TOSSUP

1. Biology - *Short Answer* Identify all of the following three groups of organisms which are in the phylum Mollusca: I. squid; II. snail; III. earthworm.

ANSWER: I AND II [SO]

BONUS

1. Biology - *Short Answer* Identify all of the following 3 types of transport in which solutes move UP their concentration gradient. I. Diffusion; II. Facilitated diffusion; III. Active transport

Answer: III ONLY [RE]

TOSSUP

2. Math - *Short Answer* If you select 2 people at random, and assuming that neither was born on February 29th, what is the probability that they share the same birthday?

Answer: 1/365

BONUS

2. Math - *Short Answer* How many different non-zero sums of money can you create using one or more of the following coins: a penny, a nickel, a dime, and a quarter?

Answer: 15 DIFFERENT SUMS OF MONEY

TOSSUP

3. Earth and Space - *Short Answer* What soil horizon is characterized by high levels of decomposing organic matter?

ANSWER: O HORIZON [EB; MDE ESS-G]

BONUS

3. Earth and Space - *Short Answer* Identify all of the following three properties that can distinguish muscovite from biotite. I. Color; II. Cleavage; III. Chemical composition

ANSWER: I and III [ESS-RM]

TOSSUP

4. Chemistry - *Multiple Choice* Which of the following elements generally only forms single bonds?
W) oxygen
X) fluorine
Y) carbon
Z) nitrogen

ANSWER: X) FLUORINE [SO]

BONUS

4. Chemistry - *Short Answer* What is the empirical formula of glucose, C6H12O6?

ANSWER: CH2O (DO NOT ACCEPT: C6H12O6) [SO]

TOSSUP

5. Physics - *Short Answer* What is the equivalent resistance, in ohms, of two three ohm resistors wired in series?

ANSWER: 6 [RE; RR Phys-EM]

BONUS

5. Physics - *Short Answer* Two charged particles experience an attractive force of magnitude F. If the distance between the particles is halved, by what factor is the attractive force's magnitude multiplied?

ANSWER: 4 [RE; RR Phys-EM]

TOSSUP

6. Energy - *Short Answer* Scientists at the Department of Energy have recently finalized new lightbulb efficiency requirements. Order the following three types of lightbulbs from least efficient to most efficient:

1) LED
2) incandescent
3) fluorescent

ANSWER: 231 [SO]

BONUS

6. Energy - *Short Answer* Researchers at Pacific Northwest National Lab are using deep learning to improve rates of early cancer detection. What term refers to cancers which originate in connective tissue?

ANSWER: SARCOMA [SO]

TOSSUP

7. Biology - *Short Answer* What section of DNA, located upstream of the coding segment, serves as the location of RNA polymerase binding and the initiation of transcription?

ANSWER: PROMOTER [RE]

BONUS

7. Biology - *Short Answer* What type of interspecies interaction is characterized by one species benefiting while the other species is unaffected?

ANSWER: COMMENSALISM [RE]

TOSSUP

8. Math - *Short Answer* There are 1000 people in Townsville. 200 people in Townsville have a car, and 300 people in Townsville have a phone. If 100 people in Townsville have a car and a phone, what is the number of people who have neither a car nor a phone?

Answer: 600 PEOPLE

BONUS

8. Math - *Short Answer* How many total rectangles can be made in a 4 x 5 grid of squares?

Answer: 150 RECTANGLES

TOSSUP

9. Earth and Space - *Short Answer* What stage of stellar evolution will the Sun enter immediately after it uses up its hydrogen reserves?

ANSWER: RED GIANT [EB; RR ESS-SA]

BONUS

9. Earth and Space - *Short Answer* Place the following three moons in order of increasing size: I. Titan; II. Triton; III. Enceladus

ANSWER: III, II, I [EB; SE ESS-SS]

TOSSUP

10. Chemistry - *Multiple Choice* Which of the following compounds is considered to be a strong acid?
W) Hydrofluoric acid
X) Phosphorous acid
Y) Acetic acid
Z) Sulfuric acid

ANSWER: Z) SULFURIC ACID [SO]

BONUS

10. Chemistry - *Short Answer* How many total bonds can be found in one molecule of butane, C4H10?

ANSWER: 13 [SO]

TOSSUP

11. Physics - *Short Answer* Identify all of the following 4 scales for which absolute zero is the zero of the scale. I. Celsius; II. Kelvin; III. Fahrenheit; IV. Rankine

Answer: II and IV [RE]

BONUS

11. Physics - *Short Answer* A block slides down a frictionless ramp from a height of 10 meters. Taking gravitational acceleration to be 10 m/s^2, how fast is the block moving at the bottom of the ramp in meters per second?

Answer: 10 [RE]

TOSSUP

12. Energy - *Multiple Choice* Researchers at Pacific Northwest National Lab are monitoring animal-borne diseases and how to mitigate their threat to global health Which of the following diseases is NOT transmitted by mosquitoes?
W) Tuberculosis
X) Malaria
Y) West Nile fever
Z) Dengue

ANSWER: W) TUBERCULOSIS

BONUS

12. Energy - *Short Answer* Scientists at Oak Ridge National Lab are studying neutron stars. They model a neutron star with a rotation rate of 1,000 Hertz. In seconds, how long does it take for the star to make a single revolution?

ANSWER: 0.001 (ACCEPT: 1/1000) [EM; RR Energy-ESS]

TOSSUP

13. Biology - *Short Answer* What strong carbohydrate polymer accounts for the majority of mass in wood, and gives plants structural integrity?

Answer: LIGNIN [RE]

BONUS

13. Biology - *Short Answer* In the human stomach, what enzyme is primarily responsible for protein digestion?

ANSWER: PEPSIN [AT]

TOSSUP

14. Math - *Short Answer* What is the tangent of 60 degrees?

Answer: √3

BONUS

14. Math - *Short Answer* What is the volume of a silo created by a cylinder of radius 2 meters and height 4 meters with a 2 meter radius hemisphere on top?

Answer: 64pi/3

TOSSUP

15. Earth and Space - *Short Answer* What adjective is used to describe metamorphic rocks containing clear parallel bands of minerals?

ANSWER: FOLIATED [RE; ESS-RM]

BONUS

15. Earth and Space - *Short Answer* Owen has happened upon a roadcut with exposed rock. He notices a relatively thin, dark colored, igneous rock cutting across what appears to be sedimentary beds. What geologic feature is he observing?

ANSWER: DIKE [RE; MDE ESS-G]

TOSSUP

16. Chemistry - *Multiple Choice* A bomb calorimeter is used to measure which of the following quantities in a reaction?
W) Product concentration
X) Heat release
Y) Pressure change
Z) Solution absorbance

ANSWER: X) HEAT RELEASE [SO]

BONUS

16. Chemistry - Short Answer When cornstarch and water are mixed, a fluid is formed that is soft when lightly touched but hardens when punched. This is an example of what type of fluid, whose shear strengths depend on the stress placed on them?

ANSWER: NON-NEWTONIAN FLUID [SO]

TOSSUP

17. Physics - *Short Answer* A ball is thrown upward with a speed of 30 meters per second. Taking gravitational acceleration to be 10 meters per second squared, in seconds, how long is the ball in the air?

Answer: 6 seconds [RE]

BONUS

17. Physics - *Multiple Choice* Bernoulli's equation is derived from the conservation of which of the following quantities?
W) Linear momentum
X) Angular momentum
Y) Energy
Z) Mass

Answer: Y) ENERGY [RE]

TOSSUP

18. Energy - *Multiple Choice* Researchers at DOE labs are studying the four fundamental forces. Which of the following expresses force in SI base units?
W) meters per second
X) kilogram meters per second
Y) meters per second squared
Z) kilogram meters per second squared

ANSWER: Z) KILOGRAM METERS PER SECOND SQUARED [SO]

BONUS

18. Energy - *Short Answer* Researchers at the Oak Ridge National Lab are studying specific sequences of nucleic acids and how they affect cells. Assume you are comparing 3 unrelated DNA sequences. Giving your answer as a fraction, what is the chance that at a single location on the sequence, all 3 nucleotides are the same?

ANSWER: 1/16 [SO]

TOSSUP

19. Biology - *Short Answer* Identify all of the following three types of signaling that does not require the signaling molecule to travel through the bloodstream:

1) Paracrine
2) Synaptic
3) Endocrine

ANSWER: 1 AND 2 [EH]

BONUS

19. Biology - *Multiple Choice* Which of the following terms describes the central region of a chromosome where the two sister chromatids are connected?

W) Centrosome
X) Centroid
Y) Centriole
Z) Centromere

Answer: Z) CENTROMERE [AT]

TOSSUP

20. Math - *Short Answer* Convert 12 base 10 to base 6.

Answer: 20

BONUS

20. Math - *Short Answer* A game at Hawaii's state fair costs 2 dollars to play. If there's a 20% chance of winning $5, a 30% chance of winning $4, and a 50% chance of winning nothing, what is the expected value of playing this game in dollars?

Answer: -$0.80 [accept: loss of 80 cents/$0.80; do not accept: $0.80]

TOSSUP

21. Earth and Space - *Short Answer* What term is given to a pair of stars that orbits a shared center of mass?

ANSWER: BINARY [EB; RR ESS-SA]

BONUS

21. Earth and Space - *Multiple Choice* The sidereal and synodic period of the Moon's orbit around the Earth differ due to which of the following?

W) Earth's rotation about its axis

X) The Moon's rotation about its axis

Y) Earth's orbit about the sun

Z) Jupiter's orbit around the sun

ANSWER: Y) EARTH'S ORBIT ABOUT THE SUN [RE]

TOSSUP

22. Chemistry - *Multiple Choice* What is the geometry of solid NaCl?

W) cubic

X) tetrahedral

Y) hexagonal

Z) planar

ANSWER: W) CUBIC [SO]

BONUS

22. Chemistry - *Short Answer* Owen mixes 2 liters of a 1 molar glucose solution with 4 liters of a 4 molar glucose solution. What is the new molarity of his solution?

ANSWER: 3 M

TOSSUP

23. Physics - *Multiple Choice* Kepler's 2nd law stating that satellites sweep out the same area of their orbit for the same amount of time orbiting is derived from the conservation of which of the following quantities?

W) Linear momentum

X) Angular momentum

Y) Gravitational potential energy

Z) Mass

Answer: X) ANGULAR MOMENTUM [RE]

BONUS

23. Physics - *Multiple Choice* What name is given to the part of a circuit that stores energy in the form of a magnetic field?

W) Battery

X) Capacitor

Y) Light bulb

Z) Inductor

Answer: Z) INDUCTOR [RE]