

ROUND 5A

TOSS-UP

1) CHEMISTRY *Multiple Choice* What fundamental constant is obtained when a photon's wavelength is multiplied by its frequency?

- W) The speed of light
- X) Planck's constant
- Y) Avogadro's number
- Z) Boltzmann's constant

ANSWER: W) THE SPEED OF LIGHT

BONUS

1) CHEMISTRY *Short Answer* The following three ions are all isoelectronic with neon: O^{2-} , F^- , Na^+ [**O two minus, F minus, N A plus**]. Rank them in terms of their ionic radii, from smallest to largest.

ANSWER: Na^+ , F^- , O^{2-}

TOSS-UP

2) MATH *Multiple Choice* What theorem guarantees the existence of at least one complex root for any non-constant single-variable polynomial with real coefficients?

- W) Fundamental Theorem of Arithmetic
- X) Fundamental Theorem of Polynomials
- Y) Zero-Factor Theorem
- Z) Fundamental Theorem of Algebra

ANSWER: Z) FUNDAMENTAL THEOREM OF ALGEBRA

BONUS

2) MATH *Short Answer* Consider a bag of five marbles, 3 red and 2 white. You draw marbles from the bag until you draw the last white marble, at which point you stop. What is the probability you stop drawing after the 2nd marble?

ANSWER: 1/10 (ACCEPT: 0.1 or 10%)

TOSS-UP

3) PHYSICS *Short Answer* Identify all of the following three phenomena that could be observed in a radio wave: 1. diffraction, 2. interference, 3. deflection in an electric field.

ANSWER: 1 AND 2 (ACCEPT: DIFFRACTION AND INTERFERENCE)

BONUS

3) PHYSICS *Short Answer* From least to greatest, order the magnitudes of the following three quantities for a wheel on a car that is skidding along the road, if the wheel continues to rotate: 1. Translational kinetic energy, 2. Rotational kinetic energy, 3. Total kinetic energy.

ANSWER: 2, 1, 3 (ACCEPT: ROTATIONAL KINETIC ENERGY, TRANSLATIONAL KINETIC ENERGY, TOTAL KINETIC ENERGY)

TOSS-UP

4) EARTH AND SPACE *Multiple Choice* Conditions for tornadoes are favorable in which of the following mountain ranges?

- W) Atlas
- X) Appalachians
- Y) Alps
- Z) Andes

ANSWER: X) APPALACHIANS

BONUS

4) EARTH AND SPACE *Short Answer* Identify both the general habitat and type of organisms that are represented by the oldest fossils of the Paleozoic [*pay-lee-uh-ZOH-ik*] Era.

ANSWER: MARINE INVERTEBRATES (DO NOT ACCEPT: INVERTEBRATES)

TOSS-UP

5) CHEMISTRY *Short Answer* What is the major product of the Hall-Heroult Process?

ANSWER: ALUMINUM

BONUS

5) CHEMISTRY *Multiple Choice* Which of the following is the best example of determinate error?

- W) Random error
- X) Measurement error
- Y) Systematic error
- Z) Sampling error

ANSWER: Y) SYSTEMATIC ERROR

TOSS-UP

6) BIOLOGY *Multiple Choice* In the human digestive system, nutrient absorption predominantly occurs in which of the following?

- W) Duodenum [*doo-uh-DEE-nuhm*] and jejunum [*ji-JOO-nuhm*]
- X) Stomach and duodenum
- Y) Jejunum and ileum [*IL-ee-uhm*]
- Z) Ileum and cecum [*SEE-kuhm*]

ANSWER: W) DUODENUM AND JEJUNUM

BONUS

6) BIOLOGY *Multiple Choice* If a cell has 8 chromosomes during mitotic prophase, how many chromosomes will it have during metaphase and anaphase?

- W) 16 in metaphase, 8 in anaphase
- X) 8 in metaphase, 8 in anaphase
- Y) 8 in metaphase, 4 in anaphase
- Z) 4 in metaphase, 8 in anaphase

ANSWER: X) 8 IN METAPHASE, 8 IN ANAPHASE

TOSS-UP

7) ENERGY *Multiple Choice* In comparison to a gallon of gasoline, how much energy is contained in a gallon of ethanol?

- W) 70%
- X) 90%
- Y) 110%
- Z) 120%

ANSWER: W) 70%

BONUS

7) ENERGY *Short Answer* What is the secondary voltage, in volts, in a transformer with a primary current of 50 amps, a secondary current of 100 amps, and a 110-volt primary voltage?

ANSWER: 55

TOSS-UP

8) EARTH AND SPACE *Short Answer* The 40-inch telescope at Yerkes [**YUR-keez**] Observatory is the largest in the world of what class of telescope?

ANSWER: REFRACTING

BONUS

8) EARTH AND SPACE *Multiple Choice* 3.6 Billion years ago cyanobacteria [**sy-uh-noh-bak-TEER-ee-uh**] caused the precipitation of calcium carbonate into structures of thin sheets of limestone. What is the name of these limestone sheets?

- W) Stalactites [**stuh-LAK-tyts**]
- X) Stalagmites [**stuh-LAG-myts**]
- Y) Stromatolites [**stroh-MAT-l-uts**]
- Z) Trilobites [**TRY-loh-byts**]

ANSWER: Y) STROMATOLITES

TOSS-UP

9) MATH *Short Answer* While sitting in his car at a train crossing, a driver decided to time how long it took for a 1-mile long train to pass him directly. If it took exactly 75 seconds for the train to pass, at how many miles per hour was the train traveling?

ANSWER: 48

BONUS

9) MATH *Multiple Choice* A fair coin is flipped 4 times. Which of the following events is LEAST likely to occur?

- W) Exactly 2 heads occur
- X) At least 3 heads occur
- Y) No two consecutive flips are the same
- Z) The second and third flips are the same

ANSWER: Y) NO TWO CONSECUTIVE FLIPS ARE THE SAME

TOSS-UP

10) BIOLOGY *Multiple Choice* Which of the following terms is used to describe the movement of leaves and flowers toward the sun?

- W) Thigmomorphogenesis [**THIG-moh-mawr-fuh-JEN-uh-sis**]
- X) Heliotropism [**hee-lee-O-truh-piz-uhm**]
- Y) Nastic movements
- Z) Siesmonastic movements [**sys-moh-NUH-stik**]

ANSWER: X) HELIOTROPISM

BONUS

10) BIOLOGY *Multiple Choice* Which of the following plants belong to the phylum [**FY-luhm**] Pterophyta [**ter-uh-FY-tuh**]?

- W) Ferns and palm trees
- X) Bryophytes and Horsetails [**BRY-uh-fyts**]
- Y) Horsetails and ferns
- Z) Palm trees and ginkgo

ANSWER: Y) HORSETAILS AND FERNS

TOSS-UP

11) CHEMISTRY *Short Answer* What halogen has the greatest effect on a given molecule's lipophilicity?

ANSWER: FLUORINE

BONUS

11) CHEMISTRY *Short Answer* What general group of laboratory techniques is used to separate mixtures and has varieties such as thin-layer, affinity, and ion exchange?

ANSWER: CHROMATOGRAPHY

TOSS-UP

12) Physics *Short Answer* What is the SI [**S⁻¹**] unit of radioactivity that is equivalent to 1 inverse second and is defined as the activity of a quantity of radioactive material in which one nucleus decays every second?

ANSWER: BECQUEREL

BONUS

12) Physics *Multiple Choice* How much work must be done, in joules, on a 15 kilogram mass in order to increase its speed from 7.5 meters per second to 11.5 meters per second?

- W) 120
- X) 450
- Y) 570
- Z) 1100

ANSWER: Y) 570

TOSS-UP

13) EARTH AND SPACE *Multiple Choice* A long narrow bay with an irregular outline, such as Chesapeake Bay, was formed by

- W) Wave action
- X) Stream erosion and later submersion
- Y) Glacier erosion and later submersion
- Z) Faulting

ANSWER: X) STREAM EROSION AND LATER SUBMERSION

BONUS

13) EARTH AND SPACE *Multiple Choice* What two minerals contribute to the Earth's magnetic field?

- W) Iron oxides and magnetite
- X) Calcium chloride and magnetite
- Y) Iron oxides and calcium chloride
- Z) Magnetite and calcium chloride

ANSWER: W) IRON OXIDES AND MAGNETITE

TOSS-UP

14) BIOLOGY *Multiple Choice* Which of the following animals possess two circuits of blood flow, the pulmocutaneous [**POOL-moh-kyoo-tay-NEE-uhs**] and systemic?

- W) Salamanders
- X) Snakes
- Y) Lizards
- Z) Birds

ANSWER: W) SALAMANDERS

BONUS

14) BIOLOGY *Multiple Choice* Photosynthesis requires water as a reactant. In which of the following product molecules do the oxygen atoms from the water end up?

- W) O₂
- X) H₂O
- Y) C₆H₁₂O₆ [**C- six H- twelve O- six**]
- Z) ATP

ANSWER: W) O₂

TOSS-UP

15) Chemistry *Short Answer* Two electrons are located within the same orbital of the same atom. In order to satisfy the Pauli Exclusion Principle, what must the spin magnetic quantum numbers of these two electrons be?

ANSWER: $+\frac{1}{2}$ and $-\frac{1}{2}$

BONUS

15) Chemistry *Short Answer* 3.0 moles of propane are combusted in oxygen. Providing your answer to two significant digits, how many moles of carbon dioxide are formed?

ANSWER: 9.0

TOSS-UP

16) ENERGY *Multiple Choice* As the battery capacity decreases how does the rate of discharge change?

- W) Increases
- X) Decreases
- Y) Stays the same
- Z) Depends on brand

ANSWER: W) INCREASES

BONUS

16) ENERGY *Short Answer* What process in plant cells is primarily responsible for storing energy from ATP and NADPH [**A-T-P** and **N-A-D-P-H**] by synthesizing sugars?

ANSWER: CALVIN CYCLE (ACCEPT: CALVIN-BENSON CYCLE OR LIGHT INDEPENDENT REACTIONS)

TOSS-UP

17) MATH *Short Answer* Differentiate $f(x) = e^{\cos x}$ [f of x equals e to the power of cosine of x] with respect to x .

ANSWER: $-\sin(x)e^{\cos x}$

BONUS

17) MATH *Short Answer* The average of x and y is 5. The average of x and z is 4. Find y in terms of z .

ANSWER: $y = 2 + z$ (ACCEPT: $y = z + 2$)

TOSS-UP

18) BIOLOGY *Multiple Choice* All codon combinations specify a particular amino acid, with the EXCEPTION of which of the following?

- W) Nonsense codons
- X) Missense codons
- Y) Promoters
- Z) Silent codons

ANSWER: W) NONSENSE CODONS

BONUS

18) BIOLOGY *Short Answer* What type of perennials die back each year and survive as tubers until the next growing season?

ANSWER: HERBACEOUS

TOSS-UP

19) PHYSICS *Short Answer* Indicate, by number, all of the following three particles that are considered to be force-carrying particles by the Standard Model: 1) photon; 2) gluon; 3) graviton

ANSWER: 1, 2, AND 3 (ACCEPT: ALL OF THEM)

BONUS

19) PHYSICS *Short Answer* Identify all of the following four particles that can be found in isolation: 1) up quark; 2) electron; 3) neutrino; 4) proton.

ANSWER: 2, 3, AND 4 (ACCEPT: ELECTRON, NEUTRINO, AND PROTON)

TOSS-UP

20) ENERGY *Multiple Choice* Which of the following is a term used to describe the ability to trim electricity usage at specific times of the day?

- W) Demand Response
- X) Energy Efficiency
- Y) Peak Load
- Z) Solar Inverter

ANSWER: W) DEMAND RESPONSE

BONUS

20) ENERGY *Multiple Choice* Which of the following materials would mostly likely be used for a radiant heat barrier?

- W) Asphalt
- X) Glass
- Y) Cement
- Z) Aluminum

ANSWER: Z) ALUMINUM

TOSS-UP

21) MATH *Short Answer* Simplify the following expression: i^{33} [*i to the thirty-third power*].

ANSWER: i

BONUS

21) MATH *Multiple Choice* What is the product of the mean, median, and mode of the following set of data: {1, 1, 2, 3, 5, 8, 13}

- W) 9
- X) 33/7
- Y) 99/7
- Z) 33

Answer: Y) 99/7

TOSS-UP

22) CHEMISTRY *Multiple Choice* Identify the statement that does NOT describe a prostaglandin [*pros-tuh-LAN-din*] lipid function.

- W) Prostaglandins are involved in the inflammatory response process
- X) Prostaglandins play a role in blood clot formation but not clot reduction
- Y) Prostaglandins can induce labor contractions
- Z) Prostaglandins can help to increase kidney blood flow

ANSWER: X) PROSTAGLANDINS PLAY A ROLE IN BLOOD CLOT FORMATION BUT NOT CLOT REDUCTION

BONUS

22) CHEMISTRY *Short Answer* What is the VSEPR [*ves-per*] shape of the xenon [*ZEE-non*] tetrafluoride molecule?

ANSWER: SQUARE PLANAR

TOSS-UP

23) BIOLOGY *Multiple Choice* Which of the following is NOT a major site of lymphoid tissue?

- W) Thymus gland [**THY-muhs**]
- X) Spleen
- Y) Tonsils
- Z) Kidney

ANSWER: Z) KIDNEY

BONUS

23) BIOLOGY *Multiple Choice* Which of the following hormones causes plants to grow toward light?

- W) Cytokinin [**sy-tuh-KY-nin**]
- X) Auxin [**AWK-sin**]
- Y) Gibberellin [**jib-uh-REL-in**]
- Z) Abscisic

ANSWER: X) AUXIN