

## Round 13

### 1. EARTH and SPACE

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

Fog forms when the difference between temperature and dew point is:

- W) More than 7.5 degrees Celsius
- X) Between 5 and 7.5 degrees Celsius
- Y) Between 2.5 and 5 degrees Celsius
- Z) Less than 2.5 degrees Celsius

Toss Up Answer: Z

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Bonus: Multiple Choice

Name how the environmental lapse rate changes going from the troposphere into the stratosphere:

- W) In the troposphere, it is positive; in the tropopause, it is negative; in the stratosphere, it is positive
- X) In the troposphere, it is negative; in the tropopause, it is positive; in the stratosphere, it is negative
- Y) In the troposphere, it is positive; in the tropopause, it is zero; in the stratosphere, it is negative
- Z) In the troposphere, it is negative; in the tropopause, it is zero; in the stratosphere, it is positive

Bonus Answer: Y

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### 2. PHYSICS

Writer: Brian Lim

Toss Up: Short Answer

What law of physics states that a planet orbiting a single star moves in an elliptical orbit?

Bonus Answer: Kepler's First Law [of Planetary Motion]

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Bonus: Short Answer

If a charged particle enters a uniform magnetic field at an angle of 45 degrees to the field direction, what is the geometry of the path of the particle?

Bonus Answer: Helix [or helical]

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### 3. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of these is not an accepted domain of life?

- W) Archea
- X) Bacteria
- Y) Eukarya
- Z) Protista

Toss Up Answer: Z

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Bonus: Short Answer

What is the causative agent of Scrapie?

Bonus Answer: prion

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### 4. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

Rank the following by increasing polarizability: hexane, benzene, methane

**Bonus Answer:** methane benzene hexane

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**Bonus: Multiple Choice**

What is the main ingredient of cement?

- W) silica
- X) alumina
- Y) calcium oxide
- Z) aluminum sulfate

**Bonus Answer:** Y

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## 5. BIOLOGY

**Writer:** Siam Muquit

**Toss Up: Multiple Choice**

Which type of microscopy takes advantage of differences in the refractive index of biological materials and the surrounding medium to create an image without a stain?

- W) scanning electron
- X) transmission electron
- Y) fluorescence
- Z) phase-contrast

**Toss Up Answer:** Z

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**Bonus: Short Answer**

What does MRSA stand for?

**Bonus Answer:** Methicillin-resistant Staphylococcus Aureus

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## 6. MATHEMATICS

**Writer:** Larry Wong

**Toss Up: Short Answer**

How many prime number are even?

**Bonus Answer:** 1

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**Bonus: Short Answer**

A horizontal line splits a circle with the equation of  $x^2 + y^2 = 66$ , what is the equation of the line?

**Bonus Answer:**  $y = 0$

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## 7. BIOLOGY

**Writer:** Benjamin Avrahami

**Toss Up: Multiple Choice**

Photosynthesis and cellular respiration are said to be complimentary reactions. Which molecule is involved in both the Calvin cycle in photosynthesis and glycolysis in cellular respiration?

- W) OAA
- X) PGA
- Y) PGAL
- Z) 1,3-BPG

**Toss Up Answer:** Y

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**Bonus: Short Answer**

In chemiosmosis, how many hydrogen ions need to diffuse out of the membrane through ATP synthase before a

molecule of ATP can be formed?

**Bonus Answer: 3**

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## 8. CHEMISTRY

**Writer: Andrew Chen**

**Toss Up: Short Answer**

What element is most commonly added in the vulcanization of rubber?

**Bonus Answer: sulfur**

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**Bonus: Multiple Choice**

Which of the following elements wasn't first isolated through electrolysis?

- W) potassium
- X) antimony
- Y) fluorine
- Z) lithium

**Bonus Answer: X**

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## 9. PHYSICS

**Writer: Brian Lim**

**Toss Up: Multiple Choice**

What best describes the relationship between a planet's escape velocity and its radius and mass?

- W) Escape velocity increases as radius increases or mass increases
- X) Escape velocity increases as radius increases or mass decreases
- Y) Escape velocity increases as radius decreases or mass increases
- Z) Escape velocity increases as radius decreases or mass decreases

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

In terms of the permittivity of free space, denoted as  $\epsilon_0$  [epsilon naught], and the permeability of free space, denoted as  $\mu_0$  [mu naught], which expression is equivalent to the speed of light?

- W)  $\epsilon_0 \mu_0$
- X)  $1/(\epsilon_0 \mu_0)$
- Y)  $\epsilon_0 / \mu_0$
- Z)  $1/\sqrt{\epsilon_0 \mu_0}$

**Bonus Answer: Z**

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## 10. EARTH and SPACE

**Writer: Mohammed Jamil**

**Toss Up: Multiple Choice**

Which of the following renewable energy sources do not involve water

- W) Geothermal energy
- X) Hydroelectric power
- Y) Tidal power
- Z) Biomass

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which gas is attributed to be the cause of ozone depletion

- W) Carbon di Oxide
- X) Chlorofluorocarbons
- Y) Nitrogen
- Z) Methane

**Bonus Answer: X**

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**11. CHEMISTRY**

**Writer: Andrew Chen**

**Toss Up: Short Answer**

In what hybridization is the carbon atom in an aldehyde?

**Bonus Answer: sp<sup>2</sup>**

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**Bonus: Short Answer**

What is the most stable nucleus?

**Bonus Answer: nickel 62**

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**12. MATHEMATICS**

**Writer: Larry Wong**

**Toss Up: Short Answer**

The first 4 terms of an arithmetic sequence are p, 9, 3p-9, and 3p+q. What is the 2010th term of this sequence?

**Bonus Answer: 8041**

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**Bonus: Short Answer**

How many sides are in a Hexacontagon?

**Bonus Answer: 60**

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**13. CHEMISTRY**

**Writer: Andrew Chen**

**Toss Up: Multiple Choice**

Which transition metal has the lowest electronegativity?

- W) gold
- X) scandium
- Y) actinium
- Z) zinc

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Which functional group is necessary for saponification?

**Bonus Answer: ester**

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**14. MATHEMATICS**

**Writer: Larry Wong**

**Toss Up: Short Answer**

What is the sum of the first 100 positive odd integers?

**Bonus Answer: 10000**

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**Bonus: Short Answer**

How many degrees are in an interior angle of a Hexacontagon?

**Bonus Answer: 174**

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## 15. BIOLOGY

**Writer: Aryan Bhatt**

**Toss Up: Short Answer**

Where does the digestion of carbohydrates begin when eating, and which type of enzyme is used?

**Bonus Answer: The mouth, amylase (prompt on saliva)**

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**Bonus: Short Answer**

What is the enzyme that digests proteins in the human stomach?

**Bonus Answer: Pepsin**

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## 16. MATHEMATICS

**Writer: Larry Wong**

**Toss Up: Short Answer**

What is 15 in base 2?

**Bonus Answer: 1111**

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**Bonus: Short Answer**

What is 14 in hexadecimal?

**Bonus Answer: E**

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## 17. CHEMISTRY

**Writer: Andrew Chen**

**Toss Up: Short Answer**

Rank the following by conductivity: copper, bronze, silver, gold

**Bonus Answer: silver copper gold bronze, or 3 1 4 2**

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**Bonus: Multiple Choice**

A sophomore is doing a chemistry lab and mixes a sodium salt solution with a nitrate salt solution. A white precipitate forms. What could it be?

W) silver chloride

X) iron iodide

Y) iron nitrate

Z) potassium chlorate

**Bonus Answer: W**

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## 18. PHYSICS

**Writer: Brian Lim**

**Toss Up: Short Answer**

When measured in meters, visible light has a wavelength with what order of magnitude?

**Bonus Answer:  $10^{-7}$**

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**Bonus: Multiple Choice**

The indices of refraction for various materials are typically measured with what type of light?

W) Red light

X) Yellow light

Y) Green Light

Z) Blue Light

**Bonus Answer: X**

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## 19. BIOLOGY

**Writer: Aryan Bhatt**

**Toss Up: Short Answer**

What alternative to the Calvin cycle is used by sugarcane and corn?

**Bonus Answer: the C<sub>4</sub> cycle (prompt on carbon fixation)**

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**Bonus: Short Answer**

Plants that use the CAM cycle as their method of carbon fixation have this adaptation because of what type of climate?

**Bonus Answer: Arid or Dry**

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## 20. PHYSICS

**Writer: Aryan Bhatt**

**Toss Up: Short Answer**

If the distance between two objects is halved and the mass of one of them is doubled, what happens to the gravitational force between them?

**Bonus Answer: It is halved (prompt on decreases)**

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**Bonus: Multiple Choice**

Which of the following is NOT a factor that affects the force of gravity between them?

- W) The distance between them
- X) The mass of the more massive object
- Y) The density of the less massive object
- Z) The mass of the less massive object

**Bonus Answer: Y**

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## 21. EARTH and SPACE

**Writer: Andrew Chen**

**Toss Up: Short Answer**

What is the name of the underground point at which an earthquake originates?

**Bonus Answer: hypocenter**

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**Bonus: Multiple Choice**

How fast is the East African Rift expanding?

- W) 2 mm per year
- X) 1 cm per year
- Y) 5 cm per year
- Z) 20 cm per year

**Bonus Answer: X**

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## 22. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Short Answer**

What specific type of semiconductor is produced by adding

phosphorus to silicon?

**Bonus Answer: N-Type**

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**Bonus: Short Answer**

How many turns are in the secondary coil of a transformer that has a primary coil with 20,000 turns and is designed to step down 12,000 volts AC to 120 volts AC?

**Bonus Answer: 200**

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## 23. BIOLOGY

**Writer: Aryan Bhatt**

**Toss Up: Short Answer**

The name for the process where an amino acid loses its amino group is called what?

**Bonus Answer: Deamination**

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**Bonus: Short Answer**

Which essential amino acid, encoded by the DNA codons GTA, GTG, GTC, and GTT, replaces glutamic acid in the  $\beta$ -globin of people with sickle-cell anemia?

**Bonus Answer: Valine**

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## 24. BIOLOGY

**Writer: Aryan Bhatt**

**Toss Up: Short Answer**

Which group of cells at the top of the heart, also known as the "pacemaker of the heart", sends an electrical signal that causes the atria to contract?

**Bonus Answer: The Sinoatrial node (accept SA node)**

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**Bonus: Short Answer**

What is the name of the valve that prevents blood from flowing from the left ventricle to the left atrium?

**Bonus Answer: Mitral valve**

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## 25. BIOLOGY

**Writer: Aryan Bhatt**

**Toss Up: Short Answer**

What is the name of the regions of repetitive DNA sequences at the ends of chromosomes?

**Bonus Answer: Telomeres?**

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**Bonus: Short Answer**

What proteins are DNA strands wrapped around in chromosomes?

**Bonus Answer: Histones**

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