TOSSUP

1. Biology - *Multiple Choice* Which of the following correctly describes why sun exposure is able to cause skin cancer?

W) Repeated heating denatures the shape and function of DNA
X) Radiation denatures proteins maintaining the packing of DNA
Y) Radiation completely destroys the nuclear membrane
Z) Radiation directly damages the DNA, disrupting its function

Answer: Z) RADIATION DIRECTLY DAMAGES THE DNA, DISRUPTING ITS FUNCTION [RE]

BONUS

1. Biology - *Short Answer* Identify all of the following that were likely characteristics of the first life on Earth: I. Eukaryotic; II. Anaerobic; III. Multicellular.

Answer: 2 ONLY [AT]

TOSSUP

2. Math - *Short Answer* What is the 4th Fibonacci number?

Answer: 3

BONUS

2. Math - *Short Answer* Find the distance between the points (1, 2, 3) and (4, 5, 6) in 3D space.

Answer: $3\sqrt{3}$

TOSSUP

3. Earth and Space - *Multiple Choice* Which of the following best describes the difference between weathering and erosion?

W) Weathering is caused by wind and precipitation while erosion is caused by rivers

X) Weathering changes the composition of a rock while erosion does not

Y) Weathering breaks down rocks while erosion transports sediment

Z) Weathering is erosion on a longer timescale

ANSWER: Y) WEATHERING BREAKS DOWN ROCK, AND EROSION TRANSPORTS SEDIMENT [EB; EDE ESS-G]

BONUS

3. Earth and Space - *Multiple Choice* Which of the following best describes how seismologists know the Earth's outer core is liquid?

W) P waves cannot pass through it

X) S waves cannot pass through it

Y) P waves can pass through it

Z) S waves can pass through it

ANSWER: X) S WAVES CANNOT PASS THROUGH IT [EB; ESS-G]

TOSSUP

4. Chemistry - *Multiple Choice* Which of the following would decrease the rate of a chemical reaction?

W) increasing temperature

X) cutting up a solid reactant into numerous pieces

Y) adding a catalyst

Z) increasing activation energy of the reaction

ANSWER: Z) INCREASING ACTIVATION ENERGY OF THE REACTION [SO]

BONUS

4. Chemistry - *Multiple Choice* Keisuke has a balloon and tests its internal pressure as a function of volume, with temperature held constant. Which of the following describes the proportionality of pressure to volume?

W) directly proportional

X) inversely proportional

Y) constant

Z) unrelated

ANSWER: X) INVERSELY PROPORTIONAL [SO]

TOSSUP

5. Physics - *Multiple Choice* What fundamental force is responsible for holding protons and neutrons together in the nucleus?

W) Weak force

X) Electromagnetic force

Y) Gravitational force

Z) Strong force

ANSWER: Z) STRONG FORCE [RE; EDE Phys-OS]

BONUS

5. Physics - *Short Answer* Ethan forgot to bring a ruler to class. He estimates a box is 6 centimeters long, 7 centimeters wide, and 5 centimeters tall. If his measurements each have an uncertainty of two centimeters, then what is the minimum volume, in cubic centimeters, of the box?

ANSWER: 60 [EB; EDE Phys-LB]

TOSSUP

6. Energy - *Multiple Choice* Researchers at Argonne National Lab are studying the mysteries of space dust, much of which is derived from comets. Most long period comets are thought to originate from what region of space located between 2000 and 200000 AU away from the sun?

W) Asteroid belt

X) Kuiper belt

Y) Oort Cloud

Z) Interstellar medium

ANSWER: Y) OORT CLOUD [SO]

BONUS

6. Energy - Short Answer Researchers at the Human Genome Institute are studying the composition of human genetic material. Given that humans have 46 chromosomes, how many chromosomes would an individual with Down syndrome or trisomy 21 have?

ANSWER: 47 [SO]

TOSSUP

7. Biology - *Multiple Choice* Which of the following stages of mitosis is not correctly matched with a process that occurs during said stage?

W) Prophase, condensation of chromatin

X) Metaphase, separation of sister chromatids

Y) Telophase, dissolution of the nuclear membrane

Z) Anaphase, mitotic spindles being shortened

Answer: X) METAPHASE, SEPARATION OF SISTER CHROMATIDS [AT]

BONUS

7. Biology - *Short Answer* What tough protein found in reptile scales is also found in human hair and fingernails?

ANSWER: KERATIN [SO]

TOSSUP

8. Math - *Short Answer* How many different triangles can you make with 6 distinct points on a circle?

Answer: 20 TRIANGLES

BONUS

8. Math - *Short Answer* If there are 4 entree options, 6 main meal options, and 9 dessert options, how many ways are there to buy two entrees, one main meal, and one dessert?

Answer: 324 WAYS

TOSSUP

9. Earth and Space - *Multiple Choice* Which of the following dwarf planets is not located in the Kuiper belt?
W) Pluto
X) Ceres
Y) Eris
Z) Haumea

ANSWER: X) CERES [EB; EDE ESS-SS]

BONUS

9. Earth and Space - *Short Answer* What planet in our solar system is the densest?

ANSWER: EARTH [EB; EDE ESS-SS]

TOSSUP

10. Chemistry - *Short Answer* What is the charge of the magnesium cation?

ANSWER: +2 [EB; RR Chem-AE]

BONUS

10. Chemistry - *Short Answer* Identify all of the following three statements that are true of atomic structure:

1) The majority of an atom's volume is empty space
2) All nuclei have at least one neutron
3) The nucleus is positively charged

ANSWER: 1 AND 3 [EB; RR Chem-AE]

TOSSUP

11. Physics - *Short Answer* What name is given to the effect responsible for making sound seem higher pitched when the source moves towards you and lower pitched when moving away?

ANSWER: DOPPLER EFFECT [RE; EDE Phys-OS]

BONUS

11. Physics - *Multiple Choice* What is the mechanical advantage of a ramp inclined at an angle of 30 degrees?

W) 2
X) sqrt(3)
Y) sqrt(5)/2
Z) sqrt(2)

Answer: W) 2 [RE]

TOSSUP

12. Energy - *Multiple Choice* Researchers at the Alternative Fuels Data Center are studying batteries for use in vehicles. Electric vehicles most commonly use which of the following types of batteries?

W) Nickel-cadmium

X) Lithium-ion

Y) Polymer-based

Z) Wet cell

ANSWER: X) LITHIUM ION [SO]

BONUS

12. Energy - *Short Answer* Researchers at Pacific Northwest National Lab are studying diseases that are specifically spread from animals to humans. What name is given to these types of diseases?

ANSWER: ZOONOTIC [RE]

TOSSUP

13. Biology - *Short Answer* Identify all of the following three terms that could be used to describe a plant: I. Heterotrophic; II. Eukaryotic; III. Autotrophic

Answer: 2 AND 3 [AT]

BONUS

13. Biology - *Short Answer* What type of RNA is used by ribosomes in order to read template strands and attach the correct corresponding amino acids?

ANSWER: tRNA [RE]

TOSSUP

14. Math - *Multiple Choice* Which of the following cannot be the unit digit of the square of an integer in base 10?

W) 4

X) 6

Y) 7

Z) 9

Answer: Y) 7

BONUS

14. Math - *Short Answer* What is the maximum number of sections of pizza you can make with 4 cuts?

Answer: 11 SECTIONS

TOSSUP

15. Earth and Space - *Multiple Choice* Which of the following igneous rocks has the largest crystals?

W) Granite

X) Basalt

Y) Andesite

Z) Rhyolite

ANSWER: W) GRANITE [EB; EDE ESS-RM]

BONUS

15. Earth and Space - *Short Answer* Place the following three storms in order of increasing wind speed: I. Tropical depression; II. Hurricane; III. Tropical storm

ANSWER: 1, 3, 2 [EB; EDE ESS-AO]

TOSSUP

16. Chemistry - *Multiple Choice* Mr. Maine weighs a sample of wood, burns it, and then weighs the remaining ash. He notices that the weight of the ash is less than the weight of the wood, seemingly violating the conversation of matter. What best explains this discrepancy?

W) His scale is broken

X) Ash weighs less per unit mass

Y) Some mass was lost as CO_2

Z) The conservation of matter does not exist

ANSWER: Y) SOME MASS WAS LOST AS CO_2 [SO]

BONUS

16. Chemistry - *Short Answer* Identify all of the following three pairs of elements that commonly bond ionically: I. Carbon and oxygen; II. Sodium and chlorine; III. Hydrogen and fluorine

ANSWER: 2 ONLY [EB; RR Chem-C]

TOSSUP

17. Physics - *Short Answer* Identify all of the following three subatomic particles that are made of quarks. I. Protons; II. Neutrons; III. Electrons

ANSWER: 1 AND 2 [EB; RR Phys-OS]

BONUS

17. Physics - *Multiple Choice* What property of a sound wave is responsible for the perceived loudness?

W) Wavelength

X) Frequency

Y) Velocity

Z) Amplitude

ANSWER: Z) AMPLITUDE [RE]

TOSSUP

18. Energy - *Short Answer* Researchers at Brookhaven National Lab are using statistics to understand the spread of pandemics. What is the mean of the following 5 numbers? 10, 21, 17, 12, 15

ANSWER: 15 [SO]

BONUS

18. Energy - *Short Answer* Researchers at Pacific Northwest National Labs are studying solid-state materials. What term refers to solids, such as glass, which lack a defined crystal structure?

ANSWER: AMORPHOUS [SO]

TOSSUP

19. Biology - *Short Answer* By name or number, order the following three phases of a seed's life cycle in chronological order after pollination. I. Germination; II. Fertilization; III. Distribution.

Answer: II, III, I [AT]

BONUS

19. Biology - *Short Answer* Identify all of the following that are true of meiosis: I. It is responsible for producing sex cells; II. It produces genetically identical cells; III. Cell division in meiosis occurs only once.

Answer: 1 ONLY [AT]

TOSSUP

20. Math - *Short Answer* Find the distance between the points (1, 2) and (4, 5) in the Cartesian plane.

Answer: $3\sqrt{2}$

BONUS

20. Math - *Short Answer* A ball is launched such that its height is given by the equation y(t) = -5t^2+45t+5 (y of t equals negative five t squared plus forty five t plus five). What is the minimum height on the interval from t = 1 to t = 5.

Answer: 45 [RE]

TOSSUP

21. Earth and Space - *Multiple Choice* Where on an HR diagram would one find a white dwarf?

W) Bottom right
X) Bottom left
Y) Top right
Z) Top left

ANSWER: X) BOTTOM LEFT [EB; EDE ESS-SS]

BONUS

21. Earth and Space - *Short Answer* At some points in space, spacecraft are able to stay in the same place due to the balance of gravitational forces from celestial bodies. What name is given to these points?

ANSWER: LAGRANGE POINTS [RE]

TOSSUP

22. Chemistry - *Short Answer* How many electrons does an H+ ion have?

ANSWER: ZERO [SO]

BONUS

22. Chemistry - *Short Answer* Brass is an alloy made up of copper and what other metal element?

ANSWER: ZINC [SO]

TOSSUP

23. Physics - *Short Answer* What particle is the mediator of the electromagnetic force and makes up light?

ANSWER: PHOTON [RE; RR Phys-OS]

BONUS

23. Physics - *Multiple Choice* A 10 gram cube of unobtainium has a specific heat capacity of 15 joules per gram-Kelvin. How many joules of energy does it take to raise the temperature of the cube fifteen degrees Kelvin?
W) 1250
X) 1750
Y) 2250
Z) 2750

ANSWER: Y) 2250 [EB; RR Phys-OS]