

ROUND ROBIN 1

TOSS-UP

1) X-Risk - *Multiple Choice* Many scientists are afraid that climate change could lead to the runaway greenhouse effect, which is currently believed to be the reason that what planet no longer has water?

W) Mercury

X) Venus

Y) Mars

Z) Neptune

ANSWER: X) Venus

BONUS

1) X-Risk - *Short Answer* A rapid intelligence explosion in the future could create what form of AI, which far surpasses humans in intelligence and most or all tasks?

ANSWER: Superintelligence (ACCEPT: Superintelligent, ASI)

TOSS-UP

2) Math - *Multiple Choice* Which of the following values of x is not part of the domain of the function $f(x)$ equals the fraction with numerator $x^2 - 4$ and denominator $x^2 + 4x + 4$?

W) -4

X) -2

Y) 2

Z) 4

ANSWER: X) -2

BONUS

2) Math - *Multiple Choice* For a given function $f(x)$, the quantity $f(x) - f(x - 1)$ approaches infinity as x goes to infinity. Which of the following functions could be $f(x)$?

W) x

X) x^2

Y) $\log x$

Z) e^{-x}

ANSWER: X) x^2

TOSS-UP

3) Chemistry - *Short Answer* What is the molecular geometry of the central phosphorus atom in PCl_5 ?

ANSWER: Trigonal bipyramidal

BONUS

3) Chemistry - *Multiple Choice* In the reaction between lead nitrate and potassium sulfate, what two ions are considered spectator ions?

W) Pb_2^+ and NO_3^-

X) Pb_2^+ and SO_4^{2-}

Y) K^+ and NO_3^-

Z) K^+ and SO_4^{2-}

ANSWER: Y) K^+ and NO_3^-

TOSS-UP

4) Earth and Space - *Multiple Choice* Which of the following grain sizes has the smallest average diameter?

W) Pebble

X) Sand

Y) Silt

Z) Clay

ANSWER: Z) Clay

BONUS

4) Earth and Space - *Short Answer* What Norwegian term describes a glacial valley partially filled with seawater?

ANSWER: Fjord

TOSS-UP

5) Biology - *Short Answer* Jason is trying to find out how many guanine nucleotides are in a double-stranded genome of a virus. If the genome contains 40% adenine, what percentage of the genome is composed of guanine?

ANSWER: 10

BONUS

5) Biology - *Short Answer* The brain and spinal cord make up what part of the nervous system, which processes signals from the rest of the body?

ANSWER: Central nervous system

TOSS-UP

6) Physics - *Multiple Choice* Tim stands on a building 30 meters tall. He throws a ball 45 degrees above the horizontal at a speed v , and throws a ball 45 degrees below the horizontal at speed v . Which of the following correctly describes the relative speeds of the balls when they each hit the ground?

- W) The first ball will hit the ground with a higher speed
- X) The first ball will hit the ground with a lower speed
- Y) They will hit the ground with the same speed
- Z) Impossible to tell

ANSWER: Y) They will hit the ground with the same speed

BONUS

6) Physics - *Short Answer* On the x -axis, two stationary point charges of magnitude Q are placed at $x = -1$ and $x = 1$ with a free electron at the origin. Identify all of the following three arrangements that would create a stable equilibrium: 1) $-Q$ at $x = -1$ and $-Q$ at $x = 1$; 2) $-Q$ at $x = -1$ and $+Q$ at $x = 1$; 3) $+Q$ at $x = -1$ and $+Q$ at $x = 1$.

ANSWER: None

TOSS-UP

7) X-Risk - *Short Answer* DDT in the environment has become a problem for organisms at the apex of the food chain. This is due to what process that concentrates toxins in higher-level predators?

ANSWER: Biomagnification (DO NOT ACCEPT: Bioaccumulation)

BONUS

7) X-Risk - *Multiple Choice* Which of the following best explains why the overuse of antibiotics can make bacteria more dangerous?

W) Antibiotics force bacteria to evolve antibiotic resistance

X) People who overuse antibiotics build tolerance to them

Y) Antibiotics disrupt the human microbiome, increasing vulnerability to pathogens

Z) Antibiotics create a false sense of security, causing doctors to ignore complications

ANSWER: W) Antibiotics force bacteria to evolve antibiotic resistance

TOSS-UP

8) Math - *Multiple Choice* In triangle ABC, line AB has a length of 5 and angle A measures 60 degrees. Which of the following could NOT be the length of BC?

W) 2.5

X) 5

Y) 10

Z) 20

ANSWER: W) 2.5

BONUS

8) Math - *Short Answer* The utility company charges a base rate of \$3.00 and an additional \$0.20 per kilowatt-hour of electricity used. How much money is spent if 18 kilowatt-hours of electricity was consumed?

ANSWER: \$6.60

TOSS-UP

9) Chemistry - *Short Answer* Sodium-23 is sodium's only naturally occurring isotope. How many neutrons are in an atom of sodium-23?

ANSWER: 12

BONUS

9) Chemistry - *Multiple Choice* The breakdown of hydrogen peroxide, H_2O_2 , produces which of the following sets of compounds?

W) H_2 and O_2

X) H_2O and H_2

Y) H_2O and O_2

Z) H_2 , O_2 , and O_3

ANSWER: Y) H_2O and O_2

TOSS-UP

10) Earth and Space - *Short Answer* What term describes the plane on which the major bodies of the solar system orbit?

ANSWER: Ecliptic

BONUS

10) Earth and Space - *Short Answer* What mineral makes up the majority of the rings of Saturn?

ANSWER: Water ice (ACCEPT: Ice)

TOSS-UP

11) Biology - *Multiple Choice* Which of the following plants would open its stomata only at night?

- W) Corn
- X) Sugarcane
- Y) Pineapple
- Z) Rose

ANSWER: Y) Pineapple

BONUS

11) Biology - *Multiple Choice* Which of the following immunoglobulin [im-myun-oh-GLOB-yoo-lin] classes plays the biggest role during the allergic response?

- W) IgA
- X) IgE
- Y) IgG
- Z) IgM

ANSWER: X) IgE

TOSS-UP

12) Physics - *Multiple Choice* Which of the following elements of a circuit dissipates heat?

- W) Resistor
- X) Capacitor
- Y) Inductor
- Z) Wire

ANSWER: W) Resistor

BONUS

12) Physics - *Short Answer* Identify all of the following four elements of a circuit that store energy: 1) Resistor; 2) Capacitor; 3) Inductor; 4) Wire

ANSWER: 2 and 3

TOSS-UP

13) X-Risk - *Multiple Choice* Machine learning, a subfield of computer science, studies which broad category of problems?

- W) Minimizing damage caused by security failures
- X) Deriving models from training data
- Y) Incorporating neurology into algorithm design
- Z) Making computer code more understandable

ANSWER: X) Deriving models from training data

BONUS

13) X-Risk - *Multiple Choice* Which subfield of AI security aims to develop AI systems that will achieve the goals intended by their designers, rather than unintended goals?

- W) AI interpretability
- X) AI alignment
- Y) AI capabilities
- Z) AI ethics

ANSWER: X) AI alignment

TOSS-UP

14) Math - *Short Answer* Identify all of the following three trigonometric functions whose inverses have a domain of all real numbers: 1) Sine; 2) Secant; 3) Tangent.

ANSWER: 3 only

BONUS

14) Math - *Short Answer* An arithmetic sequence has a common difference of 10 and its sixth term is 52. What is the 18th term?

ANSWER: 172

TOSS-UP

15) Chemistry - *Multiple Choice* When a burning strip of magnesium is smothered in carbon dioxide, it continues to burn, producing magnesium oxide and carbon. In this reaction, what is the oxidizing agent and reducing agent, respectively?

- W) Magnesium and carbon dioxide
- X) Carbon dioxide and magnesium
- Y) Magnesium oxide and carbon
- Z) Carbon and magnesium oxide

ANSWER: X) Carbon dioxide and magnesium

BONUS

15) Chemistry - *Short Answer* Benzoic acid is solid at standard conditions and has a standard enthalpy of formation of -400 kilojoules per mole. One mole of benzoic acid requires 10 kilojoules of heat to melt at its melting point and 80 kilojoules to vaporize at its boiling point. What is the lowest possible standard enthalpy of formation of one mole of gaseous benzoic acid?

ANSWER: -310

TOSS-UP

16) Earth and Space - *Multiple Choice* Which of the following minerals, when pure, would not produce any carbon dioxide when reacted with HCl?

- W) Calcite
- X) Dolomite
- Y) Gypsum
- Z) Aragonite

ANSWER: Y) Gypsum

BONUS

16) Earth and Space - *Multiple Choice* La Ninas usually coincide with an increase in fishery productivity in the Eastern South Pacific due to which of the following phenomena?

- W) Increased upwelling
- X) Thickened thermocline
- Y) Increased surface water thickness
- Z) Increased runoff

ANSWER: W) Increased upwelling

TOSS-UP

17) Biology - *Short Answer* ATP synthase utilizes the gradient of which ion to produce ATP?

ANSWER: Proton (ACCEPT: Hydrogen, H⁺, H₃O⁺)

BONUS

17) Biology - *Short Answer* A protein is composed of 15 amino acids. How many water molecules are needed to break all the peptide bonds?

ANSWER: 14

TOSS-UP

18) Physics - *Multiple Choice* An object with mass m and velocity v collides perfectly elastically with another object with mass $2m$ and velocity $-v$. Which of the following is true about the kinetic energy before and after the collision?

- W) The kinetic energy of the objects increases
- X) The kinetic energy of the objects decreases
- Y) The kinetic energy of the objects remains the same
- Z) The kinetic energy of the objects increases then decreases

ANSWER: Y) The kinetic energy of the objects remains the same

BONUS

18) Physics - *Short Answer* To one significant figure, how many seconds does it take for a block to slide from rest down a frictionless 98-meter long incline angled at 30 degrees?

ANSWER: 6

TOSS-UP

19) X-Risk - *Short Answer* One of the first steps of uranium enrichment processes involves converting uranium oxide into a gas which can be more easily separated by density. Which gas is most commonly used for this purpose?

ANSWER: Uranium hexafluoride (ACCEPT: UF₆)

BONUS

19) X-Risk - *Short Answer* One of the primary health effects of nuclear fallout is the concentration of radioactive isotopes of what element in the thyroid?

ANSWER: Iodine

TOSS-UP

20) Math - *Multiple Choice* All of the following figures have the same area. Which has the smallest perimeter?

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

ANSWER: W) Circle

BONUS

20) Math - *Multiple Choice* Two math classes are competing with one another to see who scores the higher average on the upcoming exam. If class A averaged 75 points, class B averaged 90 points, and the classes together averaged 87 points, what is the ratio between the number of students in class A to class B?

- W) 1:2
- X) 1:3
- Y) 1:4
- Z) 1:5

ANSWER: Y) 1:4

TOSS-UP

21) Chemistry - *Short Answer* The electrolysis of water produces diatomic hydrogen and oxygen gases. What is the ratio of the volume of hydrogen gas produced to the volume of oxygen gas produced?

ANSWER: 2

BONUS

21) Chemistry - *Multiple Choice* A 1 gram sample of which of the following elements would have the greatest number of molecules?

W) Hydrogen

X) Helium

Y) Lithium

Z) Beryllium

ANSWER: W) Hydrogen

TOSS-UP

22) Earth and Space - *Short Answer* Order the following three stages of a one solar mass star in chronological order: 1) White dwarf; 2) Red giant; 3) Main sequence.

ANSWER: 3, 2, 1

BONUS

22) Earth and Space - *Short Answer* Identify all of the following three parameters that vary during the Milankovitch cycles: 1) Orientation of Earth's rotational axis; 2) Obliquity of Earth's rotational axis; 3) Obliquity of Earth's magnetic axis.

ANSWER: 1 and 2

TOSS-UP

23) Biology - *Short Answer* When epinephrine [ep-uh-NEF-rin] binds to its receptor, it induces the cyclization of ATP into what second messenger?

ANSWER: Cyclic AMP (ACCEPT: cAMP)

BONUS

23) Biology - *Short Answer* What hypothesis states that force from transpiration is transmitted along the entire length of the xylem, and drives the ascent of xylem sap?

ANSWER: Cohesion-tension hypothesis

TOSS-UP

24) Physics - *Multiple Choice* Which elementary particle is responsible for carrying the strong force?

W) Z boson

X) Muon

Y) Gluon

Z) Neutrino

ANSWER: Y) Gluon

BONUS

24) Physics - *Short Answer* A ball is attached to a string and is experiencing uniform circular motion. Identify all of the following three quantities that are zero: 1) Magnitude of torque; 2) Magnitude of angular acceleration; 3) Magnitude of net acceleration.

ANSWER: 1 and 2