Round 14

1. MATHEMATICS

Writer: Elias Milborn

Toss Up: Short Answer

What is the probability of, in no particular order, flipping exactly 2 heads and 2 tails when flipping 4 coins?

Bonus Answer: 3/8 (accept .375 or 37.5%)

Bonus: Short Answer

Given a circle centered at 1,2 what is the slope of a tangent line which passes through the point (3,3)

Bonus Answer: -2

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2. 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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3. EARTH and SPACE

Writer: George Papastefanou

Toss Up: Short Answer

How long does it take for a satellite in geosynchronous orbit to travel once around the Earth?

Bonus Answer: One day

Bonus: Short Answer

What is the orbital period, to the nearest year, of Halley's Comet?

Bonus Answer: 75 years

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4. BIOLOGY

Writer: Matthew Lee

Toss Up: Multiple Choice

During chemiosmosis, protons enter and exit which component of the ATP synthase complex?

W) rotor

X) internal rod

Y) stator

Z) catalytic knob

Toss Up Answer: Y

Bonus: Short Answer

What is the name of the only member of the electron transport chain in cellular respiration that is not a protein?

Bonus Answer: Ubiquinone

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5. EARTH and SPACE

Writer: Elias Milborn

Toss Up: Short Answer

Pandora is a moon of which planet?

Bonus Answer: Saturn

Bonus: Multiple Choice

Sea water is approximately what percent salt by mass?

W) 1%

X) 2%

Y) 4%

Z) 8%

Bonus Answer: Y

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6. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following is the most correct statement of the equivalence principle?

W) General relativity is equivalent to Newtonian gravity under certain conditions

X) All kinds of energy are equivalent

Y) The effects of accelerating a frame are indistinguishable from gravitational forces

Z) The acceleration due to gravity is equivalent to GM/r under Newtonian conditions

Toss Up Answer: Y

Bonus: Short Answer

When a particle collides with its corresponding antiparticle, they annihilate, producing photons with energy equal to their rest mass energy. Imagine that you had 1 g of hydrogen and 1 g of anti-hydrogen. If the energy released when they collide is in the form [a x 10^k Joules], what's the value of k?

Bonus Answer: 14

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7. EARTH and SPACE

Writer: Seiji Yawata

Toss Up: Multiple Choice

The Cascadia Subduction Zone separates the North American Plate and the

W) Caribbean Plate

X) Juan de Fuca Plate

Y) Okhotsk Plate

Z) Cocos Plate

Toss Up Answer: X

Bonus: Short Answer

During which geologic period did Pangaea start breaking up?

Bonus Answer: Jurassic

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8. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What type of damping provides the quickest approach to zero amplitude for a damped oscillator?

W) Hyperdamping

X) Overdamping

Y) Critical Damping

Z) Underdamping

Toss Up Answer: Y

Bonus: Short Answer

What is the damping coefficient equal to for a critically damped spring system with a spring constant of 1000 Newtons/meters and oscillating mass of 10 kg?

Bonus Answer: 10Hz [at critical damping the damping coefficient is equal to the undamped resonant frequency, which is equal to the sqrt(spring constant/mass)]

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9. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of the following is an example of a strong nucleophile but a weak base?

W) CH3OH

X) OH-

Y) I-

Z) F-

Toss Up Answer: Y

Bonus: Short Answer

By name or number, which of the following are second order reactions? Sn1, Sn2, E1, E2

Bonus Answer: Sn2 and E2 only (accept 2, 4 only)

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10. MATHEMATICS

Writer: Siam Muquit

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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11. PHYSICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is true about a light wave?

W) Its energy is directly proportional to its wavelength.

X) Its energy is directly proportional to its frequency.
Y) Its energy is directly proportional to its amplitude.
Z) Its energy is not related to any other of its properties.
Toss Up Answer: X

Bonus: Short Answer
Find the electrostatic force between two perfect spheres, both with charge 1 and are 1 meter apart from each other. Give your answer in scientific notation.
Bonus Answer: 8.99 × 10^9 N•m2/C2

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12. MATHEMATICS

Writer: Hanna Yang
Toss Up: Multiple Choice
For which of the following values of x is (x^2+x+4)/(x) an integer?
W) 1
X) 4
Y) 3
Z) 5
Toss Up Answer: X

Bonus: Short Answer
Find the remainder when 343x^3+49x^2+14x+1 is divided by 7x - 1.
Bonus Answer: 5

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13. CHEMISTRY

Writer: Siam Muquit
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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14. BIOLOGY

Writer: Matthew Lee
Toss Up: Short Answer
What molecule or one of its derivatives serves as the final electron acceptor in fermentation?
Bonus Answer: Pyruvate

Bonus: Short Answer
In alcoholic fermentation, pyruvate is converted to a compound which acts as the final electron acceptor, being converted to ethanol in the process. What is this compound called?
Bonus Answer: Acetaldehyde

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15. CHEMISTRY

Writer: Hanna Yang
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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16. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer
What is the process of breaking down fatty acids and converting them to acetyl CoA called?

Bonus Answer: beta oxidation

Bonus: Short Answer
For every 6 molecules of carbon dioxide consumed for photosynthesis, how many molecules of water are consumed?

Bonus Answer: 12

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17. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice
A 5 kg ball is ejected from a spring and it rolls 8m up a frictionless incline at 30 degrees before coming to a stop. Assuming that g = 10 m/s^2 (READ AS 10 meters per second squared) and that the spring constant is 100N/m, how far does the spring has to be compressed initially?
W) 1m
X) 2m
Y) 4m
Z) 6m

Toss Up Answer: X

Bonus: Short Answer
The potential energy of a 1kg particle is represented by U(x,y,z) = 2xy + 3z^2 (READ AS: U of x, y, z equals 2xy plus 3 z squared). What is the magnitude of the force acting on the particle at position (0,4,1)?

Bonus Answer: 10 N

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18. BIOLOGY

Writer: Matthew Lee

Toss Up: Multiple Choice
Theodore Engelmann performed a famous experiment with filamentous algae and aerobic bacteria. What was he trying to find out about photosynthesis?
W) action spectrum
X) absorption spectrum
Y) electromagnetic spectrum

Z) spectrophotomic range

Toss Up Answer: W

Bonus: Short Answer

What metallic atom is at the center of the light-absorbing head of a chlorophyll molecule?

Bonus Answer: Magnesium

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19. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

An electron travels 45 degrees north of east in a magnetic field which points 45 degrees west of north. In what direction does the magnetic force acting on the electron points?

Bonus Answer: Down

Bonus: Short Answer

A 2C charge travels through a magnetic field B = 6i + 15j + 9k with velocity v = 2i + 5j + 3k. What is the magnetic force acting on the charge?

Bonus Answer: 0

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20. CHEMISTRY

Writer: Hanna Yang

Toss Up: Short Answer

Name the most reactive nonmetal.

Bonus Answer: Fluorine

Bonus: Short Answer

Name the transition metal whose carbide is known to be one of the hardest, is used in drills, saws, and lightbulbs, and has the highest melting point of all pure metals.

Bonus Answer: Tungsten

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21. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

An object oscillates with equation $x = 2\cos(5\pi t)$ (READ AS: x equals 2 times cosine of open parentheses 5 PI times t close parentheses). What is the frequency of the oscillation?

W) 0.5

X) 1

Y) 2.5

Z) 4

Toss Up Answer: Y

Bonus: Multiple Choice

An LC circuit consists of a 5 henry inductor and a 20 farad capacitor connected to a battery in a series circuit. What is the frequency of the oscillation of the current in the circuit?

W) $0.05/\pi$ (0.05/PI)

X) $0.1/\pi$ (0.1/PI)

Y) $2/\pi$ (2/PI)

Z) $3/\pi$ (3/PI)

Bonus Answer: W

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22. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What is the process of electrons being shuttled between Photosystem I and the cytochrome complex called?

Bonus Answer: cyclic electron flow

Bonus: Multiple Choice

In linear electron flow during the light reactions, electrons shuttled by Plastocyanin reduce what molecule?

W) P700

X) P680

Y) Plastoquinone

Z) Ferredoxin

Bonus Answer: W

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23. CHEMISTRY

Writer: Hanna Yang

Toss Up: Short Answer

Name the most reactive member of the alkaline earth metals.

Bonus Answer: Radium

Bonus: Short Answer

By name or by number, Identify the ion(s) that has/have the smallest ionic radius?

Ca 2+, Sr 2+, Mg 2 +, Na +, F -

Bonus Answer: Mg 2+

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24. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of these is not an abiotic factor that influences climate?

W) Sunlight

X) Precipitation

Y) Wind

Z) Bodies of water

Toss Up Answer: Z

Bonus: Short Answer

What type of population distribution characterizes human populations?

Bonus Answer: Clumped distribution (Accept clumped)

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25. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

How is oxygen transported in blood?

W) It is dissolved in the blood

X) It is carried by hemoglobin on white blood cells

Y) It is carried by hemoglobin on red blood cells

Z) It is carried by hemoglobin on platelets

Toss Up Answer: Y

Bonus: Short Answer

By name or by number, identify which of the following was can carbon dioxide be transported in blood?

1. It can be dissolved in the blood
2. It can be carried by hemoglobin on white blood cells
3. It can be carried by hemoglobin on red blood cells
4. It can be carried by hemoglobin on platelets

Bonus Answer: 1 & 3

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