

## Round 8

### 1. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

The work done by a friction force is

W) always -

X) always 0

Y) either positive or negative depending upon the situation.

Z) always +

Toss Up Answer: W

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Bonus: Multiple Choice

: As defined in physics, work is:

W) scalar quantity

X) always a positive quantity

Y) a vector quantity

Z) always 0

Bonus Answer: W

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### 2. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the chemical formula of tetraphosphorus decaoxide?

Bonus Answer: P<sub>4</sub>O<sub>10</sub>

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Bonus: Short Answer

What is the bond order of the central atom in CO<sub>3</sub><sup>(-2)</sup>?

Bonus Answer: 4/3 (accept: 1 1/3)

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### 3. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

In terms of mass, what are the four biggest planets in our solar system?

Bonus Answer: Jupiter, Saturn, Neptune, Uranus

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Bonus: Multiple Choice

Dark energy makes up about how much of the energy in the universe?

W) 20%

X) 40%

Y) 70%

Z) 80%

Bonus Answer: Y

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### 4. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

A pendulum which is suspended from the ceiling of a railroad car is observed to hang at an angle of 10 degrees to the

right of vertical. Which of the following answers could explain this phenomena?

- W) The railroad car is at rest
- X) The railroad car is accelerating to the left.
- Y) The railroad car is accelerating to the right.
- Z) Huh?

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Two forces have magnitudes of 11 newtons and 5 newtons. The magnitude of their sum could NOT be equal to which of the following values?

- W) 16
- X) 5
- Y) 9
- Z) 7

**Bonus Answer: X**

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## 5. EARTH and SPACE

**Writer: Jan Wojcik**

**Toss Up: Multiple Choice**

Which of the following statements is FALSE regarding the volcano in each statement?

- W) Shield volcanoes can stretch up to 3 or 4 miles in diameter
- X) Cinder cone volcanoes rarely rise past 1,000 feet in elevation
- Y) Stratovolcanoes are some of the smallest volcanoes in the world
- Z) Volcanic domes commonly occur within the craters or on the flanks of large composite volcanoes

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Which of the following statements is true regarding stratovolcanoes?

- W) Most commonly occur at subduction zones
- X) They produce basaltic magma
- Y) Their eruptions are infrequent
- Z) They are never dormant

**Bonus Answer: W**

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## 6. BIOLOGY

**Writer: Calvin Vuong**

**Toss Up: Multiple Choice**

Which of the following statements concerning photosynthetic light reactions is false?

- W) Photosystem I contains the P700 reaction center.
- X) The electron transport chain following photosystem I drives chemiosmosis.
- Y) NADPH is the final electron acceptor.
- Z) Electrons are replenished in photosystem II by the splitting of water.

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Which of the following molecules is not present in the electron transport chain immediately following photosystem II?

W) cytochrome complex

X) plastoquinone

Y) ferredoxin

Z) plastocyanin

**Bonus Answer: Y**

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**7. CHEMISTRY**

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

What happens in a hydrogen atom when an electron jumps from an excited energy state to a more stable energy state?

W) electromagnetic radiation is emitted by the atom

X) electromagnetic radiation is absorbed by the atom

Y) the atom becomes a positively charged ion

Z) the atom becomes a negatively charged ion

**Toss Up Answer: W**

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**Bonus: Short Answer**

A closed 5-liter vessel contains a sample of neon gas. The temperature inside the container is 25°C, and the pressure is 1.5 atmospheres. (The gas constant, R, is equal to 0.08 L·atm/mol·K.) If the neon gas in the vessel is replaced with an equal molar quantity of helium gas, which of the following properties of the gas in the container will be changed?

I. Pressure

II. Temperature

III. Density

**Bonus Answer: III only**

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**8. MATHEMATICS**

**Writer: George Zhou**

**Toss Up: Short Answer**

What is the solution for square root of the quantity  $x+5$  equals  $x+3$

**Bonus Answer: -1** \*(do not except: [-1 and -4] or [-3])

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**Bonus: Short Answer**

In a certain language of a certain people of a certain world, to frack a number is to find the average of the number and its square. For example, the frack of 2 is 3 since it is the average of 2 and 2 squared. what is the frack of 100?

**Bonus Answer: 2020**

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**9. BIOLOGY**

**Writer: Calvin Vuong**

**Toss Up: Multiple Choice**

Which of the following hormones does not promote, directly or indirectly, spermatogenesis?

W) prostaglandins

X) luteinizing hormone

Y) follicle stimulating hormone

Z) gonadotropin releasing hormone

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Which hormone is synthesized in the hypothalamus and released via the anterior pituitary gland?

- W) prolactin
- X) thyroid-stimulating hormone
- Y) adrenocorticotrophic hormone
- Z) oxytocin

**Bonus Answer: Z**

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## 10. EARTH and SPACE

**Writer: Shantanu Jha**

**Toss Up: Short Answer**

What is the average temperature of the universe today to the nearest Kelvin?

**Bonus Answer: 3K**

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**Bonus: Short Answer**

What is the most common star in the Milky Way Galaxy?

**Bonus Answer: Red Dwarf**

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## 11. MATHEMATICS

**Writer: Shamaul Dilmohamed**

**Toss Up: Multiple Choice**

The sum  $(1+3+3^2+\dots+3^n)$  is equal to which of the following?

- W)  $2 \cdot 3^n$
- X)  $4 \cdot 3^n$
- Y)  $(3^{(n+1)}+1)/2$
- Z)  $(3^{(n+1)}-1)/2$

**Toss Up Answer: Z**

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**Bonus: Short Answer**

In space, what is the graph of the equation  $x^2 = y$ ?

**Bonus Answer: A parabolic cylinder**

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## 12. CHEMISTRY

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

A solution of  $\text{H}_2\text{SO}_3$  is found to have a hydrogen ion concentration of  $1 \times 10^{-3}$  molar at  $25^\circ\text{C}$ . What is the hydroxide ion concentration in the solution?

- W)  $1 \times 10^{-1}$
- X)  $1 \times 10^{-3}$
- Y)  $1 \times 10^{-11}$
- Z)  $1 \times 10^{-13}$

**Toss Up Answer: Y**

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**Bonus: Short Answer**

If the pH of a solution is changed from 1 to 3 with the addition of an antacid, what percentage of  $[\text{H}^+]$  was neutralized?

**Bonus Answer: 99%**

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### 13. BIOLOGY

Writer: Olivia Gallager

Toss Up: Short Answer

What type of immune cell is involved in humoral immunity?

Bonus Answer: B cells

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Bonus: Short Answer

What is the most common type of immunoglobulin?

Bonus Answer: Immunoglobulin G

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### 14. CHEMISTRY

Writer: Siam Muquit

Toss Up: Short Answer

What is the molecular geometry of ammonia ( $\text{NH}_3$ )?

Bonus Answer: Trigonal Pyramidal

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Bonus: Multiple Choice

How many lone pairs are in Xenon tetrafluoride ( $\text{XeF}_4$ )?

W) 0

X) 1

Y) 2

Z) 3

Bonus Answer: Y

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### 15. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the name for the rule that states that when you have a limit of indeterminate form as a fraction, it is equal to the limit of the derivative of the numerator over the derivative of the denominator?

Bonus Answer: L'Hopital's rule

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Bonus: Short Answer

What famous function, named after a mathematician, takes the infinite sum of the reciprocals of the natural numbers raised to an argument?

Bonus Answer: Riemann zeta function

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### 16. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

For an object moving in uniform circular motion, the direction of the instantaneous acceleration vector is:

W) tangent to the path of motion

X) equal to zero

Y) directed radially outward

Z) directed radially inward

Toss Up Answer: Z

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Bonus: Multiple Choice

A Newton is equal to which of the following?

- W) kilogram-meter per second
- X) meter per second squared
- Y) kilogram-meter per second
- Z) ) kilogram per meter-second

**Bonus Answer: Y**

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## 17. CHEMISTRY

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Which of the following does not exhibit resonance stabilization?

- W) Ozone
- X) SO<sub>2</sub>
- Y) NO<sub>3</sub>
- Z) H<sub>2</sub>O

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the bond order of H<sub>2</sub>O?

**Bonus Answer: 2**

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## 18. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Short Answer**

A ball leaves a girl's hand with an upward velocity of 6 meters per second. What is the maximum height of the ball above the girl's hand?

**Bonus Answer: 1.8 meters**

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**Bonus: Short Answer**

A boy throws a ball vertically upward with a velocity of 6 meters per second. How long does it take the ball to return to the boy's hand?

**Bonus Answer: 1.22 seconds**

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## 19. BIOLOGY

**Writer: Zoe Orlin**

**Toss Up: Short Answer**

What is the powerhouse of the cell?

**Bonus Answer: Mitochondria!!!**

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**Bonus: Short Answer**

What do you use to see?

**Bonus Answer: Eyes**

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## 20. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Short Answer**

A toy train moves in a circle of 8 meters radius with a speed of 4 meters per second. What is the magnitude of the acceleration of the train?

**Bonus Answer: 2 meters per second<sup>2</sup>**

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**Bonus: Short Answer**

A certain machine exerts a force of 200 newtons on a box whose mass is 30 kilograms. The machine moves the box a distance of 20 meters along a horizontal floor. What amount of work does the machine do on the box?

**Bonus Answer: 4000 J (joules)**

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## 21. BIOLOGY

**Writer: Zoe Orlin**

**Toss Up: Short Answer**

What are the 5 senses?

**Bonus Answer: Taste smell sight hearing touch**

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**Bonus: Short Answer**

What is an important component to "taste"?

**Bonus Answer: Smell!**

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## 22. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Short Answer**

A box is initially at rest on a horizontal, frictionless table. If a force of 10 Newtons acts on the box for 3 seconds, what is the momentum of the box at the end of the 3 second interval?

**Bonus Answer: 30 N (newton) seconds**

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**Bonus: Short Answer**

A 10 kilogram body initially moving with a velocity of 10 meters per second makes a head-on collision with a 15 kilogram body initially at rest. The two objects stick together. What is the velocity of the combined system just after the collision?

**Bonus Answer: 4 meters per seconds**

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## 23. BIOLOGY

**Writer: Zoe Orlin**

**Toss Up: Short Answer**

What is the material that makes up part of your nose and ears?

**Bonus Answer: Cartilage**

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**Bonus: Short Answer**

How does one acquire an infection of the ear?

**Bonus Answer: By a virus or bacteria**

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## 24. BIOLOGY

**Writer: Sean Vaysburd**

**Toss Up: Multiple Choice**

What is a technique for studying cell membrane structure and function?

W) cell fractionation

X) freeze fracture

Y) cell centrifugation

Z) inserting radioactive substances

**Toss Up Answer: X**

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**Bonus: Short Answer**

Which type of microscope is useful for studying the internal structure of cells?

**Bonus Answer: transmission electron microscope**

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## **25. BIOLOGY**

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

What hormone regulates sleep cycles?

**Bonus Answer: Melatonin**

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**Bonus: Short Answer**

What blood type is considered the universal donor?

**Bonus Answer: O-, O-neg, O-negative**

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