

## 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**

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#### 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.**

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### 2. 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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### 3. 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**

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#### 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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### 4. CHEMISTRY

#### Toss Up: Short Answer

What is the name of the elements in Group 16?

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

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**Bonus: Short Answer**

When Carbonic acid is created, it always decomposes into:

**Bonus Answer: Dihydrogen Monoxide and Carbon Dioxide (Accept: H<sub>2</sub>O and CO<sub>2</sub>, Water and CO<sub>2</sub>)**

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## 5. 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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## 6. 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**

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**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**

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## 7. 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  $\ln(4) - \ln(2)$ )**

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**Bonus: Short Answer**

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

**Bonus Answer: 2**

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## 8. 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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## 9. 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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## 10. 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**

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**Bonus: Short Answer**

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

**Bonus Answer: 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup> 3d<sup>5</sup>**

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## 11. 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**

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**Bonus: Short Answer**

Which type of RNA is most common in the cell?

**Bonus Answer: rRNA**

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## 12. EARTH and SPACE

**Toss Up: Short Answer**

All of Saturn's moons are composed predominantly of what substance?

**Bonus Answer: Ice**

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**Bonus: Short Answer**

What are the scientific names for the two regions of a sunspot?

**Bonus Answer: Umbra and penumbra**

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## 13. EARTH and SPACE

**Toss Up: Short Answer**

What is a pulsating variable star whose brightness varies in a very regular time period of about 1-50 days?

**Bonus Answer: Cepheid**

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**Bonus: Short Answer**

What is the part of the Sun that we can see without any instruments?

**Bonus Answer: Photosphere**

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## **14. EARTH and SPACE**

**Toss Up: Short Answer**

What is the term for the amount of energy released from each square meter of an object's surface each second?

**Bonus Answer: Energy flux**

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**Bonus: Short Answer**

Give another name for the Pleiades.

**Bonus Answer: M45 or The Seven Sisters or The False Dipper**

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## **15. 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**

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**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**

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## **16. CHEMISTRY**

**Toss Up: Multiple Choice**

What form of hybridization is found in Sulfur Hexafluoride?

- W) sp<sup>3</sup>
- X) sp<sup>3</sup>d<sup>2</sup>
- Y) sp<sup>3</sup>d<sup>3</sup>
- Z) sp<sup>4</sup>d<sup>3</sup>

**Toss Up Answer: Y**

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**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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## 17. BIOLOGY

**Toss Up: Short Answer**

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

**Bonus Answer: DNA Polymerase (accept DNA Polymerase III)**

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**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**

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## 18. 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)  $1/2$

Y)  $-1/2$

Z) square root 6 minus square root 2 all over 2

**Toss Up Answer: W**

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**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**

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## 19. MATHEMATICS

**Toss Up: Multiple Choice**

Which of the following expressions in x grows fastest?

W)  $3^x$  [3 to the x]

X)  $10(3/2)^x$  [10 times three halves to the x]

Y)  $x^2$  [x squared]

Z)  $2^{(2x)}$  [2 to the 2x]

**Toss Up Answer: Z**

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**Bonus: Short Answer**

Given  $504 = 2^3 \times 3^2 \times 7$  [504 equals 2 cubed times 3 squared times 7], compute the sum of the positive divisors of 504

**Bonus Answer: 1560**

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## 20. MATHEMATICS

**Toss Up: Multiple Choice**

1. What statistical average is most appropriate to use when the quantities being averaged when one or more of the quantities are not necessarily bounded?

W) Geometric mean

X) median

Y) Harmonic mean

Z) Arithmetic mean

**Toss Up Answer: Y**

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**Bonus: Short Answer**

You pick two cards at random without replacement from a standard, 52 card deck. Compute the probability

exactly one is a heart.

**Bonus Answer: 13/34**

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## 21. EARTH and SPACE

**Toss Up: Multiple Choice**

Light from distant galaxies comes mostly from which of the following?

- W) Planets
- X) Low mass stars
- Y) High mass stars
- Z) Black holes

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Which planet has the highest escape velocity?

- W) Mercury
- X) Earth
- Y) Uranus
- Z) Jupiter

**Bonus Answer: Z**

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## 22. EARTH and SPACE

**Toss Up: Multiple Choice**

What percent of Sun-like stars in the sky that appear to be single stars are actually binary stars?

- W) About 25%
- X) About 35%
- Y) About 50%
- Z) About 60%

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What is the 29 ½ days it takes the Moon to complete an orbit around the Earth called?

**Bonus Answer: Synodic month**

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## 23. EARTH and SPACE

**Toss Up: Short Answer**

A solar eclipse can only occur at what phase of the moon?

**Bonus Answer: New Moon**

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**Bonus: Short Answer**

What constellation cannot be seen in the summer sky of the northern hemisphere?

**Bonus Answer: Orion**

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## 24. EARTH and SPACE

**Toss Up: Short Answer**

What mountain has the highest point in the Western Hemisphere?

**Bonus Answer: Mt. Aconcagua**

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**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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**25. EARTH and SPACE**

**Toss Up: Short Answer**

What is the second longest Peninsula in the world?

**Bonus Answer: Baja California**

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**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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