Round 12

1. PHYSICS

Toss Up: Short Answer

What is the equivalent capacitance in Farads of two capacitors connected in series, one with a capacitance of 4 microFarads and the other with a capacitance of 2 microFarads?

Bonus Answer: 4/3 microFarads

Bonus: Short Answer

Give your answer in scientific notation, in Farads, rounded to the nearest tenth. What is the approximate capacitance between two parallel plates of surface area 10cm squared, separated by a distance of 1 meter?

Bonus Answer: 8.9*10^-14 Farads

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2. PHYSICS

Toss Up: Multiple Choice

In the capacitor discharge formula q = q0e^(−t/(RC)) (read as q naught times e raised to the power of negative t over quantity R times C) the term RC is more commonly referred to as:

W) The time limit

X) The time of charge

Y) The time constant

Z) It does not have a specific name

Toss Up Answer: Z

Bonus: Short Answer

Resistor 1 has twice the resistance of resistor 2. They are connected in parallel to a battery.The ratio of the thermal energy generation rate in 1 to that in 2 is:

Bonus Answer: 1:2

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3. PHYSICS

Toss Up: Short Answer

The Laplacian of an electric potential field is equal to the negative free charge density over this quantity. This quantity is equal to the negative time derivative of the magnetic flux, and in an inductor, it is equivalent to the inductance multiplied by the negative time derivative of the current. It is classically defined as Coulomb’s constant multiplied by the sum of charge over distance, and also as the line integral of the electric field “dot dl.” When it is multiplied by current, it gives power dissipated by a resistor. Kirchoff’s Loop Rule states that the sum of this value around a loop in a circuit is zero. Name this quantity this is equal to the current times resistance by Ohm’s Law.

Bonus Answer: Voltage (accept electric potential)

Bonus: Multiple Choice

A certain capacitor, in series with a 720-Ω resistor, is being charged. At the end of 10 ms(milliseconds) its charge is half the final value. The capacitance is about:

W) 9.6 μF

X) 14 μF

Y) 20 μF

Z) 7.2F

Bonus Answer: Y

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4. PHYSICS

Toss Up: Multiple Choice

A non-relativistic free electron has kinetic energy K. If its wavelength doubles, what is its kinetic energy in terms of K?
W) 4K
X) K/4
Y) K
Z) K/2
Toss Up Answer: X

Bonus: Short Answer
A molecule with a magnetic moment of 83 N*m/T(read as Newton-meters per Tesla) experiences what amount of torque in N*m (read as Newton-meter) when subjected to an external magnetic force of 120 teslas?
Bonus Answer: 9960 N*m

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5. PHYSICS

Toss Up: Multiple Choice
If the wave function ψ is spherically symmetric then the radial probability density is given by:If the wave function ψ is spherically symmetric then the radial probability density is given by:
W) 4πr^2*ψ
X) |ψ|^2
Y) 4πr^2|ψ|^2
Z) 4π|ψ|^2
Toss Up Answer: Y

Bonus: Short Answer
Maxwell's equations are to electric and magnetic fields as [ ] equation is to the wave function for a particle.
Bonus Answer: Schrodinger's

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6. MATHEMATICS

Toss Up: Multiple Choice
If θ is an angle such that sin(θ) < 0 and cos (θ) = 0, where in the coordinate plane is it located?
W) Between the 2nd and 3rd quadrants
X) Between the 3rd and 4th quadrants
Y) Between the 1st and 4th quadrants
Z) Between the 1st and 2nd quadrants
Toss Up Answer: Y

Bonus: Short Answer
What is the remainder of x^10+x+1 divided by (x-1)^2 ?
Bonus Answer: 11x-8

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7. MATHEMATICS

Toss Up: Short Answer
What is the inverse of the 2x2 matrix (row 1: 6 10), (row 2: 3 5)?
Bonus Answer: The matrix has no inverse (b.c. determinant = 0).

Bonus: Short Answer
The legs of an isosceles triangle have a length of 10, and the altitudes to the legs have a length of 6. In simplified radical form, what is the length of the altitude to the base of the triangle?
Bonus Answer: 3 * sqrt(10) (Do not accept sqrt(90))

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8. MATHEMATICS

Toss Up: Short Answer

If n is a positive integer, what is the smallest value of n such that n! + 1 is a perfect square?

Bonus Answer: 4

Bonus: Short Answer

If z1 = 3 - 4i and z2 = 7 + i, find the absolute value of z1z2 in simplest terms.

Bonus Answer: 25*sqrt(2)

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9. 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

Bonus: Short Answer

Compute the square root of 5476

Bonus Answer: 74

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10. BIOLOGY

Toss Up: Short Answer

The strongest known biological oxidizing agent plays a key role in photosynthesis. What is it called?

Bonus Answer: P680

Bonus: Short Answer

What was the phage that Hershey and Chase used in their experiments, and what two radioactive substances did they tag it with?

Bonus Answer: T2, S35 and P32 (Do NOT accept Sulfur and Phosphorus)

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11. BIOLOGY

Toss Up: Multiple Choice

Which is not associated with the proteasomal degradation pathway?

W) Response to oxidative stress

X) Regulation of gene expression

Y) Kinetochore attachment

Z) The Cell cycle

Toss Up Answer: Y

Bonus: Short Answer

If a reaction with a Delta G of +3.4 kcal/mol is coupled with ATP hydrolysis, what is the net Delta G?

Bonus Answer: -3.9 kcal/mol

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12. BIOLOGY

Toss Up: Multiple Choice

Which process is in play when we respond less strongly to repeated stimuli over time?

W) Sensory Adaptation

X) Habituation

Y) Accomodation
Z) Maturation

Toss Up Answer: X

Bonus: Multiple Choice

The learning phase during which a conditioned response is established is called:
W) Learning
X) Possession
Y) Acquisition
Z) Incubation

Bonus Answer: Y

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13. BIOLOGY

Toss Up: Short Answer

Which amino acid would constitute a disulfide bridge?

Bonus Answer: Cysteine

Bonus: Short Answer

What is the name of the cellular machinery that removes introns?

Bonus Answer: Spliceosome

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14. CHEMISTRY

Toss Up: Multiple Choice

Which electronic transition requires the addition of the most energy?
W) n=1 to n=3
X) n=5 to n=2
Y) n=2 to n=3
Z) n=4 to n=1

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following is FALSE?
W) The 4d orbitals are in the fourth period of the periodic table.
X) The 7s orbitals are in the seventh period of the periodic table.
Y) The 4f orbitals are in the sixth period of the periodic table.
Z) The 6s orbitals are spherical in shape.

Bonus Answer: W

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15. CHEMISTRY

Toss Up: Short Answer

Order the following by the strength of their intermolecular forces, from strongest to weakest. 1. Methane, 2. Chloromethane, 3. Water, 4. Ethanol

Bonus Answer: 3, 4, 2, 1

Bonus: Short Answer

What does napthalene smell like?

Bonus Answer: Mothball, insect killer, mold killer

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16. CHEMISTRY

Toss Up: Short Answer

What is K sub W?

Bonus Answer: 1.0*10^-14

Bonus: Multiple Choice

Which of the following acids is not diprotic?

W) Sulfuric Acid

X) Oxalic Acid

Y) Carbonic Acid

Z) Citric Acid

Bonus Answer: Z

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17. CHEMISTRY

Toss Up: Short Answer

How many different structures can Formic Acid (HCO2H) form?

Bonus Answer: Two (2)

Bonus: Short Answer

What is the pH of a Ca(OH)2 solution with Calcium(2+) concentration of 5.O x 10^-6?

Bonus Answer: 9.00 (Accept: Nine)

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18. CHEMISTRY

Toss Up: Short Answer

Which metallic element is in the liquid state at room temperature?

Bonus Answer: Mercury

Bonus: Multiple Choice

In a gaseous, exothermic reaction, which of the following changes makes no difference to the position of equilibrium?

W) Change of Temperature

X) Adding more reactants

Y) Adding a catalyst

Z) Removing products

Bonus Answer: Y

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19. CHEMISTRY

Toss Up: Short Answer

What feature of a chemical species allows it to acts as a ligand in a complex ion?

Bonus Answer: It has a lone pair of electrons that can act as a Lewis base. (Accepts: Has electrons that act as a Lewis Base, Acts as a Lewis base)

Bonus: Multiple Choice

Which of the following ionic solutions is colorless?

W) Cu(2+)

X) Ni(2+)

Y) Mn(7+)

Z) Zn(2+)

Bonus Answer: Z

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20. CHEMISTRY

Toss Up: Short Answer

What is the chemical formula of Thiocyanate?

Bonus Answer: SCN- (Read as: SCN minus)

Bonus: Multiple Choice

Which of the following is the name of an isotope of Hydrogen?

W) Protium

X) Hydronium

Y) Kydronium

Z) Zirconium

Bonus Answer: W

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21. EARTH and SPACE

Toss Up: Multiple Choice

In which constellation is the closest Cepheid variable to Earth?

W) Ursa Minor

X) Lyra

Y) Carina

Z) Sagittarius

Toss Up Answer: W

Bonus: Short Answer

Polaris will be further to the north celestial pole in 3000 AD than Altai. What phenomenon is mostly responsible for this?

Bonus Answer: Precession of the equinoxes

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22. EARTH and SPACE

Toss Up: Short Answer

In approximately 4 billion years, another galaxy is predicted to collide with the Milky Way. What is the name of this galaxy?

Bonus Answer: Andromeda

Bonus: Multiple Choice

What is the third most abundant element in the universe?

W) Helium

X) Lithium

Y) Carbon

Z) Oxygen

Bonus Answer: Z

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23. EARTH and SPACE

Toss Up: Short Answer

What is the term used to describe silt and mud deposited by a stream during periods of high water?

Bonus Answer: Alluvial

Bonus: Multiple Choice

Which radioactive element is generally present in smoke detectors today?

W) Americium

X) Radium

Y) Radon

Z) Actinium

Bonus Answer: W

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24. EARTH and SPACE

Toss Up: Multiple Choice

Which corner of the H-R diagram would a white dwarf most likely be found?

W) Upper Left

X) Lower Left

Y) Upper Right

Z) Lower Right

Toss Up Answer: X

Bonus: Short Answer

What element is the penultimate element formed in the core of a supergiant?

Bonus Answer: Silicon

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25. 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 worlds what percent of the world’s undiscovered oil and natural gas reserves?

W) 7%

X) 13%

Y) 22%

Z) 35%

Bonus Answer: Y

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