Round 38

1. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

Who first suggested that radiant energy could exist only in discrete quanta which were proportional to the frequency in order to explain the frequency distribution of blackbody radiation?

W) Isaac Newton

X) Max Planck

Y) Ernest Rutherford

Z) Paul Dirac

Toss Up Answer: X

Bonus: Short Answer

Later solved by Planck's quantum radiation formula, what asymptotic result of the classical Rayleigh-Jeans Law was the most troubling?

Bonus Answer: Ultraviolet Catastrophe

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2. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the area of the circle x^2+y^2=6/pi^2 in terms of pi

Bonus Answer: 6/pi

Bonus: Short Answer

What is the area of the circle x^2-4x+y^2-6y-2=0 in terms of pi

Bonus Answer: 15pi

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3. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What law most directly states that the total of the electric flux out of a closed surface is equal to the charge enclosed divided by the permittivity?

Bonus Answer: Gauss's Law

Bonus: Short Answer

When a magnet is moved into a coil of wire, changing the magnetic field and magnetic flux through the coil, a voltage will be generated in the coil according to which law?

Bonus Answer: Faraday's Law

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4. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the slope of the tangent line to e^(2x) at x=3

Bonus Answer: 2e^6

Bonus: Short Answer

What is the slope of the tangent line to ln(2x) at x=3

Bonus Answer: 1/3

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5. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What type of radiation is both the most penetrating and the most effectively stopped if blocked by a hydrogen-rich material?

W) Alpha

X) Beta

Y) Gamma

Z) Neutron

Toss Up Answer: Z

Bonus: Multiple Choice

What type of radiation originates from the electron cloud?

W) Alpha

X) Beta

Y) X-Ray

Z) Gamma

Bonus Answer: Y

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6. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

Convert CD from hexadecimal to decimal

Bonus Answer: 205

Bonus: Short Answer

Convert CD from hexadecimal to binary

Bonus Answer: 11001101

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7. PHYSICS

Writer: Jan Wojcik

Toss Up: Multiple Choice

An electron is placed in a horizontally hollow cylindrical solenoid with the current moving clockwise around the solenoid. The electron is released from rest in the middle of the solenoid. What direction will the electron move in?

W) To the left

X) To the right

Y) Stays in the same place

Z) Oscillates between both ends

Toss Up Answer: X

Bonus: Multiple Choice

There are two charges, one with charge +2Q and one with charge -4Q a distance of 2 meters from each other. Assuming the universal charge constant is 1.6*10^-19, which of the following is the force of attraction felt by the two charges, rounded to one decimal place

W) 4.8*10^-19 C

X) 9.6*10^-19 C

Y) 2.4*10^-19 C

Z) 3.2*10^-19 C

Bonus Answer: Z

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8. MATHEMATICS

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

What is the sum of the interior angles of a nonagon?

Bonus Answer: 1260 degrees

Bonus: Short Answer

How many edges does an octahedral prism have?

Bonus Answer: 24 edges

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9. PHYSICS

Writer: Raafiul Hossain

Toss Up: Short Answer

What is energy measured in?

Bonus Answer: Joules

Bonus: Short Answer

What is the unit of charge?

Bonus Answer: Columbus

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10. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

What types of cells in the stomach are pepsins produced from?

Bonus Answer: Chief cells

Bonus: Short Answer

What factor of the blood clotting cascade converts prothrombin into active thrombin?

Bonus Answer: Factor III; Tissue Factor; Thromboplastin

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11. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

The conjugate base of HCl is which of the following?

W) A weak acid

X) A strong acid

Y) A weak base

Z) A strong base

Toss Up Answer: Y

Bonus: Short Answer

How many sigma and pi bonds does carbon dioxide have?

Bonus Answer: 2 sigma, 2 pi

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12. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

What hormone released by jextaglomerular cells of the kidney regulates blood pressure and filtration rate?

Bonus Answer: Renin

Bonus: Short Answer

What types of exocrine glands bud their secretions off along with a small portion of the cell itself?

Bonus Answer: Apocrine glands

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13. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

In the reaction A + B -> C + D, which of the following occurs when reactant B is added?

W) The concentration of A decreases

X) The concentration of C decreases

Y) The concentration of D decreases

Z) The reaction shifts to the left

Toss Up Answer: W

Bonus: Short Answer

Given the specific heat capacity of water is 4.18 Joule/gram*C, if you have 20 grams of water and want to heat it from 10 degrees C to 15 degrees C, how many joules must be added?

Bonus Answer: 418 Joules

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14. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

What functional group normally allows the cell to differentiate old and new DNA strands in prokaryotes?

Bonus Answer: Methyl group; -CH3

Bonus: Short Answer

What is it called when the hematocrit rises above normal levels?

Bonus Answer: hypercythemia; erythrocythemia; hypererythrocythemia

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15. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

Which of the following describes the carbon dioxide molecule?

W) Polar and Linear

X) Polar and Bent

Y) Nonpolar and Linear

Z) Nonpolar and Bent

Toss Up Answer: Y

Bonus: Short Answer

What hybridization is typically found in linear molecules?

Bonus Answer: sp

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16. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

What organelle does the cisternal maturation model describe?

Bonus Answer: Golgi apparatus; Golgi complex

Bonus: Short Answer

What is the part on the retina where cones are tightly packed and creates a small depression?

Bonus Answer: Fovea; Fovea centralis

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17. CHEMISTRY

Writer: Andrew Chen

Toss Up: Multiple Choice

Why is diamond a thermal conductor, even though it isn't an electrical conductor?

W) heat vibrations can move along the rigid structure

X) carbon has a low heat capacity

Y) there are no impurities which increase resistance

Z) carbon has a high heat capacity

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following has the highest carbon content?

W) wrought iron

X) cast iron

Y) pig iron

Z) slag

Bonus Answer: Y

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18. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

Which glial cells secrete cerebrospinal fluid?

Bonus Answer: Ependymal cells

Bonus: Short Answer

Oxygen attaches to hemoglobin to form oxyhemoglobin. What is it resultant molecule called when carbon dioxide attaches to hemoglobin?

Bonus Answer: Carbaminohemoglobin

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19. CHEMISTRY

Writer: Andrew Chen

Toss Up: Multiple Choice

Which of the following exhibits diamagnetism?

W) bronze

X) water

Y) liquid oxygen

Z) diamond

Toss Up Answer: X

Bonus: Short Answer

Order the following by second ionization energy, from lowest to highest: Sodium, Magnesium, Aluminum

Bonus Answer: Magnesium, Aluminum, Sodium

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20. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

What substance protects the stomach from consuming itself?

Bonus Answer: Mucus

Bonus: Multiple Choice

In which organs is thrombopoietin produced?

W) Heart and Liver

X) Liver and Kidney

Y) Kidney and Pancreas

Z) Pancreas and Liver

Bonus Answer: X

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21. EARTH and SPACE

Writer: Shantanu Jha

Toss Up: Short Answer

What physical quantity is the Schwarzschild radius of a Black Hole most dependent on?

Bonus Answer: Mass

Bonus: Multiple Choice

If the event horizon of a black hole is 10 km, then what is the radius of its photon sphere?

W) 10km

X) 15km

Y) 20km

Z) 25km

Bonus Answer: X

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22. BIOLOGY

Writer: Nten Nylam

Toss Up: Short Answer

What is it called when a species of animal becomes two separate species while inhabiting the same area?

Bonus Answer: Sympatric speciation

Bonus: Multiple Choice

Cladograms are used to determine?

W) Taxonomy

X) Geographic Distribution

Y) Genotype

Z) Evolutionary relatedness

Bonus Answer: Z

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23. EARTH and SPACE

Writer: Shantanu Jha

Toss Up: Short Answer

What is the average temperature of the universe today to the nearest Kelvin?

Bonus Answer: 3K

Bonus: Short Answer

What is the most common star in the Milky Way Galaxy?

Bonus Answer: Red Dwarf

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24. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

How does atropine counter the effects of nerve gas?

W) Atropine binds to the nerve gas and inactivates it

X) Atropine inactivates acetylcholinesterase and allows more acetylcholine to cross the synaptic cleft

Y) atropine blocks the acetylcholine receptor which blocks the excess acetylcholine lingering in the synaptic cleft

Z) atropine stimulates the production of an enzyme that breaks down the nerve gas

Toss Up Answer: Y

Bonus: Short Answer

In order to flower, what does a short-day plant need?

Bonus Answer: Night that is longer than a certain critical length

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25. EARTH and SPACE

Writer: Jan Wojcik

Toss Up: Multiple Choice

Which of the following statements is FALSE regarding the volcano in each statement?

W) Shield volcanoes can stretch up to 3 or 4 miles in diameter

X) Cinder cone volcanoes rarely rise past 1,000 feet in elecvation

Y) Stratovolcanoes are some of the smallest volcanoes in the world

Z) Volcanic domes commonly occur within the craters or on the flanks of large composite volcanoes

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following statements is true regarding stratovolcanoes?

W) Most commonly occur at subduction zones

X) They produce basaltic magma

Y) Their eruptions are infrequent

Z) They are never dormant

Bonus Answer: W

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