

Round 11

1. 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 $2^n (2^n) + 1$, where n is a non-negative integer, are known as this.

Bonus Answer: Fermat Primes

2. 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

3. ENERGY

Toss Up: Multiple Choice

In a conventional light bulb, what is the ratio of light energy to the heat energy produced?

- W) 1:9
- X) 3:2
- Y) 1:1
- Z) 7:3

Toss Up Answer: W

Bonus: Multiple Choice

The arctic is estimated to hold what percent of the world's undiscovered oil and natural gas reserves?

- W) 7%
- X) 13%
- Y) 22%
- Z) 35%

Bonus Answer: Y

4. 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

5. 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

6. 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

7. 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

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8. 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 HPO_4^{2-} (Read as: Hydrogen Phosphate)?

Bonus Answer: PO_4^{3-} (Accept: Phosphate, PO four 3 minus)

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9. 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

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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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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^3 bonded carbon atoms

Y) sp^2 bonded carbon atoms

Z) (W) and (X)

Bonus Answer: Y

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11. MATHEMATICS

Toss Up: Multiple Choice

A point with coordinates (3,5) is rotated 90 degrees clockwise about the point (2,1) and is then reflected across the y-axis. What are the coordinates of the resulting image?

W) (-5,-3)

X) (-4,0)

Y) (-6,0)

Z) (-5,-1)

Toss Up Answer: Y

Bonus: Multiple Choice

A quadrilateral ABCD has two congruent opposite side segments, AB and CD. Which of the following would have to be true in order for the quadrilateral to be a square?

- W) The circumcircle of ABC is centered at the midpoint of AC
- X) The medians of ABCD are perpendicular
- Y) The perpendicular bisectors of AB and CD are the same line
- Z) None of the above.

Bonus Answer: Z

12. MATHEMATICS

Toss Up: Multiple Choice

Given the equation of a conic section, $y^2/16 - x^2/25 = 1$, what is the length of the conjugate axis?

- W) 16
- X) 8
- Y) 10
- Z) 25

Toss Up Answer: Y

Bonus: Multiple Choice

Compute $\log(\text{base } 2)$ of 2048^2

- W) 20
- X) 22
- Y) 24
- Z) 26

Bonus Answer: X

13. 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

14. 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

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

15. EARTH and SPACE

Toss Up: Multiple Choice

Light from distant galaxies comes mostly from which of the following?

- W) Planets
- X) Low mass stars
- Y) High mass stars
- Z) Black holes

Toss Up Answer: Y

Bonus: Multiple Choice

Which planet has the highest escape velocity?

- W) Mercury
- X) Earth
- Y) Uranus
- Z) Jupiter

Bonus Answer: Z

16. 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

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

17. 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

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

18. 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

19. EARTH and SPACE**Toss Up: Multiple Choice**

What percent of stars in the sky that appear to be single stars are actually binary stars

- W) About 25%
- X) About 35%
- Y) About 50%
- Z) About 60%

Toss Up Answer: Y

Bonus: Short Answer

What is the 29 ½ days it takes the Moon to complete an orbit around the Earth called?

Bonus Answer: Synodic month

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

Bonus: Short Answer

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

Bonus Answer: ADH (Antidiuretic hormone); Vasopressin

21. EARTH and SPACE

Toss Up: Short Answer

A solar eclipse can only occur at what phase of the moon?

Bonus Answer: New Moon

Bonus: Short Answer

What constellation cannot be seen in the summer sky of the northern hemisphere?

Bonus Answer: Orion

22. 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

23. 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

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

Bonus: Short Answer

How do pythons and boas move?

Bonus Answer: Rectilinear Motion

25. BIOLOGY

Toss Up: Multiple Choice

How many cotyledons do edicts have?

- W) 5
- X) 1
- Y) 0
- Z) 2

Toss Up Answer: Z

Bonus: Short Answer

How many stages in a butterfly's life cycle?

Bonus Answer: Four (4)
