Round 1

1. MATHEMATICS

Toss Up: Short Answer

What is the length of the longest diagonal of a unit cube?

Bonus Answer: root3

Bonus: Short Answer

What is the largest integer that cant be written as the sum of 3's and 4's?

Bonus Answer: 5

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2. CHEMISTRY

Toss Up: Short Answer

What is the oxidation state of chlorine in perchloric acid?

Bonus Answer: +7

Bonus: Short Answer

The formula for the combustion of methane is CH4 + 2O2 yields CO2 + 2H2O. Given that the heat of formation of methane gas is -75 kilojoules per mole, the heat of formation of carbon dioxide is -400 kilojoules per mole, and the heat of formation of water is -300 kilojoules per mole, find the heat of combustion for methane.

Bonus Answer: 925kj/mol

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3. CHEMISTRY

Toss Up: Multiple Choice

Which noble gas is the most reactive?

W) Xenon

X) Radon

Y) Helium

Z) Argon

Toss Up Answer: W

Bonus: Short Answer

How many carbon atoms are in a single molecule of trinitrotolulene, or TNT?

Bonus Answer: 7

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4. MATHEMATICS

Toss Up: Short Answer

You are trying to give 5 apples to 3 friends. You can give any number of apples to each friend, including 0. How many ways are there to share the apples?

Bonus Answer: 56 (its 8C3)

Bonus: Multiple Choice

If a cubic function equals 0 at exactly two points, which of the following must be true?

W) the function passes through the origin

X) there is a double root

Y) the function is even

Z) one of the roots is imaginary

Bonus Answer: X

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5. ENERGY

Toss Up: Short Answer

What is the term for oil derived from oil shales or tar sands?

Bonus Answer: Syncrude

Bonus: Multiple Choice

Burning of which of the following fuels produces the least amount of carbon dioxide per unit of energy?

W) coal

X) oil

Y) natural gas

Z) all of these produce the same amount of CO_2

Bonus Answer: Y

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6. EARTH and SPACE

Toss Up: Multiple Choice

Which radioactive isotope is most useful for determining the age of mastodont bones found in late Pleistocene sediments?

W) U-238

X) C-14

Y) K-40

Z) Rb-87

Toss Up Answer: X

Bonus: Multiple Choice

The absolute age of a rock is the approximate number of years ago that the rock formed. The absolute age of an igneous rock can best be determined by

W) comparing the amounts of decayed and undecayed radioactive isotopes in the rock

X) omparing the sizes of the crystals found in the upper and lower parts of the rock

Y) examining the rock's relative position in a rock outcrop

Z) examining the environment in which the rock is found

Bonus Answer: W

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7. PHYSICS

Toss Up: Multiple Choice

A body at rest in a system is capable of doing work if:

W) the potential energy of the system is positive

X) it is free to move in such a way as to decrease the potential energy of the system

Y) it is free to move in such a way as to increase the potential energy of the system

Z) it is free to move in such a way as to decrease its kinetic energy

Toss Up Answer: X

Bonus: Short Answer

If the force of a non-linear spring is defined as $F(x) = 3x^2+2x+5$, what is the work done on the spring if it's stretched to 3 meters from equilibrium?

Bonus Answer: 51 J

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8. MATHEMATICS

Toss Up: Multiple Choice

Which of the following salts is responsible for the browning of pretzels?

W) Sodium Chloride

X) Sodium Hydroxide

Y) Potassium Chloride

Z) Potassium Carbonate

Toss Up Answer: X

Bonus: Short Answer

Consider the reaction A + 2B yields 4C. Assume all species in the reaction are gaseous. If the reaction is at equilibrium, and the concentration of every species is 2 molar, calculate the equilibrium constant of the reaction.

Bonus Answer: 2

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9. BIOLOGY

Toss Up: Multiple Choice

Which of the following proteins is involved in forming the cleavage furrow of a cell during cytokinesis?

W) G-coupled proteins

X) Keratin

Y) Myosin

Z) Tubulin

Toss Up Answer: Y

Bonus: Short Answer

Name the method in which a new species develops due to a population separated from one another by geographical isolation.

Bonus Answer: Allopatric speciation (OR geographic speciation)

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10. MATHEMATICS

Toss Up: Multiple Choice

Give the range for the following six values 2, 7, 11, 19, 25, 33:

W) 2

X) 31

Y) 33

Z) 15

Toss Up Answer: X

Bonus: Short Answer

What percent of a circle is 6/5pi radians?

Bonus Answer: 216

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11. BIOLOGY

Toss Up: Multiple Choice

Which of the following is a neurotransmitter important for the functioning of myofilaments?

W) Dopamine

X) Acetylcholine

Y) Serotonin

Z) Acetaminophen

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following is not a layer of the epidermis in thin skin?

W) Stratum corneum

X) Stratum lucidum

Y) Stratum spinosum

Z) Stratum basale

Bonus Answer: X

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12. EARTH and SPACE

Toss Up: Multiple Choice

Which of the following models of the Moon's origin is currently considered most likely?

W) The Moon was spun off by a rapidly spinning, molten Earth.

X) The Moon was a passing body that was captured by Earth's gravity.

Y) The Moon formed in place at the same time that Earth formed.

Z) The Moon was ejected from a molten Earth by a giant impact.

Toss Up Answer: Z

Bonus: Multiple Choice

In which parts of Earth's interior would melted or partially melted material be found?

W) stiffer mantle and inner core

X) stiffer mantle and outer core

Y) crust and inner core

Z) asthenosphere and outer core

Bonus Answer: Z

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13. CHEMISTRY

Toss Up: Short Answer

Which nitrogen hydride is the most stable?

Bonus Answer: ammonia

Bonus: Multiple Choice

Why isn't silicon a suitable candidate for life like carbon is?

W) Silicon is too heavy

X) Silicon atoms are too big to form pi bonds

Y) Silicon is more reactive

Z) Silicon is rarer in the earth's crust

Bonus Answer: X

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14. CHEMISTRY

Toss Up: Multiple Choice

Which of the following, when added to hydrofluoric acid, would decrease its acidity?

W) sodium fluoride

X) ammonium nitrate

Y) acetic acid

Z) sodium nitrate

Toss Up Answer: W

Bonus: Short Answer

What is the name of the type of relatively unstable bonding found in many electron deficient compounds, such as BeH2?

Bonus Answer: three center bond

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15. EARTH and SPACE

Toss Up: Multiple Choice

Within the early Earth's vast molten region, substances underwent a process known as differentiation, during which

W) substanes of low density rise to Earth's surface, while those of high density sink toward its center

X) substances of high density float to Earth's surface, while those of low density sink toward its center.

Y) substances of high and low density chemically combine to form uniformly dense substances.

Z) substances of high density form gases, while those of low density form solids.

Toss Up Answer: W

Bonus: Multiple Choice

Earth's magnetic field is likely a result of

W) convection currents in Earth's mantle

X) convection currents in Earth's core

Y) a high concentration of iron in Earth's crust

Z) high-energy particles in the solar wind

Bonus Answer: X

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16. CHEMISTRY

Toss Up: Multiple Choice

Which element has 10 stable isotopes, the highest of any element?

W) Lead

X) Xenon

Y) Tin

Z) Copper

Toss Up Answer: Y

Bonus: Short Answer

Name the compound that has a formula of C60.

Bonus Answer: buckminsterfullerene (or buckyballs)

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17. PHYSICS

Toss Up: Short Answer

It is known that 28 g of a certain ideal gas occupy 22.4 liters at standard conditions. The volume occupied by 42 g of this gas at standard conditions is:

Bonus Answer: 33.6 liters

Bonus: Multiple Choice

Use R = 8.2 × 10−5 m3 · atm/mol · K and NA = 6.02 × 10^23 mol−1. The approximate number of air molecules in a 1m3 volume at 300K and atmospheric pressure is:

W) 41

X) 450

Y) 2.5 × 10^25
Z) 5.4 × 10^26

Bonus Answer: Y

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18. EARTH and SPACE

Toss Up: Multiple Choice

Which statement best describes how galaxies generally move?
W) Galaxies move toward one another.
X) Galaxies move away from one another.
Y) Galaxies move randomly.
Z) Galaxies do not move.

Toss Up Answer: X

Bonus: Multiple Choice

The observable universe is estimated to be roughly 16-20 billion years old. Which statement best describes why a galaxy located 25 billion light-years from Earth may not be visible to an observer on Earth?
W) Galaxies 25 billion light-years away would emit no visible light.
X) Light from beyond 20 billion light years has not yet reached Earth.
Y) Light from beyond 20 billion light years passed out galaxy before Earth existed.
Z) No galaxies are located farther than 5 billion light-years from Earth.

Bonus Answer: X

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19. CHEMISTRY

Toss Up: Short Answer

In 1774, Joseph Priestly isolated what element by heating a powdered mercury compound?

Bonus Answer: Oxygen

Bonus: Multiple Choice

Which of these is the strongest electrolyte
W) HNO2
X) (NH2)2CO
Y) C2H5OH
Z) NH4

Bonus Answer: W

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20. BIOLOGY

Toss Up: Multiple Choice

Which of the following is a ground tissue with thick secondary cells walls reinforced with lignin?
W) Collenchyma
X) Parenchyma
Y) Cleochyma
Z) Sclerenchyma

Toss Up Answer: Z

Bonus: Short Answer

What anatomical structure is a projection of the cell membrane used for phagocytosis?

Bonus Answer: Pseudopods/pseudopodia

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21. BIOLOGY

Toss Up: Multiple Choice

What structure is present in cilia and flagella?

W) 9+0

X) 9+1

Y) 9+2

Z) 9+3

Toss Up Answer: Y

Bonus: Short Answer

Dicots feature vascular bundles arranged in what formation within the stem?

Bonus Answer: Arranged in a ring.

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22. PHYSICS

Toss Up: Short Answer

A parallel circuit has two resistors, one with a resistance of 4 ohms, and the other of 8 ohms. What is the equivalent resistance of the circuit? State the answer as a fraction.

Bonus Answer: 8/3 ohms

Bonus: Short Answer

What is the equivalent capacitance of a parallel circuit with capacitors of 8 micro-Farads, 12 micro-Farads, and 15 micro-Farads?

Bonus Answer: 35 micro-Farads

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23. PHYSICS

Toss Up: Short Answer

In a well-known physical experiment, two small masses were suspended by a thread, each positioned near two much larger stationary masses. A mirror was used to measure the angle through which the thread twists due to the rotation of the small masses' movement. Which physicist conducted this experiment, and what constant did he/she derive from it?

Bonus Answer: Henry Cavendish (accept "Cavendish") and Universal gravitational constant (accept "big G", don't accept "gravity" or just "g")

Bonus: Short Answer

A skydiver leaps from a plane at a high altitude. Given acceleration due to gravity is equal to 10 meters per second squared and it takes 45 seconds for the skydiver to fall, calculate the height at which the skydiver fell from, rounded to the nearest thousand meters.

Bonus Answer: 20000 [Calculation: x = a * t^2 = (10 m/s^2)(45s)^2 = 20250m -> rounded to 20000]

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24. EARTH and SPACE

Toss Up: Multiple Choice

Rock samples brought back from the Moon show absolutely no evidence of chemical weathering. This is most likely due to

W) the lack of an atmosphere on the Moon

X) extremely low surface temperatures on the Moon

Y) lack of biological activity on the Moon

Z) large quantities of water in the lunar "seas"

Toss Up Answer: W

Bonus: Multiple Choice

A major belt of asteroids is located between Mars and Jupiter. What is the approximate average distance between the Sun and this major asteroid belt?

W) 110 million kilometers

X) 220 million kilometers

Y) 390 million kilometers

Z) 850 million kilometers

Bonus Answer: Y

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25. BIOLOGY

Toss Up: Short Answer

What sequence on the mRNA of specific proteins determines whether or not the ribosome translating the mRNA will be bound to the rough endoplasmic reticulum?

Bonus Answer: Signal sequence (OR targeting signal, localization signal, localization sequence, transit peptide, or leader sequence)

Bonus: Short Answer

What are the three types of articulating vertebrae in the human vertebral column?

Bonus Answer: Cervical, thoracic, and lumbar vertebrae

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