TOSSUP

1. Biology - *Short Answer* Identify all of the following three things that are characteristic of the digestive systems of carnivores: I. Short digestive tract; II. Symbiotic relationship with cellulose-digesting microorganisms; III. Well-developed appendix.

Answer: 1 ONLY [AT]

BONUS

1. Biology - *Short Answer* What taxonomic term refers to vertebrates with jaws?

ANSWER: GNATHOSTOMES [SO]

TOSSUP

2. Math - *Short Answer* If f(x) = 2x+3 (f of x equals two x plus three), and g(x) = 2x+4 (g of x equals two x plus four), find f(g(x)) (f of g of x)

Answer: 4x+11

BONUS

2. Math - *Short Answer* What is the area of a quadrilateral with vertices at points (0, 0), (5, 4), (7, 8), and (3, 9)?

Answer: 25.5

TOSSUP

3. Earth and Space - *Short Answer* Place the following four minerals in order of increasing hardness according to the Mohs scale; I. Gypsum; II. Quartz; III. Talc; IV. Topaz

ANSWER: 3, 1, 2, 4 [EB; F ESS-RM]

BONUS

3. Earth and Space - *Short Answer* Geologists have taken a cross section of Ordovician limestone finding an intruded basaltic dike surrounded by white marble on either side. What type of metamorphism has occurred?

ANSWER: CONTACT METAMORPHISM [RE ESS-G]

TOSSUP

4. Chemistry - *Short Answer* A galvanic cell has a zinc anode and a nickel cathode. If zinc's standard reduction potential is -0.76 volts and the cell potential of the galvanic cell is 0.5 volts, what is the standard reduction potential of nickel in volts?

ANSWER: -0.26 V

BONUS

4. Chemistry - *Short Answer* A radioactive element is an element with no stable isotopes. What radioactive element has the lowest atomic number?

ANSWER: TECHNETIUM [SO]

Commented [1]: This assumes a non-exotic nucleon right
They can't challenge this with positronium or some other zero-proton composite particle

TOSSUP

5. Physics - *Short Answer* Uranium 238, having 92 protons and 146 neutrons undergoes a single alpha decay then two beta minus decays. How many protons and neutrons does the resulting nuclide have?

Answer: 92 protons, 142 neutrons [RE]

BONUS

5. Physics - Order the following 3 objects in terms of first to last to reach the bottom of a ramp when rolling without slipping given that each has the same mass and radius. I. Hollow sphere; II. Hoop; III. Solid sphere

Answer: III, I, II [RE]

TOSSUP

6. Energy - *Short Answer* Researchers at Argonne National Lab are studying the biological effects of aging such as the development of arthritis or cancer. What is the term for the maximum amount of times a cell can divide before cell division stops due to shortening telomeres?

ANSWER: HAYFLICK LIMIT [SO]

BONUS

6. Energy - *Short Answer* What SI prefix is used to represent a multiple of 10 to the 12th power of the base unit?

ANSWER: TERA

TOSSUP

7. Biology - *Multiple Choice* A depletion of which of the following neurotransmitters is known to be an underlying cause of depression?
W) Dopamine
X) Acetylcholine
Y) Glutamate
Z) Serotonin

Answer: Z) SEROTONIN [AT]

BONUS

7. Biology - *Short Answer* 12% of men in a certain population are red-green colorblind. Rounding to the nearest ten percent, what proportion of women in this population are carriers for the colorblindness allele?

ANSWER: 20% [SO]

TOSSUP

8. Math - *Short Answer* Find the value of *n* that makes the four-digit number 223n (*two two three n*) divisible by 11, where n is the units digit of the number.

ANSWER: 3

BONUS

8. Math - *Short Answer* If f(x)=x^3-3x^2+4 (f of x equals x cubed minus three x squared plus four) models the number of children in a park at a given time x hours after noon for x > 0 (x is greater than 0), then in hours, at what time will there be no children in the park?

Answer: 2:00 PM (or equivalent)

Commented [2]: reworded for a bit more clarity if thats fine

TOSSUP

9. Earth and Space - *Short Answer* The gravitational influence of Jupiter produces regions in the asteroid belt in which there are very few asteroids. What is the name of these regions?

ANSWER: KIRKWOOD GAPS [EL]

BONUS

9. Earth and Space - *Short Answer* Identify all of the following 3 particles that are NOT components of the solar wind: 1) Photons; 2) Electrons; 3) Alpha Particles.

ANSWER: 1 ONLY [EL]

TOSSUP

10. Chemistry - *Short Answer* What equation can be used to calculate the pH of a buffer using the concentrations of the acid and its conjugate base along with the pKa?

ANSWER: HENDERSON-HASSELBALCH EQUATION [SO]

BONUS

10. Chemistry - *Short Answer* Identify all of the following three molecules which are polar:

1) Ammonium
2) Nitrogen dioxide
3) Sulfur trioxide

ANSWER: 2 ONLY [EB]

TOSSUP

11. Physics - *Short Answer* It is an incorrect statement to say that the moon orbits around the Earth. Instead, both celestial bodies orbit around what point in space?

Answer: BARYCENTER (accept: center of mass) [RE]

BONUS

11. Physics - *Short Answer* What is the net force, in newtons, on a 1 cubic meter object completely submerged in water with twice the density of water?

Answer: 9,800 newtons [RE]

TOSSUP

12. Energy - *Multiple Choice* Researchers at Argonne National Lab are worried about the slowing of the thermohaline circulation off the coast of Greenland. Which of the following is responsible for this slowing?
W) Increased precipitation off the coast
X) Increased rates of sea ice formation
Y) Increased albedo of coastal waters
Z) Influx of freshwater from melting glaciers

ANSWER: Z) INFLUX OF FRESHWATER FROM MELTING GLACIERS

BONUS

12. Energy - *Short Answer* Researchers at SLAC National Accelerator Lab are working to understand the nature of gluons. To the nearest integer and in mega electron volts over c squared, what is the mass of a gluon?

ANSWER: 0 [SO]

TOSSUP

13. Biology - *Short Answer* Tyler wants to track the growth of a tree. In 2010, he placed a marker in the trunk of the tree, 5 meters above the ground. If the tree grows at a rate of 1 meter per year, how high, in meters, will the marker be in 2025?

ANSWER: 5 meters [RE]

BONUS

13. Biology - *Multiple Choice* What term describes fruit which develop from multiple carpels of the same flower?
W) Multiple
X) Aggregate
Y) Simple
Z) Complete

ANSWER: X) AGGREGATE [AT]

TOSSUP

14. Math - *Short Answer* What is the total surface area of a cone with slant height of length 13, and radius of 5 in terms of pi?

Answer: 90 pi

BONUS

14. Math - *Short Answer* What is the sum of the reciprocals of the roots of the equation 2x^2 + 7x - 9 = 0 (two x squared plus seven x minus nine equals 0)?

Answer: 7/9

TOSSUP

15. Earth and Space - *Short Answer* What name is given to the phenomenon in calcite in which light with different polarization refracts at different angles, splitting and forming two images?

ANSWER: BIREFRINGENCE [RE]

BONUS

15. Earth and Space - *Short Answer* Identify all of the following four minerals that are NOT silicates. I. Olivine; II. Fluorite; III. Azurite; IV. Quartz

ANSWER: 2, 3 [ESS-RM]

TOSSUP

16. Chemistry - *Short Answer* What is the oxidation state of carbon in trifluoromethane, with formula CHF3?

ANSWER: +2 [SO]

BONUS

16. Chemistry - *Multiple Choice* Which of the following correctly describes the polarity of the bonds in CO_2, and the polarity of a molecule of CO_2, respectively?
W) polar, nonpolar
X) nonpolar, polar
Y) both polar
Z) both nonpolar

ANSWER: W) POLAR, NONPOLAR [SO]

TOSSUP

17. Physics - *Short Answer* The period of a pendulum is initially two seconds. If the string length is doubled and gravitational acceleration is halved, what is the new period of the pendulum?

Answer: 4 SECONDS [RE]

BONUS

17. Physics - *Multiple Choice* In order for a process to be considered thermodynamically favorable, the change in what property of the universe must always be greater than 0?
W) Enthalpy
X) Heat released
Y) Entropy
Z) Change in mass

Answer: Y) ENTROPY [RE]

TOSSUP

18. Energy - *Multiple Choice* Researchers at the National Energy Technology Laboratory are using diamond anvils to better understand seismic wave behavior. In geology research, diamond anvils are used to mimic geologic conditions at which of the following locations?

W) at mid-ocean ridges
X) deep in the mantle
Y) at igneous intrusions
Z) at continental rifts

ANSWER: X) DEEP IN THE MANTLE [SO]

BONUS

18. Energy - *Short Answer* Researchers at SLAC National Accelerator Lab accelerate particles to create high speed collisions. Occasionally, a particle and its antiparticle collide and both are converted into light. What is the name of this process?

ANSWER: ANNIHILATION [RE]

TOSSUP

19. Biology - *Multiple Choice* A plant cell placed in a solution with a very high solute concentration will undergo which of the following processes?

W) Lysis
X) Plasmolysis
Y) Sporogenesis
Z) Denaturation

ANSWER: X) PLASMOLYSIS [AT]

BONUS

19. Biology - *Short Answer* Identify all of the following three enzymes that would be found on the leading strand during E. coli DNA replication:

1) Single stranded binding protein
2) RNA primase
3) DNA polymerase III

ANSWER: All of them

TOSSUP

20. Math - *Short Answer* Convert the polar point, (6, pi/6) to rectangular coordinates.

Answer: (3sqrt3, 3)

BONUS

20. Math - *Short Answer* Evaluate (5+3i)^2 (quantity five plus three i end quantity squared) in terms of a+bi?

Answer: 16+30i

TOSSUP

21. Earth and Space - *Short Answer* What is the name for the supermassive object at the center of the Milky Way?

ANSWER: SAGITTARIUS A* [EB; F ESS-OA]

BONUS

21. Earth and Space - *Short Answer* Brown dwarfs are not main sequence stars because their energy primarily comes not from hydrogen fusion, but from what type of energy?

Answer: GRAVITATIONAL ENERGY [AE]

TOSSUP

22. Chemistry - *Multiple Choice* Methanol is an alcohol with chemical formula CH3OH. Alcohols are molecules which contain which of the following functional groups?
W) carboxyl
X) hydroxyl
Y) ketone
Z) aldehyde

ANSWER: X) HYDROXYL [SO]

BONUS

22. Chemistry - *Short Answer* What constant, which is used to define the kelvin, can be thought of as the equivalent of the ideal gas constant for individual particles?

ANSWER: BOLTZMANN'S CONSTANT

TOSSUP

23. Physics - *Short Answer* A magnetic field of magnitude 10 teslas points in the positive x-direction. If an electron with velocity 100 m/s moves in the positive x-direction, in newtons, what is the magnitude of the resulting force on the electron?

Answer: 0 [RE]

BONUS

23. Physics - *Short Answer* An object is placed 6 meters away from a converging lens with focal length 2 meters. What is the resulting magnification of this system?

Answer: -0.5 (must have the negative sign, accept negative 0.5) [RE]