

## Round 28

### 1. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

An object travels through a fluid. What is the relationship between drag force and speed?

- W) linear relationship
- X) square relationship
- Y) exponential relationship
- Z) no relationship

Toss Up Answer: X

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Bonus: Multiple Choice

A person holding a heavy ball with outstretched arms spins in place while sitting in a chair. The person brings the ball closer. What happens to the angular velocity of the person?

- W) it increases
- X) it decreases
- Y) it stays constant
- Z) it increases and then decreases

Bonus Answer: W

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### 2. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

What best describes the index of refraction of air?

- W) it is slightly greater than 0
- X) it is slightly less than 0
- Y) it is slightly greater than 1
- Z) it is slightly less than 1

Toss Up Answer: Y

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Bonus: Short Answer

the speed of light in a particular medium is  $2.0 \times 10^8$  m/s. What is the index of refraction of the medium?

Bonus Answer: 1.5

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### 3. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

What type of light cannot be given off by a laser?

- W) ultraviolet
- X) red
- Y) green
- Z) white

Toss Up Answer: Z

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Bonus: Short Answer

What is the term for the radiation of a perfectly opaque and non-reflective body?

Bonus Answer: blackbody radiation

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## 4. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

An object slides across a horizontal surface and eventually comes to a stop. What is true of the object?

- W) its kinetic energy was converted to thermal energy
- X) the energy related to the motion of the object was destroyed
- Y) the kinetic energy of the object stayed constant
- Z) the potential energy of the object increased

Toss Up Answer: W

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Bonus: Short Answer

What unit is defined as the energy needed to raise the temperature of a gram of liquid water by 1 degree Celsius?

Bonus Answer: calorie

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## 5. 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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## 6. 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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## 7. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the value of 125 to the  $\frac{2}{3}$  power?

Bonus Answer: 25

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Bonus: Short Answer

What is the argument of  $1 + \sqrt{3}i$ ?

Bonus Answer: 60

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## 8. MATHEMATICS

Writer: William Xiang

Toss Up: Short Answer

Find the first derivative of  $10x^3 + 3x^2 + 3$  in the simplest form.

Bonus Answer:  $30x^2 + 6x$

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**Bonus: Short Answer**

How many points of inflection does the graph  $x^3 + 5$  have?

**Bonus Answer: 1**

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**9. BIOLOGY**

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

A female lizard washes ashore on an island after riding a floating log for hundreds of miles across the sea. She is the only member of her species to have ever made it to the island. After arriving, she lays 20 fertile eggs that hatch and form the basis of a lizard population on the island. Which of the following is NOT a likely result?

- W) The new island population will have less genetic diversity than the ancestral population.
- X) Mutation will add new alleles to the new population and thus increase its genetic diversity over time.
- Y) There will be little or no gene exchange between the new population and the ancestral population.
- Z) The new island population will have greater genetic diversity than the ancestral population.

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Loss of heterozygosity can be caused by all of the following EXCEPT:

- W) genetic drift.
- X) positive frequency-dependent selection.
- Y) heterozygote advantage.
- Z) inbreeding.

**Bonus Answer: Y**

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**10. BIOLOGY**

**Writer: Mohammed Jamil**

**Toss Up: Multiple Choice**

Which of the following processes in cellular respiration produce the most ATP

- W) Glycolysis
- X) Link Reaction
- Y) Krebs Cycle
- Z) Oxidative Phosphorylation

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which of the following is not used in cellular respiration

- W) Glucose
- X) NADH
- Y) FADH<sub>2</sub>
- Z) NADPH

**Bonus Answer: Z**

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**11. BIOLOGY**

**Writer: Mohammed Jamil**

**Toss Up: Multiple Choice**

Surfactant helps to prevent the alveoli from collapsing by:

W) humidifying the air before it enters

X) Reducing the surface tension of alveolar fluid

Y) warming the air before it enters

Z) protecting the surface of alveoli from dehydration and other environmental variations

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Respiratory control centers are located in the

W) midbrain and medulla

X) pons and midbrain

Y) medulla and pons

Z) upper spinal chord and medulla

**Bonus Answer: Y**

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## 12. BIOLOGY

**Writer: Jason Weng**

**Toss Up: Short Answer**

What organelle in a human cell is responsible for breaking down waste material?

**Bonus Answer: Lysosome**

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**Bonus: Short Answer**

Order the following from the least specific to the most: Species, Family, Order, Phylum

**Bonus Answer: Phylum, Order, Family, Species (4, 3, 2, 1)**

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## 13. BIOLOGY

**Writer: Jason Weng**

**Toss Up: Short Answer**

How many subunits does a tubulin protein have?

**Bonus Answer: 2**

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**Bonus: Short Answer**

The blood enter systemic circulation via the aorta, and returns to the heart via what common vein?

**Bonus Answer: Vena Cava (accept superior or inferior vena cava)**

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## 14. BIOLOGY

**Writer: Jason Weng**

**Toss Up: Short Answer**

Into what common vein does lymph dump into to bring it back into circulation?

**Bonus Answer: Subclavian vein**

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**Bonus: Short Answer**

Usually, what functional group is added to molecules as part of the detoxification process in the ER to allow it to be urinated out?

**Bonus Answer: Hydroxyl Group (OH group)**

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## 15. BIOLOGY

**Writer: Jason Weng**

**Toss Up: Short Answer**

What type of circulation is between the heart and the lungs?

**Bonus Answer: Pulmonary circulation**

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**Bonus: Short Answer**

As what form of ion does carbon dioxide travel as in the blood?

**Bonus Answer: Bicarbonate ion (HCO<sub>3</sub><sup>-</sup>)**

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**16. BIOLOGY**

**Writer: Jason Weng**

**Toss Up: Short Answer**

The group of cells that break down bone cells are collectively called as what?

**Bonus Answer: Osteoclast**

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**Bonus: Short Answer**

What class of immunoglobulins are present in tears, saliva, etc?

**Bonus Answer: IGA**

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**17. BIOLOGY**

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

In plant cells grown in the presence of a metabolic poison that specifically inhibits mitochondrial F<sub>1</sub> ATP synthase, one would expect:

W) the pH difference across the cristae to be greater than normal.

X) the pH difference across the cristae to be less than normal.

Y) the electron transport chain to become inoperative.

Z) oxygen consumption to cease.

**Toss Up Answer: W**

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**Bonus: Short Answer**

With proofreading, what is approximately the error rate of DNA polymerase?

**Bonus Answer: One error in every 10<sup>9</sup> bases.**

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**18. CHEMISTRY**

**Writer: Nten Nylam**

**Toss Up: Multiple Choice**

Which of these is not an amorphous solid?

W) sodium chloride

X) polystyrene

Y) potassium nitrate

Z) benzoic acid

**Toss Up Answer: X**

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**Bonus: Short Answer**

What is the amount of heat (in joules) needed to raise 5 grams of aluminum by 20 degrees, considering the specific heat of aluminum is 0.900 J/ g x Celsius?

**Bonus Answer: 90 joules**

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**19. CHEMISTRY**

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

A 20.0 g sample of mercury(II) oxide is heated strongly, causing it to decompose to metallic Hg and O<sub>2</sub> gas. What volume of O<sub>2</sub> gas is produced (measured at STP)?

- W) 1.03 L
- X) 2.07 L
- Y) 4.14 L
- Z) 14.0 L

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

When 30.0 mL of 0.10 M AgNO<sub>3</sub> is added to 30.0 mL of 0.10 M NaCl, aqueous NaNO<sub>3</sub> and solid AgCl are formed. How much solid AgCl is produced?

- W) 0.0030 mol
- X) 0.0060 mol
- Y) 0.030 mol
- Z) 0.060 mol

**Bonus Answer: W**

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## 20. CHEMISTRY

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

How much Sr(OH)<sub>2</sub> • 8 H<sub>2</sub>O (M = 265.76) is needed to prepare 250.0 mL of solution in which [OH<sup>-</sup>] = 0.100 M?

- W) 3.32 g
- X) 6.64 g
- Y) 9.97 g
- Z) 13.3 g

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

A 10.00 g sample of a compound containing only carbon, hydrogen, and oxygen forms 23.98 g CO<sub>2</sub> and 4.91 g H<sub>2</sub>O upon complete combustion. What is the empirical formula of the compound?

- W) C<sub>2</sub>H<sub>2</sub>O
- X) C<sub>3</sub>H<sub>3</sub>O
- Y) C<sub>6</sub>H<sub>3</sub>O<sub>2</sub>
- Z) C<sub>6</sub>H<sub>6</sub>O

**Bonus Answer: X**

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## 21. CHEMISTRY

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

Which of the following is a nonelectrolyte in aqueous solution?

- W)  $\text{H}_2\text{SO}_4$
- X)  $\text{NaC}_2\text{H}_3\text{O}_2$
- Y)  $\text{K}_2\text{CO}_3$
- Z)  $\text{CH}_2\text{O}$

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

An aqueous solution of potassium sulfate has a freezing point of  $-2.24^\circ\text{C}$ . What is its molality?

( $K_f = 1.86^\circ\text{C}\cdot\text{m}^{-1}$ )

- W) 0.401 m
- X) 0.602 m
- Y) 1.20 m
- Z) 4.17 m

**Bonus Answer: W**

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## 22. CHEMISTRY

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

Dissolution of which salt in water results in a decrease in the temperature of the solution?

- W)  $\text{KHSO}_4$
- X)  $\text{NaOH}$
- Y)  $\text{AlCl}_3$
- Z)  $\text{NH}_4\text{NO}_3$

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

What is observed when equal volumes of 0.1 M aqueous  $\text{HCl}$  and 0.01 M aqueous  $\text{Na}_2\text{SO}_3$  are mixed?

- W) Colorless solution and a white precipitate
- X) Colored solution and a white precipitate
- Y) Colorless solution and a colored precipitate
- Z) Colorless solution, no precipitate, and gas evolution

**Bonus Answer: Z**

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## 23. EARTH and SPACE

**Writer: Zoe Orlin**

**Toss Up: Multiple Choice**

How many miles per hour is the Earth moving?

- W) 65,000
- X) 67,000
- Y) 69,000
- Z) 70,000

**Toss Up Answer: X**

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**Bonus: Short Answer**

When magma hardens into rock, which type of rock is it?

**Bonus Answer: Igneous**

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**24. EARTH and SPACE**

**Writer: Zoe Orlin**

**Toss Up: Multiple Choice**

Moonquakes occur due to

W) Asteriods

X) Tidal stresses

Y) Rotation irregularities

Z) Moonquakes do not happen

**Toss Up Answer: X**

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**Bonus: Short Answer**

Where did the largest earthquake ever happen?

**Bonus Answer: Alaska**

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**25. EARTH and SPACE**

**Writer: Zoe Orlin**

**Toss Up: Multiple Choice**

What was the magnitude of the largest earthquake ever?

W) 9

X) 9.1

Y) 9.5

Z) 9.6

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

How much north does the Earth's magnetic north pole move per year?

W) 30 miles

X) 35 miles

Y) 40 miles

Z) 45 miles

**Bonus Answer: Y**

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