

Round 13

1. MATHEMATICS

Toss Up: Multiple Choice

A right triangle has a hypotenuse of length 12. The altitude to the hypotenuse has a length of 8. What is the area of this triangle?

- W) 36
- X) 48
- Y) 60
- Z) The triangle is impossible to construct

Toss Up Answer: Z

Bonus: Short Answer

Two REAL numbers x and y satisfy the system of equations: $x + y = 12$; $x^2 + y^2 = 64$. Find the value of the product xy .

Bonus Answer: The system has no solutions.

2. MATHEMATICS

Toss Up: Short Answer

In simplest terms, find the value of the limit as x approaches 0 of $(4^x - 2^x) / x$

Bonus Answer: $\ln(2)$ (do not accept $\ln(4) - \ln(2)$)

Bonus: Short Answer

How many real solutions for x does the equation $x = \ln(x) + 2$ have?

Bonus Answer: 2

3. MATHEMATICS

Toss Up: Multiple Choice

If the test scores of Mr. Coco's Calculus test are assumed to have a normal distribution, and if the mean test score was 91, what can be said about the median test score of that test?

- W) The median was lower than 91
- X) The median was higher than 91
- Y) The median was 91
- Z) The median cannot be determined

Toss Up Answer: Y

Bonus: Multiple Choice

The z-score for Shantanu's physics test grade was found to be 0.375. If he scored a 94 on the test, and the standard deviation was 8, what was the mean test score on the physics test?

- W) 91
- X) 95
- Y) 92
- Z) 98

Bonus Answer: W

4. MATHEMATICS

Toss Up: Multiple Choice

Simplify $(\sin 15 \cos 75 - \cos 15 \sin 75) / (\cos 15 \cos 75 + \sin 15 \sin 75)$

- W) negative square root of 3

- X) $\frac{1}{2}$
Y) $-\frac{1}{2}$
Z) square root 6 minus square root 2 all over 2

Toss Up Answer: W

Bonus: Short Answer

Compute $(2+2\sqrt{3})i^6$. [2+2 times the square root of 3, i to the 6th power]

Bonus Answer: 4096

5. BIOLOGY

Toss Up: Multiple Choice

Which of these is not a stop codon?

- W) UAA
X) UGG
Y) UGA
Z) UAG

Toss Up Answer: X

Bonus: Short Answer

What was the first codon-amino acid pair to be identified? (Give both the codon and the amino acid)

Bonus Answer: UUU and phenylalanine

6. BIOLOGY

Toss Up: Multiple Choice

Modern research has shown that silent mutations can be harmful in all of the following ways except:

- W) Causing a short pause during codon-anticodon pairing in translation
X) Reducing the stability of the mRNA's 3D structure
Y) Causing improper splicing of the primary transcript
Z) Slowing the rate of transport of mRNA across the nuclear membrane

Toss Up Answer: Z

Bonus: Short Answer

Which type of RNA is most common in the cell?

Bonus Answer: rRNA

7. BIOLOGY

Toss Up: Short Answer

In eukaryotes, which enzyme proofreads while DNA replication takes place?

Bonus Answer: DNA Polymerase (accept DNA Polymerase III)

Bonus: Short Answer

What is the general name for a point mutation in which a single nucleotide change results in a codon that codes for a different amino acid?

Bonus Answer: missense mutation

8. CHEMISTRY

Toss Up: Short Answer

What is the name of the elements in Group 16?

Bonus Answer: Chalcogens (Accept: Chalcogen, Oxygen Family)

Bonus: Short Answer

When Carbonic acid is created, it always decomposes into:

Bonus Answer: Dihydrogen Monoxide and Carbon Dioxide (Accept: H₂O and CO₂, Water and CO₂)

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9. CHEMISTRY

Toss Up: Multiple Choice

Which of the following is the ionic charge of the Dimercury ion?

- W) 1+
- X) 0
- Y) 2+
- Z) 1-

Toss Up Answer: Y

Bonus: Short Answer

What is the electron configuration of Iron(III)? Include its full electron configuration.

Bonus Answer: 1s² 2s² 2p⁶ 3s² 3p⁶ 3d⁵

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10. CHEMISTRY

Toss Up: Multiple Choice

What form of hybridization is found in Sulfur Hexafluoride?

- W) sp³
- X) sp³d²
- Y) sp³d³
- Z) sp⁴d³

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following amino acids is aromatic?

- W) Tryptophan
- X) Glutamic Acid
- Y) Methionine
- Z) Lysene

Bonus Answer: W

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11. EARTH and SPACE

Toss Up: Multiple Choice

Which of the following minerals breaks in parallel sheets?

- W) Pyroxene
- X) Halite
- Y) Muscovite
- Z) Calcite

Toss Up Answer: Y

Bonus: Multiple Choice

During a supernova, what percentage of the total energy released is composed of neutrinos?

- W) 10
- X) 50

Y) 75

Z) 99

Bonus Answer: Z

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12. EARTH and SPACE

Toss Up: Short Answer

Order the four gas giants in size from the largest to the smallest.

Bonus Answer: Jupiter, Saturn, Uranus, Neptune

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Bonus: Multiple Choice

Which one of these statements about Neptune's moon, Triton, is true?

W) It orbits in retrograde motion.

X) Its orbit is highly eccentric.

Y) It fractured billions of years ago and reformed.

Z) It does not have an atmosphere.

Bonus Answer: W

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13. EARTH and SPACE

Toss Up: Multiple Choice

What upwelling ocean current off the coast of South America causes the most productive marine ecosystem in the world?

W) Gulf Stream

X) South Pacific Gyre

Y) Humboldt Current

Z) Cromwell Current

Toss Up Answer: Y

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Bonus: Short Answer

What is the coldest planet in the solar system?

Bonus Answer: Uranus

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14. EARTH and SPACE

Toss Up: Short Answer

The Kappa Cygnids and the Northern Delta Aquarids are names for what phenomena?

Bonus Answer: Meteor Showers

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Bonus: Short Answer

What substance is responsible for Neptune's blue-green color?

Bonus Answer: Methane gas (accept methane)

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15. ENERGY

Toss Up: Short Answer

Which compound in the atmosphere contributes the most to the greenhouse effect?

Bonus Answer: water

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Bonus: Short Answer

What is China's largest renewable energy source?

Bonus Answer: Hydro

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