

## 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)  $8.85 \cdot 10^{(-12)}$  Farads / meters

Y)  $8.99 \cdot 10^{(9)}$  Farads / meters

Z)  $6.67 \cdot 10^{(-11)}$  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**

1. What statistical average is most appropriate to use when the quantities being averaged when one or more of the quantities are not necessarily bounded?

W) Geometric mean

X) median

Y) Harmonic mean

Z) Arithmetic mean

**Toss Up Answer: Y**

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**Bonus: Short Answer**

You pick two cards at random without replacement from a standard, 52 card deck. Compute the probability

exactly one is a heart.

**Bonus Answer: 13/34**

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#### 6. MATHEMATICS

**Toss Up: Short Answer**

What is the limit as  $x$  approaches 0 of  $x^x$ ?

**Bonus Answer: Does not exist. (NOT 1)**

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**Bonus: Short Answer**

Let  $f(x)$  be a function with no real roots. If  $f(3) = 4$ , then in what quadrants can  $f(x)$  be in?

**Bonus Answer: All four quadrants (b.c. there's no specification  $f$  has to be continuous)**

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#### 7. 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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## 8. 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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## 9. BIOLOGY

**Toss Up: Multiple Choice**

You find a new creature measuring over 4 millimeters in size in your bedroom. You notice that it has 6 legs so you know it is some type of:

W) Arachnid

X) Larva

Y) Insect

Z) Echinoderm

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Which class does a spider belong to?

**Bonus Answer: Arachnid**

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## 10. 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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## 11. 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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## 12. 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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## 13. 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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## 14. CHEMISTRY

### Toss Up: Short Answer

1)An aqueous solution with amount of of OH<sup>-</sup> ions is greater than that of H<sup>+</sup> 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**

Stars in which portion of an Hertzsprung-Russel diagram are most likely to have supernova deaths?

W) Bottom right

X) Bottom left

Y) Top right

Z) Center

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

What characteristics do stars in this region of the diagram have compared to those in the other regions?

W) Hot surface temperature and bright

X) Cool surface temperature and bright

Y) Hot surface temperature and dim

Z) Cool surface temperature and dim

**Bonus Answer: X**

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## 21. EARTH and SPACE

**Toss Up: Multiple Choice**

What is closest to the ratio of the total mass of the asteroids of the asteroid belt to the mass of the moon?

W) 100

X) 10

Y) 1

Z) 0.1

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is currently believed to be the reason that the asteroid belt, rather than another planet, formed in that region of the solar system?

**Bonus Answer: Gravitational disturbance by Jupiter prevented sufficient accretion of matter.**

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## 22. EARTH and SPACE

**Toss Up: Short Answer**

What is the name for a section of the Earth's crust that has been displaced, but that still maintains its internal structure?

**Bonus Answer: massif**

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**Bonus: Multiple Choice**

Which of the following is a metamorphic form of shale?

W) quartzite

X) slate

Y) marble

Z) schist

**Bonus Answer: X**

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## 23. 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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## **24. 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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## **25. ENERGY**

**Toss Up: Multiple Choice**

A metal coin and a plastic coin are heated to the same temperature. The two coins have the same size and shape, are dropped into the same tub of cold water at the same time, and are left for 30 seconds. Which coin will have the lower temperature?

W) Metal coin

X) Plastic Coin

Y) Both coins will have the same temperature

Z) Cannot be determined

**Toss Up Answer: W**

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**Bonus: Short Answer**

What is the general name for material that is used to block the flow of heat?

**Bonus Answer: Insulator**

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