera 1 meter away from the lamp, how tall is the lamp's image in centimeters?

ANSWER: 40 (ACCEPT: -40)

TOSS-UP

21) Energy - *Multiple Choice* Scientists at the Stanford Energy Modeling Forum are researching the effects of natural gas production on US energy products. Recent increases in gas production are primarily due to gas present in which of the following rock types?

- W) Limestone
- X) Sandstone
- Y) Schist
- Z) Shale

ANSWER: Z) Shale

BONUS

21) Energy - *Multiple Choice* Scientists at Stanford's Beckman Center are using disaccharide [**dy-SACK-ur-ide**]-based solvents in biological processes. Which of the following reactions can be used to synthesize polysaccharides [**pol-ee-SACK-ur-ides**]?

- W) Hydrolysis [**hy-DRAW-luh-sis**]
- X) Dehydration synthesis
- Y) Glycogenesis [**gly-koh-JEN-uh-sis**]
- Z) Esterification

ANSWER: X) Dehydration synthesis

TOSS-UP

22) Earth and Space - *Short Answer* What series of nuclear fusion reactions is primarily responsible for fusing hydrogen to helium in the Sun?

ANSWER: Proton-proton chain

BONUS

22) Earth and Space - *Multiple Choice* Which of the following processes is responsible for producing the internal heat that drives Io's volcanism?

- W) Tidal forces causing friction
- X) Jupiter's magnetic field causing friction
- Y) Remnant heat from formation
- Z) Reflected heat from Jupiter's surface

ANSWER: W) Tidal forces causing friction

TOSS-UP

23) Biology - *Short Answer* Identify all of the following three parts of a phage [FAYJ] that enters an infected bacteria cell: 1) Phage DNA; 2) Viral envelope; 3) Protein shell.

ANSWER: 1 only

BONUS

23) Biology - *Short Answer* In times of drought, plants tend to close their stomata to prevent water loss. What hormone, produced in the roots in response to water deficiency, signals the closing of the stomata?

ANSWER: Abscisic **[ab-SIZ-ik]** acid