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1. Chemistry

Toss Up: Short Answer

Mass spectrometers shoot which subatomic particle at a sample to ionize it?

Toss Up Answer: electrons

Bonus: Multiple Choice

Radium-226 is most likely to undergo which type of nuclear decay?

W) electron capture

X) alpha

Y) beta

Z) positron

Bonus Answer: X

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2. Physics

Toss Up: Multiple Choice

What is the relativistic mass of a particle with a rest mass of 8g traveling at a speed of .6c?

W) 4g

X) 8g

Y) 10g

Z) 12g

Toss Up Answer: Y

Bonus: Multiple Choice

What is the length of a 1 meter rod traveling on a spaceship going at .8c, as measured by an astronaut on the ship?

W) .8m

X) .6m

Y) 1m

Z) 1.25m

Bonus Answer: Y

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3. Chemistry

Toss Up: Multiple Choice

What is the mass of an electron relative to a proton?

W) 9.1×10^{-31}

X) 8.2×10^{-14}

Y) 1/1836

Z) 0.51

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following is not a component of a phospholipid?

- W) water
- X) glycerol
- Y) fatty acid
- Z) phosphate group

Bonus Answer: W

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4. Physics

Toss Up: Short Answer

What is the third derivative of displacement with respect to time

Toss Up Answer: Jerk

Bonus: Short Answer

What is the fourth derivative of displacement with respect to time

Bonus Answer: jounce or snap

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5. Chemistry

Toss Up: Multiple Choice

The longest wavelength absorption in the UV visible spectrum of acetone, CH_3COCH_3 , occurs at 335 nm. Predict the energy required to excite an electron from a lone pair orbital on the oxygen atom to an antibonding orbital centred on the carbonyl group.

- W) 3.7 eV
- X) .27 eV
- Y) 2.99 eV
- Z) 1.67 eV

Toss Up Answer: W

Bonus: Multiple Choice

The Pauling electronegativities of fluorine and chlorine are 4.0 and 3.0 respectively. Estimate the dipole moment of chlorine monofluoride, ClF.

- W) 4 D
- X) 3 D
- Y) 1.6 D
- Z) 1 D

Bonus Answer: Z

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6. Biology

Toss Up: Short Answer

What does the Shannon Index quantify?

Toss Up Answer: Biodiversity of a community (accept similar responses)

Bonus: Short Answer

What would be the Simpson's Index value for a population with infinite biodiversity?

Bonus Answer: 0

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7. Mathematics

Toss Up: Short Answer

What is the 451st derived function of $y = e^{\lambda x}$?

Toss Up Answer: $y = e^{\lambda x}$ (DO NOT ACCEPT: $e^{\lambda x}$)

Bonus: Short Answer

What is the 451st derived function of $y = -\sin(e^{\lambda x})$?

Bonus Answer: $y = \cos(e^{\lambda x}) * (e^{\lambda x})^{451}$ (ACCEPT: $y = \cos(e^{\lambda x}) * (e^{451\lambda x})$) (DO NOT ACCEPT: any expression w/o $y =$)

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8. Earth and Space Science

Toss Up: Multiple Choice

There are many mineral categories. Which of the following mineral groups below is classified based on varying ratios of silicon and oxygen?

- W) Sulfides
- X) Phosphates
- Y) Carbonates
- Z) Silicates

Toss Up Answer: Z

Bonus: Short Answer

Of the following minerals listed, which belong in the mineral group of silicates: Olivine, Mica, Topaz and Talc.

Bonus Answer: Olivine, Mica, Topaz (1, 2, 3)

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9. Biology

Toss Up: Multiple Choice

The chemical EDTA is routinely used in many experiments. For example, EDTA is used in electrophoresis buffer solutions. Which of the following statements is not true?

- W) EDTA has a strong binding affinity for divalent and some trivalent cations.
- X) EDTA is a catalyst for polymer formation and essential for protein and nucleic acid polymerization.
- Y) EDTA is a chelator.
- Z) EDTA is used to help denature proteins and weaken cell membranes.

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following statements is not true?

- W) Insects, birds, and many reptiles excrete nitrogenous waste in the form of urea.
- X) Neurons have evolved to speed the communication between distant cells in multi-cellular organisms.
- Y) Synapses are specialized connections between neurons to facilitate the formation of complex neuronal networks.
- Z) The regulatory proteins tropomyosin and troponin control the contraction of contractile filaments, actin and myosin.

Bonus Answer: W

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10. Earth and Space Science

Toss Up: Multiple Choice

What is the penultimate spectral type of a star?

W) F

X) G

Y) K

Z) M

Toss Up Answer: Y

Bonus: Short Answer

What spectral type is the Sun?

Bonus Answer: G

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11. Mathematics

Toss Up: Short Answer

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

Toss Up Answer: $6/\pi$

Bonus: Short Answer

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

Bonus Answer: 15π

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12. Chemistry

Toss Up: Multiple Choice

What is the name given to the non-superimposable mirror image forms of chiral compounds?

W) Diastereomers

X) Stereoisomers

Y) Enantiomers

Z) Cis-trans isomers

Toss Up Answer: Y

Bonus: Short Answer

What metal is used as a reducing agent to obtain iron from iron oxide in the Thermite process?

Bonus Answer: Aluminum

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13. Earth and Space Science

Toss Up: Short Answer

Identify on which days day and night are equal in length.

1) estival solstice 2) autumnal equinox 3) hibernal solstice 4) vernal equinox

Toss Up Answer: 2 and 4

Bonus: Short Answer

Approximately how many degrees of latitude contain areas that will see a noon sun at the zenith during some point in the year?

Bonus Answer: ~47 degrees (between the Tropic of Cancer and the Tropic of Capricorn)

14. Mathematics

Toss Up: Short Answer

How many seconds are in a day

Toss Up Answer: 86400

Bonus: Multiple Choice

How many days are in a second

W) 1.16×10^{-3}

X) 1.16×10^{-4}

Y) 1.16×10^{-5}

Z) 1.16×10^{-6}

Bonus Answer: Y

15. Energy

Toss Up: Multiple Choice

Which of the following is measured by total harmonic distortion, a standard for gauging the quality of power provided to customers?

W) How distorted the waveform is from a pure sinusoidal waveform

X) How distorted the waveform is from a triangular waveform

Y) The difference between a sinusoidal waveform and a triangular waveform

Z) the maximum value of a sinusoidal wave form with respect to the reference point of the waveform

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following is NOT an accurate representation of a limitation on the production and use of bioplastics?

W) using crops for plastic diverts plants from the food supply

X) bioplastics are unlikely to disintegrate in a landfill

Y) bioplastics produce a variety of pollutants when burned

Z) Individuals at home would find it more difficult to compost bioplastics

Bonus Answer: Y