

Round 11

1. PHYSICS

Toss Up: Short Answer

What is the S.I. unit for Inductance?

Bonus Answer: Henry

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

2. PHYSICS

Toss Up: Short Answer

What is the metric unit for mass?

Bonus Answer: Kilogram (kg)

Bonus: Short Answer

What is the SI unit of force?

Bonus Answer: Newton

3. 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

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

4. 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

Bonus: Multiple Choice

A radium atom, ^{226}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

5. MATHEMATICS**Toss Up: Short Answer**

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

Bonus Answer: 132

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: $\sqrt{6}$ - $\sqrt{2}$, $\sqrt{6}$ + $\sqrt{2}$

6. 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: $\frac{12}{7}$

Bonus: Short Answer

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

Bonus Answer: $\frac{3}{5}$

7. 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

Bonus: Short Answer

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

Bonus Answer: Fermat Primes

8. 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 ϕ is the golden ratio

Y) $\sqrt{3+i}$

Z) $6 - \pi i$

Toss Up Answer: Z

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)

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

Bonus: Short Answer

What is the major excitatory neurotransmitter in the brain?

Bonus Answer: Glutamate

10. 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

Bonus: Short Answer

Who invented the polio vaccine?

Bonus Answer: Jonas Salk

11. 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

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

12. 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

Bonus: Short Answer

What process is involved in the breakdown of fats?

Bonus Answer: Beta Oxidation

13. 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

Bonus: Short Answer

How do pythons and boas move?

Bonus Answer: Rectilinear Motion

14. 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

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

15. 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

Bonus: Short Answer

What is the conjugate base of HPO_4^{2-} (Read as: Hydrogen Phosphate)?

Bonus Answer: PO₄(3-) (Accept: Phosphate, PO four 3 minus)

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16. 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) sp³ bonded carbon atoms
- Y) sp² bonded carbon atoms
- Z) (W) and (X)

Bonus Answer: Y

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17. 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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18. 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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19. 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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20. 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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21. 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)

22. EARTH and SPACE

Toss Up: Short Answer

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

Bonus Answer: Ice

Bonus: Short Answer

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

Bonus Answer: Umbra and penumbra

23. 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

Bonus: Short Answer

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

Bonus Answer: Photosphere

24. 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

Bonus: Short Answer

Give another name for the Pleiades.

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

25. 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

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
