Round 10

TOSSUP

1) MATH *Short Answer* Felix is a dice-rolling genius. He rolls a 5 on a dice with probability 3/7. What is the expected number of rolls it takes to roll 6 5s?

ANSWER: 14

BONUS

2) MATH *Short Answer* What is the probability that there is a 1 in one of the digits of a two-digit number?

ANSWER: 0.8

TOSSUP

2) EARTH AND SPACE *Short Answer* What is the location where an earthquake begins known as?

ANSWER: FOCUS OR HYPOCENTER

BONUS

2) EARTH AND SPACE *Short Answer* What type of igneous rock texture has a fine grained texture around a coarse-grained texture due to crystallization in the magma chamber and eruption into the atmosphere mid-crystallization?

ANSWER: PORPHYRY OR PORPHYRITIC

TOSSUP

3) CHEMISTRY *Multiple Choice* Which of the following species is the conjugate acid of ammonia, NH3?

W) N2
X) H2
Y) NH2–
Z) NH4+

ANSWER: Z) NH4+

BONUS

3) CHEMISTRY *Short Answer* Identify by name or number, all of the following three compounds that have "boat" and "chair" configurations? 1) Glucose 2) Water 3) Cyclohexane 4) Toluene

ANSWER: 1 AND 3 (GLUCOSE AND CYCLOHEXANE)

TOSSUP

4) PHYSICS *Multiple Choice* The distribution of the charge density on the surface of a conducting solid depends upon which of the following properties of the conductor?

W) the density
X) the shape
Y) the size
Z) the age

ANSWER: X) THE SHAPE

BONUS

4) PHYSICS *Short Answer* A roll of gold toilet paper is suspended from a wall by a frictionless axle. Someone pulls on the roll and lets go. Which of the following will happen next?

W) the paper will unroll at a constant speed
X) the paper will unroll at a decreasing speed
Y) the paper will unroll at an increasing speed
Z) the paper will immediately stop unrolling

ANSWER: Y) THE PAPER WILL UNROLL AT AN INCREASING SPEED

TOSSUP

5) EARTH AND SPACE *Short Answer* What mining method uses water to excavate, transport, concentrate, and recover heavy minerals from alluvial deposits?

ANSWER: PLACER (MINING)

BONUS

5) EARTH AND SPACE *Short Answer* Milankovitch cycles are caused by variations in which of the following? 1) Precession 2) Obliquity 3) Seasons 4) Eccentricity 5) Sunspots

ANSWER: 1,2,4

TOSSUP

6) BIOLOGY *Multiple Choice* Select all of the following four hormones that are secreted by the duodenum when chyme arrives from the stomach:

1. Gastrin
2. Secretin
3. Leptin
4. Cholecystokinin

ANSWER: 2 and 4

BONUS

6) BIOLOGY *Short Answer* What branch of the peripheral nervous system exerts control on the digestive system independently of the central nervous system?

ANSWER: ENTERIC NERVOUS SYSTEM

TOSSUP

7) CHEMISTRY *Multiple Choice* Which of the following occurs when an electron in a hydrogen atom changes from an excited energy state to a more stable energy state?

W) electromagnetic radiation is emitted by the atom
X) electromagnetic radiation is absorbed by the atom
Y) the atom becomes a positively charged ion
Z) the atom becomes a negatively charged ion

ANSWER: W) ELECTROMAGNETIC RADIATION IS EMITTED BY THE ATOM

BONUS

7) CHEMISTRY *Short Answer* What are the coefficients of each compound in the combustion of 1 mole of hexane. Name each compound, not its chemical formula, and its coefficient and use fractions, if needed.

ANSWER: HEXANE - 1, OXYGEN - 19/2, CARBON DIOXIDE - 6, WATER - 7 (ACCEPT IN ANY ORDER)

TOSSUP

8) ENERGY *Short Answer* Scientists at Berkeley's Water Energy Resilience Research Institute have been researching how to increase the recharge rate of aquifers. What aquifer, the largest in the US, may be of special concern to the researchers.

ANSWER: OGALLALA AQUIFER

BONUS

8) ENERGY *Multiple Choice* Scientists at Berkeley's Water Energy Resilience Research Institute have created a solar umbrella to increase the wavelength of sunlight before it interacts with evaporation ponds. Which of the following is most likely an application of this technology?

W) Prevent dangerous secondary waste products from being formed by UV radiation
X) Increase the rate of evaporation in the ponds to reduce waste to a solid state
Y) Promote growth of pond organism in the pond that will process waste products
Z) Inhibits evaporation in the ponds that might introduce waste products into the atmosphere.

ANSWER: X) INCREASE THE RATE OF EVAPORATION IN THE PONDS TO REDUCE WASTE TO A SOLID STATE

TOSSUP

9) BIOLOGY *Multiple Choice* You observe a winter twig and notice that it has several scars that are spaced along its length. You correctly identify these as bud scars, which consists of whorls of scales that enclose the apical bud for part of the year. If the twig has 6 such bud scars, how many years did it take for the twig to grow to its current size?

ANSWER: 7

BONUS

9) BIOLOGY *Multiple Choice* Based on the mitochondrial genome, which of the following free living organisms is most closely related to mitochondria?

W) Cyanobacteria
X) Alphaproteobacteria
Y) Neisseria
Z) Bartonella

ANSWER: X) ALPHAPROTEOBACTERIA

TOSSUP

10) EARTH AND SPACE *Multiple Choice* This soil horizon contains organic components such as [HUE-mus] humus and detritus at different stages of decomposition.

W) A Horizon

X) E Horizon
Y) I Horizon
Z) O Horizon

ANSWER: Z) O HORIZON

BONUS

10) EARTH AND SPACE *Short Answer* What class of neutron stars have extremely powerful magnetic fields?

ANSWER: MAGNETAR

TOSSUP

11) CHEMISTRY *Short Answer* This device was also known as an “electron gun.” It was used by J.J. Thompson in its namesake experiment. Name this high-vacuum tube which produces a luminous image on a fluorescent screen, and also used in television.

ANSWER: CATHODE RAY TUBE

BONUS

11) CHEMISTRY *Multiple Choice* The transformation of shiny metallic beta tin to its less dense allotropic form known as grey tin or alpha tin, can be known as which of the following?

W) Tin transmutation
X) Tin pest
Y) Gray's disease
Z) Tinnification

ANSWER: X) TIN PEST

TOSSUP

12) PHYSICS *Multiple Choice* Two long current carrying conductors are placed in parallel 2 inches apart. If a DC current flows in the same direction through each conductor, which of the following is true?

W) The conductors attract each other
X) The conductors repel each other
Y) No force exerts on both conductors
Z) None of the above

ANSWER: W) THE CONDUCTORS ATTRACT EACH OTHER

BONUS

12) PHYSICS *Multiple Choice* A team of skydivers jumps from a plane and holds hands to form a flower-like design. As the skydivers begin their free fall which of the following, if any, will happen next?

1) Acceleration decreases
2) Velocity increases
3) Acceleration remains constant

ANSWER: 1) and 2)

TOSSUP

13) ENERGY *Multiple Choice* Scientists at Los Alamos National Lab created the ChemCam which detects the composition of rocks on Mars by shining an infrared laser on them to create plasma and then observing the emitted colors. If the ChemCam observed a lilac colored pasma, which of the following elements is most likely a component of the rock?

W) Sodium
X) Lithium
Y) Potassium
Z) Strontium

ANSWER: Y) POTASSIUM

BONUS

13) ENERGY *Multiple Choice* Researchers at Los Alamos National Lab have created a new type of solar panel by depositing a fluorescent layer on top of glass panels. The fluorescent layer contains quantum dots. Which of the following best describes the role of quantum dots in these solar panels?

W) Converting sunlight directly into usable electricity
X) Convert sunlight into shorter wavelengths of light with higher energy
Y) Redirect sunlight to the edge of the window to be captured by photovoltaic cells
Z) Convert sunlight into longer wavelengths that are trapped in the glass

ANSWER: Z) CONVERT SUNLIGHT INTO LONGER WAVELENGTHS THAT ARE TRAPPED IN THE GLASS

TOSSUP

14) MATH *Short Answer* What is the derivative of (sinx)/x?

ANSWER: (COSX)/X - (SINX)/X^2

BONUS

14) MATH *Short Answer* Find values of x that satisfy the equation $4^x - 5(2^x) + 4 = 0$.

ANSWER: 0 AND 2 (ACCEPT IN ANY ORDER)

TOSSUP

15) PHYSICS *Multiple Choice* A disk is rotating counterclockwise on a table. What is the direction of its angular momentum?

W) Pointing straight down from the surface of the disk
X) Pointing straight up from the surface of the disk
Y) Pointing parallel with the surface of the table
Z) No direction

ANSWER: X) POINTING STRAIGHT UP FROM THE SURFACE OF THE DISK

BONUS

15) PHYSICS *Multiple Choice* A charged particle moving through a magnetic field will experience the largest force when

W) moving with the field.
X) moving against the field.
Y) moving at a 45° angle to the field.
Z) moving at a 90° angle to the field.

ANSWER: Z) MOVING AT A 90° ANGLE TO THE FIELD.

TOSSUP

16) CHEMISTRY *Short Answer* What roughly spherical aggregate with a hydrophobic core and a hydrophilic surface is formed by surfactant molecules in water, leading to the formation of a colloidal suspension?

ANSWER: MICELLE

BONUS

16) CHEMISTRY *Short Answer* What quantity is in the numerator of the exponent in the Arrhenius equation?

ANSWER: ACTIVATION ENERGY (ACCEPT: E_A)

TOSSUP

17) BIOLOGY *Multiple Choice* Members of which of the following fungal phyla form mycorrhizae with land plants?

W) Glomeromycota
X) Basidiomycota
Y) Chytridiomycota
Z) Zygomycota

ANSWER: W) GLOMEROMYCOTA

BONUS

17) BIOLOGY *Short Answer* In plant anatomy, what is the band of cell wall material composed of suberin and lignin that is responsible for preventing water from entering the pericycle except through the cytoplasm of endodermal cells?

ANSWER: CASPARIAN STRIP

TOSSUP

18) MATH *Short Answer* Goldbach's Conjecture states that any even number greater than two can be written as the sum of two numbers with what property?

ANSWER: PRIME

BONUS

18) MATH *Multiple Choice* The polar equation, r = 3sin(3t), (read: r equals 3 times the sine of angle 3t) represents which of the following graphs?

W) cardioid
X) three-leaved rose
Y) Archimedian-spiral
Z) limacon

ANSWER: X) THREE-LEAVED ROSE

TOSSUP

19) ENERGY *Short Answer* Researchers at Pacific Northwest National Lab have discovered that atmospheric dust can promote the melting of snow on the tops of mountains such as the Himalayas by absorbing sunlight. What is this property called, which describes how much incident light is reflected or absorbed and is very high for ice and snow?

ANSWER: ALBEDO

BONUS

19) ENERGY *Short Answer* Researchers at Pacific Northwest National Lab are studying catalytic bias in enzyme reactions by investigating the protein environment around the catalytic core of [FeFe] hydrogenase. What specific class of enzyme is [FeFe] hydrogenase?

ANSWER: REDOX (CATALYST) OR OXIDOREDUCTASE

TOSSUP

20) BIOLOGY *Multiple Choice* Which of the following laboratory techniques would be used to identify a DNA binding protein by its ability to bind to an artificially designed oligonucleotide probe?

W) Northern Blotting
X) Far Eastern Blotting
Y) Western Blotting
Z) Southwestern Blotting

ANSWER: Z) SOUTHWESTERN BLOTTING

BONUS

20) BIOLOGY *Short Answer* What chemical is one of the most widely used fluorescent dyes used in laboratories for visualizing DNA during gel electrophoreses?

ANSWER: ETHIDIUM BROMIDE

TOSSUP

21) PHYSICS *Multiple Choice* Which of the following statements is not true regarding waves?

W) Destructive interference creates nodes.
X) Diffraction occurs when a wave bends around an obstacle.
Y) Total internal reflection occurs when light moves from a lighter optical medium to a denser one.

Z) Total internal reflection occurs when light moves from a denser optical medium to a lighter one.

ANSWER: Y) TOTAL INTERNAL REFLECTION OCCURS WHEN LIGHT MOVES FROM A LIGHTER OPTICAL MEDIUM TO A DENSER ONE.

BONUS

21) PHYSICS *Short Answer* A beat frequency of 5 Hertz is detected and the frequency of one of the sound sources is 15 Hertz. What are possible value(s) of the wavelength of the second sound source, in meters, assuming that the speed of sound is 340 meters per second?

ANSWER: 17 and 34 METERS

TOSSUP

22) MATH *Multiple Choice* Which of the following is true about the function f(x) = cos(x).

W) Its third derivative is -sin(x)
X) The fourth term in its Taylor series expansion is -x^6/6!
Y) cos(pi/2+x) = -cos(x)
Z) Its symmetrical about the y-axis

ANSWER: X) THE FOURTH TERM IN ITS TAYLOR SERIES EXPANSION IS -x^6/6!

BONUS

22) MATH *Short Answer* In triangle ABC, if (a+b+c)(a-b+c) = 3ac, find angle B.

ANSWER: PI/3 RADIANS OR 60 DEGREES

TOSSUP

23) EARTH AND SPACE *Multiple Choice* Which of the following is not a formation at a convergent plate boundary?

W) Andes mountains
X) Marianas trench
Y) The Alps
Z) Mid-Atlantic ridge

ANSWER: Z) MID-ATLANTIC RIDGE

BONUS

23) EARTH AND SPACE *Short Answer* The Andes mountain is created by convergence of two plates. Name each plate and its type.

ANSWER: SOUTH AMERICAN - CONTINENTAL AND NAZCA - OCEANIC (ACCEPT IN ANY ORDER)