

Round 9

1. MATHEMATICS

Toss Up: Short Answer

Alice flips a coin until it lands up heads. To the nearest tenth, what is the expected number of flips she will make?

Bonus Answer: 2

Bonus: Multiple Choice

What is the name of the curve traced by a fixed point on a circle that is rolling around fixed circle of the same radius? It also appears in the Mandelbrot set.

- W) cardioid
- X) nephroid
- Y) cycloid
- Z) hyperellipse

Bonus Answer: W

2. EARTH and SPACE

Toss Up: Short Answer

What volcano has erupted in the years 79 A.D., 1139, 1631, 1779, 1793, 1872, 1906, and 1944?

Bonus Answer: Vesuvius

Bonus: Short Answer

What is the name of the very old mountain belt located in southern Missouri and Northern Arkansas?

Bonus Answer: the ozarks

3. CHEMISTRY

Toss Up: Multiple Choice

Which of the following statements about catalysts is true?

- W) They increase the value of the equilibrium constant.
- X) They increase the amount of product present at equilibrium.
- Y) They increase the concentration of the reactants.
- Z) They reduce the activation energy of the reaction.

Toss Up Answer: Z

Bonus: Multiple Choice

What is the product of water and pentyl ethanoate under acidic conditions?

- W) Ethanoic acid and pentanol
- X) Butanol and water
- Y) Ethanoic acid, two equivalents
- Z) Pentanol, two equivalents

Bonus Answer: W

4. EARTH and SPACE

Toss Up: Multiple Choice

What is the name given to planets that lie within a habitable zone of a star?

- W) Extraneous Planets

- X) Habitable Planets
- Y) Goldilocks Planet
- Z) Temperate Planets

Toss Up Answer: Y

Bonus: Short Answer

What is the name given to a cloud of dust and gas in outer space?

Bonus Answer: nebula

5. CHEMISTRY

Toss Up: Multiple Choice

Which of the following has the greatest entropy?

- W) Gaseous Substances
- X) Gases
- Y) Liquids
- Z) Solids

Toss Up Answer: X

Bonus: Short Answer

What is the name of the equation used to determine if a reaction is spontaneous or not?

Bonus Answer: Gibbs-Free Energy Equation

6. EARTH and SPACE

Toss Up: Short Answer

How many Dwarf planets are in the solar system?

Bonus Answer: 3

Bonus: Short Answer

What is the approximate date for the Earth's formation?

Bonus Answer: 4.5 billion BC

7. MATHEMATICS

Toss Up: Short Answer

What is the magnitude of the quantity $(i + 1)^{10}$?

Bonus Answer: 32

Bonus: Short Answer

If the sum of the interior angles of a polygon is 18 thousand degrees, how many sides does it have?

Bonus Answer: 102

8. CHEMISTRY

Toss Up: Short Answer

What is the geometric configuration of HF?

Bonus Answer: Linear

Bonus: Multiple Choice

For which of the following compounds is cis-trans isomerism possible?

- W) hept-1-ene
- X) but-1-ene
- Y) 2-methylpropene

Z) but-2-ene

Bonus Answer: Z

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9. MATHEMATICS

Toss Up: Short Answer

A square is inscribed in a circle, which is inscribed in a unit square. What is the area of the smaller square?

Bonus Answer: 1/2

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Bonus: Short Answer

What is the remainder when 7^{420} is divided by 3?

Bonus Answer: 1

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10. PHYSICS

Toss Up: Short Answer

What is the charge of a muon?

Bonus Answer: -1 [or -1e]

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Bonus: Multiple Choice

As an object falls freely, how does the energy of the object change?

W) kinetic energy and potential energy both increase

X) kinetic energy and potential energy both decrease

Y) kinetic energy increases while potential energy decreases

Z) kinetic energy decreases while potential energy increases

Bonus Answer: Y

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11. MATHEMATICS

Toss Up: Multiple Choice

What is the least positive integer with exactly six factors?

W) 6

X) 12

Y) 18

Z) 24

Toss Up Answer: X

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Bonus: Short Answer

Giving your answer as one, two, three, or four, in what quadrant will theta terminate if sine theta and secant theta are both negative?

Bonus Answer: 3

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12. BIOLOGY

Toss Up: Short Answer

Into what common vein does lymph dump into to bring it back into circulation?

Bonus Answer: Subclavian vein

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Bonus: Short Answer

Usually, what functional group is added to molecules as part of the detoxification process in the ER to allow it to be urinated out?

Bonus Answer: Hydroxyl Group (OH group)

13. PHYSICS

Toss Up: Short Answer

Since the specific gravity of lead is 11.35, it is how

many times as dense as water?

Bonus Answer: 11.35

Bonus: Short Answer

What Greek letter denotes angular acceleration?

Bonus Answer: alpha

14. CHEMISTRY

Toss Up: Multiple Choice

Given the pressure and temperature of gas A and the temperature of gas B, which law would be most efficient in determining the pressure of gas B?

W) Gay-Lussac's Law

X) Boyle's Law

Y) Charles's Law

Z) Combined Gas Law

Toss Up Answer: W

Bonus: Short Answer

What is the metric equivalence of 760 mm Hg?

Bonus Answer: 101325 Pascals

15. PHYSICS

Toss Up: Multiple Choice

Work is a

W) vector

X) scaler

Y) cross product

Z) an imaginary number

Toss Up Answer: X

Bonus: Short Answer

What is the greek letter for angular velocity

Bonus Answer: Omega

16. CHEMISTRY

Toss Up: Short Answer

What is the atomic number of uranium?

Bonus Answer: 92

Bonus: Short Answer

Which scientist discovered the element uranium?

Bonus Answer: Klaproth, Martin Klaproth, Martin Heinrich Klaproth

17. PHYSICS

Toss Up: Short Answer

What is the speed of light in km per second?

Bonus Answer: about 1.079×10^9 km per second

Bonus: Short Answer

What equation relates and connects the the concepts of mass and energy?

Bonus Answer: $E = mc^2$

18. BIOLOGY

Toss Up: Short Answer

How many subunits does a tubulin protein have?

Bonus Answer: 2

Bonus: Short Answer

The blood enter systemic circulation via the aorta, and returns to the heart via what common vein?

Bonus Answer: Vena Cava (accept superior or inferior vena cava)

19. PHYSICS

Toss Up: Short Answer

The acceleration due to gravity on the Earth's surface is

Bonus Answer: 9.8 m/s^2

Bonus: Multiple Choice

Which of the following quantities is a scalar?

W) acceleration

X) force

Y) speed

Z) velocity

Bonus Answer: Y

20. BIOLOGY

Toss Up: Short Answer

What organelle in a human cell is responsible for breaking down waste material?

Bonus Answer: Lysosome

Bonus: Short Answer

Order the following from the least specific to the most: Species, Family, Order, Phylum

Bonus Answer: Phylum, Order, Family, Species (4, 3, 2, 1)

21. BIOLOGY

Toss Up: Multiple Choice

The amino acid sequences encoded by the red and green visual pigment genes in humans are 96% identical. These two loci are found close together on the X chromosome. What mechanism most likely led to the evolution of these two genes?

W) Horizontal gene transfer followed by sequence divergence

X) Gene duplication followed by sequence divergence

Y) Inversion of the human X chromosome

Z) Polyploidization

Toss Up Answer: X

Bonus: Multiple Choice

Genetic drift is best described as:

- W) evolutionary change due to natural selection.
- X) changes in the proportion of homozygous recessive individuals due to random mating.
- Y) a random change in allele frequencies that benefits the population.
- Z) evolutionary change due to random events.

Bonus Answer: Z

22. BIOLOGY**Toss Up: Multiple Choice**

SNPs can be characterized by all of the following EXCEPT for:

- W) always causing diseases.
- X) being common in a population.
- Y) acting as a point mutation.
- Z) acting as a transition mutation.

Toss Up Answer: W

Bonus: Short Answer

Which of the following cells are phagocytic?

- 1. Megakaryocyte
- 2. Dendritic cells
- 3. Natural killer cells
- 4. Neutrophils
- 5. Monocytes

Bonus Answer: 2, 4, 5

(Dendritic cells, Neutrophils, Monocytes)

23. BIOLOGY**Toss Up: Multiple Choice**

A female lizard washes ashore on an island after riding a floating log for hundreds of miles across the sea. She is the only member of her species to have ever made it to the island. After arriving, she lays 20 fertile eggs that hatch and form the basis of a lizard population on the island. Which of the following is NOT a likely result?

- W) The new island population will have less genetic diversity than the ancestral population.
- X) Mutation will add new alleles to the new population and thus increase its genetic diversity over time.
- Y) There will be little or no gene exchange between the new population and the ancestral population.
- Z) The new island population will have greater genetic diversity than the ancestral population.

Toss Up Answer: Z

Bonus: Multiple Choice

Loss of heterozygosity can be caused by all of the following EXCEPT:

- W) genetic drift.
- X) positive frequency-dependent selection.
- Y) heterozygote advantage.
- Z) inbreeding.

Bonus Answer: Y

24. BIOLOGY

Toss Up: Multiple Choice

Which of the following processes in cellular respiration produce the most ATP

- W) Glycolysis
- X) Link Reaction
- Y) Krebs Cycle
- Z) Oxidative Phosphorylation

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following is not used in cellular respiration

- W) Glucose
- X) NADH
- Y) FADH₂
- Z) NADPH

Bonus Answer: Z

25. BIOLOGY

Toss Up: Multiple Choice

Surfactant helps to prevent the alveoli from collapsing by:

- W) humidifying the air before it enters
- X) Reducing the surface tension of alveolar fluid
- Y) warming the air before it enters
- Z) protecting the surface of alveoli from dehydration and other environmental variations

Toss Up Answer: X

Bonus: Multiple Choice

Respiratory control centers are located in the

- W) midbrain and medulla
- X) pons and midbrain
- Y) medulla and pons
- Z) upper spinal chord and medulla

Bonus Answer: Y
