

ROUND ROBIN 4

TOSS-UP

- 1) X-Risk - *Short Answer* A nuclear winter could be caused by the ejection of light-absorbing particles into what layer of the atmosphere, where they would have a longer lifetime than those near the surface?

ANSWER: Stratosphere

BONUS

- 1) X-Risk - *Short Answer* What term describes the hypothetical point at which technological growth becomes uncontrollable and irreversibly alters human civilization?

ANSWER: Technological singularity (ACCEPT: Singularity)

TOSS-UP

2) Math - *Multiple Choice* The graph of the function $y = 2x^2 + y^2 + 4x - 5y - 5$ is an example of what conic section?

- W) Circle
- X) Ellipse
- Y) Parabola
- Z) Hyperbola

ANSWER: X) Ellipse

BONUS

2) Math - *Short Answer* Find all real solutions to the equation: $2\sqrt{x} + 3\sqrt[4]{x} - 2 = 0$ [2 square root of x plus 3 fourth root of x minus 2 equals 0]

ANSWER: 1/16

TOSS-UP

3) Chemistry - *Short Answer* The standard reduction potential of Fe_3^+ [iron three plus] to iron metal is -0.04, while the standard reduction potential of Ni_2^+ [nickel two plus] to nickel metal is -0.23. For a standard galvanic cell with solutions of Fe_3^+ [iron three plus] and Ni_2^+ [nickel two plus] in different compartments, what is the cell potential?

ANSWER: 0.19

BONUS

3) Chemistry - *Short Answer* Order the following three gases by increasing rate of effusion at 400 kelvin through a pinhole: 1) Oxygen; 2) Hydrogen fluoride; 3) Ammonia.

ANSWER: 1, 2, 3

TOSS-UP

4) Earth and Space - *Multiple Choice* What atmospheric circulation cell is bounded by the equatorial low and subtropical high?

- W) Hadley
- X) Ferrel
- Y) Walker
- Z) Polar

ANSWER: W) Hadley

BONUS

4) Earth and Space - *Short Answer* Identify all of the following three unconformities that commonly only involve sedimentary rocks: 1) Angular unconformity; 2) Nonconformity; 3) Disconformity.

ANSWER: 1 and 3

TOSS-UP

5) Biology - *Multiple Choice* Two species of corn plants can be crossed to produce a hybrid offspring that is infertile. This offspring randomly duplicates its genome, and now can self cross to produce more of itself, creating a new species. This is an example of which of the following?

- W) Sympatric speciation
- X) Allopatric speciation
- Y) Founder effect
- Z) Bottleneck effect

ANSWER: W) Sympatric speciation

BONUS

5) Biology - *Short Answer* What sex determination system is utilized by individuals of hymenoptera [HY-min-OP-tur-uh] and other social insects?

ANSWER: Haplodiploid system (ACCPET: Haplodiploidy)

TOSS-UP

6) Physics - *Short Answer* A fluid is added to a container where two pistons of non-equal areas are touching the fluid. On a piston with area 20 square centimeters, a force pushes down with a force of 70 newtons. The piston on the other side with area 40 square centimeters experiences an upward force of what magnitude, in newtons?

ANSWER: 140

BONUS

6) Physics - *Multiple Choice* Which of the following base and height dimensions for a ramp would ensure the largest magnitude of acceleration of a block placed at the top?

- W) Base: 5, Height: 3
- X) Base: 4, Height: 3
- Y) Base: 3, Height: 5
- Z) Base: 4, Height: 4

ANSWER: Y) Base: 3, Height: 5

TOSS-UP

7) X-Risk - *Short Answer* In game theory, what thought experiment involves two completely rational agents either cooperating for a mutual reward or betraying each other for an individual reward?

ANSWER: Prisoner's dilemma

BONUS

7) X-Risk - *Short Answer* One early proposal for determining whether a computer program exhibits human-level intelligence was to see if a human judge could discern textual messages sent by a computer from those sent by a human. What is this evaluation known as?

ANSWER: Turing test (ACCEPT: Imitation game)

TOSS-UP

8) Math - *Short Answer* If 45% of a certain number x is 50, what is 27% of x ?

ANSWER: 30

BONUS

8) Math - *Short Answer* Tyler draws a number from all integers between 1 and 90, inclusive and at random. What is the probability that Tyler draws a number relatively prime to both 5 and 6?

ANSWER: 4/15

TOSS-UP

9) Chemistry - *Short Answer* What is the average oxidation state of oxygen in O₂F₂?

ANSWER: +1

BONUS

9) Chemistry - *Multiple Choice* Which of the following pairs of elements will have the highest bond dissociation energy?

- W) Silver and fluorine
- X) Carbon and fluorine
- Y) Silver and iodine
- Z) Carbon and iodine

ANSWER: X) Carbon and fluorine

TOSS-UP

10) Earth and Space - *Short Answer* Quintessence and the cosmological constant are two proposed forms of what form of energy which is responsible for the accelerating expansion of the universe?

ANSWER: Dark energy

BONUS

10) Earth and Space - *Multiple Choice* Which of the following is closest to the percentage of the total energy in the universe that is made up of dark energy?

- W) 30
- X) 50
- Y) 70
- Z) 90

ANSWER: Y) 70

TOSS-UP

11) Biology - *Multiple Choice* The enzyme nitrogenase [ny-TRAW-juh-nase] is most directly involved in which of the following processes?

- W) Ammonification
- X) Nitrogen fixation
- Y) Denitrification
- Z) Nitrification

ANSWER: X) Nitrogen fixation

BONUS

11) Biology - *Short Answer* Identify all of the following three vitamins that are fat soluble: 1) A; 2) B3; 3) E.

ANSWER: 1 and 3

TOSS-UP

12) Physics - *Multiple Choice* Which of the following changes to the force applied on a spherical surface and the radius of the sphere would result in the smallest change in pressure?

- W) Force is doubled, radius is tripled
- X) Force is tripled, radius is quadrupled
- Y) Force is tripled, radius is doubled
- Z) Force is quadrupled, radius is tripled

ANSWER: Y) Force is tripled, radius is doubled

BONUS

12) Physics - *Multiple Choice* A graduate student calculated the mass of a gold nucleus by summing the masses of the protons and neutrons within it. The mass they calculated is:

- W) Greater than the actual mass
- X) Less than the actual mass
- Y) Equal to the actual mass
- Z) Mass relative to actual mass is dependent on the specific isotope of gold

ANSWER: W) Greater than the actual mass

TOSS-UP

13) X-Risk - *Multiple Choice* Which chemical element is used in the core of implosion-type nuclear weapons, such as the one used in the Trinity test?

- W) Uranium
- X) Neptunium
- Y) Plutonium
- Z) Thorium

ANSWER: Y) Plutonium

BONUS

13) X-Risk - *Short Answer* As the global effects of climate change continue to develop, the local climate of Western Europe is predicted to cool due to the disruption of what Atlantic ocean current?

ANSWER: Gulf stream (ACCEPT: AMOC, Atlantic meridional overturning circulation)

TOSS-UP

14) Math - *Multiple Choice* In base 10, the sum of AB and CD is AEF, where each letter represents a unique integer digit. Which of the following integers could C equal?

- W) 3
- X) 5
- Y) 7
- Z) 9

ANSWER: Z) 9

BONUS

14) Math - *Short Answer* How many unique triangles with integer side lengths have a perimeter of 36 and area of 72?

ANSWER: 0

TOSS-UP

15) Chemistry - *Multiple Choice* Which of the following reactions is a redox reaction?

- W) $2\text{NO}_2 \longrightarrow [\text{yields}] \text{N}_2\text{O}_4$
- X) $\text{P}_4\text{O}_{10} + 6\text{H}_2\text{O} \longrightarrow 4\text{H}_3\text{PO}_4$
- Y) $\text{HCl} + \text{NaHCO}_3 \longrightarrow \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$
- Z) $2\text{H}_2\text{O}_2 \longrightarrow 2\text{H}_2\text{O} + \text{O}_2$

ANSWER: Z) $2\text{H}_2\text{O}_2 \longrightarrow 2\text{H}_2\text{O} + \text{O}_2$

BONUS

15) Chemistry - *Short Answer* A basic buffer is prepared using 10^{-3} moles of an acid with a pK_a of 3 and 10^{-3} moles of the acid's conjugate acid. What is the pH of the buffer?

ANSWER: 3

TOSS-UP

16) Earth and Space - *Short Answer* What is the oxidation state of iron in pyrite?

ANSWER: +2 (ACCEPT: 2)

BONUS

16) Earth and Space - *Multiple Choice* Abigail is studying the land formations in Mt. Washington and discovers a dike that cuts through an older body of granite. Which of the following principles allows her to determine the relative age of the two rocks?

- W) Superposition
- X) Original horizontality
- Y) Lateral continuity
- Z) Cross-cutting relationships

ANSWER: Z) Cross-cutting relationships

TOSS-UP

17) Biology - *Multiple Choice* Which of the following would occur more often in C3 plants than in C4 plants?

- W) Thriving in high-intensity light
- X) Photorespiration
- Y) PEP carboxylase fixes CO₂
- Z) Open stomata at night

ANSWER: X) Photorespiration

BONUS

17) Biology - *Short Answer* Identify all of the following three viruses that belong to the family retroviridae [ret-ro-VEER-uh-dee]: 1) HIV; 2) Rhinovirus; 3) Coronavirus.

ANSWER: 1 only

TOSS-UP

18) Physics - *Short Answer* What general technique is used to modulate the properties of electronic materials by introducing impurities to modify their band structure?

ANSWER: Doping

BONUS

18) Physics - *Multiple Choice* Which of the following elements, when presented as an impurity in silicon, would result in a p-type semiconductor?

- W) Phosphorus
- X) Antimony
- Y) Carbon
- Z) Boron

ANSWER: Z) Boron

TOSS-UP

19) X-Risk - *Multiple Choice* What is the term to describe hardy organisms that are the first to colonize barren environments or disrupted steady-state ecosystems?

- W) Foundation species
- X) Climax species
- Y) Keystone species
- Z) Pioneer species

ANSWER: Z) Pioneer species

BONUS

19) X-Risk - *Multiple Choice* AI boxing refers to a proposal to mitigate the risk of unaligned AI by doing which of the following?

- W) Isolating it from the world at large except for select communication channels
- X) Placing the AI's communications under the oversight of another AI system
- Y) Separating an AI's capabilities programming from its safety programming, to prevent the two interfering
- Z) Building the AI out of modular systems so that each module can be safety-tested individually

ANSWER: W) Isolating it from the world at large except for select communication channels

TOSS-UP

20) Math - *Short Answer* Currently, the time on a digital clock is 12:28. A palindrome time is when the time with colon removed is a palindrome, such as at 2:12 or 10:01. How many minutes are there until the next palindrome time?

ANSWER: 33 (ACCEPT: 63)

BONUS

20) Math - *Short Answer* What is the degree measure of the angle formed by the hour and minute hand at 12:28 on an analog clock?

ANSWER: 154

TOSS-UP

21) Chemistry - *Multiple Choice* Which of the following elements appears closest to red during a flame test?

- W) Sodium
- X) Magnesium
- Y) Potassium
- Z) Calcium

ANSWER: Z) Calcium

BONUS

21) Chemistry - *Multiple Choice* Carbon-14, which has a half-life of 6,000 years, is initially present in a geologic deposit and decays without replacement, while all carbon-12 initially present does not decay. When the ratio of carbon-12 to carbon-14 in the geologic deposit triples, which of the following is closest to the number of years that have passed?

- W) 6000
- X) 12000
- Y) 18000
- Z) 24000

ANSWER: X) 12000

TOSS-UP

22) Earth and Space - *Multiple Choice* Which of the following types of radiation would best inform a team of scientists about the presence of dust near a galaxy's center?

- W) Ultraviolet
- X) Infrared
- Y) Radio
- Z) Optical

ANSWER: X) Infrared

BONUS

22) Earth and Space - *Short Answer* Saturn's largest known moon, Titan, is notable for having clouds and lakes primarily composed of what chemical compound?

ANSWER: Methane

TOSS-UP

23) Biology - *Short Answer* Klinefelter's syndrome is characterized by how many copies of the X chromosome?

ANSWER: 2

BONUS

23) Biology - *Multiple Choice* Huntington's disease is characterized by which of the following inheritance patterns?

- W) Autosomal dominant
- X) Autosomal recessive
- Y) Sex-linked dominant
- Z) Sex-linked recessive

ANSWER: W) Autosomal dominant

TOSS-UP

24) Physics - *Short Answer* A student is observing the properties of electrons ejected from a material when exposed to light. What quantity of the material can the student measure along with the electron kinetic energy to find the energy of the photons?

ANSWER: Work function

BONUS

24) Physics - *Multiple Choice* In the Stern-Gerlach [GUR-lock] experiment, the deflection of silver atoms in a magnetic field was due to what quantum property of the atoms?

- W) Orbital angular momentum
- X) Spin
- Y) Charge
- Z) Mass

ANSWER: X) Spin