Round 11

1. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

Which of the following elements has the largest number of possible oxidation states?

W) Fe

X) Cl

Y) Ca

Z) Mn

Toss Up Answer: X

Bonus: Multiple Choice

What is the minimum number of electrons needed to balance the following half-reaction with whole number coefficients?

IO_3^- -> I_2

W) 1 e-

X) 2 e-

Y) 5 e-

Z) 10 e-

Bonus Answer: Z

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2. MATHEMATICS

Writer: Aaron Gee

Toss Up: Short Answer

If you roll 2 fair dice simultaneously, what is the probability, given as a fraction, that you will roll the number 6 on AT LEAST one die?

Bonus Answer: 11/36

Bonus: Short Answer

Find the sum of all interior angles, in degrees, in a regular polygon having 14 sides

Bonus Answer: 2160 degrees

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3. BIOLOGY

Writer: Jason Mohabir

Toss Up: Multiple Choice

Which of the following is true regarding anthrax:

W) Anthrax is caused by a virus

X) Anthrax is highly contagious

Y) Inhalation anthrax and cutaneous anthrax are caused by separate strains of anthrax

Z) Inhalation Anthrax requires infection with a large number of spores

Toss Up Answer: Z

Bonus: Short Answer

Give the binomial nomenclature of the pathogen that causes anthrax:

Bonus Answer: Bacillus anthracis

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4. EARTH and SPACE

Writer: Matthew Lee

Toss Up: Short Answer

Potential evapotranspiration as measured on a town's water budget is most directly affected by what variable?

Bonus Answer: Air temperature

Bonus: Multiple Choice

Why is adiabatic warming on the leeward side of a mountain range rapid?

W) because of a decreased relative humidity

X) because of cloud formation

Y) because of a lower temperature on the windward side of the mountain range

Z) because of adiabatic expansion

Bonus Answer: W

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5. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

What is the name of the first livestock virus eradicated by a vaccine?

W) Smallpox

X) Polio

Y) Rinderpest

Z) Mumps

Toss Up Answer: Y

Bonus: Short Answer

By mass, what element makes up most of the human body?

Bonus Answer: Oxygen

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6. EARTH and SPACE

Writer: Shantanu Jha

Toss Up: Short Answer

What phenomena best explains why the sky is blue?

Bonus Answer: Rayleigh Scattering

Bonus: Short Answer

What are the high intensity spots of light at the horizontal points of the 22 degree halo that may form around the sun due to ice crystals in the air called?

Bonus Answer: Parhelia (ALSO ACCEPT: Sun Dogs, Parhelion)

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7. BIOLOGY

Writer: Matthew Lee

Toss Up: Multiple Choice

What enzyme, which can be inhibited or activated, serves as the point in which the cell is committed to performing glycolysis?

W) Hexokinase

X) Phosphoglucoisomerase

Y) Phosphoglycerokinase

Z) Phosphofructokinase

Toss Up Answer: Z

Bonus: Multiple Choice

The electrons from the electron carrier FADH2 are initially shuttled to which complex in the electron transport chain?

W) complex I

X) complex II

Y) complex III

Z) complex IV

Bonus Answer: X

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8. MATHEMATICS

Writer: George Zhou

Toss Up: Multiple Choice

3^12=27^x. What is the value of x?

W) x=12

X) x=4

Y) x=6

Z) x=3

Toss Up Answer: X

Bonus: Short Answer

3^12+3^11+3^10=b*3^a What is the positive difference between the product and the sum of a and b?

Bonus Answer: 107

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9. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

How many ATP molecules are produced by the Calvin cycle?

Bonus Answer: 0

Bonus: Short Answer

How many ATP are used in the Calvin cycle to make one glucose molecule?

Bonus Answer: 18

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10. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the name for the rule that states that when you have a limit of indeterminant form as a fraction, it is equal to the limit of the derivative of the numerator over the derivative of the denominator?

Bonus Answer: L'hopital's rule

Bonus: Short Answer

What famous function, named after a mathematician, takes the infinite sum of the reciprocals of the natural numbers raised to an argument?

Bonus Answer: Riemann zeta function

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11. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What element is in all alloys classified as amalga?

Bonus Answer: Mercury (accept: Hg)

Bonus: Short Answer

You have a solution of 5 molar Sodium Phosphate and n to prepare a solution of 500 millimolar Sodium Phosphate. How much water would you add to 100 milliliter of the original 5 molar solution to produce the 500 millimolar solution?

Bonus Answer: 900 MILLILITERS (or 0.9 LITERS)

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12. EARTH and SPACE

Writer: Matthew Lee

Toss Up: Short Answer

Identify on which days day and night are equal in length.

1) estival solstice 2) autumnal equinox 3) hibernal solstice 4) vernal equinox

Bonus Answer: 2 and 4

Bonus: Short Answer

Approximately how many degrees of latitude contain areas that will see a noon sun at the zenith during some point in the year?

Bonus Answer: ~47 degrees (between the Tropic of Cancer and the Tropic of Capricorn)

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13. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Glycoproteins are mainly synthesized by ribosomes attached to which structure?

Bonus Answer: the rough endoplasmic reticulum (accept: rough ER; do NOT accept: ER or endoplasmic reticulum)

Bonus: Short Answer

Drugs like barbiturates commonly increase the size of which endomembrane organelle?

Bonus Answer: the smooth endoplasmic reticulum

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14. EARTH and SPACE

Writer: Jan Wojcik

Toss Up: Short Answer

Name the wave that you would typically feel during an earthquake if you were standing on the ground after feeling the first primary wave.

Bonus Answer: S-wave (secondary wave)

Bonus: Short Answer

An earthquake is measured to have a Richter scale value of around 4. Another earthquake is measured to have a Richter scale value of 7. How much smaller is the first earthquake to the second earthquake?

Bonus Answer: 1000 times smaller (accept 1000)

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15. CHEMISTRY

Writer: Jan Wojcik

Toss Up: Multiple Choice

A certain chemical reaction has an equilibrium constant Keq (pronounced K-sub EQ) of 2.0. Which of the following statements is true?

W) The products are favored

X) The reactants are favored

Y) The reaction is in equilibrium

Z) The reaction is reversible

Toss Up Answer: X

Bonus: Multiple Choice

A certain chemical reaction involves reactants A and B and one product C. Reactant A and product C are both gases and reactant B is liquid water. The concentration of A, B, and C are 0.1 M (read as 0.1 Molar), 0.5 M and 0.01 M respectively. If the order of the equilibrium constant is 3 and the coefficient in front of C in the chemical reaction was 2, what is the value of the equilibrium constant K?

W) 0.0001
X) 0.005
Y) 0.05
Z) 0.001

Bonus Answer: Z

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16. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Multiple Choice

How many miles per hour is the Earth moving?

W) 65,000
X) 67,000
Y) 69,000
Z) 70,000

Toss Up Answer: X

Bonus: Short Answer

When magma hardens into rock, which type of rock is it?

Bonus Answer: Igneous

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17. CHEMISTRY

Writer: Shanjeed Ali

Toss Up: Short Answer

What is the energy level and orbital of the outermost electrons in a ground state sulfur atom?

Bonus Answer: 3p

Bonus: Short Answer

What is the maximum number of covalent bonds sulfur can form?

Bonus Answer: 6

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18. EARTH and SPACE

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Which of the following is not a silicate?

W) Quartz
X) Halite
Y) Feldspar
Z) Mica

Toss Up Answer: X

Bonus: Multiple Choice

Which of these mineral groups has the best cleavage?

W) Silicates

X) Sulfides

Y) Oxides

Z) Carbonates

Bonus Answer: Z

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19. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

A Carnot heat engine operates between 400K and 500 K. What is its efficiency?

Bonus Answer: 20%

Bonus: Multiple Choice

A Carnot heat engine and an irreversible heat engine both operate between the same high temperature and low temperature reservoirs. They absorb the same energy from the high temperature reservoir as heat. Which statement is true?

W) The irreversible engine does more work.

X) The Carnot engine transfers less energy to the low temperature reservoir as heat.

Y) The irreversible engine has the greater efficiency.

Z) The irreversible engine cannot absorb the same energy from the high temperature reservoir as heat without violating the second law of thermodynamics.

Bonus Answer: X

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20. CHEMISTRY

Writer: George Papastefanou

Toss Up: Short Answer

What is the last element of the periodic table to occur naturally on Earth?

Bonus Answer: Plutonium, element 94

Bonus: Short Answer

Which element is most abundant in the entire Earth?

Bonus Answer: Iron (do not accept Oxygen, that's just the crust)

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21. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

Two particles interact by conservative forces. In addition, an external force acts on each particle. They complete round trips, ending at the points where they started. Which of the following must have the same values at the beginning and tend of this trip?

W) the total kinetic energy of the two-particle system

X) the potential energy of the two-particle system

Y) the total linear momentum of the two-particle system

Z) the mechanical energy of the two-particle system

Toss Up Answer: X

Bonus: Multiple Choice

A force of 10 N holds an ideal spring with a 20 N/m spring constant in compression. The potential energy stored in the spring is:

W) 0.5J

X) 2.5J

Y) 5J

Z) 10J

Bonus Answer: X

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22. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

What's the stopping potential, in eV/C (READ AS: electron volts per coulomb) of a photoelectron ejected from a metal with work function of 1eV when the incident photon's energy is 3.5 eV?

Bonus Answer: 2.5 eV/C

Bonus: Multiple Choice

Two students conduct separate Compton scattering experiments with visible light and x-rays. The scattered radiation is observed at the same scattering angle. Which of the following statements about the observed results is true?

W) the x rays have the greater shift in wavelength and the greater change in photon energy

X) the two radiations have the same shift in wavelength and the visible light has the greater change in photon energy

Y) the two radiations have the same shift in wavelength and the same change in photon energy

Z) the two radiations have the same shift in wavelength and the x rays have the greater change in photon energy

Bonus Answer: Z

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23. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

An infinitely long wire carries a current of three amps. How does the magnetic field outside the wire look like?

Bonus Answer: Circles the wire

Bonus: Short Answer

Iron is what type of magnetic material?

Bonus Answer: ferromagnetic

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24. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

Vectors A and B each have magnitude L. What is the cross product of these vectors if the angle between them when drawn with their tails at the same point is 60 degrees.

W) Zero

X) L/2

Y) L^2

Z) (L^2)/2

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following is true when a system is at equilibrium?

W) The object is at rest.

X) The object is not accelerating.

Y) The object is at constant velocity.

Z) Internal forces sum to zero.

Bonus Answer: X

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25. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

Aaron, whose mass is 45 kilograms, is riding his 5.0 kilogram skateboard down the sidewalk with a constant speed of 6.0 meters per second when he rolls

across a 10.0 meter long patch of sand on the pavement. The sand provides force of friction of 6.0 newtons. What is Aaron's speed in meters per second as he emerges from the sand?

W) 0

X) 1.8

Y) 3.8

Z) 5.8

Toss Up Answer: Z

Bonus: Short Answer

Which of the following contains a scalar quantity? Force, energy, or acceleration?

Bonus Answer: Energy

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