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1. Chemistry

Toss Up: Multiple Choice

What does Pauli's Exclusion Principle state?

W) Electrons of an atom must have the same spin

X) No two electrons of an atom travel in the same orbital

Y) no two electrons in an atom can be at the same time in the same state or configuration

Z) Electrons can switch spin automatically

Toss Up Answer: Y

Bonus: Short Answer

What law states that electrons in the same orbitals reorganize themselves to maximize spin?

Bonus Answer: Hund's law

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2. Biology

Toss Up: Short Answer

Where in the DNA are short tandem repeats usually located?

Toss Up Answer: Accept introns OR noncoding DNA

Bonus: Short Answer

Why do DNA molecules travel through the gel in gel electrophoresis?

Bonus Answer: DNA has a negative charge

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3. Chemistry

Toss Up: Short Answer

What activates pepsinogen to change into pepsin?

Toss Up Answer: Hydrochloric acid

Bonus: Short Answer

What is the pH of gastric juice to the nearest tenth?

Bonus Answer: 1.5 to 2.5 (or any number in between)

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4. Energy

Toss Up: Multiple Choice

Which material takes the least energy and CO₂ to produce?

W) Wood

X) Aluminum

Y) Glass

Z) HDPE (High Density Polyethylene Plastic)

Toss Up Answer: W

Bonus: Short Answer

What electrophysical process is behind wireless charging?

Bonus Answer: Induction

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5. Earth and Space Science

Toss Up: Multiple Choice

Which one of these is NOT true?

- W) All planets revolve in the same direction.
- X) All planets rotate in the same direction.
- Y) The orbits of the planets are all ellipses.
- Z) The orbits of the planets are nearly in the same plane.

Toss Up Answer: X

Bonus: Multiple Choice

Coal is believed to have been principally formed in which of the following types of environment?

- W) river beds
- X) swamps
- Y) volcanic regions
- Z) deserts

Bonus Answer: X

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6. Physics

Toss Up: Short Answer

A ball with mass 0.2 kg is thrown at a wall with velocity 20 m/s and rebounds with a velocity of 15 m/s. What is the impulse of the net force imposed on the ball?

Toss Up Answer: 7 kgm/s

Bonus: Short Answer

In a jousting game, a student of 60 kg with velocity 5 m/s is rolled towards a student of 30 kg at rest. When they collide, their poles conserve all of their kinetic energy as potential energy and redistribute it. What is the final velocity of the 30 kg student to the tenth place?

Bonus Answer: 6.6 m/s

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7. Mathematics

Toss Up: Short Answer

What is the imaginary unit "i" when raised to the power 30?

Toss Up Answer: -1

Bonus: Short Answer

What is the sum of the first 50 positive integers?

Bonus Answer: 1275

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8. Physics

Toss Up: Short Answer

As a pendulum is raised to higher altitudes, its period?

Toss Up Answer: Increases

Bonus: Short Answer

The SI unit of pressure is?

Bonus Answer: Pascal

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9. Mathematics

Toss Up: Short Answer

What type of number is defined as a number that is not a root of a polynomial with rational coefficients?

Toss Up Answer: Transcendental numbers

Bonus: Short Answer

Of the following, which of these numbers is transcendental? π , e , i , ϕ , $e \times i$, $2^{\sqrt{2}}$

Bonus Answer: π , e , $e \times i$, $2^{\sqrt{2}}$

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10. Physics

Toss Up: Short Answer

A charged particle is moving in a UNIFORM magnetic field. If the direction of motion of the charged particle is parallel to the magnetic field, describe the shape of the charged particle's path.

Toss Up Answer: Straight line

Bonus: Multiple Choice

For a parallel-plate capacitor with plate area " A " and plate separation " d ", the capacitance is proportional to which of the following?

W) A/d^2

X) $A \times d$

Y) A divided by d

Z) d divided by A

Bonus Answer: Y

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11. Chemistry

Toss Up: Multiple Choice

Which of the following is the most electronegative element?

W) Carbon

X) Vanadium

Y) Selenium

Z) Fluorine

Toss Up Answer: Z

Bonus: Short Answer

What is the name given to the hybrid orbital created with a steric number of 3?

Bonus Answer: $2sp^2$

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12. Chemistry

Toss Up: Short Answer

What is the name for a molecule with tetrahedral electron geometry but only three substituent groups?

Toss Up Answer: trigonal pyramidal

Bonus: Multiple Choice

Which of the following is not an ionic compound?

- W) NaCl
- X) HF
- Y) FeCl₃
- Z) H₂SO₄

Bonus Answer: X

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13. Chemistry

Toss Up: Multiple Choice

If the rate of a reaction decreases fourfold when the concentration of a reactant is halved, what is the order of the reaction with respect to that reactant?

- W) zero order
- X) first order
- Y) second order
- Z) third order

Toss Up Answer: Y

Bonus: Short Answer

In a rate law, what are the units of k when the order is 3?

Bonus Answer: L² mol⁻² s⁻¹

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14. Physics

Toss Up: Short Answer

Two trailers, X with mass 500kg and Y with mass 2000kg, are being pulled at the same speed. Find the ratio of the kinetic energy of Y to that of X in simplest terms.

Toss Up Answer: 4:1 (or 4 to 1)

Bonus: Multiple Choice

Given a potential energy function U(x), the corresponding force F is in the positive x direction if:

- W) U is positive
- X) U is negative
- Y) U is an increasing function of x
- Z) U is a decreasing function of x

Bonus Answer: Z

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15. Earth and Space Science

Toss Up: Short Answer

What is the closest star to the solar system, 4.25 light years away from the sun?

Toss Up Answer: Proxima Centauri

Bonus: Short Answer

On approximately which two days of the Gregorian calendar do full moons most commonly appear?

Bonus Answer: 15th and 16th of each month

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16. 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) $\frac{3}{2}$

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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17. Chemistry

Toss Up: Multiple Choice

The term(s) most useful in determining the solubility of a substance is (are)

W) K_a and Q

X) K_{sp}

Y) Q and Le Chatelier's Principle

Z) K_c

Toss Up Answer: X

Bonus: Multiple Choice

The effect of temperature on a chemical system is best described using

W) K_a and Q

X) K_{sp}

Y) Le Chatelier's Principle

Z) K_c

Bonus Answer: Y

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18. Physics

Toss Up: Short Answer

If the acceleration is always perpendicular to an object's velocity, what can be deduced about the object's motion?

Toss Up Answer: It is circular motion.

Bonus: Short Answer

If the acceleration of an object is opposite its velocity, what can be said about the object's velocity over time? Assume that the direction of the velocity is positive.

Bonus Answer: It is decreasing.

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19. Mathematics

Toss Up: Short Answer

What is the smallest even triangular number?

Toss Up Answer: 6

Bonus: Multiple Choice

If p and q are inversely proportional, and p = 7 when q = 24, then find p when q = 12.

- W) 3.5
- X) 7
- Y) 12
- Z) 14

Bonus Answer: Z

20. Biology

Toss Up: Multiple Choice

Select the description that most correctly describes the term recessive:

- W) A weak phenotype.
- X) An allele that confers a weak phenotype.
- Y) A phenotype conferred when only one copy of an allele is present.
- Z) A phenotype conferred when two copies of an allele are present.

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following interactions is most responsible for the structural stability of soluble globular proteins?

- W) Dipole-dipole interactions.
- X) Electrostatic interactions.
- Y) Hydrogen bonds.
- Z) The Hydrophobic Effect.

Bonus Answer: Z

21. Mathematics

Toss Up: Multiple Choice

Find the points of intersection of the following curves:

$$y = \sqrt{x^2 - x + 29}$$

$$y = x + 2$$

- W) (5,7)
- X) $(\sqrt{2} - 1, \sqrt{2} + 1)$
- Y) $(\sqrt{29} - 1, \sqrt{29} + 1)$
- Z) (2,4)

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following expressions is not divisible by 9

- W) $5^3 + 7^3$

X) $4^5 + 2^5$

Y) $10^3 - 7^3$

Z) $9^7 - 6^7$

Bonus Answer: W

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22. Physics

Toss Up: Short Answer

A conveyor-belt, horizontally, moves a 600Kg bag a distance of 100 meters through the airport. How much work was done?

Toss Up Answer: No work was done.

Bonus: Short Answer

A dryer has a power rating of 2500 watts. To dry a few towels this dryer uses 6,750,000 joules of energy. How long will it take to dry these towels, in minutes

Bonus Answer: 45 minutes

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23. Biology

Toss Up: Multiple Choice

A female lizard washes ashore on an island after riding a floating log for hundreds of miles across the sea. She is the only member of her species to have ever made it to the island. After arriving, she lays 20 fertile eggs that hatch and form the basis of a lizard population on the island. Which of the following is NOT a likely result?

W) The new island population will have less genetic diversity than the ancestral population.

X) Mutation will add new alleles to the new population and thus increase its genetic diversity over time.

Y) There will be little or no gene exchange between the new population and the ancestral population.

Z) The new island population will have greater genetic diversity than the ancestral population.

Toss Up Answer: Z

Bonus: Multiple Choice

Loss of heterozygosity can be caused by all of the following EXCEPT:

W) genetic drift.

X) positive frequency-dependent selection.

Y) heterozygote advantage.

Z) inbreeding.

Bonus Answer: Y

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24. Physics

Toss Up: Multiple Choice

What kind of friction will act on a rolling, round object at an instant if the surface is horizontal and rough and no other force acts in the horizontal direction?

W) Static Friction

X) Kinetic Friction

Y) Rolling Friction

Z) No Friction

Toss Up Answer: Y

Bonus: Short Answer

If the acceleration due to gravity is 10 m/s^2 , find the force required to move an object of mass 200 kilograms up an incline of 1 in 50 with an acceleration of 2 m/s^2 and a frictional force of 20 N.

Bonus Answer: 420 N

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25. Mathematics

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

$3^{12} + 3^{11} + 3^{10} = b \cdot 3^a$ What is the positive difference between the product and the sum of a and b?

Bonus Answer: 107

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