

## Round 13

### 1. 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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### 2. 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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### 3. 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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### 4. 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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## 5. 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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## 6. 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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## 7. 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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## 8. 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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**9. 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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**10. 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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**11. 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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**12. 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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### 13. 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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### 14. 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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### 15. 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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## 16. 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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## 17. 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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## 18. 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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## 19. 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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## **20. 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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## **21. 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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## **22. 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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## **23. 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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## **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. 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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