

## Round 6

### 1. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

What is the magnitude of a vector 4 meters in the x direction, 1 meter in the y direction, and 8 meters in the z direction?

- W) 7 meters
- X) 9 meters
- Y) 11 meters
- Z) 13 meters

Toss Up Answer: X

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Bonus: Short Answer

Unit X equals " $\sqrt{A / B}$ " and is in units " $(\text{Mass} \cdot \text{Time}) / \text{Length}^2$ ". If A has units "Length / Time", what are the units of B?

Bonus Answer:  $\text{Length}^5 / (\text{Mass}^2 \cdot \text{Time}^3)$

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### 2. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

Which of the following quantities are vector?

- W) Work
- X) Speed
- Y) Torque
- Z) Power

Toss Up Answer: Y

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Bonus: Multiple Choice

Which of the following terms is NOT commonly used to represent a higher-order derivative of displacement?

- W) Acceleration
- X) Jounce
- Y) Lock
- Z) Spin

Bonus Answer: Z

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### 3. PHYSICS

Writer: William Xiang

Toss Up: Short Answer

A ball is thrown with an initial velocity of 10 meters per second off the top of a 30 foot building, at an angle 30 degrees above the horizontal. Assuming there is no air friction and the scenario occurs on Jupiter where objects have a gravitational acceleration of 25 meters per second squared, find the time it takes, in seconds, for the ball to reach ground level. Round to the nearest tenth.

Bonus Answer: 0.4

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Bonus: Multiple Choice

A boy in freefall swings a ball tied to a string around in horizontal circles. Assuming no air friction, which of the following forces are NOT acting ball?

- W) Centripetal Force

- X) Centrifugal Force
- Y) Gravitational Force
- Z) Normal Force

**Bonus Answer: Z**

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## 4. PHYSICS

**Writer: Shihab Karim**

**Toss Up: Multiple Choice**

As defined in physics, speed is:

- W) a vector quantity
- X) always negative
- Y) always zero
- Z) always positive

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Electric current may be expressed in which one of the following units?

- W) joules/coulomb
- X) coulombs/second
- Y) coulombs/volt
- Z) ohms/second

**Bonus Answer: X**

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## 5. MATHEMATICS

**Writer: Jessica Titensky**

**Toss Up: Short Answer**

What is  $\tan(\arcsin(9/41))$

**Bonus Answer: 9/40**

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**Bonus: Short Answer**

What is  $\sin(\operatorname{arccot}(\tan(\arccos(3/5))))$

**Bonus Answer: 3/5**

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## 6. MATHEMATICS

**Writer: Jessica Titensky**

**Toss Up: Short Answer**

What is the amplitude of  $y=4\sin(5x+3)$

**Bonus Answer: 4**

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**Bonus: Short Answer**

What is the period of  $y=4\sin(5x+3)$  rounded to the nearest 100th

**Bonus Answer: 1.26**

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## 7. 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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## 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. 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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## 10. 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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**11. 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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**12. 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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**13. 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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**14. 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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## 15. 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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## 16. 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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## 17. BIOLOGY

**Writer: Sean Vaysburd**

**Toss Up: Multiple Choice**

Which is not a part of the nucleus?

W) nuclear envelope

X) nucleolus

Y) chromatin

Z) plasmodesmata

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which is not a part of the cytoskeleton?

W) microfilaments

X) intermediate filaments

Y) microtubules

Z) gap junctions

**Bonus Answer: Z**

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## 18. 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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## 19. 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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## 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: Nicholas Adit**

**Toss Up: Multiple Choice**

The shape of a PCl<sub>3</sub> 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 <sup>210</sup>X and 75 percent of it exists as <sup>214</sup>X. What is the atomic weight of element X?

**Bonus Answer: 211**

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## 22. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following species is amphoteric?

W)  $\text{Na}_3\text{PO}_4$

X)  $\text{HSO}_4^-$

Y)  $\text{KOH}$

Z)  $\text{HNO}_3$

Toss Up Answer: X

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Bonus: Short Answer

A 600-milliliter container holds 2 moles of  $\text{O}_2(\text{g})$ , 3 moles of  $\text{H}_2(\text{g})$ , and 1 mole of  $\text{He}(\text{g})$ . Total pressure within the container is 760 torr. What is the partial pressure of  $\text{O}_2$ ?

Bonus Answer: 253 torr

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## 23. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

What is the penultimate spectral type of a star?

W) F

X) G

Y) K

Z) M

Toss Up Answer: Y

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Bonus: Short Answer

What spectral type is the Sun?

Bonus Answer: G

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## 24. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

To the nearest order of magnitude, how thick are Saturn's rings?

W) 10 m

X) 100 m

Y) 1000 m

Z) 10000 m

Toss Up Answer: W

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Bonus: Short Answer

Which planets have active plate tectonics?

Bonus Answer: Earth

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## 25. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

What is the US state with the most glaciers?

Bonus Answer: Washington

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**Bonus: Short Answer**

How many glaciers are there in Hawaii rounded to the nearest 1000?

**Bonus Answer: 0**

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