

## Round 23

### 1. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

Negative charges are accelerated by electric fields toward points

- W) at lower electric potentials
- X) at higher electric potentials
- Y) where the electric field is weaker
- Z) where the electric field is stronger

Toss Up Answer: X

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Bonus: Multiple Choice

The potential at point A in an electric field is 10V higher than at point B. If a negative charge,  $q = -2 \text{ C}$ , is moved from point A to point B, then the potential energy of this charge will

- W) decrease by 20 J
- X) decrease by 5 J
- Y) increase by 5 J
- Z) increase by 20 J

Bonus Answer: Z

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### 2. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

For an ohmic conductor, doubling the voltage without changing the resistance will cause the current to

- W) decrease by a factor of 2
- X) decrease by a factor of 4
- Y) increase by a factor of 4
- Z) increase by a factor of 2

Toss Up Answer: Z

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Bonus: Short Answer

If a 60-watt lightbulb operates at a voltage of 120 V, what is the resistance of the bulb?

Bonus Answer: 240 ohms

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### 3. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

A charge of mass  $m$  and charge  $q$  is moving in a circle of radius  $r$  and speed  $v$  due to a uniform magnetic field  $B$ . If the speed is doubled to  $2v$ , what happens to the period,  $T$ ?

- W)  $T$  increases by a factor of 2
- X)  $T$  increases by a factor of 4
- Y)  $T$  stays the same
- Z)  $T$  decreases by a factor of 2

Toss Up Answer: Y

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Bonus: Short Answer

A particle of charge  $-0.04 \text{ C}$  is projected with speed  $2 \times 10^4 \text{ m/s}$  into a uniform magnetic field,  $B$ , of strength  $0.5 \text{ T}$ . If the particle's velocity as it enters the field is perpendicular to  $B$ , what is the magnitude of the magnetic force on this

particle?

**Bonus Answer: 400 N**

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#### 4. PHYSICS

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

What is the wavelength of a 5 Hz wave that travels with a speed of 10 m/s ?

W) 0.25 m

X) 0.5 m

Y) 1 m

Z) 2 m

**Toss Up Answer: Z**

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**Bonus: Short Answer**

A string, fixed at both ends, supports a standing wave with a total of 4 nodes. If the length of the string is 6 m, what is the wavelength of the wave?

**Bonus Answer: 4 m**

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#### 5. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

If  $2x+y=5$  and  $2y+x=6$ , find  $(x-y)^2$

**Bonus Answer: 1**

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**Bonus: Short Answer**

Given a 3-4-5 right triangle, find the area of its inscribed circle.

**Bonus Answer: pi**

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#### 6. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

Express 122121 base 3 in base 9.

**Bonus Answer: 577**

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**Bonus: Short Answer**

1011101 base 2 is what in base 7?

**Bonus Answer: 151**

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#### 7. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

What is the area of an isosceles triangle with legs 15 and altitude 12?

**Bonus Answer: 108**

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**Bonus: Short Answer**

Find the area of a triangle if 2 of its sides are 3 and 6, and its included angle is 30 degrees.

**Bonus Answer:  $9\sqrt{3}/2$**

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#### 8. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

If Bill can come up with 5 math questions in 1 hour, how many math questions can he come up with in 12 minutes?

**Bonus Answer: 1**

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**Bonus: Short Answer**

Find the area of a triangle with side lengths 9, 7, and 6.

**Bonus Answer:  $2\sqrt{110}$**

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**9. BIOLOGY**

**Writer: Zoe Orlin**

**Toss Up: Multiple Choice**

Global warming has been linked to a decrease in

- W) the size of polar icecaps
- X) temperature of Earth
- Y) rate of species extinction
- Z) rate of carbon dioxide production

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Why is a mushroom a heterotroph?

- W) it manufactures its own food
- X) It divides by mitosis
- Y) It transforms light energy into chemical energy
- Z) It obtains nutrients from the environment

**Bonus Answer: Z**

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**10. BIOLOGY**

**Writer: Zoe Orlin**

**Toss Up: Multiple Choice**

Every cell in a puppy's skin, eyes, and leg muscles contains

- W) equal amounts of ATP
- X) identical genetic information
- Y) proteins that are all identical
- Z) organelles for the synthesis of glucose

**Toss Up Answer: X**

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**Bonus: Short Answer**

Oxygenated blood contains a high percentage of

**Bonus Answer: Hemoglobin**

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**11. BIOLOGY**

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Which of these is an example of an inhibiting hormone?

- W) Somatostatin
- X) ACTH
- Y) ADH
- Z) GH

**Toss Up Answer: W**

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**Bonus: Short Answer**

In the secondary messenger system characteristic of water-soluble hormones, what enzyme is often used to produce ATP?

**Bonus Answer: Adenyl cyclase**

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## **12. BIOLOGY**

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

Through what process do cells engulf extracellular particles?

**Bonus Answer: Phagocytosis**

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**Bonus: Multiple Choice**

Which of the following is not a function of the Golgi Body?

W) separates proteins and lipids according to their destination

X) modifies certain molecules

Y) manufacturing ribosomes

Z) packaging materials into vesicles for transport outside the cell

**Bonus Answer: Y**

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## **13. BIOLOGY**

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

In DNA, to which carbon of the sugar is the nitrogenous base bonded?

**Bonus Answer: Accept one OR one prime**

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**Bonus: Short Answer**

On which carbon of the sugar is the hydroxyl group located?

**Bonus Answer: Accept three OR three prime**

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## **14. BIOLOGY**

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

Which two scientists proved that DNA replication was semi-conservative?

**Bonus Answer: Meselson and Stahl**

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**Bonus: Short Answer**

Meselson and Stahl replaced an element in DNA with an isotope in order to tag the original DNA molecule. Which element did they replace?

**Bonus Answer: Nitrogen**

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## **15. BIOLOGY**

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

Who discovered that DNA has equal amounts of adenine and thymine as well as equal amounts of guanine and cytosine?

**Bonus Answer: Accept Erwin Chargaff OR Chargaff**

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**Bonus: Short Answer**

What method was used to obtain Photograph 51, which was used to determine the structure of DNA?

**Bonus Answer: X-ray diffraction**

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**16. BIOLOGY**

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

Where are short tandem repeats usually located?

**Bonus Answer: Acceptor introns OR noncoding DNA**

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**Bonus: Short Answer**

Why do DNA molecules travel through the gel in gel electrophoresis?

**Bonus Answer: DNA has a negative charge**

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**17. BIOLOGY**

**Writer: Shanjeed Ali**

**Toss Up: Multiple Choice**

What stimulates root branching in plants?

- W) Gibberellin
- X) Auxin
- Y) Ethylene
- Z) Cytokinin

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

A plant with low levels of gibberellin will have:

- W) high levels of ethylene
- X) decreased levels of lignin
- Y) undeveloped leaves
- Z) decreased growth

**Bonus Answer: Z**

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**18. CHEMISTRY**

**Writer: Elias Milborn**

**Toss Up: Short Answer**

What is the IUPAC name for  $\text{SnCl}_2 \cdot 6\text{H}_2\text{O}$ ?

**Bonus Answer: Tin (II) Chloride Hexahydrate**

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**Bonus: Multiple Choice**

Which of the following elements has the valence electron configuration of  $3s^2 3p^3$ ?

- W) Phosphorous
- X) Oxygen
- Y) Bromine
- Z) Nitrogen

**Bonus Answer: W**

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**19. CHEMISTRY**

**Writer: Elias Milborn**

**Toss Up: Multiple Choice**

Which of the following is a weak electrolyte?

W) ammonia

X) dilute sulfuric acid

Y) 1 Molar sulfuric acid

Z) dilute perchloric acid

**Toss Up Answer: W**

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**Bonus: Short Answer**

What is the most common name for the conformation for the ring structure of cyclohexane adopts to reach a strain-free value?

**Bonus Answer: Chair**

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## 20. CHEMISTRY

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

What is the net ionic reaction for the reaction between silver nitrate and potassium chloride?

**Bonus Answer:  $\text{Ag}^+ + \text{Cl}^- \rightarrow \text{AgCl}$**

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**Bonus: Short Answer**

Which of the following compounds are insoluble in water: potassium nitrate, barium chromate, nickel(II) hydroxide, and magnesium chloride?

**Bonus Answer: Barium chromate and nickel(II) hydroxide**

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## 21. CHEMISTRY

**Writer: Shanjeed Ali**

**Toss Up: Multiple Choice**

How many elements are diatomic?

W) 5

X) 6

Y) 7

Z) 8

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Which elements are liquid at room temperature?

**Bonus Answer: Mercury, Bromine**

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## 22. CHEMISTRY

**Writer: Aryan Bhatt**

**Toss Up: Multiple Choice**

Which of the following is NOT a strong acid?

W) hydrobromic acid (HBr)

X) perchloric acid (HClO<sub>4</sub>)

Y) hydroiodic acid (HI)

Z) chloric acid (HClO<sub>3</sub>)

**Toss Up Answer: Y**

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**Bonus: Short Answer**

33mL of 3M Hydrochloric acid is titrated with sodium hydroxide to form water and sodium chloride. How many mols of 11M sodium hydroxide are needed to balance this reaction?

**Bonus Answer: 9 mols**

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**23. EARTH and SPACE**

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

How many planets in our solar system have moons?

**Bonus Answer: 6**

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**Bonus: Short Answer**

What layer of the atmosphere lies between the troposphere and mesosphere?

**Bonus Answer: Stratosphere**

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**24. EARTH and SPACE**

**Writer: Benjamin Avrahami**

**Toss Up: Multiple Choice**

At above what size does a rock need to be in order to be a boulder?

W) 15.3

X) 25.6

Y) 40.2

Z) 22.9

**Toss Up Answer: X**

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**Bonus: Short Answer**

At which two zones of Earth's atmosphere does the temperature rise as the altitude increases?

**Bonus Answer: Stratosphere and Thermosphere**

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**25. EARTH and SPACE**

**Writer: Benjamin Avrahami**

**Toss Up: Short Answer**

From least to greatest, order these minerals in order of pressure needed to create it: Schist, Phyllite, Gneiss, Slate

**Bonus Answer: 3, 2, 4, 1**

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**Bonus: Short Answer**

During what era did oxygen begin to enter the atmosphere in abundance?

**Bonus Answer: Early Proterozoic or Proterozoic**

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