Round 30

1. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

What is the penultimate spectral type of a star?

W) F

X) G

Y) K

Z) M

Toss Up Answer: Y

Bonus: Short Answer

What spectral type is the Sun?

Bonus Answer: G

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2. CHEMISTRY

Writer: Jason Mohabir

Toss Up: Multiple Choice

The H–C–O bond angle in H2C=O (formaldehyde) is approximately:

W) 90

X) 109

Y) 120

Z) 180

Toss Up Answer: Y

Bonus: Short Answer

In which compound does carbon have the highest oxidation state?

1. CH4
2. HCN
3. H2CO
4. CH2Cl2

Bonus Answer: 2. HCN

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3. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

The kinases that perform cellular activities throughout the cell cycle are allosterically regulated by what molecules?

Bonus Answer: cyclins

Bonus: Multiple Choice

Synapsis begins during which stage of prophase I?

W) leptotene

X) zygotene

Y) diplotene

Z) diakinesis

Bonus Answer: X

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4. MATHEMATICS

Writer: Aaron Gee

Toss Up: Multiple Choice

If an arc of 60° on circle 1 has the same length as an arc of 45° on circle 2, what is the ratio of the area of circle 1 to the area of circle 2?

W) 9:16

X) 9:15

Y) 4:3

Z) 2:5

Toss Up Answer: W

Bonus: Short Answer

What is the reciprocal of the complex number 2 + i?

Bonus Answer: (2/5) – (1/5)i

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5. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

In plant cells grown in the presence of a metabolic poison that specifically inhibits mitochondrial F1 ATP synthase, one would expect:

W) the pH difference across the cristae to be greater than normal.

X) the pH difference across the cristae to be less than normal.

Y) the electron transport chain to become inoperative.

Z) oxygen consumption to cease.

Toss Up Answer: W

Bonus: Short Answer

With proofreading, what is approximately the error rate of DNA polymerase?

Bonus Answer: One error in every 10^9 bases.

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6. MATHEMATICS

Writer: Elias Milborn

Toss Up: Short Answer

What is the probability of, in no particular order, flipping exactly 2 heads and 2 tails when flipping 4 coins?

Bonus Answer: 3/8 (accept .375 or 37.5%)

Bonus: Short Answer

Given a circle centered at 1,2 what is the slope of a tangent line which passes through the point (3,3)

Bonus Answer: -2

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7. EARTH and SPACE

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

A stream can lengthen its channel by:

W) hydraulic action

X) headward erosion

Y) downcutting

Z) vertical accretion

Toss Up Answer: X

Bonus: Multiple Choice

In uniform flat rocks, drainage patterns are typically

W) Radial

X) dendritic

Y) trellis

Z) braided

Bonus Answer: X

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8. BIOLOGY

Writer: Jason Mohabir

Toss Up: Multiple Choice

Which protein did Nobel Laureate Christian Anfinsen characterize to come to the conclusion that the native structure is determined only by the protein's amino acid sequence?

W) catalase

X) ribonuclease A

Y) luciferase

Z) amylase

Toss Up Answer: X

Bonus: Short Answer

What is the name of the thought experiment that postulates that because of the very large number of degrees of freedom in an unfolded polypeptide chain, the molecule has an astronomical number of possible conformations?

Bonus Answer: Levinthal's paradox OR Levinthal

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9. EARTH and SPACE

Writer: Jan Wojcik

Toss Up: Multiple Choice

Which of the following pairs of minerals share the same cleavage?

W) Fluorite and Calcite

X) Mica and Galena

Y) Cryolite and Fluorite

Z) Halite and Sylvite

Toss Up Answer: Z

Bonus: Short Answer

In how many directions does muscovite break (cleave)?

Bonus Answer: 1 (one)

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10. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

Which of the following is not commonly produced by eletrolysis?

W) NaOCl

X) Al

Y) Fe

Z) NaOH

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following pairs of constants are not mathematically related to eachother?

W) Equilibrium constant and Gibbs Free Energy

X) Rate Constant and Activation Energy

Y) Standard Cell Voltage and Equilibrium Constant

Z) Standard Cell Voltage and Rate Constant

Bonus Answer: Z

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11. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

If we could observe all forms of radiation, what would the brightest star be?

Bonus Answer: Betelgeuse

Bonus: Multiple Choice

In 12000 years, which star will take the place of our North Star?

W) Aldebaran

X) Vega

Y) Sirius

Z) Rigel

Bonus Answer: X

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12. BIOLOGY

Writer: Josh Tish

Toss Up: Short Answer

You perform a transformation and calculate a viable count of 9000 cells/mL. If your transformation efficiency was 10%, how many colonies would you expect to see if you plate 100uL of cells onto selective media?

Bonus Answer: 90

Bonus: Short Answer

If the mother of a child suffers from diabetes mellitus and deafness (DAD) and the father does not, what is the likelihood that the child will develop degenerative optomosis?

*Note: Diabetes mellitus and deafness (DAD) is a genetic disorder, not separate ailments.

Bonus Answer: 100%. (EXPLANATION: DAD is caused by mutations in mtDNA, which are passed on only by the mother.)

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13. MATHEMATICS

Writer: Elias Milborn

Toss Up: Multiple Choice

Which of the following is an accurate representation of the inverse of f(x) = x^3 - 5?

W) x^3 - 5

X) (x - 5)^3

Y) (x - 5)^(1/3)

Z) 1/(x-5)^3

Toss Up Answer: Y

Bonus: Short Answer

The three sides of a triangle are 5cm, 6cm, and 8cm. What is the cosine of the smallest angle in reduced fractional

form?

Bonus Answer: 25/32

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14. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What is the repeated 6-base DNA sequence of a human telomere?

Bonus Answer: TTAGGG

Bonus: Multiple Choice

Which histone binds to linker DNA in DNA packing?

W) H3

X) H2B

Y) H4

Z) H1

Bonus Answer: Z

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15. CHEMISTRY

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is the lightest element with no stable isotopes?

W) Tellurium

X) Technetium

Y) Promethium

Z) Radon

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following is the strongest intermolecular force?

W) Hydrogen Bonding

X) Ionic Bonding

Y) London Dispersion Force

Z) Covalent Bonding

Bonus Answer: W

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16. MATHEMATICS

Writer: Justin Lam

Toss Up: Short Answer

What is the volume of a sphere if the radius is 7 inches? (use 22 / 7 for pi) You may either use fractions or decimals rounded to the nearest hundredth as your answer.

Bonus Answer: V = 4312 / 3 cubic inches

or V = 1437. 33 cubic inches

(they must include the correct units)

Bonus: Short Answer

Find the surface area of a rectangular prism if the length is 2 inches, the width is 3 inches, and the height is 2 inches.

Bonus Answer: V = 32 square inches

(they must include the correct units)

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17. BIOLOGY

Writer: Jason Mohabir

Toss Up: Multiple Choice

Which of the following phospholipids is released by phagocytic cells and leads to superoxide radical production in alveoli macrophages?

W) Plasmalogens

X) Phosphatidylinositol

Y) Cardiolipin

Z) Platelet activating factor

Toss Up Answer: Z

Bonus: Short Answer

Which of the following forms of movement do the phospholipids of plasma membranes have routinely exhibit? Answer with the number.

1. Diffusion in the plane of the bilayer
2. Translocation from one side of the bilayer to the other side
3. Rotation of fatty-acid residues around saturated carbon atoms

Bonus Answer: 1 and 3

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18. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of the following is an example of a strong nucleophile but a weak base?

W) CH3OH

X) OH-

Y) I-

Z) F-

Toss Up Answer: Y

Bonus: Short Answer

By name or number, which of the following are second order reactions?

1. Sn1
2. Sn2
3. E1
4. E2

Bonus Answer: Sn2 and E2 only (accept 2, 4 only)

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19. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Polarity in the developing Drosophila embryo is determined by:

W) a protein gradient of the segmentation protein engrailed

X) a protein gradient of the bicoid protein expressed from maternal mRNA

Y) a protein gradient of the gap protein hunchback

Z) expression of the segmentation protein engrailed throughout the embryo

Toss Up Answer: X

Bonus: Multiple Choice

When a four-cell Xenopus embryo is divided into ventral and dorsal halves,
the half containing the Nieuwkoop center will develop:
W) ventralized features
X) dorsalized features
Y) as a normal embryo
Z) only to the 8-cell stage

Bonus Answer: X

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20. ENERGY

Writer: Olivia Gallager

Toss Up: Short Answer

Which of the following, by name or number, are not considered to be a greenhouse gas: Nitrous Oxide, Water Vapor, Methane, and Nitrogen gas.

Bonus Answer: Nitrogen Gas, 4

Bonus: Short Answer

What are the two most used fuels for nuclear reactors?

Bonus Answer: Plutonium and Uranium

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21. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of the following is thought to have underwent secondary endosymbiosis?
W) Ciliate
X) Dinoflagellates
Y) Diatoms
Z) Algae

Toss Up Answer: Z

Bonus: Short Answer

From what specific class of bacteria are mitochondria thought to originate from?

Bonus Answer: Alpha proteobacteria

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22. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Certain atoms exhibit paramagnetic or diamagnetic bonding. Of the following below which choice is classified as paramagnetic?
W) Zinc (Zn)
X) Krypton (Kr)
Y) Helium (He)
Z) Oxygen (O)

Toss Up Answer: Z

Bonus: Short Answer

Melting point is effected by bond strength. By name or number, order the following compounds in increasing order of melting point:

1. graphite
2. methane
3. lithium
4. sodium chloride

Bonus Answer: Methane, lithium, sodium chloride, graphite (2, 3 , 4, 1)

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23. ENERGY

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

In a typical power plant used to generate electricity in the U.S., the
percentage of energy in the fuel that is converted to electricity is about:
W) 60%
X) 90%
Y) 20%
Z) 35%

Toss Up Answer: Z

Bonus: Short Answer

The Nuclear Waste Policy Act of 1982 and amendments require what
Federal agency to site, construct and operate a geologic repository for disposal of high-level nuclear waste?

Bonus Answer: U.S. Department of Energy

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24. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

Factor (mn)^2 - p^2.

Bonus Answer: (mn - p)(mn + p)

Difference of Squares

Bonus: Short Answer

Factor a^4 + 4b^4.

Bonus Answer: (a^2 + 2b^2 + 2ab)(a^2 + 2b^2 - 2ab)

Solution:

a^4 + 4b^4 = a^4 + 4a^2b^2 + 4b^4 - 4a^2b^2

(a^2+2b^2)^2 - (2ab)^2 = (a^2 + 2b^2 + 2ab)(a^2 + 2b^2 - 2ab)

Difference of Squares

(This is also the Sophie Germain Identity)

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25. ENERGY

Writer: Aaron Gee

Toss Up: Short Answer

Used normally, a 150-watt, 120 volt light bulb requires how many amps of current?

Bonus Answer: 1.25 Amps

Bonus: Short Answer

If 10 joules of energy are required to move 5 coulombs of charge between two points, the potential difference between the two points is equal to how many volts?

Bonus Answer: 2 volts

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