

ROUND ROBIN 7

TOSS-UP

1) Longtermism - *Multiple Choice* According to Toby Ord in *The Precipice*, which of the following represents the most pressing existential threat to humanity?

- W) Climate change
- X) Natural pandemics
- Y) Supervolcanic eruptions
- Z) AGI misalignment

ANSWER: Z) AGI misalignment

BONUS

1) Longtermism - *Multiple Choice* Economist Robin Hanson proposed a Great Filter argument for humanity's existence. Which of the following would be evidence that this Great Filter lies in humanity's future?

- W) Lack of primitive extraterrestrial species
- X) Observation of abundant extraterrestrial life
- Y) Evolutionary bias against intelligence
- Z) Extreme difficulty of abiogenesis [ay-BI-uh-JEN-eh-sis]

ANSWER: X) Observation of abundant extraterrestrial life

TOSS-UP

2) Math - *Short Answer* Let vector $u = [-1, 2]$ and vector $v = [2, 3]$. Simplify $2u - 3v$.

ANSWER: $[-8, -5]$

BONUS

2) Math - *Short Answer* A circle has a radius of 4 inches. To the nearest inch, find the length of the arc intercepted by a central angle of 240 degrees.

ANSWER: 17 inches

TOSS-UP

3) Chemistry - *Short Answer* What is the chemical formula of the anhydride of phosphorous acid?

ANSWER: P₄O₆

BONUS

3) Chemistry - *Short Answer* What is the ratio of the root mean square speed of oxygen gas at 300 Kelvin to that of sulfur dioxide at 600 Kelvin?

ANSWER: 1

TOSS-UP

- 4) Earth and Space - *Short Answer* Order the following three igneous rock textures in order of increasing time of crystallization: 1) Glassy; 2) Aphanitic [AY-fuh-NIH-dik]; 3) Phaneritic [FA-nuh-RIH-dik].

ANSWER: 1, 2, 3

BONUS

- 4) Earth and Space - *Short Answer* Identify all of the following four water pollution sources that would be considered point sources: 1) Lawn fertilizers; 2) Power plants; 3) Agricultural pesticides; 4) Industrial stormwater discharges.

ANSWER: 2 and 4

TOSS-UP

5) Biology - *Short Answer* How many subunits do heteromeric [heh-dur-AW-mur-ik] G proteins contain?

ANSWER: 3

BONUS

5) Biology - *Multiple Choice* Albuterol [al-BEW-der-all] is commonly used in nebulizers to treat asthma attacks by causing bronchiolar [bron-key-OLL-ar] dilation and smooth muscle relaxation. Albuterol is an agonist for which of the following types of receptors?

- W) Alpha adrenergic [A-drih-NER-jik]
- X) Beta adrenergic
- Y) Muscarinic acetylcholine [MUS-kuh-RIH-nik uh-SEE-dul-KO-leen]
- Z) Nicotinic [NIH-kuh-TIH-nik] acetylcholine

ANSWER: X) Beta adrenergic

TOSS-UP

6) Physics - *Short Answer* A circuit is comprised of a battery and two resistors in series, one with twice the resistance of the other. If the circuit's current is 0.1 amps and the larger resistor has 10 ohms of resistance, what is the voltage of the battery, in volts?

ANSWER: 1.5

BONUS

6) Physics - *Short Answer* Two circuits both have three resistors with resistances of 100 ohms each, connected to a 6 volt battery. One circuit has all resistors in series and has a current of I . What is the current of the other circuit with all its resistors in parallel, in terms of I ?

ANSWER: $9I$

TOSS-UP

7) Longtermism - *Multiple Choice* A perceptron [per-SEP-tron] is an example of what type of simple neural network, distinguished by its lack of cycles?

- W) Feedforward neural network
- X) Reinforcement neural network
- Y) Generalized perceptron network
- Z) Unsupervised neural network

ANSWER: W) Feedforward neural network

BONUS

7) Longtermism - *Multiple Choice* Feedforward neural networks are commonly trained with which method, in which a loss function is minimized by adjusting neural weights by a vector of partial derivatives?

- W) Differential descent
- X) Gradient descent
- Y) Reinforcement learning
- Z) Anti-Hebbian [HEH-bee-in] learning

ANSWER: X) Gradient descent

TOSS-UP

8) Math - *Short Answer* A transversal intersects two parallel lines at an oblique angle. Identify all of the following four angle pairs that are congruent: 1) Corresponding angles; 2) Consecutive interior angles; 3) Alternate interior angles; 4) Alternate exterior angles.

ANSWER: 1, 3, and 4

BONUS

8) Math - *Multiple Choice* Two fair six-sided dice are rolled and then that many fair coins are flipped. Let S be the set of all possible ordered sequences of the coin tosses. How many elements are in S?

- W) 8188
- X) 8189
- Y) 8190
- Z) 8191

ANSWER: W) 8188

TOSS-UP

9) Chemistry - *Multiple Choice* Titanium occupies a hexagonal closest packed structure under standard conditions. Which of the following is closest to the percent of space occupied by atoms in a titanium crystal?

- W) 55
- X) 65
- Y) 75
- Z) 85

ANSWER: Y) 75

BONUS

9) Chemistry - *Multiple Choice* Which of the following comparisons between molarity and molality is NOT true?

- W) Molarity and molality can both be used to measure concentration
- X) The units for molarity are moles per liter of solution while the units of molality are moles per kilogram of solvent
- Y) Molarity is affected by changes in temperature while molality is not
- Z) Molarity results in an accurate and precise measurement of concentration while molality does not

ANSWER: Z) Molarity results in an accurate and precise measurement of concentration while molality does not

TOSS-UP

10) Earth and Space - *Short Answer* What common spectral line has been used to measure the galactic rotation curve and the distribution of atomic hydrogen in the galaxy?

ANSWER: 21 centimeter line (ACCEPT: Hydrogen line, H I line)

BONUS

10) Earth and Space - *Multiple Choice* Which of the following is the atomic weight in AMU of the heaviest nuclide involved in the most common form of the CNO cycle?

- W) 4
- X) 8
- Y) 12
- Z) 15

ANSWER: Z) 15

TOSS-UP

11) Biology - *Short Answer* What cells in the leaves contain the largest number of chloroplasts per cell, making them the primary site of photosynthesis?

ANSWER: Palisade cells (ACCEPT: Mesophyll, Palisade mesophyll)

BONUS

11) Biology - *Multiple Choice* Which of the following best describes Emsleyan [EM-slee-in] mimicry?

- W) A harmful species mimics a less harmful species
- X) A harmless species mimics a harmful species
- Y) Two harmful species mimic each other
- Z) One member of a species mimics another member of the same species

ANSWER: W) A harmful species mimics a less harmful species

TOSS-UP

12) Physics - *Short Answer* Identify all of the following three effects that would result from an increase in plate area in a capacitor: 1) Stronger electric field; 2) Increased electrical energy; 3) Increased magnetic energy.

ANSWER: 2 only

BONUS

12) Physics - *Multiple Choice* A ball is undergoing circular motion with a linearly increasing velocity. The rate of change of momentum is proportional to what power of the ball's instantaneous velocity?

- W) First
- X) Second
- Y) Third
- Z) Fourth

ANSWER: X) Second

TOSS-UP

13) Longtermism - *Multiple Choice* Current mRNA-based COVID vaccines use what technology as the primary means of delivery?

- W) Buffered solution
- X) Dendritic cell vector
- Y) Lipid nanoparticle delivery
- Z) Polyplex delivery

ANSWER: Y) Lipid nanoparticle delivery

BONUS

13) Longtermism - *Multiple Choice* What is an advantage of lipid nanoparticle delivery over buffer solution delivery?

- W) The lipid gives greater protection against degradation
- X) Ionizable cationic lipids are a common pharmaceutical product
- Y) Microfluidic reaction chambers can be easily scaled up
- Z) Lipid nanoparticle delivery has been more thoroughly tested

ANSWER: W) The lipid gives greater protection against degradation

TOSS-UP

14) Math - *Short Answer* What is the smallest positive integer that has exactly 5 factors?

ANSWER: 16

BONUS

14) Math - *Short Answer* What is the area of a triangle whose sides are lengths 8, 11, and 17?

ANSWER: $6\sqrt{35}$

TOSS-UP

15) Chemistry - *Multiple Choice* Which of the following IR wavenumber ranges, in inverse centimeters, are characteristic of organic molecules with a carbonyl [car-BAW-nil] group?

- W) 3200-3000
- X) 2400-2200
- Y) 1800-1600
- Z) 1200-1000

ANSWER: Y) 1800-1600

BONUS

15) Chemistry - *Short Answer* Identify all of the following three elements that have a green flame test: 1) Lithium; 2) Strontium; 3) Beryllium.

ANSWER: None

TOSS-UP

16) Earth and Space - *Multiple Choice* At which of the following latitudes is sea surface salinity typically highest?

- W) 0 degrees
- X) 30 degrees
- Y) 60 degrees
- Z) 90 degrees

ANSWER: X) 30 degrees

BONUS

16) Earth and Space - *Short Answer* The Planck feedback is a simple climate feedback loop based on the fact that a hotter body radiates more than a cold body, cooling the planet. What law best describes this relationship?

ANSWER: Stefan-Boltzmann law (ACCEPT: Planck's law)

TOSS-UP

17) Biology - *Short Answer* Identify all of the following three genomic regulatory elements that are cis-acting, regulating transcription on the same chromosomal allele: 1) Operator; 2) Repressor; 3) Promoter.

ANSWER: 1 and 3

BONUS

17) Biology - *Short Answer* According to the ABC model, identify all of the following three flower components whose development is regulated by the B gene: 1) Petal; 2) Stamen; 3) Carpel.

ANSWER: 1 and 2

TOSS-UP

18) Physics - *Short Answer* What equation explains why fluids flow through thinner sections of a pipe with a higher velocity?

ANSWER: Continuity equation

BONUS

18) Physics - *Short Answer* Incompressible air travels through a tunnel of cross-sectional area 240 square meters at 7 meters per second. What is the new air velocity in the tunnel while a train with cross sectional area of 100 square meters goes through?

ANSWER: 12

TOSS-UP

19) Longtermism - *Short Answer* What term describes a utility function which will accept the first possibility considered that is above a certain utility threshold, regardless of whether this option produces the greatest possible utility?

ANSWER: Satisficing (ACCEPT: Satisficer, Satisfice, or a similar form)

BONUS

19) Longtermism - *Multiple Choice* It has been speculated that an AGI which satisfies its reward function would be safer than an AGI maximizer. What behavior is considered the main contributor to existential risk specifically from a satisficing AGI?

- W) Self-modifying source code so the utility function is always satisfied
- X) Self-modifying source code into a maximizing utility function
- Y) Preventing any human behavior that would create a maximizer
- Z) Using all the world's resources to build more satisficing AGI

ANSWER: X) Self-modifying source code into a maximizing utility function

TOSS-UP

20) Math - *Short Answer* Vivienne has a 24 inch by 30 inch poster board. If she shortens the length of one side of this poster by 3 inches, the poster would have area 648 square inches. What would the area of the poster be in square inches if instead she shortens the length of the other side by 2 inches?

ANSWER: 660

BONUS

20) Math - *Multiple Choice* What is the sum of all 4-digit integers that can be made from the digits 0, 1, 2, and 3 if each digit is to be used exactly once for each integer?

- W) 38664
- X) 39330
- Y) 39996
- Z) 40000

ANSWER: W) 38664

TOSS-UP

21) Chemistry - *Short Answer* What functional group is generated through the dehydration of an amide [A-mide], and is composed of a carbon atom triple bonded to a nitrogen atom?

ANSWER: Nitrile

BONUS

21) Chemistry - *Short Answer* How many vibrational degrees of freedom does hydrazine [HI-druh-zeen] have?

ANSWER: 12

TOSS-UP

22) Earth and Space - *Short Answer* In 2013, a coronal mass ejection produced a massive amount of ultrarelativistic ionizing radiation that temporarily created a third section of what regions surrounding Earth?

ANSWER: Van Allen belts

BONUS

22) Earth and Space - *Short Answer* Micro black holes are a proposed class of black holes thought to have formed during the primordial universe. These black holes would be extremely difficult to detect because their mass has been reduced significantly via what process?

ANSWER: Hawking radiation

TOSS-UP

23) Biology - *Multiple Choice* Which of the following best explains the mechanism of Thermogenin [THER-muh-JEN-in], which allows for generation of heat in brown adipose [A-dih-pohse] tissue?

- W) Inhibits Complex I of the electron transport chain
- X) Detaches the F1 subunit of ATP Synthase
- Y) Increases the permeability of the inner mitochondrial membrane
- Z) Fully oxidizes Coenzyme Q, causing it to become dysfunctional

ANSWER: Y) Increases the permeability of the inner mitochondrial membrane

BONUS

23) Biology - *Short Answer* What term describes the final development stage of an insect, where it is sexually mature and typically winged?

ANSWER: Imago [uh-MAY-go] (ACCEPT: Adult)

TOSS-UP

24) Physics - *Multiple Choice* The current and turn density of a solenoid [SOLE-ih-noyd] with radius 2 cm are both tripled. What happens to the magnetic field 5 cm from the solenoid's center?

- W) Increases
- X) Remains constant
- Y) Decreases
- Z) Depends on the material

ANSWER: X) Remains constant

BONUS

24) Physics - *Multiple Choice* Compared to other fundamental forces, gravity is extremely weak. For two 1 kilogram objects, which of the following is closest to the electric charge, in coulombs, that makes the gravitational and electric forces equal?

- W) 10^{-5}
- X) 10^{-10}
- Y) 10^{-15}
- Z) 10^{-20}

ANSWER: X) 10^{-10}