Round 12

1. MATHEMATICS

Toss Up: Multiple Choice

If θ is an angle such that sin(θ) < 0 and cos (θ) = 0, where in the coordinate plane is it located?

W) Between the 2nd and 3rd quadrants

X) Between the 3rd and 4th quadrants

Y) Between the 1st and 4th quadrants

Z) Between the 1st and 2nd quadrants

Toss Up Answer: Y

Bonus: Short Answer

What is the remainder of x^10+x+1 divided by (x-1)^2 ?

Bonus Answer: 11x-8

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2. ENERGY

Toss Up: Short Answer

Which compound contributes the most to global warming?

Bonus Answer: water

Bonus: Short Answer

What is China's largest renewable energy source?

Bonus Answer: Hydro

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3. PHYSICS

Toss Up: Multiple Choice

An acceptor replacement atom in silicon might have electrons in its outer shell

W) 3

X) 4

Y) 5

Z) 6

Toss Up Answer: W

Bonus: Multiple Choice

When a forward bias is applied to a p-n junction the concentration of electrons on the p side:

W) increases slightly

X) increases dramatically

Y) decreases slightly

Z) decreases dramatically

Bonus Answer: X

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4. PHYSICS

Toss Up: Multiple Choice

Monochromatic light is normally incident on a diffraction grating that is 1cm wide and has 10,000 slits. The first order line is deviated at a 30◦ angle. What is the wavelength, in nm, of the incident light?

W) 300

X) 500

Y) 877

Z) 1000

Toss Up Answer: X

Bonus: Multiple Choice

A spectral line of a certain star is observed to be “red shifted” from a wavelength of 500nm to a wavelength of 1500nm. Interpreting this as a Doppler effect, the speed of recession of this star is:

W) .33c

X) .5c

Y) .71c

Z) .8c

Bonus Answer: Z

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5. PHYSICS

Toss Up: Multiple Choice

The equation of continuity for fluid flow can be derived from the conservation of:

W) energy

X) mass

Y) angular momentum

Z) volume

Toss Up Answer: X

Bonus: Multiple Choice

A coil has a resistance of 60Ω and an impedance of 100Ω. Its reactance, in ohms, is:

W) 40

X) 60

Y) 80

Z) 117

Bonus Answer: Y

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6. CHEMISTRY

Toss Up: Multiple Choice

Which of the following factors will contribute to a decrease in oxygen in a pond?

W) decreasing salinity

X) increasing acidity

Y) increasing temperature

Z) increasing surface tension of the water

Toss Up Answer: Y

Bonus: Multiple Choice

When KCl dissolves in water, the solution cools noticeably to the touch. It may be concluded that

W) the entropy increase overcomes the unfavorable heat of dissolution

X) KCl is relatively insoluble in water

Y) the entropy decreases when KCl dissolves

Z) the boiling point of the solution will be less than 100 degrees Celsius

Bonus Answer: W

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7. MATHEMATICS

Toss Up: Short Answer

What is the 5th non-triangular number?

Bonus Answer: 8

Bonus: Short Answer

Name all the following that are true:

1. An icosahedron has 18 faces.
2. A regular hexahedron has 16 edges.
3. There are only nine regular polyhedra.
4. A regular octahedron has 4 times the volume of a regular tetrahedron with the same side length.

Bonus Answer: 2,4 (an icosahedron has 20 faces; a cube has 12 edges)

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8. BIOLOGY

Toss Up: Multiple Choice

Which mollusk does not possess a radula?

W) Squid

X) Scallop

Y) Snail

Z) Chiton

Toss Up Answer: X

Bonus: Short Answer

What is the scientific name for the job or role an organism plays in its habitat?

Bonus Answer: Niche

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9. BIOLOGY

Toss Up: Multiple Choice

What branching nerve fibers receive messages?

W) Axons

X) Axes

Y) Dendrons

Z) Dendrites

Toss Up Answer: Z

Bonus: Multiple Choice

What protein was first isolated in red blood cells?

W) Myoglobin

X) Hemocyanin

Y) Spectrin

Z) Collagen

Bonus Answer: Y

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10. MATHEMATICS

Toss Up: Short Answer

What is the inverse of the 2x2 matrix (row 1: 6 10), (row 2: 3 5)?

Bonus Answer: The matrix has no inverse (b.c. determinant = 0).

Bonus: Short Answer

The legs of an isosceles triangle have a length of 10, and the altitudes to the legs have a length of 6. In simplified radical form, what is the length of the altitude to the base of the triangle?

Bonus Answer: 3 * sqrt(10) (Do not accept sqrt(90))

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11. PHYSICS

Toss Up: Short Answer

The Curie temperature is the temperature at which ferromagnets become paramagnets. What is the name for the point at which antiferromagnets become paramagnets?

Bonus Answer: The Neel temperature

Bonus: Multiple Choice

A hall probe measures which of the following

W) Capcitance

X) Viscosity

Y) Magnetic Field

Z) Electric Field

Bonus Answer: Y

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12. CHEMISTRY

Toss Up: Multiple Choice

Diamond is classified as

W) a covalent crystal

X) an ionic crystal

Y) a molecular crystal

Z) a metallic crystal

Toss Up Answer: W

Bonus: Multiple Choice

A liquid substance that exhibits low intermolecular attractions is expected to have

W) low viscosity, low boiling point, and low heat of vaporization

X) high viscosity, low boiling point, and low heat of vaporization

Y) low viscosity, high boiling point, and low heat of vaporization

Z) low viscosity, low boiling point, and high heat of vaporization

Bonus Answer: W

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13. MATHEMATICS

Toss Up: Short Answer

If n is a positive integer, what is the smallest value of n such that n! + 1 is a perfect square?

Bonus Answer: 4

Bonus: Short Answer

If z1 = 3 - 4i and z2 = 7 + i, find the absolute value of z1z2 in simplest terms.

Bonus Answer: 25*sqrt(2)

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14. CHEMISTRY

Toss Up: Multiple Choice

Which element is expected to have the greatest polarizability?

W) Fe

X) Ca

Y) Ne

Z) S

Toss Up Answer: W

Bonus: Multiple Choice

A student observed that a small amount of acetone sprayed on the back of the hand felt very cool compared to a similar amount of water. Your explanation of this phenomena should be that

W) all organic compounds do this

X) acetone has a lower viscosity and transfers heat quanta better

Y) water has a higher heat capacity than acetone, therefore retaining more heat

Z) the higher vapor pressure of acetone results in more rapid evaporation and heat loss

Bonus Answer: Z

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15. CHEMISTRY

Toss Up: Multiple Choice

Compared to ideal gases, real gases tend to have

W) larger volumes

X) lower average kinetic energies

Y) lower pressures

Z) Both (W) and (Y)

Toss Up Answer: Z

Bonus: Multiple Choice

A gas has a density, at STP, of 3.48 g L^-1. The most reasonable formula for this compound is

W) C2H6

X) C6H6

Y) CCl4

Z) CaF2

Bonus Answer: X

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16. CHEMISTRY

Toss Up: Multiple Choice

Sulfur forms the following compounds: SO2, SCl2, and SO32-. Which form of hybridization is NOT represented by these molecules?

W) sp

X) sp2

Y) sp3

Z) None of these

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following is least related to the strength of a covalent bond?
W) vibrational frequency
X) bond order
Y) bond length
Z) bond direction

Bonus Answer: Z

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17. EARTH and SPACE

Toss Up: Short Answer

What mountain has the highest point in the Western Hemisphere?

Bonus Answer: Mt. Aconcagua

Bonus: Multiple Choice

Which of the following describes how sea ice is different from continental ice?
W) Continental ice is denser than sea ice
X) Sea ice is saline while continental ice is fresh
Y) Sea ice floats on the water while continental ice sits on land
Z) Sea ice is constantly changing while continental ice remains the same

Bonus Answer: Y

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18. BIOLOGY

Toss Up: Short Answer

Give the genus and species name of the organism that Beadle and Tatum worked with.

Bonus Answer: Neurospora crassa

Bonus: Short Answer

Archibald Garrod is credited with the discovery of which disease, characterized by blackened urine?

Bonus Answer: Alkaptonuria

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19. CHEMISTRY

Toss Up: Multiple Choice

Which of these molecules has the most pi bonds?
W) HCN
X) PF5
Y) NH3
Z) SO3

Toss Up Answer: W

Bonus: Short Answer

What name should be given to a molecule with the formula N2O5?

Bonus Answer: dinitrogen pentoxide

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20. BIOLOGY

Toss Up: Short Answer

Name the two types of cell death.

Bonus Answer: Apoptosis, Necrosis

Bonus: Short Answer

In C4 and CAM photosynthesis, which specific enzyme is used to fix CO2 in lieu of RuBisCO?

Bonus Answer: PEP Carboxylase

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21. EARTH and SPACE

Toss Up: Short Answer

What is the second longest Peninsula in the world?

Bonus Answer: Baja California

Bonus: Short Answer

What is a system or group of parallel mountain ranges together with the intervening plateaus and other features?

Bonus Answer: Cordillera

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22. EARTH and SPACE

Toss Up: Short Answer

Thousands of rivers drain the continental United States. These rivers primarily drain into which three bodies of water?

Bonus Answer: GULF OF MEXICO, ATLANTIC OCEAN (ACCEPT: GULF OF ST. LAWRENCE), PACIFIC OCEAN (ACCEPT: SEA OF CORTEZ, GULF OF CALIFORNIA)

Bonus: Short Answer

What is the longest Peninsula in the world?

Bonus Answer: Malay Peninsula

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23. EARTH and SPACE

Toss Up: Multiple Choice

The reason there aren't any active volcanoes in the Himalayan mountain range is because:

W) The Indian plate is composed of basaltic igneous rock, which only melts at higher temperatures.
X) It was formed by localized faults in the Earth's upper crust.
Y) It was formed by the collision of two continental plates with no significant density differences.
Z) It is composed of extinct volcanoes.

Toss Up Answer: Y

Bonus: Short Answer

The South Georgia and the South Sandwich Islands were formed by the collision of which two tectonic plates?

Bonus Answer: South Sandwich Plate and South American Plate

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24. BIOLOGY

Toss Up: Short Answer

Which model is currently accepted as representative of the dynamic nature of the Golgi apparatus?

Bonus Answer: Cisternal Maturation model

Bonus: Short Answer

Which cytoskeletal element functions in cleavage furrow formation?

Bonus Answer: Microfilament

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25. EARTH and SPACE

Toss Up: Multiple Choice

In the Bowen Reaction Series, which of the following minerals would solidify last in a mass of cooling magma?

W) Biotite Mica

X) Pyroxene
Y) Olivine
Z) Amphibole
Toss Up Answer: W

Bonus: Short Answer
What is the name given to any fragmental material produced by a volcanic eruption regardless of composition and fragment size?
Bonus Answer: Tephra

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