

## Round 11

### 1. CHEMISTRY

#### Toss Up: Multiple Choice

Which of the follow is true regarding complex ions?

- W) Their formation constants are usually very small and they often form colored coordination compounds.
- X) Their formation constants are usually very small and they often form colorless coordination compounds.
- Y) Their formation constants are usually very large and they often form colored coordination compounds.
- Z) Their formation constants are usually very large and they often form colorless coordination compounds.

**Toss Up Answer: Y**

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#### Bonus: Multiple Choice

Which of the following is a monodentate ligand?

- W) Oxalate
- X) Chloride Ion
- Y) Aluminum (III) Ion
- Z) Ammonium Ion

**Bonus Answer: X**

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### 2. MATHEMATICS

#### Toss Up: Short Answer

Find the perimeter of a right triangle with legs 11 and 60.

**Bonus Answer: 132**

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#### Bonus: Short Answer

In a 15-75-90 degrees right triangle with hypotenuse 4, what are the lengths of the shorter and longer leg, respectively? Exact answers please.

**Bonus Answer: radical 6 - radical 2, radical 6 + radical 2**

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### 3. MATHEMATICS

#### Toss Up: Short Answer

If Bruce can do a job in 3 hours, and Clark can do the same job in 4 hours, how long, in hours, will it take them to do the job if they work together? You may leave your answer as a fraction.

**Bonus Answer: 12/7**

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#### Bonus: Short Answer

What is the eccentricity of an ellipse with  $a = 5$  and  $b = 4$ ?

**Bonus Answer: 3/5**

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### 4. EARTH and SPACE

#### Toss Up: Multiple Choice

What upwelling ocean current off the coast of South America causes the most productive marine ecosystem in the world?

- W) Gulf Stream
- X) South Pacific Gyre
- Y) Humboldt Current
- Z) Cromwell Current

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What compound makes Neptune blue?

**Bonus Answer: Methane**

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## 5. MATHEMATICS

**Toss Up: Multiple Choice**

Fermat's Last Theorem conjectures that no three positive integers  $a, b$ , and  $c$  can satisfy the equation  $a^n + b^n = c^n$  for any integer value of  $n$  greater than 2. It went unproved for more than 300 years until it was finally proved in 1994 by a mathematician who received a substantial monetary prize only this year. What is the name of this mathematician?

W) Grigori Perelman

X) John Nash

Y) Andrew Wiles

Z) Terence Tao

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Prime numbers of the form  $2^n + 1$ , where  $n$  is a non-negative integer, are known as this.

**Bonus Answer: Fermat Primes**

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## 6. EARTH and SPACE

**Toss Up: Short Answer**

The Kappa Cygnids and the Northern Delta Aquarids are names for what phenomena?

**Bonus Answer: Meteor Showers**

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**Bonus: Short Answer**

What substance is responsible for Neptune's blue-green color?

**Bonus Answer: Methane gas (accept methane)**

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## 7. CHEMISTRY

**Toss Up: Short Answer**

In complex of manganese (II) ion exhibiting a low spin state, how many d electrons are paired?

**Bonus Answer: Four**

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**Bonus: Short Answer**

What is the conjugate base of  $\text{HPO}_4^{2-}$  (Read as: Hydrogen Phosphate)?

**Bonus Answer:  $\text{PO}_4^{3-}$  (Accept: Phosphate, PO four 3 minus)**

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## 8. ENERGY

**Toss Up: Multiple Choice**

Which country generates the highest percentage of its energy from nuclear power?

W) France

X) China

Y) Britain

Z) Denmark

**Toss Up Answer: W**

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**Bonus: Short Answer**

List the operating temperatures from lowest to highest of these types of fuel cells

PEMFC  
PAFC  
MCFC  
SOFC

**Bonus Answer: 1,2,3,4**

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## 9. BIOLOGY

**Toss Up: Multiple Choice**

Which part of the brain is associated with coordinated movement?

- W) Cerebrum
- X) Cerebellum
- Y) Diencephalon
- Z) Corpus Callosum

**Toss Up Answer: X**

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**Bonus: Short Answer**

What is the major excitatory neurotransmitter in the brain?

**Bonus Answer: Glutamate**

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## 10. CHEMISTRY

**Toss Up: Multiple Choice**

For compounds with the same number of carbon atoms, the compound with the lowest boiling point is expected to be

- W) a ketone
- X) an amine
- Y) an ether
- Z) an alcohol

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

To have cis and trans isomers, a compound must have

- W) sp bonded carbon atoms
- X) sp<sup>3</sup> bonded carbon atoms
- Y) sp<sup>2</sup> bonded carbon atoms
- Z) (W) and (X)

**Bonus Answer: Y**

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## 11. CHEMISTRY

**Toss Up: Multiple Choice**

Which of the following pairs of constants are NOT mathematically related to each other?

- W) Equilibrium constant and Gibbs free energy
- X) Rate constant and activation energy
- Y) Standard cell voltage and equilibrium constant
- Z) Standard cell voltage and rate constant

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which of the following is FALSE?

W) Reduction involves a gain of electrons

X) Batteries are galvanic cells

Y) A thermodynamically favored reaction always has a positive E

Z) Electrolysis reactions always produce a gas at at least one electrode.

**Bonus Answer: Z**

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## 12. CHEMISTRY

**Toss Up: Multiple Choice**

The evaporation of any liquid is expected to have

W) a positive delta H and a negative delta S

X) a negative delta H and a negative delta S

Y) a positive delta H and a positive delta S

Z) a positive delta H and a negative delta S

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Which of the following is most likely to be true?

W) Combustion of organic compounds has a negative delta H

X) A positive delta G indicates a thermodynamically favorable reaction.

Y) A positive delta S always means that the reaction is thermodynamically favored.

Z) A thermodynamically favored reaction always goes to completion.

**Bonus Answer: W**

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## 13. EARTH and SPACE

**Toss Up: Short Answer**

All of Saturn's moons are composed predominantly of what substance?

**Bonus Answer: Ice**

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**Bonus: Short Answer**

What are the scientific names for the two regions of a sunspot?

**Bonus Answer: Umbra and penumbra**

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## 14. MATHEMATICS

**Toss Up: Multiple Choice**

Which of the following cannot be the root of a polynomial with rational coefficients?

W)  $5i + 6$

X)  $\phi - 1/2$ , where  $\phi$  is the golden ratio

Y)  $\sqrt{3+i}$

Z)  $6 - \pi i$

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the name given to a number that is not a root of any non-zero polynomial equation with rational coefficients?

**Bonus Answer: Transcendental number (Accept transcendental)**

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## 15. EARTH and SPACE

**Toss Up: Short Answer**

What is a pulsating variable star whose brightness varies in a very regular time period of about 1-50 days?

**Bonus Answer: Cepheid**

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**Bonus: Short Answer**

What is the part of the Sun that we can see without any instruments?

**Bonus Answer: Photosphere**

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**16. CHEMISTRY**

**Toss Up: Multiple Choice**

Modern automobiles use a catalytic converter to

- W) increase horsepower by burning more gasoline
- X) absorb pollutants from the exhaust
- Y) complete the combustion of unburned gases
- Z) cool the exhaust gases

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

A catalyst will NOT

- W) increase the forward reaction rate
- X) shift the equilibrium to favor the products
- Y) alter the reaction pathway
- Z) increase the speed at which equilibrium will be achieved

**Bonus Answer: X**

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**17. EARTH and SPACE**

**Toss Up: Short Answer**

What is the term for the amount of energy released from each square meter of an object's surface each second?

**Bonus Answer: Energy flux**

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**Bonus: Short Answer**

Give another name for the Pleiades.

**Bonus Answer: M45 or The Seven Sisters or The False Dipper**

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**18. PHYSICS**

**Toss Up: Short Answer**

What is the S.I. unit for Inductance?

**Bonus Answer: Henry**

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**Bonus: Multiple Choice**

Which law states that for any closed loop path, the sum of the length elements times the magnetic field in the direction of the length element is equal to the permeability times the electric current enclosed in the loop?

- W) Faraday's Law of Induction
- X) Kirchhoff's Law
- Y) Coulomb's Law
- Z) Ampere's Law

**Bonus Answer: Z**

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## 19. BIOLOGY

### Toss Up: Multiple Choice

Which of the following is most closely related to sharks?

- W) Trout
- X) Blue Gill
- Y) Manta Ray
- Z) Octopus

**Toss Up Answer: Y**

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### Bonus: Short Answer

Who invented the polio vaccine?

**Bonus Answer: Jonas Salk**

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## 20. BIOLOGY

### Toss Up: Multiple Choice

Which of these human diseases is not caused by roundworms?

- W) Filariasis
- X) Ancylostomiasis
- Y) Ascariasis
- Z) Typhoid fever

**Toss Up Answer: Z**

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### Bonus: Short Answer

What hormone causes vesicles carrying aquaporins to embed in the membranes of cells in the collecting duct?

**Bonus Answer: ADH (Antidiuretic hormone); Vasopressin**

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## 21. PHYSICS

### Toss Up: Short Answer

What is the metric unit for mass?

**Bonus Answer: Kilogram (kg)**

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### Bonus: Short Answer

What is the SI unit of force?

**Bonus Answer: Newton**

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## 22. BIOLOGY

### Toss Up: Multiple Choice

What is an algal bloom that occurs in salt water called?

- W) Pelagic tide
- X) Red tide
- Y) Red spring
- Z) Nitrifying effect

**Toss Up Answer: X**

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### Bonus: Short Answer

What process is involved in the breakdown of fats?

**Bonus Answer: Beta Oxidation**

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## 23. PHYSICS

**Toss Up: Multiple Choice**

Any change in the magnetic environment of a coil of wire will cause a voltage (emf) to be "induced" in the coil. Which law summarizes the ways in which voltage can be generated using this method?

- W) Ohm's Law
- X) Faraday's Law
- Y) Pascal's Law
- Z) Coulomb's Law

**Toss Up Answer: X**

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**Bonus: Short Answer**

A magnet is brought close to a flat square coil of 50 loops. The coil is .2 meters on each side, and the magnetic field passing through the coil increased uniformly from 3 Tesla to 8 Tesla in 4 seconds. While that change in magnetic field takes place what is the induced emf in the coil?

**Bonus Answer: -2.5 Volts**

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**24. BIOLOGY**

**Toss Up: Multiple Choice**

In which fluid-filled cavity do organs develop in organisms such as earthworms?

- W) Ring
- X) Column
- Y) Coelom
- Z) Peritoneal cavity

**Toss Up Answer: Y**

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**Bonus: Short Answer**

How do pythons and boas move?

**Bonus Answer: Rectilinear Motion**

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**25. PHYSICS**

**Toss Up: Multiple Choice**

The binding energy of a nucleus is the energy that must be supplied to:

- W) remove a nucleon
- X) remove an alpha particle
- Y) to remove a beta particle
- Z) separate the nucleus into its constituent nucleons

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

A radium atom,  $^{226}\text{Ra}$  emits an alpha particle. The number of protons in the resulting atom is

- W) 84
- X) 85
- Y) 86
- Z) 88

**Bonus Answer: W**

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