Round 25

1. EARTH and SPACE

Toss Up: Multiple Choice

Where in the H-R Diagram would Betelgeuse be found?

W) Upper Left Corner

X) Lower Left Corner

Y) Upper Right Corner

Z) Lower Right Corner

Toss Up Answer: Y

Bonus: Multiple Choice

At what distance is absolute magnitude the same as apparent magnitude?

W) 1 AU

X) 100 AU

Y) 1 parsec

Z) 10 parsecs

Bonus Answer: Z

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2. MATHEMATICS

Toss Up: Multiple Choice

An angle must lie in which two quadrants of the Cartesian coordinate plane for its cosecant to be negative?

W) one and two

X) two and three

Y) three and four

Z) four and one

Toss Up Answer: Y

Bonus: Short Answer

According to the Fundamental Theorem of Algebra, how many roots in the complex number system must a 7th degree polynomial have?

Bonus Answer: At least 1 (accept 1 as an answer)

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3. EARTH and SPACE

Toss Up: Multiple Choice

Although scientists are unable to obtain samples by drilling, they believe the predominant mineral in the mantle is:

W) quartz

X) olivine

Y) potassium feldspar

Z) iron pyrite

Toss Up Answer: X

Bonus: Multiple Choice

If the intent is to neutralize soil acidity, the mixing of which of the following materials in the soil would be the LEAST effective?

W) gypsum

X) pure $CaCO_3$

Y) ground limestone

Z) ground oyster shells

Bonus Answer: W

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4. CHEMISTRY

Toss Up: Multiple Choice

Which of the following is the lightest element with no stable isotopes?

W) Tellurium

X) Technetium

Y) Promethium

Z) Radon

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following is the strongest intermolecular force?

W) Hydrogen Bonding

X) Ionic Bonding

Y) London Dispersion Force

Z) Covalent Bonding

Bonus Answer: W

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5. EARTH and SPACE

Toss Up: Multiple Choice

What is the defining characteristic of the classification of types of supernovas?

W) total energy released

X) elemental spectral lines

Y) duration of the supernova

Z) size of the initial star

Toss Up Answer: X

Bonus: Short Answer

What element is released in a Type IA supernova that is not released in other Type I supernovae?

Bonus Answer: silicon

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6. CHEMISTRY

Toss Up: Multiple Choice

Which of the following is insoluble in water?

W) Magnesium Chloride

X) Ammonium Hydroxide

Y) Potassium Carbonate

Z) Barium Sulfate

Toss Up Answer: Z

Bonus: Short Answer

What is the chemical name and formula of the compound that makes up quartz?

Bonus Answer: Silicon Dioxide SiO_2

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7. BIOLOGY

Toss Up: Short Answer

What is the name of the gene sequence that is recognized by VDJ recombinases?

Bonus Answer: Recombination signal sequences, RSS

Bonus: Short Answer

In V(D)J recombination, which enzyme adds nucleotides to allow for further diversity?

Bonus Answer: Terminal Deoxynucleotidyl Transferase, TdT

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8. MATHEMATICS

Toss Up: Short Answer

What is the equation for the axis of symmetry of (3x^2) - 6x + 4?

Bonus Answer: x = 1 (Don't accept 1 by itself)

Bonus: Multiple Choice

Which of the following is equivalent to 3(mod 4)?

W) 32(mod4)

X) -16(mod4)

Y) -13(mod 4)

Z) 0(mod 4)

Bonus Answer: Y

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9. BIOLOGY

Toss Up: Short Answer

What is the name of the gene recombination that allows for the diversity of an antibody's heavy chain?

Bonus Answer: V(D)J Recombination

Bonus: Short Answer

Which scientist won a Nobel prize in 1987 in Physiology or Medicine for his discovery on the mechanism behind antibody diversity?

Bonus Answer: Susumu Tonegawa, Tonegawa

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10. CHEMISTRY

Toss Up: Multiple Choice

What is the second most electronegative element?

W) Fluorine

X) Oxygen

Y) Chlorine

Z) Neon

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following is a weak electrolyte?

W) Ammonium Hydroxide

X) Glucose

Y) Water

Z) Nitric Acid

Bonus Answer: W

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11. PHYSICS

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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12. MATHEMATICS

Toss Up: Multiple Choice

For the function f(x) = (x^2)/(x), what is the limit as x approaches 0?

W) 0

X) 1

Y) infinity

Z) There exist no limit.

Toss Up Answer: W

Bonus: Short Answer

What is the line called that connects two points of a function, generally associated with average rate of change?

Bonus Answer: Secant line

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13. PHYSICS

Toss Up: Multiple Choice

Light from a monochromatic lamp is shone upon a sheet of metal, and yet, the photoelectric effect is not observed. What change in the setup will most likely result in an observed photoelectric effect?

W) Increasing the brightness of the lamp

X) Moving the lamp closer to the sheet of metal

Y) Decreasing the wavelength of the light

Z) Increasing the surface area of the sheet of metal

Toss Up Answer: Y

Bonus: Short Answer

An electric current of 1 Ampere is flowing along an infinite horizontal wire in the x-axis. At x = 0 m the wire splits into a circle of radius 0.05 m and then comes back together at x = 4 m. What is the magnitude in Tesla of the magnetic field in the middle of this loop of wire?

Bonus Answer: 0

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14. MATHEMATICS

Toss Up: Multiple Choice

What is the derivative of the curve y = x^3 at the origin?

W) 0

X) 3
Y) 2
Z) 3/2
Toss Up Answer: W

Bonus: Short Answer
Find dy/dx of y = sin^2 x
Bonus Answer: 2 (sin x) (cos x)

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15. PHYSICS

Toss Up: Multiple Choice
An electrical current flows across an infinite rectilinear wire. If its intensity of is doubled, then the magnetic field at a generic point:
W) quadruples
X) doubles
Y) halves
Z) remains unchanged
Toss Up Answer: X

Bonus: Short Answer
The current I(t) flowing for a wire for t >= 0 is given by I(t) = 2^(-t). Find the total charge that will flow through the wire.
Bonus Answer: 1/(ln 2)

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16. BIOLOGY

Toss Up: Short Answer
The A site, P site, and E site are located in which organelle?
Bonus Answer: ribosome

Bonus: Short Answer
Which site does the tRNA enter the ribosome?
Bonus Answer: A site, aminoacyl-tRNA site

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17. PHYSICS

Toss Up: Multiple Choice
When 236U fissions, the products might be which of the following?
W) Ba-146 (READ AS: barium 146), Kr-89 (READ AS: krypton 89), and a proton
X) Ba-146 (READ AS: barium 146), Kr-89 (READ AS: krypton 89), and a neutron
Y) Cs-148 (READ AS: cesium 148) and Br-85 (READ AS: barium 85)
Z) two uranium nuclei
Toss Up Answer: X

Bonus: Short Answer
In the proton-proton cycle, two hydrogen atoms initially react to form what 3 particles?
Bonus Answer: Deuterium, a positron, and an electron neutrino (ACCEPT neutrino)

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18. BIOLOGY

Toss Up: Short Answer
What are noncoding regions of dna called?
Bonus Answer: introns

Bonus: Short Answer

What are coding regions of dna called?

Bonus Answer: exons

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19. CHEMISTRY

Toss Up: Multiple Choice

If 2 moles if Ar and 5 moles of Xe are placed into one container. What is the partial pressure of Ar is the container is at 14 atm?

W) 2 atm

X) 5 atm

Y) 4 atm

Z) 10 atm

Toss Up Answer: Y

Bonus: Short Answer

How much faster is the effusion of helium gas compared to ammonia gas, to the nearest whole number?

Bonus Answer: 2

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20. BIOLOGY

Toss Up: Short Answer

How many classes of immunoglobulins are there in the human body?

Bonus Answer: 5

Bonus: Short Answer

Which immunoglobulin is the largest, with 10 light and heavy chains each?

Bonus Answer: IgM, Immunoglobulin M, Immunoglobulin Mu

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21. PHYSICS

Toss Up: Multiple Choice

You decide to set off on a voyage to another star. To stop your muscles from atrophying, you want to generate artificial gravity by having your ship constantly accelerate at 1 g from your reference frame. Ignoring fuel requirements, is there a problem with generating artificial gravity this way over very long time frames?

W) Yes, this setup would not work to generate artificial gravity

X) Yes, 1 g isn't enough to prevent your muscles from atrophying

Y) No, this can be used indefinitely to generate artificial gravity

Z) Yes, eventually the ship would need to go faster than the speed of light, which is impossible

Toss Up Answer: Y

Bonus: Short Answer

A box of mass 3 kg is placed on the edge of a merry-go-round of radius 4 m. The coefficient of static friction between the box and the merry-go-round is 0.4. What is the square of the merry-go-round's speed at the moment the box slides off?

Bonus Answer: 12 (m/s)^2

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22. BIOLOGY

Toss Up: Short Answer

What hormone is released in response to low blood sugar levels?

Bonus Answer: glucagon

Bonus: Multiple Choice

Which of the following changes occur upon the activation of the sympathetic nervous system?
W) Heart rate increases
X) Rate of digestion increases
Y) Pupils constrict
Z) Glucose is converted to glycogen

Bonus Answer: W

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23. CHEMISTRY

Toss Up: Short Answer

By name or number, which of the following is associated with inversion of stereochemistry? Sn1, Sn2, E1, E2

Bonus Answer: Sn2 only (2 only)

Bonus: Short Answer

Which rule states that in E1 and E2 reactions, the more substituted double bond is more likely to occur?

Bonus Answer: Saytzeff rule

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24. BIOLOGY

Toss Up: Multiple Choice

Which of the following cells come from megakaryocytes?
W) Erythrocytes
X) Leukocytes
Y) Blood Thrombocytes
Z) Osteocytes

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following diseases is caused by a point mutation?
W) Huntington's Disease
X) Hemophilia B
Y) Cystic Fibrosis
Z) Tay-Sachs Disease

Bonus Answer: X

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25. BIOLOGY

Toss Up: Multiple Choice

Which of the following are characteristics of both bacteria and fungi?
W) Cell wall, unicellularity, and mitochondria
X) Cell wall, DNA, and plasma membrane
Y) Nucleus, organelles, and unicellularity
Z) Nucleus, RNA, and cell wall

Toss Up Answer: X

Bonus: Multiple Choice

Terminally differentiated cells are most often found in which phase of the cell cycle?
W) G0
X) G1

Y) G2
Z) S

Bonus Answer: W

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