Round 11

1. PHYSICS

Writer: Siam Muquit

Toss Up: Multiple Choice

In a simple series circuit, which of these is equal among all resistors?

W) Potential difference

X) Resistance

Y) Current

Z) Capacitance

Toss Up Answer: Y

Bonus: Multiple Choice

A circuit is made with a battery and four resistors connected in series. Two resistors changed to be in parallel in the circuit. What is the change in the power dissipated by the original two resistors?

W) The power increases

X) The power decreases

Y) The power stays the same

Z) No power is being generated by any resistor

Bonus Answer: W

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2. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

Which principle of quantum mechanics allows for the quantum state of any particle to be expressed as a linear combination of distinct quantum states?

Bonus Answer: Superposition principle

Bonus: Short Answer

A free electron has a momentum of 5.0 × 10^(−24) kg · m/s (read as 5.0 times 10 to the negative 24 kilogram times meter per second). The wavelength of its wave function in meters is:

Bonus Answer: ~1.3×10^(-10) meters (explanation: deBroglie wavelength)

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3. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

A magnetic field CANNOT:

W) Exert a force on a charged particle

X) Change the trajectory of a charged particle

Y) Change the kinetic energy of a charged particle

Z) Do no work on a charged particle

Toss Up Answer: Y

Bonus: Multiple Choice

A magnet and a conducting loop are placed next to each other at rest on a horizontal surface. If the magnet with the north pole facing left is put through the loop and is moved left in which direction will the induced current within the loop move with reference to the magnet?

W) Into the magnet

X) Counter-clockwise
Y) Clockwise
Z) There is no current.

Bonus Answer: X

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4. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

When charging or discharging a capacitor, what the quantity RC (read as resistance times capacitance) known as?

Bonus Answer: Time constant

Bonus: Multiple Choice

At point 'A' on a circuit the wire is grounded. At point 'B' on the same circuit there is a emf of 30 volts. If there are two identical resistors with resistance of 10 ohms in parallel, between point 'A' and point 'B', what is the current in ampere flowing through either resistor?

W) 15
X) 3
Y) 9
Z) 6

Bonus Answer: X

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5. PHYSICS

Writer: Jan Wojcik

Toss Up: Multiple Choice

Which of the following is NOT true about magnetism?

W) Electric field lines go from the North pole to the South pole
X) There are instances where electric field lines cross each other
Y) Cutting a magnet in half will not create two magnetic monopoles
Z) They are all true

Toss Up Answer: X

Bonus: Short Answer

By name or number, list all of the following elements that are ferromagnetic: Cobalt, Manganese, Cobalt, Cadmium, Silver

Bonus Answer: Cobalt. Accept: Co, 1

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6. MATHEMATICS

Writer: Siam Muquit

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

Bonus: Short Answer

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

Bonus Answer: 3/5

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7. MATHEMATICS

Writer: Seiji Yawata

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

Bonus Answer: Fermat Primes

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8. MATHEMATICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

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

W) 5*i + 6

X) phi - 1/2, where phi 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)

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9. MATHEMATICS

Writer: Siam Muquit

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(base 2) of 2048^2

W) 20

X) 22

Y) 24

Z) 26

Bonus Answer: X

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10. BIOLOGY

Writer: Siam Muquit

Toss Up: Short Answer

Which model is currently accepted as representative of the dynamic nature of the Golgi apparatus?

Bonus Answer: Cisternal Maturation model

Bonus: Short Answer

Which cytoskeletal element functions in cleavage furrow formation?

Bonus Answer: Microfilament

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11. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of these would not be found in a plant vacuole?

W) pigments

X) poisons

Y) inorganic ions

Z) smaller organelles

Toss Up Answer: Z

Bonus: Short Answer

Which cytoskeletal element has a diameter of 7nm?

Bonus Answer: Microfilament

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12. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

After three rounds of cell fractionation, the pellet would be rich in:

W) nuclei

X) microsomes

Y) mitochondria

Z) ribosomes

Toss Up Answer: X

Bonus: Multiple Choice

P53 is a

W) tumor-inducing protein

X) tumor-suppressing protein

Y) tumor-inducing hormone

Z) tumor-suppressing hormone

Bonus Answer: X

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13. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which experimental treatment would increase the rate of sucrose transport into a plant cell?

W) decreasing extracellular sucrose concentration

X) decreasing extracellular pH
Y) decreasing cytoplasmic pH
Z) adding a substance that makes the membrane more permeable to H+ ions
Toss Up Answer: X

Bonus: Short Answer
If the entire cell cycle in a certain cell takes 24 hours, how long does mitosis take?
Bonus Answer: 2 hours

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14. CHEMISTRY

Writer: Prangon Ghose
Toss Up: Short Answer
What is the coordination number of Ag2C2O2 (Silver Oxalate)?
Bonus Answer: 2

Bonus: Short Answer
What two elements are liquid at room temperature?
Bonus Answer: Bromine and Mercury (Accept: Br and Hg)

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15. CHEMISTRY

Writer: Prangon Ghose
Toss Up: Short Answer
What is the stoichiometric point when exactly enough titrant is used to react?
Bonus Answer: Equivalence Point

Bonus: Short Answer
What is the point in a titration at which an indicator changes color?
Bonus Answer: Endpoint

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16. CHEMISTRY

Writer: Prangon Ghose
Toss Up: Multiple Choice
For which of the following can the Ksp values be compared to determine relative molar solubilities?
W) Ag2CrO4 and AgBr (Read as: Silver Chromate and Silver Bromide)
X) Ag2SO4 and CaSO4 (Read as: Silver Sulfate and Calcium Sulfate)
Y) PbCl2 and PbSO4 (Read as: Lead two Chloride and Lead two Sulfate)
Z) ZnS and AgI (Read as: Zinc Sulfide and Silver Iodide
Toss Up Answer: Z

Bonus: Short Answer
What is the molecular geometry associated with a coordination number of 6?
Bonus Answer: Octahedral

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17. CHEMISTRY

Writer: Prangon Ghose
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

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18. CHEMISTRY

Writer: Prangon Ghose

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 HPO4(2-) (Read as: Hydrogen Phosphate)?

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

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19. CHEMISTRY

Writer: William Chan

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

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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20. EARTH and SPACE

Writer: Andrew Chen

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

Bonus: Short Answer
What is the coldest planet in the solar system?
Bonus Answer: Uranus

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21. EARTH and SPACE

Writer: Amrit Hingorani
Toss Up: Short Answer
The Kappa Cygnids and the Northern Delta Aquarids are names for what phenomena?
Bonus Answer: Meteor Showers

Bonus: Short Answer
What substance is responsible for Neptune's blue-green color?
Bonus Answer: Methane gas (accept methane)

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22. EARTH and SPACE

Writer: Amrit Hingorani
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

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23. EARTH and SPACE

Writer: Amrit Hingorani
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

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24. EARTH and SPACE

Writer: Amrit Hingorani
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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25. ENERGY

Writer: Nicholas Parker Ng

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

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