Round 7

1. PHYSICS

Toss Up: Short Answer

What is the first derivative of velocity?

Bonus Answer: Acceleration

Bonus: Short Answer

If you are on an asteroid 100 km in diameter and it is rotating at 200 meters per second, what is your angular acceleration?

Bonus Answer: 0.4 meters per second

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2. PHYSICS

Toss Up: Multiple Choice

Which law of thermodynamics states that if two thermodynamic systems are each in thermal equilibrium with a third, then they are in thermal equilibrium with each other?

W) Fourth

X) Third

Y) Second

Z) Zeroth

Toss Up Answer: Z

Bonus: Multiple Choice

What factor is the energy density in radiation of a region of space changed by if the absolute temperature is increased by a factor of 2?

W) Times 4

X) Times 1/4

Y) Times 2

Z) Times 16

Bonus Answer: Z

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3. PHYSICS

Toss Up: Multiple Choice

For what major contribution was Albert Einstein awarded the nobel prize in 1921?

W) Einstein Field Equations

X) General Theory of Reletivity

Y) Special Theory of Relativity

Z) Photoelectric Effect

Toss Up Answer: Z

Bonus: Multiple Choice

Which year in Albert Einstein's life is now known as his "annus mirabilis"?

W) 1905

X) 1921

Y) 1915

Z) 1928

Bonus Answer: W

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4. PHYSICS

Toss Up: Multiple Choice

Why do the bubbles from a freshly opened bottle of champagne grow as they rise to the surface?

W) Fluid pressure falls as the bubble rises in the glass.

X) The bubble continues to accumulate dissolved gas molecules as it moves through the champagne.

Y) The bubble does expansive work on the champagne as it loses potential energy.

Z) Friction with the champagne heats the gas inside the bubble.

Toss Up Answer: X

Bonus: Multiple Choice

The bubbles in a glass of champagne form a steady stream and leave the surface of the glass in regular time intervals. Why is this?

W) It takes a constant amount of time for gas from the air to make it to the growing bubble.

X) The bubbles occur due to vibrations in the room that have a constant frequency.

Y) The bubbles rise when the buoyant force exceeds the adhesive force.

Z) The bubbles form due to pressure waves in the champagne that have a constant wavelength.

Bonus Answer: Y

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5. PHYSICS

Toss Up: Short Answer

Which law says that the total electric flux of a closed surface is equal to the charge enclosed divided by the permittivity?

Bonus Answer: Gauss's Law

Bonus: Multiple Choice

What is the electric permittivity of free space?

W) 2.27 * 10^(-12) Farads / meters

X) 8.85 * 10^(-12) Farads / meters

Y) 8.99 * 10^(9) Farads / meters

Z) 6.67 * 10^(-11) Farads / meters

Bonus Answer: X

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6. MATHEMATICS

Toss Up: Short Answer

What is the relationship between the surface area and the volume of a solid?

Bonus Answer: The surface area is the derivative of the volume/ the volume is the integral of the surface area when the constant is 0

Bonus: Multiple Choice

When the inner diagonal of a cube is 7 times root 3 inches, what is the surface area of the cube?

W) 216 square inches

X) 294 square inches

Y) 343 square inches

Z) 512 square inches

Bonus Answer: X

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7. MATHEMATICS

Toss Up: Short Answer

What is the integral of sec x dx?

Bonus Answer: Ln (abs(sec x + tan x)) + C

Bonus: Multiple Choice

Which of these functions cannot be integrated and represented with elementary functions?

W) (sin^5)x times (cos^6)x dx

X) e^x times x^3 dx

Y) e^(x^2) dx

Z) tan x sin x dx

Bonus Answer: Y

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8. MATHEMATICS

Toss Up: Short Answer

What is the sum of the infinite geometric series whose first term is 1 and fourth term is 1/64?

Bonus Answer: 4/3

Bonus: Multiple Choice

What is the value of e to the (pi times i/2)?

W) e^-1

X) 1

Y) -1

Z) i

Bonus Answer: Z

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9. MATHEMATICS

Toss Up: Short Answer

What is 11 base 5 in base 2?

Bonus Answer: 110

Bonus: Short Answer

If log base 10 of x is 100, what is log base 100 of x?

Bonus Answer: 50

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10. BIOLOGY

Toss Up: Multiple Choice

A product of noncyclic photophosphorylation is

W) NADPH

X) water

Y) carbon dioxide

Z) ADP

Toss Up Answer: W

Bonus: Multiple Choice

All of the following occur in cyclic photophosphorylation EXCEPT:
W) Electrons move along an electron transport chain.
X) Electrons in chlorophyll become excited.
Y) ATP is produced.
Z) NADPH is produced.

Bonus Answer: Z

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11. BIOLOGY

Toss Up: Short Answer

How many turns of the Calvin Cycle are needed to make 1 glucose molecule?

Bonus Answer: 6

Bonus: Short Answer

How many molecules of ATP are required to make a glucose molecule in the Calvin Cycle?

Bonus Answer: 18 molecules of ATP (also accept "18", or "18 molecules")

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12. BIOLOGY

Toss Up: Multiple Choice

All of the following processes release carbon dioxide EXCEPT:
W) the Kreb's cycle
X) alcohol fermentation
Y) oxidative phosphorylation
Z) the conversion of pyruvate to acetyl CoA

Toss Up Answer: Y

Bonus: Multiple Choice

All of the following processes produce ATP EXCEPT:
W) glycolysis
X) the Kreb's cycle
Y) lactic acid fermentation
Z) oxidative phosphorylation of NADH

Bonus Answer: Y

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13. BIOLOGY

Toss Up: Multiple Choice

Each of the following molecules is a polymer EXCEPT:
W) protein
X) glucose
Y) cellulose
Z) starch

Toss Up Answer: X

Bonus: Multiple Choice

Hydrophilic properties are characteristic of all of the following EXCEPT:
W) polar molecules
X) molecules soluble in water

Y) molecules that readily ionize in water
Z) the long hydrocarbon chain components of some molecules

Bonus Answer: Z

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14. CHEMISTRY

Toss Up: Multiple Choice

Although water molecules are locked together by strong hydrogen bonds, they can reconfigure themselves through which phenomena:
W) Adhesion
X) Brownian Motion
Y) Quantum Tunneling
Z) The Mpemba Effect

Toss Up Answer: Y

Bonus: Short Answer

Superfluidity is a state of matter which exhibits which of the following properties:
Extreme surface tension
Near-zero viscosity
High electrical conductivity
High thermal conductivity

Bonus Answer: 2 and 4

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15. CHEMISTRY

Toss Up: Multiple Choice

Vacuum systems require materials with very low outgassing rates. Which of these metals would be suitable for use in a vacuum chamber?
W) Cadmium
X) Zinc
Y) Magnesium
Z) Aluminum

Toss Up Answer: Z

Bonus: Multiple Choice

Which one of these crystal lattice structures best describes the networking of Ti, Zn, and Mg?
W) BCC
X) FCC
Y) HCP
Z) LFC

Bonus Answer: Y

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16. CHEMISTRY

Toss Up: Short Answer

What principle states that an electron will occupy the lowest energy orbital that can receive it?

Bonus Answer: Aufbau Principle

Bonus: Short Answer

What is the name of the radioactive decay chain for uranium-235?

Bonus Answer: Actinium series or Plutonium cascade.

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17. CHEMISTRY

Toss Up: Multiple Choice

Which of the following molecules has a lewis structure that is a resonance hybrid?

W) C2H6

X) HBr

Y) SO2

Z) CH4

Toss Up Answer: Y

Bonus: Short Answer

What mass of HCL dissolved to make a 1 liter solution will give a PH of 1? Give your answer in grams rounded to the nearest hundredth.

Bonus Answer: 0.37

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18. CHEMISTRY

Toss Up: Multiple Choice

A tetrahedral molecule, XY4 would be formed if X were using the orbital hybridization:

W) p2

X) s2

Y) sp2

Z) sp3

Toss Up Answer: Z

Bonus: Multiple Choice

How does a Bronsted-Lowry differ from its conjugate base?

W) The acid has one more proton.

X) The acid has one less proton.

Y) The acid has one more electron.

Z) The acid has one less electron.

Bonus Answer: W

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19. CHEMISTRY

Toss Up: Short Answer

What is the halide with no known stable isotopes?

Bonus Answer: Astatine

Bonus: Multiple Choice

Which of the following molecules is a saturated hydrocarbon?

W) C2H4

X) C3H8

Y) CH3OH

Z) C4H6

Bonus Answer: X

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20. CHEMISTRY

Toss Up: Short Answer

What is the fuel additive in what is commonly known as "dry-gas" by solubilizing water to reduce contamination in gasoline:

Bonus Answer: Isopropyl Alcohol

Bonus: Multiple Choice

The latent heat of vaporization for water at its boiling point and in kj per mole is:

W) 6.01

X) 42.7

Y) 40.7

Z) 40,000,000

Bonus Answer: Y

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21. EARTH and SPACE

Toss Up: Short Answer

Observation of the phases of which planet gave Galileo evidence for the Copernican model.

Bonus Answer: Venus

Bonus: Short Answer

Name the four Galilean Satellites

Bonus Answer: Io, Europa, Ganymede, Callisto

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22. EARTH and SPACE

Toss Up: Multiple Choice

A pulsar is a particular type of:

W) Neutron star

X) Black hole

Y) White dwarf

Z) Black dwarf

Toss Up Answer: W

Bonus: Short Answer

What does the Schwarzschild (pronounced: Sh-worts-shield) radius of a body represent?

Bonus Answer: The radius which, if all of the mass of the body were contained within it, the body would become a black hole (or: its escape velocity would be greater than C).

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23. EARTH and SPACE

Toss Up: Multiple Choice

Sunspots and other solar activity tend to follow a cycle lasting about how long?

W) 1 year

X) 11 years

Y) 23 years

Z) 57 years

Toss Up Answer: X

Bonus: Short Answer

Identify each of the following solar events that is correctly paired with its origin

1. Prominence; the photosphere

2. Solar filament; the chromosphere
3. Coronal mass ejection; the corona

Bonus Answer: 1, 3

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24. EARTH and SPACE

Toss Up: Multiple Choice

Sunspots exist on which layer of the sun?

W) Heliosphere

X) Photosphere

Y) Chromosphere

Z) Corona

Toss Up Answer: X

Bonus: Multiple Choice

Sunspots are characterized by

W) High magnetic field flux, and cooler temperature

X) High magnetic field flux, and hotter temperature

Y) Low magnetic field flux, and cooler temperature

Z) Low magnetic field flux, and hotter temperature

Bonus Answer: W

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25. ENERGY

Toss Up: Multiple Choice

What is one advantage to geothermal energy?

W) Low cost

X) Can be built anywhere

Y) Doesn't produce any hazardous chemicals

Z) Will never run out of steam

Toss Up Answer: W

Bonus: Short Answer

In an internal combustion engine, what is the name of the device that ignites the fuel?

Bonus Answer: Spark plug

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