TOSS-UP

1. BIOLOGY; Short Answer: Also known as Lou-Gehrig’s disease, what illness is a progressive fatal neurodegenerative disease caused by the degeneration of motor neurons?

ANSWER: AMYLOTROPHIC LATERAL SCLEROSIS

BONUS

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

1a. Name line 1a.

1b. Name line 1b.

2a. Name region 2a.

2b. Name region 2b.

3. Given that a particular muscle fiber is a type I fiber, is the fiber (a) slow-twitch or fast-twitch, and (b) oxidative or glycolytic?

ANSWER: 1a. Z line, 1b. M line, 2a. I band, 2b. A band, 3a. slow-twitch, 3b. oxidative.

TOSS-UP

2. CHEMISTRY; Multiple Choice: An acid chloride plus an alcohol will yield which of the following in addition to HCl?

(W) A carboxylic acid

(X) an ester

(Y) an amide

(Z) an anhydride

ANSWER: X

BONUS

1. CHEMISTRY; Short answer:

1. Name the organic compound shown in the image.

2. This compound is washed with two equivalents of ammonia to form what compound?

3. The equivalents are washed away from this product in an acid bath to produce what new compound?

4. multiple choice: what two functional groups are found in the compound formed in question 3?



ANSWER: 1. PHTHALIC ANHYDRIDE, 2. AMMONIUM PHTHALAMATE, 3. PHTHALAMIC ACID, 4. W

TOSS-UP

3. PHYSICS; Multiple Choice: If the distance between a point charge and an infinitely

large charged plate is increased by a factor of 2, the new

force on the point charge will:

W. decrease by a factor of 4.

X. decrease by a factor of 2.

Y. remain the same.

Z. increase by a factor of 2.

ANSWER: Y

BONUS

3. PHYSICS; Multiple Choice: A positively charged particle starts at rest 25 cm from a

second positively charged particle which is held

stationary throughout the experiment. The first particle is

released and accelerates directly away from the second

particle. When the first particle has moved 25 cm, it has

reached a velocity of 10 *mls.* What is the maximum

velocity that the first parlicle will reach?

W. 10 m!s

X. 14 m!s

Y. 20 m!s

Z. Since the first particle will never escape the electric

field of the second particle, it will never stop accelerating,

and will reach an infinite velocity.

ANSWER: X

TOSS-UP

4. EARTH SCIENCE; Short Answer: What type of crysal cleavage, also known as pinacoidal cleavage, is exhibited by mica and graphite?

ANSWER: BASAL

BONUS

4. EARTH SCIENCE; Short Answer: Name the two types of monoclinic Bravais lattices, one of which layers with a rectangular lattice and the other of which layers with a rhombic lattice.

ANSWER: PRIMITIVE AND CENTERED

TOSS-UP

5. MATH; What is the term for the non-zero vectors of a square matrix which, after being multiplied by the matrix, remain proportional to the original vector and change only in magnitude but not direction?

ANSWER: EIGENVECTOR

BONUS

5. MATH; Short Answer: What is the term for the set of all eigenvectors with the same eigenvalue together with the zero vector of a particular matrix?

ANSWER: EIGENSPACE

TOSS-UP

1. ENERGY; Multiple Choice: Which of the following is the least common neutron moderator used in nuclear reactors?

w. heavy water

x. light water

y. graphite

z. beryllium

ANSWER: Z

BONUS

6. ENERGY; Short Answer: Once neutrons have reached thermal equilibrium with the moderator and have become thermal neutrons, their distribution of speeds follows what type of distribution?

ANSWER: MAXWELL-BOLTZMANN DISTRIBUTION

TOSS-UP

7. BIOLOGY; Multiple Choice: In an osteon, concentric layers of compact bone tissue surround a central cavity. Which of the following is the correct term for these layers?

(W) Canaliculi

(X) Lacunae

(Y) Haversian systems

(Z) Lamellae

ANSWER: Z

BONUS

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

1. What type of cell, designated A, is found is lamellae?

2. What cavity, designated B, is found at the center of each osteon and houses blood vessels?

3. Designated C, what dense, irregular connective tissue surrounds the outer surface of most bones?

4. Osteoclasts are a cell type that remodels and resorbs bone. What is the precursor cell to an osteoclast?

ANSWER: 1. Osteocyte, 2. Haversian canal, 3. Periosteum, 4. Monocyte

TOSS-UP

8. CHEMISTRY; Short Answer: Order the following compounds or general types of compounds in increasing order of acid strength: water, carboxylic acid, ammonia, ethane, aldehyde.

ANSWER: Ethane, ammonia, aldehyde, water, carboxylic acid

BONUS

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

1. What reaction is occurring here, where a ketone or an aldehyde is fully reduced to an alkane?

2. What solvent is usually used for this reaction?

3. An alternative reaction also reduces ketones or aldehydes to alkanes, but uses zinc amalgam and hydrochloric acid. It is particularly effective at reducing aryl-alkyl ketones. Name this reaction.

ANSWER: 1. WOLFF-KISHNER REDUCTION; 2. DIETHYLENE GLYCOL; 3. CLEMMENSEN REDUCTION

TOSS-UP

9. PHYSICS; Short Answer: What type of cyclic particle accelerator uses varying magnetic and electric fields that are carfully aligned with the traveling particle beam such that the particles’ path can be held constant as they accelerate?

ANSWER: SYNCHOTRON

BONUS

1. PHYSICS; Short Answer: What type of electromagnetic radiation produces a continuous spectrum and is produced by the deceleration of a charged particle, such as an electron, when deflected by another charged particle, such as an atomic nucleus? The spectrum becomes more intense and shifts toward higher frequencies when the energy of the accelerated particles is increased.

ANSWER: BREMSSTRAHLUNG

TOSS-UP

10. EARTH SCIENCE; Short Answer: What phenomenon occurs when charge accumulates in certain solid materials in response to applied mechanical strain?

ANSWER: PIEZOELECTRIC EFFECT

BONUS

10. EARTH SCIENCE; Short Answer: Name all of following substances that can display piezoelectricity: quartz, basalt, topaz, Rochelle salt, limestone

ANSWER: ALL EXCEPT BASALT

TOSS-UP

11. MATH; Short Answer: Find the limit as x approaches zero of h(x) = sinx / x

ANSWER: 1

BONUS

11. MATH; Short Answer: Find the limit as x approaches infinity of x to the (1/x).

ANSWER: 0

TOSS-UP

12. ENERGY; Multiple Choice: Which of the following is not a reason why natural gas is a better fuel than oil or coal?

W. It produces less carbon dioxide per joule

X. It produces far fewer pollutants

Y. It produces no nitrogen oxides

Z. It produces less sulfur dioxide than coal

Answer: Y

BONUS

12. ENERGY; Short Answer: In order to promote safety, a minute amount of a volatile odorant that smells like rotting cabbage is added to natural gas, which is otherwise colorless and almost odorless. This assists is detecting leaks before a fire or explosion occurs. What is the name of this compound?

ANSWER: BUTANETHIOL, or BUTYL MERCAPTAN

TOSS-UP

13. BIOLOGY; Short Answer: What is the term for the arrangement of ovules within a plant ovary?

ANSWER: PLACENTATION

BONUS

13. BIOLOGY; Short Answer: Name placentation types A-E.

ANSWER: basal, parietal, axile, free-central, marginal

TOSS-UP

14. CHEMISTRY; Multiple Choice: 

ANSWER: (X) AMINES

BONUS

14. CHEMISTRY; Multiple Choice: Which of the following is the correct product for the reaction shown?

ANSWER: Y

TOSS-UP

15. PHYSICS; Multiple Choice: A particle of mass *m* is fired into a magnetic field of

strength *B* at a speed *v.* The particle travels in a circular

path inside the field with a radius *r.* Which of the

following expressions gives the magnitude of the charge

on the particle?

W. *vB*

*mr*

X.

*mv*

*Br*

Y.

*mr*

*v^2 B*

Z.

*Mv^2*

*Br*

ANSWER: Y

BONUS

15. PHYSICS; Multiple Choice: A stationary loop of wire is placed in a magnetic field

directed into the page as shown. The current in the loop of wire is:

W. clockwise if the magnitude of the magnetic field is

decreasing.

X. clockwise if the magnitude of the magnetic field is

increasing.

Y. clockwise if the magnitude of the magnetic field is

increasing or decreasing.

Z. No current will flow through the loop if the magnetic

field is increasing or decreasing.

ANSWER: X

TOSS-UP

16. ERSCI/SPSCI; Short Answer: Also known as talus, what is the term for the accumulation of broken rock fragments at the base of crags, mountain cliffs, and valley shoulders and commonly refers to smaller material such as mixed gravel and loose dirt?

ANSWER: SCREE

BONUS

16. ERSCI/SPSCI; Short Answer: Name A-E.

ANSWER: BAY, STACK, STUMP, ARCH, HEADLAND

TOSS-UP

17. MATH; Short Answer: In a binary classification test, what term, also known as a recall rate, is the proportion of actual positives which are correctly identified as positives?

ANSWER: SENSITIVITY

BONUS

17. MATH; Short Answer: Visual. To the nearest percent, calculate the sensitivity and specificity of the test.

ANSWER: 67%, 91%

TOSS-UP

18. ENERGY; Multiple Choice: Which of the following is not a detrimental effect of wind power?

(W) Turbines pose a threat to birds and bats

(X) Local communities often express aesthetic concerns over wind farms

(Y) Noise pollution is a point of contention

(Z) Land used by wind farms cannot be simultaneously used for agriculture

ANSWER: Z

BONUS

18. ENERGY; Short Answer: The distribution of hourly wind speeds throughout the world very closely resembles what type of continuous probability distribution?

ANSWER: WEIBULL DISTRIBUTION

TOSS-UP

19. BIOLOGY; Multiple Choice: When a flower’s petals and sepals look very similar, they are collectively called

(W) Setals

(X) Pepals

(Y) Pesals

(Z) Tepals

ANSWER: Z—TEPALS

BONUS

19. BIOLOGY; Short Answer: Use the image to answer the following 3 questions.

1. What is the general term for the arrangement of whorls around the ovary shown in this flower?

2. What structure is represented by A, through which the pollen tube grows?

3. What bowl-shaped structure is represented by B, and is characteristic of the flower type listed in question 1?

ANSWER: 1. EPIGYNOUS FLOWER, 2. STYLE, 3. HYPANTHIUM

TOSS-UP

20. CHEMISTRY; Short Answer: What is the general term for a neutral compound that is 1,2-dipolar and contains a formally negatively charged [atom](http://en.wikipedia.org/wiki/Atom) (usually a [carbanion](http://en.wikipedia.org/wiki/Carbanion)) directly attached to a hetero atom with a formal positive charge (usually nitrogen, phosphorus or sulfur), and in which both atoms have full octets of electrons?

ANSWER: YLIDE

BONUS

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

1. What reaction is occurring here?

2. Name compound A.

3. If a simple ylide is used in this reaction, what isomer of alkane is almost exclusively produced?

ANSWER: 1. WITTIG REACTION; 2. TTRIPHENYLPHOSPHINE OXIDE; 3. Z

TOSS-UP

21. PHYSICS; Short Answer: What type of semiconductor diode, developed by Sony in 1957, has a heavily doped p-n junction and is capable of very fast operation, well into the microwave frequency region by using quantum mechanical effects?

ANSWER: TUNNEL DIODE or ESAKI DIODE

BONUS

21. PHYSICS; Short Answer: When tunnel diodes are used in the reverse direction they can act as fast rectifiers with zero offset voltage and extreme linearity for power signals. What is the term for a tunnel diode used in reverse?

ANSWER: BACK DIODE

TOSS-UP

22. ERSCI/SPSCI; Short Answer: Name all of the following four choices that are true of pulsars.

I. Their regularity of pulsation can be as accurate as an atomic clock.

II. An acceptable range of their observed periods is 9 to 15 seconds.

III. They exhibit the lighthouse effect.

IV. Magnetars are a class of pulsars.

ANSWER: I, III, IV

BONUS

22. ERSCI/SPSCI; Short Answer: Visual, three questions.

1. What is the name of this pulsar, which was discovered in 1968 and provided direct observational proof that supernovae form neutron stars?

2. What is the alternative term for a pulsar wind nebula?

3. What two types of electromagnetic radiation does this pulsar emit?

ANSWER: VELA PULSAR, PLERION, X-RAY AND GAMMA RAY

TOSS-UP

23. MATH; Short Answer: Given that a, b, and c are the sides of a triangle, and R is the circumradius of the triangle, give the formula for the area of a triangle in these terms.

ANSWER: A = abc / 4R

BONUS

23. MATH; Short Answer: Find x.

ANSWER: 20

TOSS-UP

24. ENERGY; Short Answer: What acid is used in nuclear plants as a neutron poison to slow the rate of fission, and is being proposed for use to cool the nuclear plants that have been damaged as a result of the 2011 Japan earthquake?

ANSWER: BORIC ACID

BONUS

24. ENERGY; Short Answer: Boric acid can be used as a neutron poison only in what type of nuclear reactor? This reactor was also found in the Three Mile Island reactor complex.

ANSWER: Pressurized water reactor

TOSS-UP

25. BIOLOGY; Short Answer: Regardless of whether their recombination frequency is altered or not, two genes are said to be what when they are located on the same chromosome?

ANSWER: SYNTENIC

BONUS

25. BIOLOGY; Short Answer: Given that the genes for eye type and wing type are syntenic, calculate their map distance, in centimorgans, using the information in the image.

ANSWER: 28 cM