

ROUND ROBIN 4

TOSS-UP

1) Longtermism - *Short Answer* What is the scientific term for the severity of an infectious disease, or the degree of damage it can cause to a host?

ANSWER: Virulence [VEER-yuh-lence]

BONUS

1) Longtermism - *Multiple Choice* Which of the following factors has an inverse relationship with the existential threat posed by a pathogen?

W) Reproduction rate

X) Virulence

Y) Generation interval

Z) Lethality

ANSWER: Y) Generation interval

TOSS-UP

2) Math - *Short Answer* Brandon eats 20% of the cookies in a cookie jar, and Sean eats 45% of what is left. Afterwards, there are 11 cookies left. How many cookies were in the cookie jar initially?

ANSWER: 25

BONUS

2) Math - *Short Answer* Two irregular heptagons are on a plane. What is the maximum possible number of intersections between them?

ANSWER: 38

TOSS-UP

3) Chemistry - *Multiple Choice* Which of the following molecules possesses a linear molecular geometry?

- W) Sulfur dioxide
- X) Hydrogen cyanide
- Y) Oxygen difluoride
- Z) Hydrogen sulfide

ANSWER: X) Hydrogen cyanide

BONUS

3) Chemistry - *Short Answer* Identify all of the following three compounds that are soluble in water: 1) Nickel (II) [nickel two] hydroxide; 2) Iron (III) chloride; 3) Calcium acetate [AS-uh-tate].

ANSWER: 2 and 3

TOSS-UP

4) Earth and Space - *Multiple Choice* What layer of the ocean represents the transition between the upper mixed zone and the deep zone, separated by gradients in temperature and density?

W) Epipelagic [EH-pih-puh-LA-jik]

X) Mesopelagic [MEH-soh-puh-LA-jik]

Y) Bathypelagic [BATH-ih-puh-LA-jik]

Z) Abyssopelagic [uh-BISS-oh-pul-AH-jik]

ANSWER: X) Mesopelagic

BONUS

4) Earth and Space - *Short Answer* Order the following three magma types in order of increasing viscosity: 1) Ultramafic [ULL-truh-MAY-fik]; 2) Rhyolitic [RYE-uh-LIH-dik]; 3) Andesitic.

ANSWER: 1, 3, 2

TOSS-UP

5) Biology - *Short Answer* In Southeast Asia, a malaria-causing parasite known as Plasmodium knowlesi [plaz-MO-dee-um NOLL-uh-see] can be transmitted from macaque [muh-CACK] monkeys to humans by mosquitos. What term is used to describe this type of disease that can be transmitted from animals to humans?

ANSWER: Zoonotic [zoh-NAW-tik] (ACCEPT: Zoonosis)

BONUS

5) Biology - *Short Answer* What molecule is intermediate between pyruvate [pie-ROO-vate] and ethanol during alcohol fermentation?

ANSWER: Acetaldehyde [a-sih-TAL-dih-hide] (ACCEPT: acetylaldehyde)

TOSS-UP

6) Physics - *Multiple Choice* Which of the following statements is TRUE regarding the magnetic force exerted on a particle moving perpedicularly to a magnetic field?

W) It is zero

X) It is in the same direction as the particle's movement

Y) It is at a maximum

Z) It is proportional to the particle's mass

ANSWER: Y) It is at a maximum

BONUS

6) Physics - *Multiple Choice* A refrigerator is at temperature 100 K inside a room at temperature 200 K. If the coefficient of performance of the refrigerator is 2.5 and 25J of work is done to remove its heat, how many joules of heat is removed from the refrigerator?

W) 4

X) 10

Y) 25

Z) 62.5

ANSWER: Z) 62.5

TOSS-UP

7) Longtermism - *Multiple Choice* Livestock farming practices contribute to humanity's risk from natural pandemics, since many diseases originate from animals living in poor conditions in proximity to humans. Which of the following diseases did NOT first infect humans via an animal source?

- W) HIV
- X) Ebola
- Y) Cholera
- Z) Influenza

ANSWER: Y) Cholera

BONUS

7) Longtermism - *Multiple Choice* Although anthrax is a naturally occurring disease, it is commonly used for bioterrorism because it is extremely deadly. Which of the following factors contributes to anthrax's extremely high mortality rate?

- W) No available vaccine
- X) Produces toxins that linger once the bacterium is gone
- Y) Efficient spread via human contact
- Z) Antibiotics are generally ineffective

ANSWER: X) Produces toxins that linger once the virus is gone

TOSS-UP

8) Math - *Short Answer* A row of Pascal's triangle contains thirteen numbers, the highest of which is 924. What is the sum of all of the numbers in this row?

ANSWER: 4096

BONUS

8) Math - *Short Answer* A unit square is drawn on a coordinate plane with its center at the origin and sides parallel to the axes. A random point (x, y) is chosen from the interior of the square. Expressing your answer as a fraction in simplest terms, what is the probability that $|x - y| < .2$ [the absolute value of x minus y is less than point two]?

ANSWER: $\frac{9}{25}$

TOSS-UP

9) Chemistry - *Short Answer* What is the degree of unsaturation of ortho-xylene [OR-thuh-ZY-leen]?

ANSWER: 4

BONUS

9) Chemistry - *Short Answer* Rounded to the nearest integer, how many moles of aluminum are required to produce 6 grams of hydrogen gas when dissolved in a concentrated sulfuric acid solution?

ANSWER: 2

TOSS-UP

10) Earth and Space - *Short Answer* When the largest blue supergiant stars reach the end of their lives, they undergo an extreme core-collapse scenario that leads to what extremely energetic luminous type of supernova?

ANSWER: Hypernova (ACCEPT: Collapsar)

BONUS

10) Earth and Space - *Multiple Choice* During the universe's Grand Unification Epoch, three fundamental forces were unified into a single interaction. Which of the following was NOT one of these unified forces?

- W) Electromagnetism
- X) Gravity
- Y) Strong interaction
- Z) Weak interaction

ANSWER: X) Gravity

TOSS-UP

11) Biology - *Short Answer* In annelids [AN-uh-lids], the coelom [SEE-lum] is entirely surrounded by tissue derived from which embryonic germ layer?

ANSWER: Mesoderm

BONUS

11) Biology - *Short Answer* Chickens exhibit the ZW sex determination system. If you observe a male chicken epithelial [eh-pih-THEE-lee-ul] cell in metaphase, how many Z chromatids would you observe?

ANSWER: 4

TOSS-UP

12) Physics - *Multiple Choice* What is the minimum velocity that a car can begin with to ensure it completes a vertical circular track of radius of 15 meters in terms of g ?

W) $\sqrt{15g}$

X) $\sqrt{30g}$

Y) $2\sqrt{15g}$

Z) $5\sqrt{3g}$

ANSWER: Z) $5\sqrt{3g}$

BONUS

12) Physics - *Short Answer* A mad scientist circles copper wire around a plastic cylinder. Ignoring fringe effects, identify all of the following three changes that would increase the strength of their homemade electromagnet inside the cylinder: 1) Replacing the plastic with an iron cylinder; 2) Decreasing the current; 3) Increasing the cylinder's radius.

ANSWER: 1 only

TOSS-UP

13) Longtermism - *Multiple Choice* Which scale is used to judge the risk of an asteroid impacting Earth?

- W) Piazzi [pee-AHT-zee] scale
- X) Cassini scale
- Y) Modified magnitude scale
- Z) Torino scale

ANSWER: Z) Torino scale

BONUS

13) Longtermism - *Multiple Choice* Comet impacts present a global catastrophic risk that is higher than their low abundance would suggest. Which of the following factors does NOT make contribute to this greater risk?

- W) Organic molecules in some comets are highly toxic to humans
- X) Comets are harder to detect than asteroids are, due to their irregular orbits
- Y) Comets move faster relative to Earth than asteroids do
- Z) Comets are not as well studied by astronomers

ANSWER: W) Organic molecules in some comets are highly toxic to humans

TOSS-UP

14) Math - *Short Answer* A balanced prime is a prime number n such that the difference between n and the first prime greater than n is the same as the difference between n and the first prime less than n . What is the smallest balanced prime?

ANSWER: 5

BONUS

14) Math - *Short Answer* The numbers 1 through 9 are placed randomly in a 3x3 grid. What is the probability that the sum of the numbers in the first row is 6?

ANSWER: $\frac{1}{84}$

TOSS-UP

15) Chemistry - *Short Answer* Graphite is the only stable form of pure carbon at STP. However, diamonds exist at STP because the activation energy of its conversion to graphite is too high for it to occur. As a result of this, diamonds are considered to be in what energetic state?

ANSWER: Metastable

BONUS

15) Chemistry - *Multiple Choice* The most common allotrope of oxygen is triplet oxygen, which contains two unpaired electrons in pi-antibonding orbitals. Which of the following types of magnetism does triplet oxygen exhibit?

- W) Paramagnetism
- X) Diamagnetism
- Y) Ferromagnetism [FER-UH-mag-nuh-tizm]
- Z) Ferrimagnetism [FER-IH-mag-nuh-tizm]

ANSWER: W) Paramagnetism

TOSS-UP

16) Earth and Space - *Multiple Choice* Which of the following climates is typically found on the leeward side of a mountain?

- W) Dry and warm
- X) Dry and cold
- Y) Wet and warm
- Z) Wet and cold

ANSWER: W) Dry and warm

BONUS

16) Earth and Space - *Multiple Choice* An endorheic [EN-duh-REE-ik] basin would most likely be surrounded by which of the following drainage patterns?

- W) Trellis
- X) Radial
- Y) Annular [AN-yuh-ler]
- Z) Centripetal

ANSWER: Z) Centripetal

TOSS-UP

17) Biology - *Short Answer* Identify all of the following three reproductive barriers that are prezygotic [PREE-zye-GAW-dik]: 1) Mechanical isolation; 2) Gametic isolation; 3) Behavioral isolation.

ANSWER: All

BONUS

17) Biology - *Multiple Choice* Which of the following regions of the cerebral cortex is found in the occipital [ok-SIH-puh-doll] lobe?

- W) Broca's [BRO-kuhs] area
- X) Wernicke's [VER-nih-kees] area
- Y) Sensory association cortex
- Z) Striate [STRY-ate] cortex

ANSWER: Z) Striate cortex

TOSS-UP

18) Physics - *Multiple Choice* Two point charges are spaced 2 meters apart and experience an attractive force. Assuming both charges remain constant, how will this force change if one point charge is changed to a sphere of radius 1 meter with the charge evenly distributed across the surface?

W) Magnitude increases

X) Magnitude decreases

Y) Magnitude remains constant but direction changes

Z) No change occurs

ANSWER: Z) No change occurs

BONUS

18) Physics - *Short Answer* What value describes stiffness and is the rotational equivalent of a spring constant, measured in newton-meters per radian?

ANSWER: Torsion coefficient (ACCEPT: Torsion constant)

TOSS-UP

19) Longtermism - *Short Answer* Which volcanic eruption in Indonesia may have caused a global population bottleneck at the time of its occurrence?

ANSWER: Mt. Toba (ACCEPT: Toba)

BONUS

19) Longtermism - *Short Answer* The anthropic principle states that humanity's observations are influenced by the fact that they could not have occurred without humanity's existence. What form of bias is this?

ANSWER: Selection (ACCEPT: Survivorship)

TOSS-UP

20) Math - *Short Answer* A game is played where two players alternate turns. If the probability of a given player winning the game on a given turn is $\frac{1}{3}$, what is the probability that the first player to take a turn wins the game?

ANSWER: $\frac{3}{5}$ (ACCEPT: 0.6)

BONUS

20) Math - *Multiple Choice* The number 959,310 is divisible by all of the following numbers except:

W) 5

X) 7

Y) 9

Z) 11

ANSWER: X) 7

TOSS-UP

21) Chemistry - *Short Answer* Order the following three liquids in order of increasing viscosity: 1) Water; 2) Acetone [A-sih-tone]; 3) Decane.

ANSWER: 2, 1, 3

BONUS

21) Chemistry - *Short Answer* What is the term given to compounds containing separated negatively and positively charged groups?

ANSWER: Zwitterions [ZWIH-der-EYE-ons] (ACCEPT: Dipolar ions)

TOSS-UP

22) Earth and Space - *Multiple Choice* An RR Lyrae [LIE-ray] variable star would most likely form at which of the following stages of stellar evolution?

- W) Main sequence
- X) Red giant branch
- Y) Asymptotic [ASS-im-TAW-dik] giant branch
- Z) Horizontal branch

ANSWER: Z) Horizontal branch

BONUS

22) Earth and Space - *Short Answer* As viewed from Earth, star A is 100 times brighter than star B. What is the difference in apparent magnitude between star A and star B?

ANSWER: 5

TOSS-UP

23) Biology - *Short Answer* Rhagoletis pomonella [RA-go-lay-deez puh-muh-NEH-la], also known as the apple maggot fly, originally laid eggs in hawthorns to reproduce. However, since the introduction of apples to North America, a distinct form of the flies were seen laying eggs on apples. This is an example of what type of speciation?

ANSWER: Sympatric

BONUS

23) Biology - *Short Answer* What animal phylum is characterized by the presence of flagellated [FLA-juh-lay-ted] choanocytes [ko-AN-oh-sites]?

ANSWER: Porifera (ACCEPT: sponges)

TOSS-UP

24) Physics - *Multiple Choice* A pipe of length L that is closed at one end and open at another will produce a third harmonic closest to which of the following frequencies at room temperature?

W) $\frac{1029}{L}$

X) $\frac{343}{L}$

Y) $\frac{257}{L}$

Z) $\frac{114}{L}$

ANSWER: Y) $\frac{257}{L}$

BONUS

24) Physics - *Short Answer* A large particle with a mass of 125g and charge 1 coulomb is released from rest and drops to a point where the electric potential is 4 volts lower. In meters per second, what must be the particle's velocity at this new point?

ANSWER: 8