

## Round 32

### 1. EARTH and SPACE

Writer: Seiji Yawata

Toss Up: Multiple Choice

New York City is primarily composed of sediments that were metamorphosed during the Taconic and Acadian orogenies roughly:

- W) 450 million years ago
- X) 550 million years ago
- Y) 650 million years ago
- Z) 750 million years ago

Toss Up Answer: W

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Bonus: Short Answer

When the earth is closest to the sun, what season is it in the Southern Hemisphere?

Bonus Answer: Summer

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### 2. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

Vectors A and B each have magnitude L. What is the cross product of these vectors if the angle between them when drawn with their tails at the same point is 60 degrees.

- W) Zero
- X)  $L/2$
- Y)  $L^2$
- Z)  $(L^2)/2$

Toss Up Answer: Z

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Bonus: Multiple Choice

Which of the following is true when a system is at equilibrium?

- W) The object is at rest.
- X) The object is not accelerating.
- Y) The object is at constant velocity.
- Z) Internal forces sum to zero.

Bonus Answer: X

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### 3. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Multiple Choice

The purpose of Glial cells is to

- W) insulate and protect neurons
- X) insulate and protect endothelial cells
- Y) protect the body from viral diseases
- Z) reinforce smooth muscle

Toss Up Answer: W

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Bonus: Short Answer

Blood is to the circulatory system as hemolymph is to the

Bonus Answer: hemocoel

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## 4. CHEMISTRY

Writer: Siam Muquit

Toss Up: Short Answer

What is the molecular geometry of ammonia (NH<sub>3</sub>)?

Bonus Answer: Trigonal Pyramidal

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Bonus: Multiple Choice

How many lone pairs are in Xenon tetrafluoride (XeF<sub>4</sub>)?

W) 0

X) 1

Y) 2

Z) 3

Bonus Answer: Y

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## 5. MATHEMATICS

Writer: Siam Muquit

Toss Up: Short Answer

Given  $y = |x - 6|$ , what is the derivative at  $x = 6$ ?

Bonus Answer: The derivative does not exist

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Bonus: Short Answer

Find the derivative of  $x^3 / x^2$

Bonus Answer: 1

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## 6. 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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## 7. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

What are the purine bases in DNA?

**Bonus Answer: Adenine and guanine**

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**Bonus: Short Answer**

What are the pyrimidine bases in RNA?

**Bonus Answer: Cytosine and uracil**

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## 8. EARTH and SPACE

**Writer: Seiji Yawata**

**Toss Up: Multiple Choice**

The Cascadia Subduction Zone separates the North American Plate and the

W) Caribbean Plate

X) Juan de Fuca Plate

Y) Okhotsk Plate

Z) Cocos Plate

**Toss Up Answer: X**

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**Bonus: Short Answer**

During which geologic period did Pangaea start breaking up?

**Bonus Answer: Jurassic**

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## 9. CHEMISTRY

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

A solution of H<sub>2</sub>SO<sub>3</sub> is found to have a hydrogen ion concentration of  $1 \times 10^{-3}$  molar at 25°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 [H<sup>+</sup>] was neutralized?

**Bonus Answer: 99%**

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## 10. BIOLOGY

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

Which two monosaccharides make up lactose?

**Bonus Answer: Glucose and galactose**

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**Bonus: Short Answer**

Which two monosaccharides make up sucrose?

**Bonus Answer: Glucose and fructose**

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## 11. EARTH and SPACE

**Writer: Elias Milborn**

**Toss Up: Short Answer**

Pandora is a moon of which planet?

**Bonus Answer: Saturn**

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**Bonus: Multiple Choice**

Sea water is approximately what percent salt by mass?

- W) 1%
- X) 2%
- Y) 4%
- Z) 8%

**Bonus Answer: Y**

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## 12. BIOLOGY

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

What term describes the number of times a normal human cell population can divide?

**Bonus Answer: Hayflick limit**

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**Bonus: Multiple Choice**

What controls the Hayflick limit?

- W) apoptosis
- X) length of telomeres
- Y) genomic instability
- Z) genetic drift

**Bonus Answer: X**

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## 13. 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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## 14. 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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## 15. 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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## 16. MATHEMATICS

**Writer: Shamaul Dilmohamed**

**Toss Up: Short Answer**

What type of number is defined as a number that is not a root of a polynomial with rational coefficients?

**Bonus Answer: Transcendental numbers**

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**Bonus: Short Answer**

Of the following, which of these numbers of transcendental? pi, e, i, phi, e times i, 2 ^ root(2)

**Bonus Answer: pi, e, e times i, 2 ^ root(2)**

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## 17. BIOLOGY

**Writer: Shanjeed Ali**

**Toss Up: Multiple Choice**

The phenomenon by which diploid cells cease to divide is known as

- W) parthenogenesis
- X) alternation of generations
- Y) cellular senescence
- Z) lysis

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What country has the highest human life expectancy?

**Bonus Answer: Japan**

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## 18. CHEMISTRY

**Writer: Prangon Ghose**

**Toss Up: Short Answer**

In a rate law, what are the units of k when the order is 1?

**Bonus Answer:  $s^{-1}$**

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**Bonus: Short Answer**

In a rate law, what are the units of k when the order is 5?

**Bonus Answer:  $L^4 \text{ mol}^{-4} s^{-1}$**

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## 19. MATHEMATICS

**Writer: Raafiul Hossain**

**Toss Up: Short Answer**

The surface area of a sphere is how many times the area of a circle?

**Bonus Answer: 4**

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**Bonus: Short Answer**

What is the area of a cone?

**Bonus Answer:  $(\pi)r^2h$**

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## 20. BIOLOGY

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

How many ATP molecules are produced by the Calvin cycle?

**Bonus Answer: 0**

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**Bonus: Short Answer**

How many ATP are used in the Calvin cycle to make one glucose molecule?

**Bonus Answer: 18**

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## 21. MATHEMATICS

**Writer: Raafiul Hossain**

**Toss Up: Multiple Choice**

A statement about a relationship between natural quantities. The statement has been tested many times, and has not been contradicted. What is it?

W) Fact

X) Hypothesis

Y) Law

Z) Theory

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

A framework that includes many well-tested and verified hypotheses about one or more aspects of the natural world.

W) Fact

X) Hypothesis

Y) Law

Z) Theory

**Bonus Answer: Z**

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## 22. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which pair of organisms is correctly matched with the interspecific interaction?

W) Commensalism: Clownfish and sea anemone

X) Parasitism: Whales and barnacles

Y) Mutualism: Oxpecker and rhino

Z) Predation: Apes and bees

Toss Up Answer: Y

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Bonus: Short Answer

List the 5 types of interspecific interaction.

Bonus Answer: Predation, Commensalism, Parasitism, Mutualism, Neutral

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## 23. 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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## 24. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which disease was famously eradicated in 1977?

W) Polio

X) Smallpox

Y) Mumps

Z) AIDS

Toss Up Answer: X

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Bonus: Short Answer

Which human body system is attacked by AIDS?

Bonus Answer: Immune system

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## 25. 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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