

## Round 36

### 1. 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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### 2. 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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### 3. PHYSICS

Writer: Sean Vaysburd

Toss Up: Short Answer

If the acceleration is always perpendicular to an object's velocity, what can be deduced about the object's motion?

Bonus Answer: It is circular motion.

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**Bonus: Short Answer**

If the acceleration of an object is opposite its velocity, what can be said about the object's velocity over time? Assume that the direction of the velocity is positive.

**Bonus Answer:** It is decreasing.

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**4. PHYSICS**

**Writer:** Sean Vaysburd

**Toss Up: Short Answer**

A car with a mass of one ton collides with a truck with a mass of ten tons. Which applies the greatest force on the other, in Newtons?

**Bonus Answer:** They both apply an equal force.

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**Bonus: Short Answer**

Which experiences greater acceleration in the collision from a car with a mass of one ton colliding with a truck with a mass of ten tons, and by how many times greater.

**Bonus Answer:** The car, it will accelerate ten times as much.

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**5. PHYSICS**

**Writer:** Ahmad Alnasser

**Toss Up: Short Answer**

A car accelerates from rest at  $4 \text{ (m/s)}^2$ . What is the distance traveled by the car in 3 seconds?

**Bonus Answer:** 18 meters (m)

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**Bonus: Multiple Choice**

A motor scooter travels east at a speed of 13 m/s. The driver then reverses direction and heads west at 17 m/s. What was the change in velocity of the scooter?

W) 13 m/s

X) 17 m/s

Y) 30 m/s

Z) 4 m/s

**Bonus Answer:** Y

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**6. MATHEMATICS**

**Writer:** Jason Weng

**Toss Up: Multiple Choice**

If  $x$  is positive, what is the minimum value of  $2x + (2/x)$ ?

W) 1

X) 2

Y) 3

Z) 4

**Toss Up Answer:** Z

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**Bonus: Multiple Choice**

What is  $f(15)$  if  $f(x) = 2\sin(x)\cos(x)$ , where  $x$  is in degrees?

W)  $(\sqrt{3})/2$

X)  $1/(\sqrt{3})$

Y)  $1/2$

Z) 1

**Bonus Answer: Y**

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## 7. MATHEMATICS

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

How many zeroes does the equation  $x^3 + 6x^2 + 11x + 6 = 0$  have?

W) 1

X) 2

Y) 3

Z) 4

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Find the solution(s) of the following system of linear equations:  $2x + 4y = 6$ ,  $x + 2y = 5$

**Bonus Answer: No solutions**

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## 8. MATHEMATICS

**Writer: Andrew Chen**

**Toss Up: Short Answer**

How many ways are there to distribute 4 identical blue balls and 3 identical red balls among 3 people?

**Bonus Answer: 315 (accept  $21 \cdot 15$ )**

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**Bonus: Short Answer**

What are all possible shapes that are yielded by inverting a circle across another circle?

**Bonus Answer: circle, line**

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## 9. MATHEMATICS

**Writer: Andrew Chen**

**Toss Up: Short Answer**

Prime factorize 273.

**Bonus Answer:  $3 \cdot 7 \cdot 13$**

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**Bonus: Multiple Choice**

Which of the following numbers is a root of unity?

W)  $1 + i$

X)  $\frac{1}{2} + (\frac{1}{2})(\sqrt{3})(i)$

Y)  $3 + 4i$

Z)  $(\frac{1}{2})(\sqrt{2}) + (\frac{3}{2})(\sqrt{2})(i)$

**Bonus Answer: X**

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## 10. 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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## 11. 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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## 12. 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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## 13. 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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## 14. 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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**15. BIOLOGY**

**Writer: Calvin Vuong**

**Toss Up: Multiple Choice**

Which of the following is a storage protein?

- W) aquaporin  
X) actin  
Y) ovalbumin  
Z) AP2

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Which of the following amino acids has a sulfhydryl group in its side chain?

**Bonus Answer: cysteine**

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**16. BIOLOGY**

**Writer: Calvin Vuong**

**Toss Up: Multiple Choice**

Introns are hydrolyzed and removed from pre-mRNA by

- W) exons  
X) spliceosomes  
Y) small nuclear ribonucleoproteins  
Z) nucleotide-pair substitution

**Toss Up Answer: X**

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**Bonus: Short Answer**

Okazaki fragments on the lagging strand of DNA are joined by which protein?

**Bonus Answer: DNA ligase (ACCEPT: ligase)**

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**17. BIOLOGY**

**Writer: Calvin Vuong**

**Toss Up: Multiple Choice**

Of the following, which is a second messenger used in cell signaling?

- W) G protein  
X) Protein kinase A  
Y) adenylyl cyclase  
Z) cAMP

**Toss Up Answer: Z**

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**Bonus: Short Answer**

Adjacent plant cells most commonly communicate via what intercellular junction?

**Bonus Answer: Plasmodesmata (ACCEPT: desmotubule)**

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## **18. CHEMISTRY**

**Writer: Raafiul Hossain**

**Toss Up: Short Answer**

Is HCL a strong acid?

**Bonus Answer: Yes**

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**Bonus: Short Answer**

Is NAOH a strong base?

**Bonus Answer: Yes**

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## **19. CHEMISTRY**

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

The shape of a  $\text{PCl}_3$  molecule is described as

W) bent

X) trigonal pyramidal

Y) linear

Z) trigonal planar

**Toss Up Answer: X**

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**Bonus: Short Answer**

Twenty-five percent of element X exists as  $^{210}\text{X}$  and 75 percent of it exists as  $^{214}\text{X}$ . What is the atomic weight of element X?

**Bonus Answer: 211**

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## **20. CHEMISTRY**

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

What are the numbers of sigma bonds and pi bonds, in ethyne, respectively?

**Bonus Answer: 3 sigma bonds, 2 pi bonds**

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**Bonus: Short Answer**

Pi bonds are created by the overlap of what type of orbital?

**Bonus Answer: p, p orbitals**

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## **21. CHEMISTRY**

**Writer: Olivia Gallager**

**Toss Up: Multiple Choice**

Which of the following has the largest ionic radius?

W) Li

X) Be

Y) Na

Z) Mg

**Toss Up Answer: X**

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**Bonus: Short Answer**

Why does Oxygen have a smaller atomic radius than boron?

**Bonus Answer: Effective nuclear charge**

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**22. CHEMISTRY**

**Writer: Olivia Gallager**

**Toss Up: Multiple Choice**

Which of the following describes the reaction that involves a hydrocarbon chain and H<sub>2</sub> gas yielding two shorter hydrocarbon chains?

W) Synthesis

X) Cracking

Y) Hydrocracking

Z) Substitution

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What electron geometry does ammonia(NH<sub>3</sub>) have?

**Bonus Answer: tetrahedral, tetrahedron also accepted**

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**23. EARTH and SPACE**

**Writer: Jan Wojcik**

**Toss Up: Short Answer**

By name or number, which of the following is not a mineral: diamond, gold, coal, silt

**Bonus Answer: Coal and silt (accept 3 and 4)**

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**Bonus: Short Answer**

The Mohs scale is used to measure mineral hardness. By name or number order the following minerals in increasing order: Fluorite, Gypsum, Quartz, Talc

**Bonus Answer: Talc, Gypsum, Fluorite, Quartz (accept 1 2 3 4, in that order)**

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**24. EARTH and SPACE**

**Writer: Jan Wojcik**

**Toss Up: Short Answer**

Name the soil horizon that contains a mixture of organic matter and highly altered mineral matter and is dark in color.

**Bonus Answer: A-horizon**

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**Bonus: Short Answer**

By name or number, which of the following phenomena cause acidification in agricultural soils:

1) Leaching of excess nitrate

2) Build-up in mostly plant-based organic matter

3) Removal of plant and animal products

4) Addition of nitrogen based fertilisers

**Bonus Answer: All of them (accept 1,2,3,4)**

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**25. EARTH and SPACE**

**Writer: Shamaul Dilmohamed**

**Toss Up: Short Answer**

In which atmospheric level does the "good" ozone preside?

**Bonus Answer: Stratosphere**

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**Bonus: Short Answer**

In which atmospheric level does the "bad" ozone reside?

**Bonus Answer: Troposphere**

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