

## Round 8

### 1. PHYSICS

#### Toss Up: Multiple Choice

What is true about the capacitance of two parallel plates?

- W) it is proportional to the square of the Area of the plates
- X) it is proportional to the inverse of the Area of the plates
- Y) it is proportional to the inverse of the plate separation
- Z) it is proportional to the plate separation

**Toss Up Answer: Y**

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#### Bonus: Multiple Choice

A 200 farad capacitor is used in a circuit. The voltage difference between the plates of the capacitor is 10 volts. What is the magnitude of the charge on each of the capacitor's plates?

- W) 100 Coulombs
- X) 2000 Coulombs
- Y) 10 Coulombs
- Z) 200 Coulombs

**Bonus Answer: X**

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### 2. PHYSICS

#### Toss Up: Short Answer

Given two frequencies of 410 Hertz and 412 Hertz, what is the period of the beats produced?

**Bonus Answer: .5 seconds**

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#### Bonus: Short Answer

A car is driving away at 50 meters/seconds from an observer at rest. The car is emitting a frequency at 80 Hz. What is the apparent frequency for the observer, given that the speed of sound is 350 meters/seconds? Give your answer to the nearest integer.

**Bonus Answer: 70 Hertz**

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### 3. 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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### 4. 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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## 5. MATHEMATICS

**Toss Up: Multiple Choice**

Compute  $3C1 + 4C2 + 5C3 + 6C4 + 7C5$ . [3 choose 1 + 4 choose 2 + 5 choose 3 + 6 choose 4 + 7 choose 5]

- W) 55
- X) 336
- Y) 240
- Z) 56

**Toss Up Answer: W**

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**Bonus: Short Answer**

Compute the square root of 5476

**Bonus Answer: 74**

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## 6. MATHEMATICS

**Toss Up: Multiple Choice**

Simplify  $(\sin 15 \cos 75 - \cos 15 \sin 75) / (\cos 15 \cos 75 + \sin 15 \sin 75)$

- W) negative square root of 3
- X) 1/2
- Y) -1/2
- Z) square root 6 minus square root 2 all over 2

**Toss Up Answer: W**

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**Bonus: Short Answer**

Compute  $(2 + 2\sqrt{3}i)^6$ . [2+2 times the square root of 3, i to the 6th power]

**Bonus Answer: 4096**

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## 7. MATHEMATICS

**Toss Up: Short Answer**

Which of the following statements concerning prime numbers are true?

1. If a and n are relatively prime then there are infinitely many primes that leave a remainder of a when divided by n.
2. All integers less than p are quadratic residues modulo p
3. There are infinitely many prime numbers

**Bonus Answer: 1 and 3**

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**Bonus: Short Answer**

If  $a_1 + a_2 + a_3 + a_4 + a_5 = 17$  for positive integers  $a_1, a_2, a_3, a_4, a_5$ , then maximize the product  $a_1 a_2 a_3 a_4 a_5$ ?

**Bonus Answer: 432**

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## **8. MATHEMATICS**

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

Which of the following expressions in  $x$  grows fastest?

W)  $3^x$  [3 to the  $x$ ]

X)  $10(3/2)^x$  [10 times three halves to the  $x$ ]

Y)  $x^2$  [ $x$  squared]

Z)  $2^{(2x)}$  [2 to the  $2x$ ]

**Toss Up Answer: Z**

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### **Bonus: Short Answer**

Given  $504 = 2^3 \times 3^2 \times 7$  [504 equals 2 cubed times 3 squared times 7], compute the sum of the positive divisors of 504

**Bonus Answer: 1560**

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## **9. 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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## **10. 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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## **11. 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 cycle

Y) lactic acid fermentation

Z) oxidative phosphorylation of NADH

**Bonus Answer: Y**

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## 12. 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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## 13. BIOLOGY

**Toss Up: Short Answer**

Which structural component of the cell cytoskeleton has alpha and beta subunits and is involved with intracellular transport?

**Bonus Answer: Microtubules**

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**Bonus: Short Answer**

What are the units of inheritance?

**Bonus Answer: Genes (accept DNA)**

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## 14. CHEMISTRY

**Toss Up: Multiple Choice**

A tetrahedral molecule, XY<sub>4</sub> would be formed if X were using the orbital hybridization:

W) p<sup>2</sup>

X) s<sup>2</sup>

Y) sp<sup>2</sup>

Z) sp<sup>3</sup>

**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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**15. 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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**16. CHEMISTRY**

**Toss Up: Short Answer**

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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**17. CHEMISTRY**

**Toss Up: Short Answer**

gypsum is what percent water by weight? (atomic masses of calcium = 40; sulfur = 32 and oxygen = 16.)

**Bonus Answer: 21!!!!!!**

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**Bonus: Short Answer**

What is the general name for a hypothetical gas that does not obeys Boyles's law at all temperatures and pressures?

**Bonus Answer: not ideal**

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**18. CHEMISTRY**

**Toss Up: Short Answer**

If the electronegativity difference in the bonding atoms is intermediate , what type of bond is formed?

**Bonus Answer: polar covalent**

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**Bonus: Short Answer**

what is the formula for potassium perchlorate?

**Bonus Answer: kclo4**

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**19. CHEMISTRY**

**Toss Up: Short Answer**

If pure water boils at 100C,how many additional calories of heat are needed to convert 1 gram of water from the liquid to the vapor?!

**Bonus Answer: 540**

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**Bonus: Short Answer**

What is the name for the straight-chain alkane containing 5 carbons?

**Bonus Answer: pentane**

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**20. EARTH and SPACE**

**Toss Up: Short Answer**

What star has the greatest apparent magnitude

**Bonus Answer: Sun**

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**Bonus: Multiple Choice**

What month can the constellation Orion be most prominent in the southern sky at about 10 pm from mid-northern latitudes

W) February

X) March

Y) December

Z) July

**Bonus Answer: Y**

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**21. EARTH and SPACE**

**Toss Up: Short Answer**

What planet has the most amount of solidified water in our solar system?

**Bonus Answer: Earth**

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**Bonus: Short Answer**

How about out solar system?

**Bonus Answer: Jupiter**

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**22. EARTH and SPACE**

**Toss Up: Short Answer**

The 29 ½ days it takes the Moon to complete an orbit around the Earth is called a

**Bonus Answer: Synodic Month**

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**Bonus: Short Answer**

The time between two successive meridian transits of the Sun as observed from a stationary spot on the Earth's

surface is called

**Bonus Answer: A day (a solar day)**

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## 23. EARTH and SPACE

**Toss Up: Short Answer**

What type of rock comes in layers?

**Bonus Answer: Sedimentary**

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**Bonus: Short Answer**

What color is a flame of lithium?

**Bonus Answer: Green**

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## 24. EARTH and SPACE

**Toss Up: Short Answer**

What are the three types of asteroids, classified based on composition?

**Bonus Answer: C-type (accept carbonaceous), M-type (accept metal-rich), S-type (accept silicate)**

**(Accept in any order)**

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**Bonus: Short Answer**

Order these three types of asteroid from most common to least common in the asteroid belt.

**Bonus Answer: C-type (accept carbonaceous), S-type (accept silicate), M-type (accept metal-rich)**

About 75% of visible asteroids in the asteroid belt are carbonaceous, about 17% are silicate asteroids, and about 10% are metal-rich asteroids

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## 25. ENERGY

**Toss Up: Multiple Choice**

Using current technologies, which of the following sources of energy is nonrenewable?

W) Geothermal

X) Wind

Y) Nuclear

Z) Solar

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Which of the following is NOT a fossil fuel?

W) Coal

X) Petroleum

Y) Natural gas

Z) Uranium

**Bonus Answer: Z**

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