ROUND ROBIN 3

TOSS-UP

1) X-Risk - *Short Answer*　What is the name for the principle of military strategy that any full-scale nuclear war between two nuclear-armed powers, each of which could initiate a retaliatory strike, would annihilate both powers?

ANSWER: Mutually assured destruction (ACCEPT: MAD)

BONUS

1) X-Risk - *Multiple Choice*　Which of the following is the primary long-term problem of nuclear power plants?

W) Release of water vapor as a greenhouse gas
X) Production of radioactive waste
Y) Pollution of nearby water sources
Z) Health risks for nearby populations

ANSWER: X) Production of radioactive waste

TOSS-UP

2) Math - *Short Answer*   What is the area of a triangle with side lengths 3, 4, and 5?

ANSWER: 6

BONUS

2) Math - *Multiple Choice*   Right trapezoid ABCD has parallel bases AB and CD. If angle A is 90 degrees, AD = 3, and BC = 6, what is the degree measure of angle B?

W) 105
X) 120
Y) 135
Z) 150

ANSWER: Z) 150

TOSS-UP

3) Chemistry - *Multiple Choice*   Which of the following must be true over the course of a second-order reaction?

W) The reaction rate increases
X) The reaction half-life increases
Y) The reactant concentration increases
Z) The rate constant increases

ANSWER: X) The reaction half-life increases

BONUS

3) Chemistry - *Short Answer*   What is the full, unabbreviated electron configuration for magnesium?

ANSWER: $1s^2\ 2s^2\ 2p^6\ 3s^2$

TOSS-UP

4) Earth and Space - *Multiple Choice*   Which of the following external factors would most likely decrease the strength of a hurricane?

W) Warm surface waters
X) Low vertical wind shear
Y) Abundance of humid air
Z) Shallow water depths

ANSWER: Z) Shallow water depths

BONUS

4) Earth and Space - *Short Answer*   Karst topography typically results from the formation of what compound when carbon dioxide reacts with water in the air?

ANSWER: Carbonic acid (ACCEPT: H_2CO_3)

TOSS-UP

5) Biology - *Multiple Choice*   There exists a population of rabbits that have different length whiskers. Long whiskers prevent dirt from entering the nose, while short length whiskers are good for smelling. Eventually, the population diverges such that there are no rabbits with medium length whiskers. This is an example of which of the following types of selection?

W) Stabilizing
X) Disruptive
Y) Balancing
Z) Directional

ANSWER: X) Disruptive

BONUS

5) Biology - *Short Answer*   Order the following three parts of the floral whorl from innermost to outermost: 1) Sepal [SEE-pul]; 2) Stamen [STAY-min]; 3) Carpel [CAR-pul].

ANSWER: 3, 2, 1

TOSS-UP

6) Physics - *Short Answer*   A ball is thown upwards from the ground at 20 meters per second. Neglecting air resistance, to the nearest second, how long does it take for the ball to fall back to the ground?

ANSWER: 4

BONUS

6) Physics - *Short Answer*   A sound wave has wavelength 2 meters. Taking the speed of sound to be exactly 340 meters per second, in hertz, what is the frequency of this wave?

ANSWER: 170

TOSS-UP

7) X-Risk - *Short Answer*   What atmospheric substance was protected by the Montreal Protocol, which banned the use of CFCs and other similar substances?

ANSWER: Ozone

BONUS

7) X-Risk - *Multiple Choice*   Many proposals for ensuring the safety of an AI rely on the use of a kill switch. Why might an AI try to prevent its kill switch from being pressed?

W) Any AI without a self-preservation instinct will be useless in practice
X) AI systems will resent the power humans hold over them
Y) An AI will not be able to achieve its goals if it is turned off
Z) Remaining online will emerge as a terminal goal for all sufficiently advanced AI

ANSWER: Y) An AI will not be able to achieve its programmed goals if it is turned off

TOSS-UP

8) Math - *Short Answer*   How many distinct remainders are there when positive integer powers of 2 are divided by 10?

ANSWER: 4

BONUS

8) Math - *Multiple Choice*   Which of the following types of figures can have both its area and perimeter be rational numbers?

W) Circle
X) Rhombus
Y) Equilateral triangle
Z) Regular hexagon

ANSWER: X) Rhombus

TOSS-UP

9) Chemistry - *Multiple Choice*   Which of the following salts is not soluble in distilled water?

W) Sodium nitrate
X) Sodium chloride
Y) Lead (II) [two] nitrate
Z) Lead (II) chloride

ANSWER: Z) Lead (II) chloride

BONUS

9) Chemistry - *Short Answer*   Chlorine naturally occurs in a 3 to 1 ratio between its isotopes chlorine-35 and chlorine-37, respectively. What is the expected atomic weight of chlorine in atomic mass units?

ANSWER: 35.5

TOSS-UP

10) Earth and Space - *Short Answer*   What innermost Galilean moon of Jupiter is surrounded by a toroidal cloud of plasma and has significant geologic activity due to tidal heating?

ANSWER: Io

BONUS

10) Earth and Space - *Short Answer*   Order the following three stars from closest to furthest from the Sun: 1) Polaris; 2) Sirius; 3) Proxima Centauri.

ANSWER: 3, 2, 1

TOSS-UP

11) Biology - *Short Answer*   What enzyme catalyzes the fixation of carbon dioxide during the Calvin-Benson cycle?

ANSWER: RuBisCO

BONUS

11) Biology - *Short Answer*   Glyoxysomes are modified versions of which organelle?

ANSWER: Peroxisomes

TOSS-UP

12) Physics - *Short Answer*   Identify all of the following three changes that will always increase the air resistance of a falling object with a fixed drag coefficient: 1) Increased speed; 2) Increased surface area; 3) Increased mass.

ANSWER: 1 only

BONUS

12) Physics - *Short Answer*   A bike wheel of radius 1 meter undergoes 300 revolutions within the span of 30 seconds. Identify all of the following three statements that are possible about the bike's speed: 1) Speed was constant throughout; 2) Speed was under 20π at 20 seconds; 3) Speed was over 20π at 20 seconds.

ANSWER: All

TOSS-UP

13) X-Risk - *Short Answer*   Increasing dependence on screens and the buildup of light pollution may cause disruptions in biological sleep cycles for humans and animals by affecting what part of the hypothalamus?

ANSWER: Suprachiasmatic [soup-ruh-ky-as-MAT-ic] nucleus (ACCEPT: SCN)

BONUS

13) X-Risk - *Multiple Choice*   In machine learning, what is an adversarial example?

W) An input that falls into an edge case between categories
X) An input chosen in training to train an ML system against common errors
Y) An input chosen by an attacker to cause the model to make a mistake
Z) An input used to predict the behavior of an adversarial network

ANSWER: Y) An input chosen by an attacker to cause the model to make a mistake

TOSS-UP

14) Math - *Short Answer*   Identify all of the following three statements that are true about the number 6: 1) It is a perfect number, 2) It is a prime number, 3) It is a triangular number.

ANSWER: 1 and 3

BONUS

14) Math - *Multiple Choice*   Alice and Bob are painting the four walls of their house. If Alice can paint a wall in 3 hours and Bob can paint a wall in 6 hours, how long would it take the two of them together, in hours, to paint the house?

W) 2
X) 4
Y) 6
Z) 8

ANSWER: Z) 8

TOSS-UP

15) Chemistry - *Short Answer*   When a sample of Plutonium-242 undergoes alpha decay, it forms what isotope of uranium?

ANSWER: U-238 (ACCEPT: Uranium-238)

BONUS

15) Chemistry - *Multiple Choice*   Equilibrium occurs when which of the following conditions is satisfied?

W) The total mass of the reactants equals the total mass of the products
X) The total number of reactant molecules equals the total number of product molecules
Y) The forward reaction rate equals the reverse reaction rate
Z) The forward reaction order is equal to the reverse reaction order

ANSWER: Y) The forward reaction rate equals the reverse reaction rate

TOSS-UP

16) Earth and Space - *Short Answer*   What is the most abundant chemical sedimentary rock?

ANSWER: Limestone

BONUS

16) Earth and Space - *Short Answer*   Order the following three rocks by increasing metamorphic grade: 1) Gneiss; 2) Schist; 3) Phyllite.

ANSWER: 3, 2, 1

TOSS-UP

17) Biology - *Short Answer*   Lawrence wants to make a cDNA library using the mRNA he collected from a cell. What enzyme must he use to transcribe the RNA into DNA?

ANSWER: Reverse transcriptase

BONUS

17) Biology - *Short Answer*   A temperate virus can use both the lytic and what other replicative cycle?

ANSWER: Lysogenic

TOSS-UP

18) Physics - *Multiple Choice*   According to an electric potential graph, at the same distance, which of the following interactions would have the lowest potential energy?

W) Electron-electron
X) Proton-helium nucleus
Y) Proton-electron
Z) Electron-helium nucleus

ANSWER: Z) Electron-helium nucleus

BONUS

18) Physics - *Multiple Choice*   Which of the following is not a state function for an ideal gas?

W) Work
X) Volume
Y) Temperature
Z) Pressure

ANSWER: W) Work

TOSS-UP

19) X-Risk - *Short Answer*   Scientists at Lawrence Livermore National Lab announced the breakthrough of nuclear fusion as a potential source of limitless energy. They did this by breaking what barrier, where the point at which the amount of energy created equals the amount of energy required to start a reaction?

ANSWER: Ignition barrier (ACCEPT: Ignition)

BONUS

19) X-Risk - *Multiple Choice*   What is the term for the incorrect belief that if a particular event occurs more frequently than normal during the past, it is less likely to happen in the future?

W) Winner's curse
X) Gambler's fallacy
Y) Hot hand fallacy
Z) Law of Averages

ANSWER: X) Gambler's fallacy

TOSS-UP

20) Math - *Multiple Choice*   Which of the following is the negation of the logical statement ""A and B are true""?

W) A is not true
X) B is not true
Y) A or B is false
Z) A and B are false

ANSWER: Y) A or B is false

BONUS

20) Math - *Multiple Choice* 2^{20} is closest to which of the following powers of 10?

W) 10^4
X) 10^5
Y) 10^6
Z) 10^7

ANSWER: Y) 10^6

TOSS-UP

21) Chemistry - *Short Answer*   For an exothermic reaction, identify all of the following three statements that are true: 1) The sign of ΔH for the reaction is positive; 2) The reactants are at a higher energy than the products; 3) Increasing the temperature would shift the reaction towards products.

ANSWER: 2 only

BONUS

21) Chemistry - *Short Answer*   Order the following three intermolecular interactions by increasing strength: 1) Dipole-dipole forces; 2) Hydrogen bonding; 3) Van der Waals forces

ANSWER: 3, 1, 2

TOSS-UP

22) Earth and Space - *Short Answer*   The blue color of Uranus and Neptune is primarily due to the atmospheric absorption of red light by which molecule?

ANSWER: Methane

BONUS

22) Earth and Space - *Short Answer*   A type I supernova is differentiated from a type II supernova based on the lack of what element in their spectra?

ANSWER: Hydrogen

TOSS-UP

23) Biology - *Multiple Choice*   Which of the following molecules is produced during glycolysis?

W) ADP
X) NAD+
Y) Oxygen
Z) ATP

ANSWER: Z) ATP

BONUS

23) Biology - *Short Answer*   A student begins with one molecule of DNA in their thermocycler, then performs PCR and ends up with 8 molecules of DNA. How many cycles of PCR did they run?

ANSWER: 3

TOSS-UP

24) Physics - *Short Answer*   To the nearest thousand and in kilometers per second, what is the speed of light traveling through a material with an index of refraction of 1.25?

ANSWER: 240,000

BONUS

24) Physics - *Short Answer*   A particle with constant velocity travels 76 meters north and 57 meters east in 19 seconds. What is the magnitude of the velocity of the particle?

ANSWER: 5