

## ROUND ROBIN 1

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### TOSS-UP

1) Longtermism - *Multiple Choice* Which of the following existential risks is commonly considered to pose the greatest threat to the global food supply chain?

- W) Asteroid impacts
- X) Supervolcano eruptions
- Y) Nuclear wars
- Z) Natural pandemics

ANSWER: Y) Nuclear wars

### BONUS

1) Longtermism - *Multiple Choice* “Nuclear winter” is a major contributor to the existential risk from nuclear war. What is hypothesized to be the primary cause of crop failures due to a “nuclear winter?”

- W) Obstruction of sunlight by stratospheric smoke
- X) Radiation damage to seeds and seedlings
- Y) Disruption of prevailing winds by plumes of heat
- Z) Damage to root systems by shockwaves

ANSWER: W) Obstruction of sunlight by stratospheric smoke

### TOSS-UP

2) Math - *Short Answer* How many times does the function  $y = e^{\sin x}$  [e to the power of sine x] intersect the x-axis?

ANSWER: 0

### BONUS

2) Math - *Multiple Choice* Which of the following numbers has the greatest value?

W)  $50^{99}$

X)  $99^{50}$

Y) 99! [ninety-nine factorial]

Z)  $2^{500}$

ANSWER: W)  $50^{99}$

### TOSS-UP

3) Chemistry - *Short Answer* The isotope Plutonium-239 can only be created from Uranium-238 through neutron capture followed by two iterations of what specific type of radioactive decay?

ANSWER: Beta minus (DO NOT ACCEPT: Beta)

### BONUS

3) Chemistry - *Multiple Choice* The relationship between gas pressure and the concentration of a dissolved gas is given by which of the following laws?

W) Gay-Lussac's law

X) Graham's law

Y) Henry's law

Z) Boyle's law

ANSWER: Y) Henry's Law

## TOSS-UP

4) Earth and Space - *Multiple Choice* Volcanic eruptions typically cool the atmosphere because they create an abundance of cloud condensation nuclei through the release of which of the following gases?

- W) Water vapor
- X) Carbon dioxide
- Y) Sulfur dioxide
- Z) Nitrous oxide

ANSWER: Y) Sulfur dioxide

## BONUS

4) Earth and Space - *Short Answer* The asthenosphere [as-THEN-uh-sphere] is primarily composed of what dense, coarse-grained igneous rock consisting mostly of olivine and pyroxene [pie-ROCKS-een]?

ANSWER: Peridotite

## TOSS-UP

5) Biology - *Multiple Choice* Which of the following statements about sensory processing is FALSE?

W) The olfactory [oll-FAK-der-ee] bulb undergoes neurogenesis [NER-uh-JEN-eh-sis] throughout life

X) Visual information on the left side of the visual field is processed by the right side of the brain

Y) Rods are responsible for color vision

Z) The auditory cortex is located in the temporal lobe

ANSWER: Y) Rods are responsible for color vision

## BONUS

5) Biology - *Short Answer* In order to convert the vibration of the eardrum into pressure waves in the fluid of the cochlea [KO-klee-uh], the stapes [STAY-pees] pushes on what structure that separates the middle and inner ears?

ANSWER: Oval window

## TOSS-UP

6) Physics - *Multiple Choice* Which of the following quantities is most accurate about an RLC circuit oscillating at resonance frequency?

- W) Impedance is maximized while resistance is unchanged
- X) Impedance is minimized while resistance is unchanged
- Y) Both impedance and resistance are maximized
- Z) Both impedance and resistance are minimized

ANSWER: X) Impedance is minimized while resistance is unchanged

## BONUS

6) Physics - *Multiple Choice* A capacitor with charge with charge 1 coulomb with plates initially a distance 0.1 mm apart is slowly separated until they are 0.5 mm apart with a constant voltage source. By what factor does the energy the capacitor can store get multiplied by?

- W)  $\frac{1}{10}$
- X)  $\frac{1}{5}$
- Y) 5
- Z) 10

ANSWER: Y) 5

## TOSS-UP

7) Longtermism - *Multiple Choice* The Earth's climate is greatly affected by the ability of land to reflect light back into space. What is the technical term for this property?

- W) Luminosity
- X) Irradiance [ih-RAY-dee-inse]
- Y) Absorptivity
- Z) Albedo

ANSWER: Z) Albedo

## BONUS

7) Longtermism - *Multiple Choice* Reductions in albedo over Earth can accelerate climate change. Which of the following processes is a major contributor to reduced albedo?

- W) Improper disposal of wastewater
- X) Destruction of rainforest
- Y) Melting of sea ice
- Z) Erosion of farmland

ANSWER: Y) Melting of sea ice

## TOSS-UP

8) Math - *Short Answer* What is the value of  $\log_{300} 3$  [log base 300 of 3] to one significant figure?

ANSWER: 0.2

## BONUS

8) Math - *Multiple Choice* A snake eyes roll occurs when a player rolls two standard dice and both show a 1. The world record for consecutive snake eyes is 7 in a row, the probability of which is closest to which of the following powers of ten?

W)  $10^{-5}$

X)  $10^{-7}$

Y)  $10^{-9}$

Z)  $10^{-11}$

ANSWER: Z)  $10^{-11}$



### TOSS-UP

9) Chemistry - *Multiple Choice* A substance does not dissolve at room temperature, but is able to dissolve when heated to 100 degrees Celsius. Which of the following is true about the identity of this substance?

- W) Could be lead chloride but not silver chloride
- X) Could be silver chloride but not lead chloride
- Y) Could be both lead chloride and silver chloride
- Z) Can be neither lead chloride nor silver chloride

ANSWER: W) Could be lead chloride but not silver chloride

### BONUS

9) Chemistry - *Short Answer* Identify all of the following three basic types of hydrocarbons that can exhibit cis-trans isomerism: 1) Alkane; 2) Alkene; 3) Alkyne [AL-kye-n].

ANSWER: 2 only

## TOSS-UP

10) Earth and Space - *Short Answer* As some protostars form an accretion [uh-KREE-shin] disk, they eject jets of ionized gas that interact with nearby gas and dust, forming what bright objects?

ANSWER: Herbig-Haro [HER-big HAIR-oh] objects

## BONUS

10) Earth and Space - *Multiple Choice* Hubble's Law is most directly useful for calculating which of the following types of redshift?

- W) Cosmological
- X) Doppler
- Y) Gravitational
- Z) Relativistic

ANSWER: W) Cosmological

## TOSS-UP

11) Biology - *Multiple Choice* Which of the following skeletal systems most accurately describes the one used by Cnidarians [nih-DARE-ee-ins] in the class Cubozoa [cue-buh-ZO-uh]?

- W) Exoskeleton
- X) Endoskeleton
- Y) Hydrostatic skeleton
- Z) Axial skeleton

ANSWER: Y) Hydrostatic skeleton

## BONUS

11) Biology - *Short Answer* The urea breath test is used to identify gastrointestinal infections caused by what spirochete [SPY-ro-keet] shaped bacteria that are a common cause of stomach ulcers?

ANSWER: Helicobacter pylori [HEE-luh-coh-BACK-ter pie-LORE-ee] (ACCEPT: H. pylori)

### TOSS-UP

12) Physics - *Short Answer* A circuit consists of a 12mF [milli-FAIR-ad] capacitor and a 20,000 ohm resistor. What is the approximate time, in seconds, required for the current in the circuit to decline by a factor of  $e$  from its initial value?

ANSWER: 240

### BONUS

12) Physics - *Multiple Choice* Which of the following phenomena first proved the existence of length contraction?

W) Muons [MEW-ons] were found near Earth's surface

X) Trains were experimentally found to travel shorter distances at high speeds

Y) The ultraviolet catastrophe

Z) The Sun's light rays reached Earth faster than expected

ANSWER: W) Muons were found near Earth's surface

## TOSS-UP

13) Longtermism - *Multiple Choice* In *Superintelligence*, Nick Bostrom proposes that intelligence and alignment of an artificial intelligence are orthogonal. Assuming this is accurate, if the intelligence of an AI increased while other factors were held constant, how would its level of alignment change?

- W) Increase
- X) Decrease
- Y) Stay the same
- Z) There is not enough information to answer the question

ANSWER: Y) Stay the same

## BONUS

13) Longtermism - *Multiple Choice* Which of the following terms describes a machine that prioritizes human objectives as opposed to its own?

- W) Beneficial
- X) Harmful
- Y) Self-destructive
- Z) Misaligned

ANSWER: W) Beneficial

### TOSS-UP

14) Math - *Short Answer* A right triangle with side lengths 3 and 4 is revolved around its shorter side. What is the volume of the figure created?

ANSWER:  $16\pi$

### BONUS

14) Math - *Short Answer* To make their new logo, Sun Industries cuts out a circle of radius 25 inches, then splits the circle into two pieces with a 48 inch long cut. In inches, what is the vertical height of the larger of these new pieces?

ANSWER: 32

### TOSS-UP

15) Chemistry - *Short Answer* What is the hybridization state of an oxygen atom in the crystalline form of silicon dioxide?

ANSWER:  $sp^3$

### BONUS

15) Chemistry - *Short Answer* Order the following four compounds in order of decreasing boiling point temperature: 1) Water; 2) Ethane; 3) Ethanol; 4) Diethyl ether [die-ETH-ull EE-ther].

ANSWER: 1, 3, 4, 2

## TOSS-UP

16) Earth and Space - *Multiple Choice* Which of the following geologic features is formed as a result of glacial activity?

- W) Yardang [YAR-dang]
- X) Kettle
- Y) Playa [PLAH-yuh]
- Z) Tombolo [tom-BOW-low]

ANSWER: X) Kettle

## BONUS

16) Earth and Space - *Short Answer* Order the following three regions of a hurricane in order of increasing wind speed: 1) Central eye; 2) Eyewall; 3) Spiral rain bands.

ANSWER: 1, 3, 2



## TOSS-UP

17) Biology - *Short Answer* Which amino acid is the only one to exhibit achirality, since its side chain consists of a single hydrogen atom?

ANSWER: Glycine

## BONUS

17) Biology - *Multiple Choice* What stage in the sexual reproduction of fungi is characterized by the fusion of the nuclei?

- W) Plasmogamy [plaz-MAH-guh-mee]
- X) Nucleogamy [noo-klee-AH-guh-mee]
- Y) Karyogamy [care-ee-AW-guh-mee]
- Z) Peryogamy [pair-ee-AH-guh-mee]

ANSWER: Y) Karyogamy

## TOSS-UP

18) Physics - *Multiple Choice* The area of each plate of a capacitor is doubled and the distance between them is halved. If connected to a circuit with a constant potential difference, by what factor does the charge stored by the plates increase by?

- W)  $\frac{1}{4}$
- X)  $\frac{1}{2}$
- Y) 2
- Z) 4

ANSWER: Z) 4

## BONUS

18) Physics - *Multiple Choice* The phase diagram of a harmonic oscillator let go from maximum displacement while experiencing constant friction will take the form of which of the following patterns?

- W) Spiral
- X) Concentric ellipses
- Y) Concentric circles
- Z) Sinusoidal [SINE-uh-SOY-dull] wave

ANSWER: W) Spiral

## TOSS-UP

19) Longtermism - *Multiple Choice* Which of the following is NOT a potential concern raised by gain-of-function research?

- W) Agroterrorism [A-gruh-terrorism]
- X) Increased transmissibility
- Y) Increased virulence
- Z) Lack of oversight

ANSWER: Z) Lack of oversight

## BONUS

19) Longtermism - *Multiple Choice* What is the biggest practical limitation on the military use of bioweapons?

- W) Lack of selectivity
- X) Undetectability
- Y) Intentional abuse
- Z) Ineffectiveness

ANSWER: W) Lack of selectivity

### TOSS-UP

20) Math - *Short Answer* Identify all of the following three trigonometric functions that are odd functions: 1)  $\sin x$  [sine of  $x$ ]; 2)  $\cot x$  [cotangent of  $x$ ]; 3)  $\sec x$  [secant of  $x$ ].

ANSWER: 1 and 2

### BONUS

20) Math - *Short Answer* Let  $n$  be the number of times a square and a circle intersect on a plane. How many different values of  $n$  can exist?

ANSWER: 9

### TOSS-UP

21) Chemistry - *Short Answer* What nuclide is formed from the beta minus decay of potassium-40?

ANSWER: Calcium-40 (ACCEPT: Ca-40, DO NOT ACCEPT: Calcium)

### BONUS

21) Chemistry - *Short Answer* What is the VSEPR [VES-per] molecular geometry of sulfur tetrafluoride?

ANSWER: Seesaw

## TOSS-UP

22) Earth and Space - *Short Answer* If a planet orbiting a 1 solar mass star had an orbital period of 8 years, what is the length of its semimajor axis in astronomical units?

ANSWER: 4

## BONUS

22) Earth and Space - *Multiple Choice* Which of the following regions of the electromagnetic spectrum would be most useful for detecting brown dwarfs?

W) Longwave radio

X) Shortwave radio

Y) Microwave

Z) Infrared

ANSWER: Z) Infrared

### **TOSS-UP**

23) Biology - *Short Answer* Identify all of the following three diseases that are X-linked disorders: 1) Hemophilia; 2) Cystic fibrosis; 3) Sickle cell anemia.

ANSWER: 1 only

### **BONUS**

23) Biology - *Short Answer* Identify all of the following three statements that are true of r-selected species: 1) Offspring reach maturity early in life; 2) They tend to follow type III survivorship curves; 3) They are favored in a stable environment.

ANSWER: 1 and 2

## TOSS-UP

24) Physics - *Multiple Choice* What term describes two electrons that are bound together, allowing materials to exhibit superconductivity?

- W) Cooper pairs
- X) Fermion pairs
- Y) Plasmon interactions
- Z) Exciton [ex-SIGH-ton] interactions

ANSWER: W) Cooper pairs

## BONUS

24) Physics - *Short Answer* A magnetic field is oriented in the negative x-axis, in the same direction as the normal area vector of a circular loop of wire. If the magnitude of the field decreases, what direction around the loop of wire will current be induced when observing anti-parallel to the loop's normal?

ANSWER: Counter-clockwise