

ROUND 10A

TOSS-UP

1) Chemistry – *Multiple Choice* Trans fats necessarily contain what functional group?

- W) Ester
- X) Alkene
- Y) Alcohol
- Z) Amine [*ah-MEEN*]

ANSWER: X) ALKENE

BONUS

1) Chemistry – *Multiple Choice* Tollens' test can detect aldehyde [*AL-deh-hide*]-containing compounds. To perform Tollens' test, an organic compound is mixed with a solution of silver ions. Which of the following indicates that the compound of interest contains an aldehyde?

- W) A silver mirror is formed
- X) Insoluble silver oxide precipitates from solution
- Y) The reaction mixture turns yellow
- Z) The aldehyde is reduced to an alcohol

ANSWER: W) A SILVER MIRROR IS FORMED

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### TOSS-UP

2) Biology – *Short Answer* What type of leukocyte [*LOO-koh-site*] is involved in phagocytosis [*fag-oh-sye-TOW-sis*] of antigen-antibody complexes and parasites?

ANSWER: EOSINOPHIL

### BONUS

2) Biology – *Short Answer* Angiotensin [*an-jee-oh-TEN-sin*] acts on the adrenal [*Ah-DREE-nul*] cortex to promote secretion of what hormone?

ANSWER: ALDOSTERONE

### TOSS-UP

3) Earth and Space – *Short Answer* What is the name for the air-lifting process that forces an air mass up and over a mountain or upland, causing the moisture to rain out on the windward slope and leaving a rainshadow effect on the leeward slope?

ANSWER: OROGRAPHIC LIFTING

### BONUS

3) Earth and Space – *Multiple Choice* The Moon always turns the same face toward the Earth, yet small variations in the visibility of its features appear to take place, such that it appears to rock slowly backward and forward. What effect accounts for this observed behavior?

- W) Transient phenomena
- X) Libration
- Y) Moonset
- Z) Earthshine

ANSWER: X) LIBRATION

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TOSS-UP

4) Physics – *Short Answer* For a particle in an infinite square potential well, how many nodes exist in the wavefunction within the well, not including the walls, in the third excited state?

ANSWER: 3

BONUS

4) Physics – *Multiple Choice* The external presence of which of the following would result in the forward bias of a p-n junction?

- W) Electric field directed toward the p region
- X) Electric field directed toward the n region
- Y) Magnetic field directed toward the p region
- Z) Magnetic field directed toward the n region

ANSWER: X) ELECTRIC FIELD DIRECTED TOWARD THE N REGION

TOSS-UP

5) Math – *Short Answer* Find the value of x for which the following vectors are parallel:
 $4\mathbf{i} - 3\mathbf{j}$ and $x\mathbf{i} + 12\mathbf{j}$.

ANSWER: -16

BONUS

5) Math – *Short Answer* Consider a pair of “loaded” six-sided dice. In this case, each die is weighted so that a one is rolled one-third of the time. The other numbers are all still equally likely. What is the probability of rolling a pair of sixes?

ANSWER: 4/225

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**TOSS-UP**

6) Energy – *Short Answer* What US state is responsible for generating the most total net electricity?

ANSWER: TEXAS

**BONUS**

6) Energy – *Short Answer* Vapor extraction, steam-assisted gravity drainage, and cold heavy oil production with sand are all methods of extracting what type of petroleum deposit, found primarily in Alberta, Canada?

ANSWER: OIL SANDS (ALSO ACCEPT: TAR SANDS, BITUMINOUS SANDS)

**TOSS-UP**

7) Chemistry – *Multiple Choice* Consider ice at 0 degrees Celsius that is heated until it becomes water at 80 degrees Celsius. Which of the following statements is TRUE concerning its volume?

- W) It monotonically [*mono-TAWN-ik-lee*] decreases
- X) It decreases until 4 degrees Celsius, then increases
- Y) It increases until 4 degrees Celsius, then remains constant
- Z) It remains constant

ANSWER: X) IT DECREASES UNTIL 4 DEGREES CELSIUS, THEN INCREASES

**BONUS**

7) Chemistry – *Multiple Choice* Which of the following transition metal 2+ ions is most commonly found in a square planar geometry?

- W) Copper
- X) Nickel
- Y) Iron
- Z) Cobalt

ANSWER: X) NICKEL

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TOSS-UP

8) Math – *Short Answer* If f of x equals the cube root of open parenthesis $x - 6$ close parenthesis, what is f inverse of 5?

ANSWER: 131

BONUS

8) Math – *Short Answer* Simplify cosine open parenthesis $x - \pi/4$ close parenthesis + sine open parenthesis $x - \pi/4$ close parenthesis.

ANSWER: $(\sqrt{2})\text{SINE } x$

TOSS-UP

9) Earth and Space – *Short Answer* The leading edge of the bowl of the Big Dipper, from bottom to top, points to what important aid to celestial navigation?

ANSWER: POLARIS (ACCEPT: NORTH STAR)

BONUS

9) Earth and Space – *Multiple Choice* Tombolos are associated with which of the following?

- W) Undersea vents
- X) Islands
- Y) Volcanoes
- Z) Wind patterns

ANSWER: X) ISLANDS

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### TOSS-UP

10) Physics – *Short Answer* Identify all of the following three statements that could be true of a particle undergoing constant acceleration: 1) Zero instantaneous velocity; 2) Quadratic increase in velocity; 3) Quadratic increase in position.

ANSWER: 1 AND 3

### BONUS

10) Physics – *Multiple Choice* Which of the following elements is useful as an isotope label due to the two most common isotopes having 1 to 1 relative abundance?

- W) Hydrogen
- X) Chlorine
- Y) Bromine [**BROH-meen**]
- Z) Iodine

ANSWER: Y) BROMINE

**TOSS-UP**

11) Energy – *Short Answer* What is the name of the process by which biomass is thermally decomposed in the absence of oxygen?

ANSWER: PYROLYSIS

**BONUS**

11) Energy – *Short Answer* What name is used for the semiconductor nanoparticles that are being studied and incorporated into solar cells, LEDs, and color displays?

ANSWER: QUANTUM DOTS



**TOSS-UP**

12) Biology – *Multiple Choice* Which of the following organisms is characterized as a parazoan [*para-ZOH-an*]?

- W) Sponge
- X) Sea cucumber
- Y) Jellyfish
- Z) Tapeworm

ANSWER: W) SPONGE

**BONUS**

12) Biology – *Multiple Choice* Which of the following is an example of simple squamous [*SKWAY-mus*] epithelium [*eh-pih-THEEL-ee-um*]?

- W) Stomach lining
- X) Intestinal lining
- Y) Lung lining
- Z) Skin

ANSWER: Y) LUNG LINING

**TOSS-UP**

13) Math – *Short Answer* What is the partial derivative with respect to  $y$  of the expression  $x^5y^4$ ?

ANSWER:  $4x^5y^3$

**BONUS**

13) Math – *Short Answer* What is the units digit of 8 to the 88<sup>th</sup> power?

ANSWER: 6

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TOSS-UP

14) Physics – *Multiple Choice* Which of the following laws is NOT always true in electrical circuits?

- W) Ohm's Law
- X) Coulomb's Law
- Y) Kirchoff's 1st Law
- Z) Faraday's Law of Induction

ANSWER: W) OHM'S LAW

BONUS

14) Physics – *Short Answer* Three resistors are in parallel and have resistances of X , X , and 200 ohms. The equivalent resistance of the circuit is 75 ohms. What is the value of X , in ohms?

ANSWER: 240

TOSS-UP

15) Chemistry – *Multiple Choice* Which of the following statements is NOT true concerning the hydrogen atom, if only gross structure contributions are accounted for?

- W) 4s orbitals are at a higher energy than 3d orbitals
- X) 4d orbitals are at a higher energy than 3d orbitals
- Y) A 2p to 1s transition is more energetic than a 4p to 2s transition
- Z) The Balmer series includes only transitions to n=2

ANSWER: W) 4s ORBITALS ARE AT A HIGHER ENERGY THAN 3d ORBITALS

BONUS

15) Chemistry – *Short Answer* Identify all of the following three diatomic [*dye-ah-TOM-ik*] compounds that MO theory predicts to be paramagnetic: 1) B₂; 2) C₂; 3) N₂.

ANSWER: 1 (ACCEPT: B₂)

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**TOSS-UP**

16) Earth and Space – *Multiple Choice* Which of the following is closest to the percentage of the ocean area that is represented by continental shelves?

- W) 10
- X) 20
- Y) 30
- Z) 40

ANSWER: W) 10

**BONUS**

16) Earth and Space – *Short Answer* What is the name for the circular ocean currents that pinch off from ocean currents in sections, causing drastic changes in sound velocity at the interface?

ANSWER: EDDIES



### TOSS-UP

17) Biology – *Multiple Choice* Zinc finger motifs are commonly found in proteins that do which of the following?

- W) Hydrolyze [*HIGH-droh-lyze*] sugars
- X) Sequester calcium
- Y) Catalyze polymerization [*pawl-ih-mer-eh-ZAY-shun*]
- Z) Bind to DNA

ANSWER: Z) BIND TO DNA

### BONUS

17) Biology – *Multiple Choice* Which of the following is a correct classification of spectrin proteins?

- W) Transmembrane
- X) Receptor
- Y) Channel
- Z) Cytoskeletal [*SIGH-toh-skeletal*]

ANSWER: Z) CYTOSKELETAL

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TOSS-UP

18) Energy – *Short Answer* DOE scientists at SLAC have previously shown that electrons can be accelerated by riding a wave of plasma. Recently, they showed that what similar particles, products of beta [*BAY-tah*] plus decay, can also be accelerated in the same manner?

ANSWER: POSITRONS (ACCEPT: ANTI-ELECTRON)

BONUS

18) Energy – *Short Answer* Identify all of the following three emissions that are reduced in biodiesel as compared to petroleum diesel: 1) Sulfur; 2) Particulates; 3) Carbon monoxide.

ANSWER: ALL OF THEM

TOSS-UP

19) Earth and Space – *Short Answer* In what constellation can the Crab Nebula be found?

ANSWER: TAURUS

BONUS

19) Earth and Space – *Short Answer* What is the name for a front that is formed when a cold front overtakes a warm front and warm air is separated from the cyclonic center?

ANSWER: OCCLUDED FRONT

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**TOSS-UP**

20) Physics – *Short Answer* A car brakes to a stop over 15 meters, applying a constant force of 800 newtons to the car. In joules, what was the initial kinetic energy of the car?

ANSWER: 12,000

**BONUS**

20) Physics – *Short Answer* A block attached to a spring is experiencing simple harmonic motion with a period of 4.0 seconds. What would the period be, in seconds to two significant figures, if the mass of the block was halved?

ANSWER: 2.8

**TOSS-UP**

21) Chemistry – *Short Answer* Rank the pH of the following three solutions, from lowest to highest: 1) One molar solution of hydrochloric acid; 2) One molar solution of acetic acid; 3) One molar solution of ammonium perchlorate.

ANSWER: 1, 2, 3

**BONUS**

21) Chemistry – *Short Answer* Identify all of the following three molecules that are likely to act as electrophiles in a substitution reaction: 1) Ammonia; 2) Bromide; 3) Methyl bromide.

ANSWER: 3

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TOSS-UP

22) Math – *Short Answer* In base 7, what is $4 + 6$?

ANSWER: ONE-THREE

BONUS

22) Math – *Short Answer* Evaluate the integral from $x = -8$ to 0 of the square root of open parenthesis $64 - x^2$ close parenthesis dx .

ANSWER: 16π

TOSS-UP

23) Biology – *Short Answer* What is the net ATP gain during glycolysis [*glye-KAWL-eh-sis*], per molecule of glucose?

ANSWER: TWO

BONUS

23) Biology – *Short Answer* In a young stem, what is the name for the immature tissues that will specifically develop into xylem and phloem?

ANSWER: PROCAMBIUM