

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 O_2F_2 ?

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

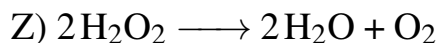
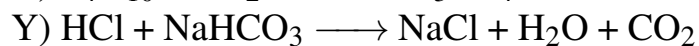
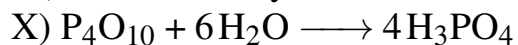
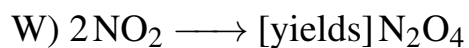
BONUS

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?



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 pKa 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