

ROUND 3A

TOSS-UP

1) Physics – *Multiple Choice* Which of the following thermodynamic properties is a path function?

- W) Energy
- X) Enthalpy [*EN-thul-pee*]
- Y) Entropy [*EN-troh-pee*]
- Z) Work

ANSWER: Z) WORK

BONUS

1) Physics – *Short Answer* A particle has a position defined by the equation $x = 3t + 18$. What is the acceleration of the particle at $t = 5$?

ANSWER: ZERO

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### TOSS-UP

2) Biology – *Multiple Choice* What is the most abundant protein in the world?

- W) Hemoglobin
- X) Rubisco
- Y) Collagen
- Z) Actin

ANSWER: X) RUBISCO

### BONUS

2) Biology – *Multiple Choice* Which of the following is a constituent of blood plasma but NOT of blood serum?

- W) Hemoglobin
- X) Fibrinogen [*fye-BRIN-oh-jen*]
- Y) Albumin [*al-BYOO-min*]
- Z) Urea

ANSWER: X) FIBRINOGEN

**TOSS-UP**

3) Energy – *Multiple Choice* Into which of the following products is the largest percentage of a barrel of oil refined?

- W) Gasoline
- X) Heating oil
- Y) Jet fuel
- Z) Diesel

ANSWER: W) GASOLINE

**BONUS**

3) Energy – *Multiple Choice* In the U.S., which of the following sectors uses the most biomass energy per year?

- W) Industrial
- X) Transportation
- Y) Commercial
- Z) Residential

ANSWER: W) INDUSTRIAL

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TOSS-UP

4) Earth and Space – *Multiple Choice* Which of the following earthquake waves travels the slowest?

- W) Body
- X) Primary
- Y) Secondary
- Z) Rayleigh

ANSWER: Z) RAYLEIGH

BONUS

4) Earth and Space – *Short Answer* What is the largest shield volcano in our Solar System?

ANSWER: OLYMPUS MONS

TOSS-UP

5) Chemistry – *Multiple Choice* Which of the following molecules is nonpolar?

- W) Acetone
- X) Carbon tetrachloride
- Y) Sulfur dioxide
- Z) Iodine chloride

ANSWER: X) CARBON TETRACHLORIDE

BONUS

5) Chemistry – *Multiple Choice* Which of the following describes the phenomenon of light emission by fireflies?

- W) Absorption
- X) Chemiluminescence [*kem-ee-loo-min-ESS-ense*]
- Y) Fluorescence
- Z) Incandescence

ANSWER: X) CHEMILUMINESCENCE

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### TOSS-UP

6) Math – *Short Answer* Giving your answer as a decimal, increasing a number by 250% is equivalent to multiplying it by what?

ANSWER: 3.5

### BONUS

6) Math – *Short Answer* A rhombus has a diagonal of length 14 and a perimeter of 48. What is the length of the other diagonal?

ANSWER:  $2\sqrt{95}$

**TOSS-UP**

7) Earth and Space – *Multiple Choice* What type of mineral composes the green sand beaches that are found in the state of Hawaii?

- W) Malachite
- X) Augite
- Y) Jade
- Z) Olivine

ANSWER: Z) OLIVINE

**BONUS**

7) Earth and Space – *Short Answer* A star has a parallax of 0.4 arcseconds. To the nearest whole light year, how far away is the star?

ANSWER: 8

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TOSS-UP

8) Physics – *Short Answer* The electric force on a point charge as a result of another charge is given as M. If the distance between the two particles is halved, what is the new force on the point charge?

ANSWER: 4M

BONUS

8) Physics – *Multiple Choice* Which of the following is closest to the amount of energy, in joules [*joules*], carried by a mole of photons with a wavelength of one micrometer?

- W) 12,000
- X) 24,000
- Y) 120,000
- Z) 240,000

ANSWER: Y) 120,000

TOSS-UP

9) Energy – *Multiple Choice* Most lignite mined in the United States comes from what state?

- W) California
- X) Wisconsin
- Y) Texas
- Z) Pennsylvania

ANSWER: Y) TEXAS

BONUS

9) Energy – *Multiple Choice* Biodiesel contains less sulfur than petroleum-based diesel. When compared to petroleum-based diesel, which of the following is true about biodiesel due to the lower amount of sulfur?

- W) It produces more pollutants
- X) It is a better lubricant
- Y) It is a worse lubricant
- Z) It has a lower flashpoint

ANSWER: X) IT IS A BETTER LUBRICANT

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**TOSS-UP**

10) Math – *Short Answer* What is the distance between the points  $(-1, 2)$  and  $(-10, 9)$ ?

ANSWER:  $\sqrt{130}$

**BONUS**

10) Math – *Short Answer* Identify all of the following 3 numbers that are evenly divisible by eight:  
1) 3,247,456; 2) 4,693,532; 3) 789,152.

ANSWER: 1 and 3 (ACCEPT: ALL BUT 2)

**TOSS-UP**

11) Chemistry – *Short Answer* Identify all of the following three types of chemical bonds that can be formed by two atomic p-orbitals: 1) Sigma bond; 2) Pi [*pie*] bond; 3) Delta bond.

ANSWER: 1 AND 2 (ACCEPT: SIGMA AND PI BONDS)

**BONUS**

11) Chemistry – *Short Answer* Identify the central atom hybridization states of the following three molecules:  
1) Phosphorous trichloride; 2) Iodine pentafluoride; 3) Formaldehyde.

ANSWER: 1) sp<sup>3</sup>; 2) d<sup>2</sup>sp<sup>3</sup> (ACCEPT: sp<sup>3</sup>d<sup>2</sup>); 3) sp<sup>2</sup>

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TOSS-UP

12) Biology – *Multiple Choice* Which of the following statements is true of root hairs?

W) They increase the surface area of the root for absorption of water

X) They are located in each stomate on the root

Y) They are found on both stems and roots

Z) They are involved in mechanical stabilization of the plant

ANSWER: W) THEY INCREASE THE SURFACE AREA OF THE ROOT FOR ABSORPTION OF WATER

BONUS

12) Biology – *Short Answer* To what phylum [*FYE-lum*] do snails belong?

ANSWER: MOLLUSCA

TOSS-UP

13) Earth and Space – *Multiple Choice* Which of the following is NOT true regarding white dwarfs?

- W) They shrink in radius as they get cooler
- X) They do not perform nuclear fusion
- Y) Their mass is mostly composed of carbon and oxygen
- Z) They can have atmospheres of helium

ANSWER: W) They shrink in radius as they get cooler

BONUS

13) Earth and Space – *Multiple Choice* The Herschels proposed a model of the Milky Way that suggested that our solar system was near the center. Which of the following did they not account for in their model?

- W) The Sun's brightness only enables us to see a limited distance into the Milky Way
- X) Their telescopes were not powerful enough to see the edge of the Milky Way
- Y) Interstellar dust obscures much of the Milky Way from our vantage point
- Z) Their sampling of stars was biased in one direction

ANSWER: Y) INTERSTELLAR DUST OBSCURES MUCH OF THE MILKY WAY FROM OUR VANTAGE POINT

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### TOSS-UP

14) Chemistry – *Multiple Choice* According to Lewis theory, which of the following conditions would most accelerate an acid-base reaction?

- W) An elevated HOMO [*HO-mo*] and a depressed LUMO [*LOO-mo*]
- X) An elevated HOMO and an elevated LUMO
- Y) A depressed HOMO and an elevated LUMO
- Z) A depressed HOMO and a depressed LUMO

ANSWER: W) AN ELEVATED HOMO AND A DEPRESSED LUMO

### BONUS

14) Chemistry – *Short Answer* Consider the reaction of 1 mole of nitrogen gas and 1 mole of oxygen gas to generate 2 moles of NO gas. In air at 20 degrees Celsius, the equilibrium abundance of NO is about one part in  $10^{16}$ . To one significant figure and in scientific notation, what is the equilibrium constant of this reaction?

ANSWER: 6 TIMES  $10^{-32}$

**TOSS-UP**

15) Energy – *Short Answer* Researchers at Lawrence Berkeley National Lab are currently using statistical methods to determine the destiny of every cell in the *Drosophila* [*droh-SAWF-il-ah*] zygote [*ZYE-goat*] as it becomes an adult, as has been previously done for *C. elegans*. What is the term for this methodology?

ANSWER: FATE MAPPING (ACCEPT: CELL LINEAGE TRACING)

**BONUS**

15) Energy – *Short Answer* While most US bioethanol is produced from corn, most US biodiesel is produced from what crop?

ANSWER: SOY (ACCEPT: SOYBEANS)

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TOSS-UP

16) Biology – *Short Answer* What human organ produces fibrinogen [*fye-BRIN-oh-jen*]?

ANSWER: LIVER

BONUS

16) Biology – *Multiple Choice* In humans, the suprachiasmatic nucleus or "biological clock" is located in which of the following parts of the brain?

- W) Pineal [*PIN-ee-ul*] gland
- X) Hypothalamus [*high-poh-THAL-ah-mus*]
- Y) Cerebral [*seh-REE-brul*] cortex
- Z) Cerebellum [*sarah-BELL-um*]

ANSWER: X) HYPOTHALAMUS

TOSS-UP

17) Physics – *Multiple Choice* Which of the following is not a logical corollary to special relativity?

- W) Time dilation
- X) Relativity of simultaneity
- Y) Curvature of spacetime
- Z) Length contraction

ANSWER: Y) CURVATURE OF SPACETIME

BONUS

17) Physics – *Short Answer* What effect describes the inelastic scattering of photons by free charged particles?

ANSWER: COMPTON EFFECT



TOSS-UP

18) Math – *Short Answer* Solve the following equation for x : log base 3 of open parenthesis $x + 5$ close parenthesis = 4?

ANSWER: 76

BONUS

18) Math – *Short Answer* If cosine of x times sine of x equals $1/5$, what is the value of open parenthesis cosine of x minus sine of x close parenthesis squared?

ANSWER: $3/5$ (ACCEPT: 0.6)

TOSS-UP

19) Biology – *Short Answer* In what human organ can one find cells possessing intercalated [*in-TER-cah-lated*] disks?

ANSWER: HEART

BONUS

19) Biology – *Short Answer* In protostomes, what structure does the blastopore become?

ANSWER: MOUTH

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### TOSS-UP

20) Chemistry – *Multiple Choice* Which of the following graphs would produce a straight line if plotted for a zero-order irreversible reaction?

- W) Concentration versus time
- X) Inverse concentration versus time
- Y) Log of concentration versus time
- Z) Inverse concentration squared versus time

ANSWER: W) CONCENTRATION VERSUS TIME

### BONUS

20) Chemistry – *Short Answer* Rank the following three acids from least to greatest in terms of acidity:  
1) 2-chlorobutanoic [*two kloro-byu-tan-OH-ik*] acid; 2) 3-chlorobutanoic acid; 3) 4-chlorobutanoic acid.

ANSWER: 3, 2, 1

**TOSS-UP**

21) Earth and Space – *Short Answer* What is the term, literally meaning “burning cloud”, for a glowing pyroclastic flow that can reach speeds of 200 kilometers per hour?

ANSWER: NUÉE ARDENTE

**BONUS**

21) Earth and Space – *Multiple Choice* What type of mass wasting event is created when many different sediment sizes channelize and begin to move in a fluidized mass down slope?

- W) Debris flow
- X) Rock avalanche
- Y) Earth flow
- Z) Debris slide

ANSWER: W) DEBRIS FLOW

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TOSS-UP

22) Math – *Short Answer* Express as a fraction the repeating decimal 0.181818, with repeating part one-eight.

ANSWER: 2/11

BONUS

22) Math – *Short Answer* What is the slope-intercept equation of the line tangent to the graph of $y = x^3 + x^2$ at the point (1,2)?

ANSWER: $y = 5x - 3$

TOSS-UP

23) Physics – *Short Answer* The maximal increase in the velocity of an ideal rocket is linearly proportional to what property of the rocket?

ANSWER: EXHAUST VELOCITY (ACCEPT: EXHAUST SPEED)

BONUS

23) Physics – *Short Answer* Bill's weight on a theoretical perfectly spherical Earth is 700 newtons. If Bill stood on the surface of a planet with the same mass and radius as Earth, but that was shaped as a hollow sphere with thickness 60 kilometers, what is Bill's new weight, in newtons to one significant figure?

ANSWER: 700