TOSS-UP

1. BIOLOGY; Multiple Choice: The lipopolysaccharide layer outside the petidoglycan cell wall of a gram negative bacterium

(W) absorbs and holds gram stain

(X) protects the bacterium against certain antibiotics

(Y) does not contain phospholipids

(Z) allows the bacterium to attach to solid objects

ANSWER: X—PROTECTS THE BACTERIUM AGAINST CERTAIN ANTIBIOTICS

BONUS

1. BIOLOGY; Short Answer: Use the image to answer the following three questions.
2. What is the shape of the pink bacteria?

B. Which of the two bacteria would Staphylococcus most likely be?

C. Which of the two bacteria would the bacterium that causes anthrax most likely be?

ANSWER: A. BACILLUS; B. PURPLE OR COCCI; C. PINK OR BACILLI

TOSS-UP

2. CHEMISTRY; Short Answer: Name all of the following three substances that are products when an alcohol is added to a carboxylic acid in the presence of a strong acid.

I. water

II. ester

III. aldehyde

ANSWER: I AND II

BONUS

1. CHEMISTRY; Short Answer: Use the image to answer the following three questions.

A. What number represents an acid anhydride?

B. What numbers are found in a triacylglycerol?

C. What number or numbers are found in an alanine amino acid?

ANSWER: A. 3; B. 1 and 4; C. 1

TOSS-UP

1. PHYSICS; Short Answer: If a guitar string is 0.5 m long, what is the wavelength of its third harmonic exactly?

ANSWER: 1/3 m

BONUS

3. PHYSICS; Multiple Choice: All of the following statements about a resonating are true except:

W. A resonating string forms a standing wave

X. The wavelength of a resonating string must coincide with one of its harmonics

Y. Some spots on a resonating string will not move at all

Z. If left alone, the amplitude of a wave on a resonating string will grow infinitely large

ANSWER: Z

TOSS-UP

4. EARTH SCIENCE; Multiple Choice: The boundary between a continent and a deep-ocean

basin is known as what?

(W) Continental margin

(X) Continental slope

(Y) Continental shelf

(Z) Continental boundary

ANSWER: X—CONTINENTAL SLOPE

BONUS

4. EARTH SCIENCE; Multiple Choice: What is the name of the portion of the seafloor that is

adjacent to major landmasses?

(W) Continental margin

(X) Deep-ocean basin

(Y) Abyssal plain

(Z) Continental margin

ANSWER: W—CONTINENTAL MARGIN

TOSS-UP

5. MATH; Multiple Choice: What statistical test is most closely associated with the test-statistic of (O-E)^2/E ?

(W) Student’s t-test

(X) Pearson’s Chi-square test

(Y) Portmanteau test

(Z) ANOVA

ANSWER: X

BONUS

5. MATH; Short Answer: Use the image to answer the following two questions.

A. Given that p = 0.10, what is the probability of a type I error occurring?

B. The degrees of freedom of this particular test must be above what integer value?

ANSWER: A. 0.10; B. 2

TOSS-UP

1. ENERGY; Short Answer: What type of coal is a relatively soft coal that is of higher quality than lignite coal but lower than anthracite coal?

ANSWER: BITUMINOUS COAL

BONUS

6. ENERGY; Short Answer: Use the image to answer the following two questions.

1. Give the names of the substances labeled 1-4.

2. What number is also known as brown coal?

ANSWER: 1. PEAT, LIGNITE, BITUMINOUS COAL, ANTHRACITE COAL; 2. 2

TOSS-UP

7. BIOLOGY; Multiple Choice: Which of the following animals is not a protostome?

(W) Hydra

(X) Rotifer

(Y) Giant squid

(Z) Coelocanth

ANSWER: Z—COELOCANTH

BONUS

7. BIOLOGY; Short Answer: Use the image to answer the following two questions.

A. Name stages 1, 2, and 3

B. Name structure 4

ANSWER: A. ZYGOTE, BLASTULA, GASTRULA; B. BLASTOPORE

TOSS-UP

8. CHEMISTRY; Short Answer: What is the most abundant organic compound on Earth?

ANSWER: CELLULOSE

BONUS

8. CHEMISTRY; Short Answer: Use the image to answer the following three questions.

A. What is the general term for this type of cell?

B. Name structures 1, 2, and 3.

C. What is the term for an electrochemical that has two equivalent half-cells of the same material differing only in concentrations?

ANSWER: A. VOLTAIC OR GALVANIC CELL; B. SALT BRIDGE, CATHODE, ANODE; C. CONCENTRATION CELL

TOSS-UP

9. PHYSICS; Multiple Choice: A 0.45 kg ball, attached to the end of a horizontal cord, is rotated in a circle of radius 1.3 m on a frictionless horizontal surface. If the cord will break when the tension in it exceeds 75 N, what is the maximum speed the ball can have?

W. 5 m/s

X. 10 m/s

Y. 15 m/s

Z. 20 m/s

ANSWER: Y. 15 m/s

BONUS

1. PHYSICS; Short Answer:

Given that g = 10 m/s^2, the weight of one cart and its passengers is 500 kg, and the radius of curvature is 10 m, at what minimum speed must one roller coaster cart be traveling when upside down at the top of a circle so that the passengers will not fall out?

ANSWER: 10 m/s

TOSS-UP

10. EARTH SCIENCE; Multiple Choice: What layer of soil is known as the subsoil?

(W) O horizon

(X) A horizon

(Y) E horizon

(Z) B horizon

ANSWER: Z—B HORIZON

BONUS

10. EARTH SCIENCE; Multiple Choice: This type of soil is also known as swelling clay soil. It has a high content of expansive clays montmorillonite, is generally used for cattle and sheep grazing, and forms from highly basic rocks such as basalt. Name this type of soil.

(W) Mollisol

(X) Vertisol

(Y) Ultisol

(Z) Alfisol

ANSWER: X—VERTISOL

TOSS-UP

11. MATH; Short Answer: Calculate the mean, median and mode of the following 7 numbers: 2, 5, 1, 14, 7, 10, 2

ANSWER: MEAN: 6, MEDIAN: 5, MODE: 2

BONUS

11. MATH; Short Answer: Give the mean, median and mode of the mean, median and mode of the following 7 numbers: 8, 1, 5, 5, 4, 7, 5

ANSWER: MEAN: 5, MEDIAN: 5, MODE: 5

TOSS-UP

12. ENERGY; Multiple Choice: Which of the following is not true of neutron moderators used in nuclear reactors?

W. Solid graphite is a common neutron moderator

X. The function of a neutron moderator is to reduce the speed of fast neutrons

Y. Heavy water is the most common neutron moderator

Z. Beryllium has been used as a neutron moderator

Answer: Y

BONUS

12. ENERGY; Multiple Choice: Which of the following is true regarding breeder reactors?

(W) They consume fissile material at a great rate than they generate it

(X) They have inferior fuel economies compared to those of normal reactors

(Y) They can only run on uranium isotopes

(Z) They can only be cooled by helium

ANSWER: Z

TOSS-UP

13. BIOLOGY; Short Answer: Given a plant whose pressure potential is 30 MPa and whose water potential is -100 MPa, calculate the solute potential of the plant.

ANSWER: -130 MPa

BONUS

13. BIOLOGY; Short Answer: Use the image to answer the following three questions.

1. The cambium located between the xylem and phloem is known as what?

2. Conversely, the cambium not located between the xylem and phloem is known as what?

3. Calculate the energy in Joules required by the plant to transport water through its xylem under the following conditions: the water is transported 50 m, the water potential is -200 MPa, the air temperature is 35 degrees Celsius, relative humidity is 75%, and the wind velocity is 5 m/s.

ANSWER: 1. FASCICULAR CAMBIUM; 2. INTERFASCICULAR CAMBIUM; 3. 0 J

TOSS-UP

14. CHEMISTRY; Short Answer: In what type of addition is one pi bond broken and two sigma bonds formed?

ANSWER: ELECTROPHILIC ADDITION

BONUS

14. CHEMISTRY; Multiple Choice: Which of the following is not true concerning electrophilic addition?

(W) The second step of an electrophilic addition is the same attack process found in an Sn1 reaction

(X) The nitrosonium ion is an example of an electrophile

(Y) Electrophilic attack results in electrophilic substitution if an aromatic compound is a reactant

(Z) It is always anti-Markovnikov

ANSWER: Z

TOSS-UP

15. PHYSICS; Short Answer: What is the term for the mathematical and conceptual opposite of an electron? It is not to be confused with a position, but rather is the lack of an electron at a position where one could exist in an atom or an atomic lattice.

ANSWER: ELECTRON HOLE

BONUS

15. PHYSICS; Multiple Choice: use the image to answer the following 4 questions.

1. What is the general term for this type of diagram?

2. What is plotted on the x-axis?

3. What does Ef stand for?

4. Order the following types of materials from largest band gap to smallest or most overlapping band gap: metal, insulator, semiconductor, semimetal.

ANSWER: 1. BAND DIAGRAM; 2. SPACE, OR SOME DIMENSION; 3. FERMI LEVEL; 4. INSULATOR, SEMICONDUCTOR, SEMIMETAL, METAL

TOSS-UP

16. ERSCI/SPSCI; Short Answer: What is the term for a distribution of matter between a distant source and an observer that is capable of bending light from the source as it approaches the observer?

ANSWER: GRAVITATIONAL LENS

BONUS

16. ERSCI/SPSCI; Multiple Choice: In what type of lensing does no distortion in shape occur, though the amount of light received from a background object changes with time?

(W) Microlensing

(X) Weak Lensing

(Y) Strong Lensing

(Z) Galaxy-galaxy Lensing

ANSWER: W

TOSS-UP

17. MATH; Multiple Choice: Which of the following is true concerning standard deviation?

(W) It is the square of the variance

(X) 72.4% of a sample will remain within one standard deviation of the mean on a normal distribution

(Y) The Greek letter rho denotes the population standard deviation

(Z) Standard error is the standard deviation of the sampling distribution associated with the estimation method

ANSWER: Z

BONUS

17. MATH; Multiple Choice: Which of the following is not true of the central limit theorem?

W. It states the conditions under which a sufficiently large number of independent random variables can be represented by a poisson distribution

X. It implies that two samples of the same size will have the same degree of certainty regardless of their respective population sizes.

Y. It implies that increased sample size will lead to increased certainty

Z. It implies that sample always less random than its population

ANSWER: W.

TOSS-UP

18. ENERGY; Short Answer: What phenomenon occurs when electrons generated from solar energy are transferred between bands with the material, resulting in the buildup of a voltage between two electrodes?

ANSWER: THE PHOTOVOLTAIC EFFECT

BONUS

18. ENERGY; Multiple Choice: Which of the following is false concerning the photovoltaic effect?

W. A photovoltaic cell contains only n-type semiconductors

X. PV Cells utilize electron holes to generate electrical energy

Y. A PV cell’s p layer absorbs photons

Z. Modern PV cells convert 7-17% of solar energy into electric energy

ANSWERS: W

TOSS-UP

19. BIOLOGY; Short Answer: What type of muscle contraction occurs when a muscle exerts a force without changing in length?

ANSWER: ISOMETRIC

BONUS

19. BIOLOGY; Short Answer: Use the image to answer the following three questions?

1. Identified by number 1, what term describes the basic repeating unit of muscle as shown in the diagram?

2. Give the names of regions 2 and 3.

3. Name number 4.

ANSWER: 1. SARCOMERE; 2. I BAND, A BAND; 3. Z LINE

TOSS-UP

20. CHEMISTRY; Short Answer: Name this molecule. It is used as a raw material for the industrial production of adipic acid and caprolactam. It is used as a nonpolar industrial solvent. It is produced by reacting benzene and hydrogen. It is a cycloalkane with molecular formula C6H12.

ANSWER: CYCLOHEXANE

BONUS

20. CHEMISTRY; Short Answer: What is the name of the protist that causes malaria?

1. Given that red bonds are axial while blue bonds are equatorial, what is the conformation of this molecule?

2. What is the ring strain of this molecule?

3. What is the major product of an E2 reaction between bromocyclohexane and the hydroxide anion?

ANSWER: 1. CHAIR; 2. 0; 3. CYCLOHEXENE

TOSS-UP

21. PHYSICS; Short Answer: What theorem is a general formula that relates the temperature of a system to its related energies? This theorem is based on the idea that in thermal equilibrium a system’s energy is shared equally among all of its various forms.

ANSWER: EQUIPARTITION THEOREM

BONUS

21. PHYSICS; Multiple Choice: Which of the following is false concerning blackbody radiation?

(W) Equipartition theorem links blackbody radiation to the ultraviolet catastrophe

(X) Ultraviolet catastrophe predicts that an ideal blackbody in thermal equilibrium will emit radiation with infinite power

(Y) Blackbodies emit light of all wavelengths at every temperature

(Z) Blackbodies absorb 100% of the energy that falls upon them

ANSWER: Y

TOSS-UP

22. ERSCI/SPSCI; Short Answer: What glacial structure results when glacial ice acts on underlying unconsolidated till or ground moraine to produce an elongated whale-shaped hill?

ANSWER: DRUMLIN

BONUS

22. ERSCI/SPSCI; Short Answer: Use the image to answer the following three questions.

1. Name structures 1 and 2

2. Name the general area represented by 3.

3. Name structure 4, which occurs during temporary halts in a glacier’s retreat.

ANSWER: 1. 1 DRUMLINS, KETTLE LAKES; 2. OUTWASH PLAIN; 3. RECESSIONAL MORAINE

TOSS-UP

23. MATH; Multiple Choice: A triangle inscribed in a semicircle must be:

W. an acute triangle

X. a right triangle

Y. an obtuse triangle

Z. an equilateral triangle

BONUS

23. MATH; Multiple Choice: If two circles are have no common points and one does not lie within the other, then how many common tangent lines do the circles have?

(W) 1

(X) 2

(Y) 3

(Z) 4

ANSWER: Z

TOSS-UP

24. ENERGY; Short Answer: What type of photosynthesis is used by plants to reduce photorespiration by temporally separating photosynthesis into different sections and by fixing CO2 as malate?

ANSWER: CAM PHOTOSYNTHESIS

BONUS

24. ENERGY; Multiple Choice: Which of the following is not true concerning CAM photosynthesis?

W. It is common in plants living in arid conditions

X. PEP carboxylase is utilized

Y. CAM plants use nitrogen inefficiently as a tradeoff for decreased photorespiration

Z. Jade plants are examples of CAM plants

ANSWER: Y

TOSS-UP

25. BIOLOGY; Short Answer: What protein that allows for the termination of translation by recognizing the stop codon in an mRNA sequence?

ANSWER: RELEASE FACTOR

BONUS

25. BIOLOGY; Short Answer: Use the image to answer the following three questions.

1. Given that the small subunit is 30S and the large subunit is 50S, would this ribosome be found in a prokaryote or eukaryote?

2. What does the P in P site stand for?

3. What enzyme connected the methionine molecule to the tRNA?

ANSWER: 1. PROKARYOTE; 2. PEPTIDYL; 3. AMINOACYL-tRNA