

## Round 9

### 1. PHYSICS

#### Toss Up: Multiple Choice

For what major contribution was Albert Einstein awarded the nobel prize in 1921?

- W) Einstein Field Equations
- X) General Theory of Reletivity
- Y) Special Theory of Relativity
- Z) Photoelectric Effect

**Toss Up Answer: Z**

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#### Bonus: Multiple Choice

Which year in Albert Einstein's life is now known as his "annus mirabilis"?

- W) 1905
- X) 1921
- Y) 1915
- Z) 1928

**Bonus Answer: W**

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### 2. PHYSICS

#### Toss Up: Multiple Choice

Why do the bubbles from a freshly opened bottle of champagne grow as they rise to the surface?

- W) Fluid pressure falls as the bubble rises in the glass.
- X) The bubble continues to accumulate dissolved gas molecules as it moves through the champagne.
- Y) The bubble does expansive work on the champagne as it loses potential energy.
- Z) Friction with the champagne heats the gas inside the bubble.

**Toss Up Answer: X**

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#### Bonus: Multiple Choice

The bubbles in a glass of champagne form a steady stream and leave the surface of the glass in regular time intervals. Why is this?

- W) It takes a constant amount of time for gas from the air to make it to the growing bubble.
- X) The bubbles occur due to vibrations in the room that have a constant frequency.
- Y) The bubbles rise when the buoyant force exceeds the adhesive force.
- Z) The bubbles form due to pressure waves in the champagne that have a constant wavelength.

**Bonus Answer: Y**

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### 3. PHYSICS

#### Toss Up: Short Answer

Which law says that the total electric flux of a closed surface is equal to the charge enclosed divided by the permittivity?

**Bonus Answer: Gauss's Law**

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#### Bonus: Multiple Choice

What is the electric permittivity of free space?

- W)  $2.27 \times 10^{-12}$  Farads / meters

X)  $8.85 \times 10^{-12}$  Farads / meters

Y)  $8.99 \times 10^9$  Farads / meters

Z)  $6.67 \times 10^{-11}$  Farads / meters

**Bonus Answer: X**

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#### 4. PHYSICS

**Toss Up: Short Answer**

What is a famous impossible result of the classical modeling of blackbody intensity as a function of frequency?

**Bonus Answer: "Ultraviolet Catastrophe"**

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**Bonus: Multiple Choice**

What is the classical law that attempts to map blackbody intensity as a function of frequency and leads to "ultraviolet catastrophe"?

W) Henderson-Hasselbalch's Law

X) Rayleigh-Jeans Law

Y) Plank's Law

Z) Kirchhoff Law

**Bonus Answer: X**

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#### 5. MATHEMATICS

**Toss Up: Multiple Choice**

The number  $(\sqrt{2})^{(\sqrt{2})}$  is:

W) Rational

X) Algebraic irrational

Y) Transcendental

Z) Impossible to tell

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Let  $f(x) = ax^7 + bx^3 + cx - 5$ , where a,b, and c are real numbers. What is the value of  $f(7)$  if  $f(-7) = 8$ ?

**Bonus Answer: -18**

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#### 6. MATHEMATICS

**Toss Up: Multiple Choice**

Which of the following distances is longest?

W) Half a kilometer

X) Half a decimeter

Y) 600 meters

Z) 40 decameters

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What is the name of a line that intersects two or more coplanar lines in different points?

**Bonus Answer: Transversal**

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#### 7. MATHEMATICS

**Toss Up: Short Answer**

Completely expand  $(x-2y)^3$

Bonus Answer:  $x^3 - 6x^2y + 12xy^2 - 8y^3$

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**Bonus: Short Answer**

What is the sum of all the terms in the seventh row of Pascal's triangle?

Bonus Answer: 128

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## 8. MATHEMATICS

**Toss Up: Multiple Choice**

What is the geometric mean of the roots of the polynomial  $2x^3 - 2x^2 - 228x - 432$

W) 4

X) 6

Y) 8

Z) 10

Toss Up Answer: X

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**Bonus: Short Answer**

The first term of an arithmetic sequence is  $x$ , and the  $x$ th term is  $x^2$ . If the common difference is equal to 7, and none of the terms are equal, what is the 12th term of the sequence?

Bonus Answer: 84

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## 9. BIOLOGY

**Toss Up: Multiple Choice**

Movement of cell against concentration gradient is called

W) Gradient

X) Osmosis

Y) Diffusion

Z) Active Transport

Toss Up Answer: Z

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**Bonus: Short Answer**

What is the third most common gas found in the air we breathe?

Bonus Answer: Argon

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## 10. BIOLOGY

**Toss Up: Multiple Choice**

Ordinary table salt is sodium chloride. What is baking soda?

W) Potassium chloride

X) Sodium bicarbonate

Y) Potassium hydroxide

Z) Potassium carbonate

Toss Up Answer: X

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**Bonus: Short Answer**

What is the fourth most abundant element in the universe in terms of mass?

Bonus Answer: Carbon

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## 11. BIOLOGY

**Toss Up: Multiple Choice**

What is active transport?

- W) Transport of substances through a membrane by means of diffusion
- X) Transport without energy consumption
- Y) Endocytosis of a substance by a membrane
- Z) Transport against a concentration gradient

**Toss Up Answer: Z**

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**Bonus: Short Answer**

Caffeine blocks a certain neurotransmitter whose transmission causes drowsiness. What is the name of this neurotransmitter?

**Bonus Answer: Adenosine**

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**12. BIOLOGY**

**Toss Up: Short Answer**

Where are lipids most commonly found in cells?

**Bonus Answer: Cell Membrane (Accept: Membrane)**

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**Bonus: Short Answer**

Where is mRNA synthesized?

**Bonus Answer: Nucleus**

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**13. BIOLOGY**

**Toss Up: Multiple Choice**

Researchers in 2015 reported that resistance to a certain antibiotic was found in a growing number of bacteria from meat samples in China. What is the name of this antibiotic that treats Gram-negative bacteria?

- W) Colistin
- X) Carbapenems
- Y) Linezolid
- Z) Vancomycin

**Toss Up Answer: W**

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**Bonus: Short Answer**

What is the name of polymer in bacterial walls not found in Gram-negative bacteria?

**Bonus Answer:**  
**Peptidoglycan**

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**14. CHEMISTRY**

**Toss Up: Short Answer**

1)An aqueous solution with amount of  $\text{OH}^-$  ions is greater than that of  $\text{H}^+$  ions is what

**Bonus Answer: basic**

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**Bonus: Short Answer**

3)Charles law talks about what?

**Bonus Answer: Hot air rising after being heated**

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**15. CHEMISTRY**

**Toss Up: Short Answer**

In the standard notation for a voltaic cell, the double vertical line "||" represents

**Bonus Answer: A standard Hydrogen Electrode (Accept: Hydrogen Electrode)**

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**Bonus: Short Answer**

Approximately how long must a current of 5.0 amperes be maintained to electroplate 60 g of calcium from molten Calcium Chloride (Molar Mass = 111 g/mol)? Answer in hours.

**Bonus Answer: 16 hours**

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## 16. CHEMISTRY

**Toss Up: Short Answer**

What is the most common isotope of Hydrogen?

**Bonus Answer: Protium**

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**Bonus: Short Answer**

What is the hybridization of carbon atoms in alkanes?

**Bonus Answer: sp<sup>3</sup>**

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## 17. CHEMISTRY

**Toss Up: Short Answer**

Which noble gas is heavier than air?

**Bonus Answer: Xenon (Accept: Xe)**

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**Bonus: Short Answer**

What is the mass of Sodium Chloride that is in the average human body? Answer in grams.

**Bonus Answer: 250 grams**

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## 18. CHEMISTRY

**Toss Up: Short Answer**

Which element is a dark red liquid at room temperature?

**Bonus Answer: Bromine**

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**Bonus: Short Answer**

What is the combining capacity of Calcium?

**Bonus Answer: 2**

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## 19. CHEMISTRY

**Toss Up: Short Answer**

What is the name of a mixture of metals?

**Bonus Answer: Alloy**

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**Bonus: Short Answer**

What is the name given to all Group 16 elements?

**Bonus Answer: Chalcogens**

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## 20. EARTH and SPACE

**Toss Up: Multiple Choice**

What star class is used to characterize the hottest stars?

W) A

X) B

Y) M

Z) O

**Toss Up Answer: Z**

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**Bonus: Short Answer**

Which two moons are larger than the smallest planet in our solar system?

**Bonus Answer: Ganymede and Titan**

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## 21. EARTH and SPACE

**Toss Up: Multiple Choice**

In which constellation is the closest Cepheid variable to Earth?

W) Ursa Minor

X) Lyra

Y) Carina

Z) Sagittarius

**Toss Up Answer: W**

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**Bonus: Short Answer**

Polaris will be further to the north celestial pole in 3000 AD than Altai. What phenomenon is mostly responsible for this?

**Bonus Answer: Precession of the equinoxes**

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## 22. EARTH and SPACE

**Toss Up: Short Answer**

In approximately 4 billion years, another galaxy is predicted to collide with the Milky Way. What is the name of this galaxy?

**Bonus Answer: Andromeda**

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**Bonus: Multiple Choice**

What is the third most abundant element in the universe?

W) Helium

X) Lithium

Y) Carbon

Z) Oxygen

**Bonus Answer: Z**

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## 23. EARTH and SPACE

**Toss Up: Short Answer**

What is the term used to describe silt and mud deposited by a stream during periods of high water?

**Bonus Answer: Alluvial**

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**Bonus: Multiple Choice**

Which radioactive element is generally present in smoke detectors today?

W) Americium

X) Radium

Y) Radon

Z) Actinium

**Bonus Answer: W**

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## 24. EARTH and SPACE

### Toss Up: Multiple Choice

Which corner of the H-R diagram would a white dwarf most likely be found?

- W) Upper Left
- X) Lower Left
- Y) Upper Right
- Z) Lower Right

**Toss Up Answer: X**

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### Bonus: Short Answer

What element is the penultimate element formed in the core of a supergiant?

**Bonus Answer: Silicon**

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## 25. ENERGY

### Toss Up: Multiple Choice

16) Which uranium oxide is most commonly used in light water reactors?

- W) uranium(IV) oxide
- X) uranium(V) oxide
- Y) uranium(VI) oxide
- Z) Yellowcake

**Toss Up Answer: W**

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### Bonus: Multiple Choice

If a 1 kg mouse runs at 5 m/s, what is its approximate energy in electronvolts?

- W)  $4.8 \times 10^{-3}$
- X)  $2.9 \times 10^{15}$
- Y)  $7.8 \times 10^{19}$
- Z)  $4.4 \times 10^{22}$

**Bonus Answer: Y**

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