

## Round 7

### 1. BIOLOGY

#### Toss Up: Multiple Choice

A product of noncyclic photophosphorylation is

- W) NADPH
- X) water
- Y) carbon dioxide
- Z) ADP

**Toss Up Answer: W**

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#### Bonus: Multiple Choice

All of the following occur in cyclic photophosphorylation EXCEPT:

- W) Electrons move along an electron transport chain.
- X) Electrons in chlorophyll become excited.
- Y) ATP is produced.
- Z) NADPH is produced.

**Bonus Answer: Z**

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### 2. EARTH and SPACE

#### Toss Up: Short Answer

Observation of the phases of which planet gave Galileo evidence for the Copernican model.

**Bonus Answer: Venus**

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#### Bonus: Short Answer

Name the four Galilean Satellites

**Bonus Answer: Io, Europa, Ganymede, Callisto**

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### 3. BIOLOGY

#### Toss Up: Short Answer

How many turns of the Calvin Cycle are needed to make 1 glucose molecule?

**Bonus Answer: 6**

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#### Bonus: Short Answer

How many molecules of ATP are required to make a glucose molecule in the Calvin Cycle?

**Bonus Answer: 18 molecules of ATP (also accept "18", or "18 molecules")**

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### 4. PHYSICS

#### Toss Up: Short Answer

What is the first derivative of velocity?

**Bonus Answer: Acceleration**

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#### Bonus: Short Answer

If you are on an asteroid 100 km in diameter and it is rotating at 200 meters per second, what is your angular acceleration?

**Bonus Answer: 0.4 meters per second**

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### 5. ENERGY

### **Toss Up: Multiple Choice**

What is one advantage to geothermal energy?

W) Low cost

X) Can be built anywhere

Y) Doesn't produce any hazardous chemicals

Z) Will never run out of steam

**Toss Up Answer: W**

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### **Bonus: Short Answer**

In an internal combustion engine, what is the name of the device that ignites the fuel?

**Bonus Answer: Spark plug**

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## **6. CHEMISTRY**

### **Toss Up: Multiple Choice**

Although water molecules are locked together by strong hydrogen bonds, they can reconfigure themselves through which phenomena:

W) Adhesion

X) Brownian Motion

Y) Quantum Tunneling

Z) The Mpemba Effect

**Toss Up Answer: Y**

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### **Bonus: Short Answer**

Superfluidity is a state of matter which exhibits which of the following properties:

Extreme surface tension

Near-zero viscosity

High electrical conductivity

High thermal conductivity

**Bonus Answer: 2 and 4**

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## **7. EARTH and SPACE**

### **Toss Up: Multiple Choice**

A pulsar is a particular type of:

W) Neutron star

X) Black hole

Y) White dwarf

Z) Black dwarf

**Toss Up Answer: W**

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### **Bonus: Short Answer**

What does the Schwarzschild (pronounced: Sh-worts-shield) radius of a body represent?

**Bonus Answer: The radius which, if all of the mass of the body were contained within it, the body would become a black hole (or: its escape velocity would be greater than C).**

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## **8. BIOLOGY**

### **Toss Up: Multiple Choice**

All of the following processes release carbon dioxide EXCEPT:

W) the Krebs cycle

X) alcohol fermentation

- Y) oxidative phosphorylation
- Z) the conversion of pyruvate to acetyl CoA

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

All of the following processes produce ATP EXCEPT:

- W) glycolysis
- X) the Krebs's cycle
- Y) lactic acid fermentation
- Z) oxidative phosphorylation of NADH

**Bonus Answer: Y**

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## 9. EARTH and SPACE

**Toss Up: Multiple Choice**

Sunspots and other solar activity tend to follow a cycle lasting about how long?

- W) 1 year
- X) 11 years
- Y) 23 years
- Z) 57 years

**Toss Up Answer: X**

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**Bonus: Short Answer**

Identify each of the following solar events that is correctly paired with its origin

1. Prominence; the photosphere
2. Solar filament; the chromosphere
3. Coronal mass ejection; the corona

**Bonus Answer: 1, 3**

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## 10. MATHEMATICS

**Toss Up: Short Answer**

What is the relationship between the surface area and the volume of a solid?

**Bonus Answer: The surface area is the derivative of the volume/ the volume is the integral of the surface area when the constant is 0**

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**Bonus: Multiple Choice**

When the inner diagonal of a cube is 7 times root 3 inches, what is the surface area of the cube?

- W) 216 square inches
- X) 294 square inches
- Y) 343 square inches
- Z) 512 square inches

**Bonus Answer: X**

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## 11. EARTH and SPACE

**Toss Up: Multiple Choice**

Sunspots exist on which layer of the sun?

- W) Heliosphere
- X) Photosphere

Y) Chromosphere

Z) Corona

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Sunspots are characterized by

W) High magnetic field flux, and cooler temperature

X) High magnetic field flux, and hotter temperature

Y) Low magnetic field flux, and cooler temperature

Z) Low magnetic field flux, and hotter temperature

**Bonus Answer: W**

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## 12. CHEMISTRY

**Toss Up: Multiple Choice**

Vacuum systems require materials with very low outgassing rates. Which of these metals would be suitable for use in a vacuum chamber?

W) Cadmium

X) Zinc

Y) Magnesium

Z) Aluminum

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which one of these crystal lattice structures best describes the networking of Ti, Zn, and Mg?

W) BCC

X) FCC

Y) HCP

Z) LFC

**Bonus Answer: Y**

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## 13. PHYSICS

**Toss Up: Multiple Choice**

Which law of thermodynamics states that if two thermodynamic systems are each in thermal equilibrium with a third, then they are in thermal equilibrium with each other?

W) Fourth

X) Third

Y) Second

Z) Zeroth

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

What factor is the energy density in radiation of a region of space changed by if the absolute temperature is increased by a factor of 2?

W) Times 4

X) Times 1/4

- Y) Times 2  
Z) Times 16

**Bonus Answer: Z**

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## 14. CHEMISTRY

**Toss Up: Short Answer**

What principle states that an electron will occupy the lowest energy orbital that can receive it?

**Bonus Answer: Aufbau Principle**

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**Bonus: Short Answer**

What is the name of the radioactive decay chain for uranium-235?

**Bonus Answer: Actinium series or Plutonium cascade.**

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## 15. BIOLOGY

**Toss Up: Multiple Choice**

Each of the following molecules is a polymer EXCEPT:

- W) protein  
X) glucose  
Y) cellulose  
Z) starch

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Hydrophilic properties are characteristic of all of the following EXCEPT:

- W) polar molecules  
X) molecules soluble in water  
Y) molecules that readily ionize in water  
Z) the long hydrocarbon chain components of some molecules

**Bonus Answer: Z**

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## 16. CHEMISTRY

**Toss Up: Multiple Choice**

Which of the following molecules has a lewis structure that is a resonance hybrid?

- W) C<sub>2</sub>H<sub>6</sub>  
X) HBr  
Y) SO<sub>2</sub>  
Z) CH<sub>4</sub>

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What mass of HCL dissolved to make a 1 liter solution will give a PH of 1? Give your answer in grams rounded to the nearest hundredth.

**Bonus Answer: 0.37**

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## 17. 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 Relativity
- 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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## 18. MATHEMATICS

**Toss Up: Short Answer**

What is the integral of  $\sec x \, dx$ ?

**Bonus Answer:  $\ln(\sec x + \tan x) + C$**

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**Bonus: Multiple Choice**

Which of these functions cannot be integrated and represented with elementary functions?

- W)  $(\sin^5 x) \cos^6 x \, dx$
- X)  $e^x \sin x^3 \, dx$
- Y)  $e^{(x^2)} \, dx$
- Z)  $\tan x \sin x \, dx$

**Bonus Answer: Y**

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## 19. CHEMISTRY

**Toss Up: Multiple Choice**

A tetrahedral molecule,  $XY_4$  would be formed if X were using the orbital hybridization:

- W)  $p^2$
- X)  $s^2$
- Y)  $sp^2$
- Z)  $sp^3$

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

How does a Bronsted-Lowry differ from its conjugate base?

- W) The acid has one more proton.
- X) The acid has one less proton.
- Y) The acid has one more electron.
- Z) The acid has one less electron.

**Bonus Answer: W**

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## 20. 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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## 21. MATHEMATICS

### Toss Up: Short Answer

What is the sum of the infinite geometric series whose first term is 1 and fourth term is  $1/64$ ?

**Bonus Answer:  $4/3$**

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### Bonus: Multiple Choice

What is the value of  $e$  to the  $(\pi \text{ times } i/2)$ ?

- W)  $e^{-1}$
- X) 1
- Y) -1
- Z)  $i$

**Bonus Answer: Z**

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## 22. 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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## 23. CHEMISTRY

**Toss Up: Short Answer**

What is the halide with no known stable isotopes?

**Bonus Answer: Astatine**

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**Bonus: Multiple Choice**

Which of the following molecules is a saturated hydrocarbon?

W) C<sub>2</sub>H<sub>4</sub>

X) C<sub>3</sub>H<sub>8</sub>

Y) CH<sub>3</sub>OH

Z) C<sub>4</sub>H<sub>6</sub>

**Bonus Answer: X**

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**24. MATHEMATICS**

**Toss Up: Short Answer**

What is 11 base 5 in base 2?

**Bonus Answer: 110**

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**Bonus: Short Answer**

If log base 10 of x is 100, what is log base 100 of x?

**Bonus Answer: 50**

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**25. CHEMISTRY**

**Toss Up: Short Answer**

What is the fuel additive in what is commonly known as "dry-gas" by solubilizing water to reduce contamination in gasoline:

**Bonus Answer: Isopropyl Alcohol**

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**Bonus: Multiple Choice**

The latent heat of vaporization for water at its boiling point and in kj per mole is:

W) 6.01

X) 42.7

Y) 40.7

Z) 40,000,000

**Bonus Answer: Y**

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