TOSS-UP

1. BIOLOGY; Short Answer: What plant hormone is responsible for the triple response, which consists of a shortening of the stem, a thickening of the stem, and bent growth of the stem?

ANSWER: ETHYLENE (GAS)

BONUS

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

1. Name structure A.

2. Members of the Poaceae family, such as wheat, have a specialized structure B called what?

3. Is this seedling undergoing epigeal or hypogeal germination?

ANSWER: 1. Epicotyl; 2. Scutellum; 3. Epigeal

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: An automobile with a mass of 3000 kg is traveling down

a straight flat road at a constant speed of 20 *mls.* The coefficient of friction between the tires and the road is 0.5. The net force acting on the automobile is:

W. O N

X. 30.000 N

Y. 60,000 N

Z. 90,000 N

ANSWER: W

BONUS

3. PHYSICS; Short Answer: A block of mass m1 slides across a frictionless surface with speed v1 and collides with a stationary block of mass

m2. The blocks stick together after the collision and move

away with a speed v2 Which of the following statements

is (are) true about the blocks?

I. m1v1= (m1 + m2)v2

II. (1/2)m1v1^2 = (1/2)(m1 + m2)v2^2

III. v1 = v2

ANSWER: I only

TOSS-UP

4. EARTH SCIENCE; Short Answer: What type of crystal 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; Short Answer: What distribution possesses the maximum entropy within the continuous distribution family, is the most prominent distribution in statistics, and is also known as the Gaussian distribution?

ANSWER: NORMAL DISTRIBUTION

BONUS

5. MATH; Short Answer:

1. Match the letters with the graphs by color.

2. What color graph represents the standard normal distribution?

3. What theorem states that under mild conditions the sum of a large number of random variables is distributed approximately normally?

ANSWER: 1. A blue, B red, C yellow, D green; 2. Red; 3. Central limit theorem

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: Blastocyst is to mammal as blastoderm is to

(W) bird

(X) amphibian

(Y) fish

(Z) echinoderm

ANSWER: W

BONUS

7. BIOLOGY; Short Answer: Use the image of a human egg cell to answer the following three questions.

1. Name region A, where the sperm cell binds and undergoes the acrosomal reaction.

2. Name region B, into which cortical granules are released in the slow block to polyspermy.

3. The cells of the corona radiata come from what ovarian structure?

ANSWER: 1. Zona Pellucida, 2. Perivitelline Space, 3. Follicle.

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 phenomenon in quantum chromodynamics explains why free quarks cannot be found and states that the force between quarks does not diminish as they are separated from each other?

ANSWER: CONFINEMENT

BONUS

1. PHYSICS; Short Answer:

1. What is the name of this type of diagram, which is a special type of Feynman diagram?

2. What is measured along the x and y axes respectively?

3. What term describes the phenomenon whereby quarks and gluons interact very weakly in very high-energy reactions?

ANSWER: 1. PENGUIN DIAGRAM; 2. SPACE, TIME; 3. ASYMPTOTIC FREEDOM

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: Give the Maclaurin series for f(x) = x^3 + 7x^2 – 19x

ANSWER: x^3 + 7x^2 – 19x

BONUS

11. MATH; Short Answer:

1. Give the remainder in Lagrange form.

2. The Lagrange form shows that Taylor’s theorem is a generalization of what other theorem in calculus?

3. What form of the remainder shows Taylor’s theorem to be a generalization of the fundamental theorem of calculus?

ANSWER: 1. 
  R_n(x) = \frac{f^{(n+1)}(\xi)}{(n+1)!} (x-a)^{n+1}.
 ; 2. Mean value theorem; 3. Integral form

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:

1. What is another term for the fallopian tube?

2. The section of the fallopian tube nearest the ovary is termed what?

3. The fingerlike projections at the ends of the fallopian tubes nearest the ovaries are termed what?

ANSWER: 1. Oviduct, 2. Infundibulum, 2. Fimbriae

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; Short Answer: Also known as streamline flow, what type of flow occurs when a fluid flows in parallel layers with no disruption between the layers?

ANSWER: LAMINAR FLOW

BONUS

15. PHYSICS; Multiple Choice: Which of the following is not true of the Reynolds number?

W. It is a dimensionless quantity

X. It is the ratio of drag to viscous force

Y. As the density of a fluid increases, its Reynolds number increases

Z. As the kinematic viscosity of a fluid increases, its Reynolds number increases

ANSWER: Z

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: What is the only type of triangle in which the medians bisect the vertex angles from which they are drawn?

ANSWER: Iscoceles

BONUS

17. MATH; Short Answer: The point where a triangle’s medians intersect is known as what?

ANSWER: Centroid

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: Which of the following is not true of ELISA, or the enzyme-linked immunosorbent assay?

(W) It is useful for determining serum antibody concentrations.

(X) Three sets of antibodies are used.

(Y) Bovine serum albumin is often used in the procedure.

(Z) It can be used as a screening test for the presence of drugs in the blood.

ANSWER: X

BONUS

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

1. What procedure is being performed in this image?

2. Nylon is one membrane that can be used in this procedure. Name the other common membrane substance.

3. What chemical substance is infused within the agarose gel to prevent the RNA from developing a secondary structure?

ANSWER: 1. Northern blotting, 2. Nitrocellulose, 3. Formaldehyde

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; Multiple Choice: A charged particle moves horizontally through a magnetic field which points directly upward. The force on the particle due to the magnetic field is:

W. perpendicular to the magnetic field and parallel to

the velocity of the particle.

X. parallel to the magnetic field and perpendicular to

the velocity of the particle.

Y. parallel to the magnetic field and parallel to the velocity

of the particle.

Z. perpendicular to the magnetic field and perpendicular

to the velocity of the particle.

ANSWER: Z

BONUS

21. PHYSICS; Multiple Choice: Two particles are held in equilibrium by the gravitational and electrostatic forces between them. Particle A has mass ma and charge qa. Particle B has mass mb and charge qb. The distance between the charges is d. Which of the following changes will cause the charges to accelerate towards one another?

W. ma is doubled and mb is doubled.

X. ma is doubled and mb is halved.

Y. qa is doubled and qb is doubled.

Z. d is doubled.

ANSWER: W

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: Also known as the embryoblast, what part of the mammalian blastocyst is located within the blastocoels and is completely surrounded by the trophoblast?

ANSWER: INNER CELL MASS

BONUS

25. BIOLOGY; Short Answer:

1. What stage is this embryo in?

2. What region near the dorsal lip is induced by the Nieuwkoop center and forms the embryo’s dorsal/ventral axis?

3. Name all of the following animals that this embryo could be: frog, mollusk, sea daisy, rotifer, cicada.

ANSWER: 1. Gastrula; 2. Spemann organizer; 3. Frog, sea daisy