

CSBL ROUND 9

TOSS-UP

1) BIO– *Multiple Choice* Which of the following is not true regarding cyclic AMP?

- W) In eukaryotes, it functions by activating PKA, or protein kinase A
- X) It is a secondary messenger in phototransduction in the eye
- Y) In bacteria, it is abundant when glucose is scarce
- Z) It is produced from ATP by the enzyme adenylate cyclase

ANSWER: X) IT IS A SECONDARY MESSENGER IN PHOTOTRANSDUCTION IN THE EYE

BONUS

1) BIO– *Short Answer* In human development, what secondary vesicle gives rise to the cerebral cortex, making up part of the forebrain?

ANSWER: Telencephalon (DO NOT ACCEPT: Prosencephalon)

TOSS-UP

2) CHEM– *Multiple Choice* Which of the following factors would not contribute to the coordination number of a complex?

- W) The radius of the central atom or ion
- X) The steric interactions between the ligands
- Y) The number of uncoordinated molecules
- Z) Electronic interactions between the central atom or ion and the ligands

ANSWER: Y) THE NUMBER OF UNCOORDINATED MOLECULES

BONUS

2) CHEM– *Short Answer* How many hydrogen atoms are in the compound 5,5-dimethylcyclohexa-1,3-dione?

ANSWER: 12

TOSS-UP

3) PHYS– *Multiple Choice* Which of the following optical terms is defined as a medium in which the refractive index for light is a function of its frequency?

- W) Dispersive
- X) Refractive

- Y) Reflective
- Z) Opaque

ANSWER: W) DISPERSIVE

BONUS

3) PHYS– *Multiple Choice* Kaons are distinguished from pions by which of the following quantities?

- W) Spin
- X) Strangeness
- Y) Baryon number
- Z) Number of quarks

ANSWER: X) STRANGENESS

TOSS-UP

4) MATH– *Short Answer* What is the radius of the circle with equation $x^2 - 2x + y^2 + 6y - 39 = 0$?

ANSWER: 7

BONUS

4) MATH– *Short Answer* An ice cream cone is a hollow cone with height 7 inches and radius 3 inches. It is then filled with ice cream. The entire hollow cone is filled with ice cream, and there is a perfect hemisphere of ice cream on top with the same radius as the cone. Give the volume of ice cream in cubic inches to two significant figures.

ANSWER: 120

TOSS-UP

5) ESS– *Short Answer* What ordering of minerals sorts minerals by the temperature at which they crystallize?

ANSWER: BOWEN'S REACTION SERIES

BONUS

5) ESS– *Short Answer* List the following four periods of geologic time in chronological order:
1) Silurian; 2) Devonian; 3) Carboniferous; 4) Ordovician

ANSWER: ORDOVICIAN; SILURIAN; DEVONIAN; CARBONIFEROUS

TOSS-UP

6) ENERGY– *Short Answer* Scientists at SLAC National Accelerator Laboratory have discovered the role played by sulfur in the ocean's carbon cycle. In a process known as cryptic sulfur cycling, bacteria use sulfur in place of oxygen to eat the corpses of what autotrophic class of organisms that play an essential part in the carbon cycle and form the foundation of marine food chains?

ANSWER: PHYTOPLANKTON (DO NOT ACCEPT: PLANKTON)

BONUS

6) ENERGY– *Multiple Choice* Scientists at SLAC National Accelerator Laboratory have glimpsed polarons in next-generation perovskite materials. Perovskite materials have the same structure as their namesake mineral perovskite, an oxide mineral with what chemical formula?

- W) Zr_2O_3
- X) $\text{Mg}(\text{OH})_2$
- Y) CaTiO_3
- Z) MgAl_2O_4

ANSWER: Y) CaTiO_3

TOSS-UP

7) BIO– *Short Answer* Charophytes, believed to be closely related to plants, possess what durable polymer within the walls of their spores, which prevents zygotes from drying out and other environmental stresses.

ANSWER: Sporopollenin

BONUS

7) BIO– *Short Answer* Identify all of the following plant groups that lack seeds: (1) Ginkgophyta, (2) Lycopphyta, (3) Gnetophyta, (4) Anthocerophyta.

ANSWER: 2 and 4

TOSS-UP

8) CHEM– *Short Answer* In electrolysis, what term is given to the difference between a cell's thermodynamically favorable hypothetical potential and its experimentally required potential?

ANSWER: OVERPOTENTIAL

BONUS

8) CHEM– *Short Answer* What is the term for the electrochemical technique that uses a varying potential with a periodic waveform and evaluates the following current in order to study the properties of an analyte?

ANSWER: CYCLIC VOLTAMMETRY

TOSS-UP

9) PHYS– *Short Answer* Gauss's law of magnetism forbids what hypothetical structure analogous to a single electric charge?

ANSWER: MAGNETIC MONOPOLE

BONUS

9) PHYS– *Short Answer* A rectangular slab with dimensions 8 x 6 x 1 is rotated with an angular velocity of 1 radian per second around a pole driven through its center parallel to its short axis. What is the linear velocity of one of its corners in standard SI units?

ANSWER: 5 METERS PER SECOND

TOSS-UP

10) MATH– *Multiple Choice* What is the minimum possible value of $3^x + 3^y$ if $x + y = 2$?

- W) 3
- X) 6
- Y) 9
- Z) 18

ANSWER: X) 6

BONUS

10) MATH– *Short Answer* An alternate universe has 5 dimensions. If an object travels 2 meters in every dimension, what is the magnitude of its displacement? Express your answer in simplest radical form.

ANSWER: $2\sqrt{5}$

TOSS-UP

11) ESS– *Multiple Choice* The environmental lapse rate is the rate of temperature decrease in what layer of the atmosphere?

- W) Thermosphere
- X) Mesosphere
- Y) Stratosphere
- Z) Troposphere

ANSWER: Z) TROPOSPHERE

BONUS

11) ESS– *Multiple Choice* Which of the following is true about magma?

- W) The loss of dissolved gases makes magma less viscous
- X) Basaltic magma typically contains more dissolved gases than rhyolitic magma
- Y) Hotter lava is more viscous
- Z) A magma's viscosity is directly related to its silica content

ANSWER: Z) A MAGMA'S VISCOSITY IS DIRECTLY RELATED TO ITS SILICA CONTENT

TOSS-UP

12) ENERGY– *Short Answer* Scientists at Brookhaven National Lab have used the LHC to create W bosons from photon collisions. This process is described by what branch of quantum theory, which combines Maxwell's equations, special relativity and quantum mechanics?

ANSWER: QUANTUM ELECTRODYNAMICS (ACCEPT: QED)

BONUS

12) ENERGY– *Short Answer* Scientists at Brookhaven National Lab have used the LHC to create W bosons from photon collisions. This is experimental proof for the discovery that won Sheldon Glashow, Abdus Salam and Steven Weinberg the 1979 Nobel Prize in physics, that at high energies, what two fundamental forces merge together into one unified force?

ANSWER: ELECTROMAGNETIC AND WEAK NUCLEAR

TOSS-UP

13) BIO– *Multiple Choice* Which of the following amino acids could an amine hormone be derived from?

- W) Histidine
- X) Tyrosine
- Y) Glycine
- Z) None of the above

ANSWER: X) TYROSINE

BONUS

13) BIO– *Short Answer* In viruses, the capsid surrounding the viral genome is made up of what smaller subunits?

ANSWER: CAPSOMERES

TOSS-UP

14) CHEM– *Short Answer* Which of the following is the strongest acid?

- W) Hydrofluoric Acid
- X) Nitrous Acid
- Y) Hydroiodic acid
- Z) Fluoroantimonic acid

ANSWER: Z) FLUOROANTIMONIC ACID

BONUS

14) CHEM– *Short Answer* The equilibrium constant for the addition of oxygen gas to nitrogen monoxide to form nitrogen dioxide at 230 degrees Celsius is 6.44×10^5 . In a container at 230 degrees Celsius, the partial pressure of nitrogen dioxide is 100 atm, the partial pressure of nitrogen monoxide is 1 atm and the partial pressure of oxygen gas is 1 atm. A) Find Q for the reaction in scientific notation to two significant digits; B) Will the reaction shift towards the reactants or the products?

ANSWER: A) 1.0×10^4 ; B) PRODUCTS

TOSS-UP

15) PHYS– *Short Answer* What principle, which can be derived from Huygen's principle and is typically considered the link between ray and wave optics, states that the path that light takes between two points is the path that can be traveled in the least amount of time?

ANSWER: FERMAT'S PRINCIPLE

BONUS

15) PHYS– *Short Answer* A ball is thrown downward off of a 100-meter tall cliff with an initial velocity of -1 meters per second. Assuming g to be 9.8 meters per second and to the first decimal place, how many meters would the ball be from the ground after 3 seconds?

ANSWER: 52.9

TOSS-UP

16) MATH– *Short Answer* What is the sum of the first 8 Fibonacci numbers?

ANSWER: 54

BONUS

16) MATH– *Multiple Choice* Which of the following terms is typically defined as a convex polyhedron composed of regular faces meeting at identical vertices, however the faces do not all have to be the same regular polygon?

- W) Platonic solid
- X) Catalan solid
- Y) Johnson solid
- Z) Archimedean solid

ANSWER: Z) ARCHIMEDEAN SOLID

TOSS-UP

17) ESS– *Multiple Choice* Which of the following terms is defined as the shaking of an earthquake causing loosely packed water-logged materials to act like fluids?

- W) Pseudoplasticity
- X) Thixotropy
- Y) Liquefaction
- Z) Fluidification

ANSWER: Y) LIQUEFACTION

BONUS

17) ESS– *Multiple Choice* Which of the following is closest to the magnitude on the moment magnitude scale of the largest-magnitude earthquake ever recorded?

- W) 8.0
- X) 8.5
- Y) 9.0
- Z) 9.5

ANSWER: Z) 9.5

TOSS-UP

18) ENERGY– *Short Answer* Scientists at Lawrence Livermore National Laboratory have detected for the first time an intermediate step between two solid phases of a transition metal. What type of chart is used to describe the conditions at which thermodynamically stable phases of a substance can exist?

ANSWER: PHASE DIAGRAM

BONUS

18) ENERGY– *Multiple Choice* Scientists at Lawrence Livermore National Laboratory have detected for the first time an intermediate step between two solid phases of what transition metal with five naturally occurring isotopes that, when combined with SiO₄, are commonly used in imitation diamonds?

- W) Zirconium

- X) Hafnium
- Y) Titanium
- Z) Yttrium

ANSWER: W) ZIRCONIUM

TOSS-UP

19) BIO– *Short Answer* Alpha and beta glucose structures differ in the placement of what functional group?

ANSWER: HYDROXYL

BONUS

19) BIO– *Short Answer* Identify all of the following sugars that are classified as aldoses: (1) Galactose, (2) Fructose, (3) Ribose, (4) Ribulose.

ANSWER: 1 and 3

TOSS-UP

20) CHEM– *Short Answer* In the electrolysis of molten sodium chloride, what forms at the cathode?

ANSWER: SODIUM

BONUS

20) CHEM– *Multiple Choice* What is the hybridization of the central iodine atom in iodine pentachloride?

- W) sp⁴
- X) sp³d
- Y) sp³d²
- Z) sp⁴d

ANSWER: Y) SP³D²

TOSS-UP

21) PHYS– *Short Answer* Which of the following statements is not true about the Doppler effect?

- W) It is responsible for astronomical redshift
- X) The equations for sound and light are the same at low speeds
- Y) The equations for sound and light are the same at high speeds

Z) If something emitting sound travels faster than the speed of sound, its sound would sound reversed

ANSWER: Y) THE EQUATIONS FOR SOUND AND LIGHT ARE THE SAME AT HIGH SPEEDS

BONUS

21) PHYS– *Short Answer* What is the observed frequency from a source emitting sound at 300 Hz and moving at 0.5c towards you? Give your answer to two significant figures.

ANSWER: 520

TOSS-UP

22) MATH– *Short Answer* In a lottery game, there are two winning tickets in 50 tickets. If a man buys 15 of those tickets, what is the probability that he wins twice?

ANSWER: 3/35

BONUS

22) MATH– *Short Answer* In a lottery game, there are two winning tickets in 50 tickets. If a man buys 15 of those tickets, what is his average profit if the payoff is \$1 and the price of a ticket is 1 cent, to the nearest cent?

ANSWER: \$0.45

TOSS-UP

23) ESS– *Multiple Choice* Which of the following types of dunes is intermediate between barchan and transverse?

- W) Parabolic
- X) Barchanoid
- Y) Longitudinal
- Z) Semibarchan

ANSWER: X) Barchanoid

BONUS

23) ESS– *Short Answer* The most common cations in seawater are sodium and magnesium, in decreasing order of abundance. What are the two most common cations, in decreasing order of abundance, in water taken from the Dead Sea in Jordan?

ANSWER: MAGNESIUM AND SODIUM