

HIGH SCHOOL - ROUND 7A

TOSS-UP

1) Biology – *Short Answer* Atherosclerotic [*athero-sklair-AW-tic*] plaques are composed of what lipid that is stored in LDL and HDL particles?

ANSWER: CHOLESTEROL

BONUS

1) Biology – *Multiple Choice* In which of the following organ systems do the tonsils primarily function?

- W) Lymphatic
- X) Digestive
- Y) Respiratory
- Z) Integumentary [*in-TEG-you-MEN-tary*]

ANSWER: W) LYMPHATIC

TOSS-UP

2) Earth and Space – *Multiple Choice* Horsts and grabens [*GRAH-bens*] are bounded by what type of fault?

- W) Strike-slip
- X) Reverse
- Y) Thrust
- Z) Normal

ANSWER: Z) NORMAL

BONUS

2) Earth and Space – *Short Answer* Identify all of the following three regions that are passive margins: 1) East coast of North America; 2) West coast of North America; 3) West coast of Africa.

ANSWER: 1, 3

TOSS-UP

3) Energy – *Short Answer* Scientists at Princeton Plasma Physics Lab are developing improvements to the fusion reactions occurring in inside a tokamak [*TOW-kah-mak*]. These fusion reactions are fueled by what isotopes of hydrogen?

ANSWER: DEUTERIUM AND TRITIUM (ACCEPT: HYDROGEN-2 AND HYDROGEN-3)

BONUS

3) Energy – *Short Answer* Researchers at Idaho National Lab are developing practical methods to reduce the cost of biofuel production from biomass. What class of biofuel is made from vegetable oil or animal fat and consists of long-chain alkyl [*AL-keel*] esters?

ANSWER: BIODIESEL (ACCEPT: DIESEL)

TOSS-UP

4) Chemistry – *Short Answer* What is the conjugate acid of ammonia?

ANSWER: AMMONIUM (ACCEPT: NH_4^+)

BONUS

4) Chemistry – *Short Answer* What is the name of the aldehyde [*AL-deh-hide*] with only a single carbon atom?

ANSWER: FORMALDEHYDE (ACCEPT: METHANAL)

TOSS-UP

5) Physics – *Multiple Choice* Kate is tuning her cello's A string by producing an A note on a string that is already tuned and comparing the sounds. Which of the following beat frequencies, in hertz, would indicate that the strings are closest to having the same pitch?

- W) 2
- X) 100
- Y) 440
- Z) 880

ANSWER: W) 2

BONUS

5) Physics – *Short Answer* Identify all of the following three statements that must be true of all satellites in geosynchronous [*jee-oh-SINK-rin-us*] orbits: 1) They stay above the same point on Earth; 2) Their altitude is affected by the mass of the satellite; 3) They have an orbital period of one sidereal day.

ANSWER: 3

TOSS-UP

6) Math – *Short Answer* Giving your answer as a decimal, increasing a number by 125% is equivalent to multiplying it by what?

ANSWER: 2.25

BONUS

6) Math – *Short Answer* Three exterior angles, one at each vertex of a triangle, have measures in the ratio of 5 to 7 to 8. What is the degree measure of the triangle's smallest interior angle?

ANSWER: 36

TOSS-UP

7) Earth and Space – *Short Answer* RR Lyrae [**L**YE-ree] and Cepheid [**S**EF-ee-id] are classes of what type of star?

ANSWER: VARIABLE

BONUS

7) Earth and Space – *Short Answer* What planet of the solar system has the highest albedo?

ANSWER: VENUS

TOSS-UP

8) Biology – *Short Answer* What is the common term for a basidiocarp [**b**ah-SID-ee-oh-karp], the fruiting body of a basidiomycete [**b**ah-sid-ee-oh-MY-seet], when it is found above ground?

ANSWER: MUSHROOM

BONUS

8) Biology – *Short Answer* In peas, tall is dominant to short, and green is dominant to yellow. If two plants that are each heterozygous [**h**etero-ZYE-gus] for both traits are bred, what is the probability that a given offspring is both tall and yellow?

ANSWER: 3/16

TOSS-UP

9) Physics – *Short Answer* A remote control car drops from a cliff and travels 19.6 meters before hitting the ground. How long, in seconds, did it spend in the air?

ANSWER: 2

BONUS

9) Physics – *Short Answer* Identify all of the following three statements that are true of free-fall: 1) Apparent weightlessness is the sensation that occurs when the gravitational force is negated by air friction; 2) Satellites orbiting the earth are in near free-fall; 3) Objects free-falling on Earth all reach terminal velocity.

ANSWER: 2

TOSS-UP

10) Math – *Short Answer* Using the point names *A, B, C, D, E, F, G,* and *H,* how many different names are there for octagon *ABCDEFGH*?

ANSWER: 16

BONUS

10) Math – *Short Answer* What are the coordinates of the vertex of the graph of $y = -4x^2 - 16x - 9$?

ANSWER: (-2, 7) (ACCEPT: $x = -2$ AND $y = 7$)

TOSS-UP

11) Chemistry – *Multiple Choice* Kevin performs a titration [*tie-TRAY-shun*] using sodium hydroxide as the titrant. He finds that the pH at the equivalence point is above 7. What does this imply about the analyte?

- W) It is a strong acid
- X) It is a weak acid
- Y) It is a strong base
- Z) It is a weak base

ANSWER: X) IT IS A WEAK ACID

BONUS

11) Chemistry – *Short Answer* Identify all of the following four molecules that are linear:
1) Carbon dioxide; 2) Selenium [*sih-LEE-nee-um*] dioxide; 3) Beryllium dichloride; 4) Xenon [*ZEE-non*] difluoride.

ANSWER: 1, 3, AND 4

TOSS-UP

12) Energy – *Multiple Choice* Argonne National Lab scientists recently developed a computer model to calculate the ionization potential of liquid water. This property was previously only approximated using photoemission spectroscopy, a technique most dependent on which of the following physical effects?

- W) Photoelectric effect
- X) Faraday effect
- Y) Two-photon absorption
- Z) Kinetic isotope effect

ANSWER: W) PHOTOELECTRIC EFFECT

BONUS

12) Energy – *Short Answer* Scientists at Argonne National Lab are researching methods to convert methane to an alcohol. What single-carbon alcohol are they trying to synthesize?

ANSWER: METHANOL

TOSS-UP

13) Earth and Space – *Short Answer* The incus, or anvil, characterizes the shape of what type of cloud that has reached the tropopause?

ANSWER: CUMULONIMBUS

BONUS

13) Earth and Space – *Short Answer* What set of prevailing winds is responsible for the curving of Atlantic hurricanes toward the northeast once they reach temperate latitudes?

ANSWER: WESTERLIES (ACCEPT: ANTITRADES)

TOSS-UP

14) Chemistry – *Short Answer* Identify all of the following three metals that are transition metals: 1) Lead; 2) Silver; 3) Aluminum.

ANSWER: 2

BONUS

14) Chemistry – *Short Answer* Consider the combustion reaction between solid carbon and gaseous oxygen to generate gaseous carbon dioxide. Identify all of the following three changes that would shift the reaction to the right: 1) Decreasing the volume of the container; 2) Adding an inert gas to the container; 3) Decreasing the temperature of the container.

ANSWER: 3

TOSS-UP

15) Math – *Short Answer* What is the discriminant of the quadratic function $y = x^2 - 5x + 8$?

ANSWER: -7

BONUS

15) Math – *Short Answer* Evaluate the integral from $x = -10$ to 0 of the square root of open parenthesis $100 - x^2$ close parenthesis dx .

ANSWER: 25π

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**TOSS-UP**

16) Physics – *Short Answer* A particular mineral rod can withstand approximately 200 joules of energy input from impact without shattering. If the rod weighs 5 kilograms, then, to the nearest meter, how far can it be dropped without shattering?

ANSWER: 4

**BONUS**

16) Physics – *Short Answer* Vince drops a football from a cliff and notes that it takes 2 seconds for it to hit the ground. He throws an identical football from the same height, but with a horizontal velocity of 5 meters per second. Assuming the ground is level, then to the nearest whole meter, how far from the point of release will the ball land?

ANSWER: 22

### TOSS-UP

17) Biology – *Short Answer* What enzyme joins all of the various Okazaki fragments together in DNA replication?

ANSWER: DNA LIGASE (ACCEPT: LIGASE)

### BONUS

17) Biology – *Short Answer* If nondisjunction occurs in meiosis I [*my-OH-sis one*], how many of the daughter cells at the end of meiosis will have an abnormal number of chromosomes?

ANSWER: FOUR

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### TOSS-UP

18) Energy – *Multiple Choice* Argonne National Laboratory researchers are examining the formation of the solid-electrolyte interphase layers on graphite electrodes in lithium-ion batteries. Which of the following best describes the graphite electrode during battery discharge?

- W) Cathode
- X) Anode
- Y) Catholyte
- Z) Bipolar plate

ANSWER: X) ANODE

### BONUS

18) Energy – *Short Answer* Scientists at Pacific Northwest National Lab are collecting xenon-136 in order to study a special type of double beta decay. What particle does regular beta decay produce that this special type of double beta decay does not?

ANSWER: NEUTRINO (ACCEPT: ANTINEUTRINO, ELECTRON ANTINEUTRINO, ELECTRON NEUTRINO)

### TOSS-UP

19) Math – *Short Answer* The mean of a set of 5 numbers is 6. Four of the numbers are 2, 3, 5, and 8. What is the fifth number?

ANSWER: 12

### BONUS

19) Math – *Short Answer* The sums of three whole numbers taken in pairs are 16, 17, and 23. What is the product of these three numbers?

ANSWER: 660

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### TOSS-UP

20) Physics – *Short Answer* Identify all of the following three forces that are classified as non-inertial or fictitious: 1) Wind resistance; 2) Centrifugal; 3) Coriolis.

ANSWER: 2, 3

### BONUS

20) Physics – *Short Answer* A certain particle has a potential energy of zero at a given moment. Identify all of the following three statements that must be TRUE of the particle: 1) The force on the particle is zero; 2) The particle is at equilibrium; 3) The particle has zero acceleration.

ANSWER: NONE OF THEM

### TOSS-UP

21) Chemistry – *Multiple Choice* Doping a silicon crystal with which of the following elements would produce an n-type semiconductor?

- W) Bismuth [*BIZ-muth*]
- X) Selenium [*sih-LEE-nee-um*]
- Y) Sulfur
- Z) Tin

ANSWER: W) BISMUTH

### BONUS

21) Chemistry – *Short Answer* Rank the following three atoms in terms of increasing first ionization energy: 1) Chlorine; 2) Phosphorous; 3) Silicon.

ANSWER: 3, 2, 1

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### TOSS-UP

22) Earth and Space – *Short Answer* Hydrogen and helium make up approximately 97 percent of the Sun's mass. What element, making up about one percent of the Sun's mass, is the next most abundant?

ANSWER: OXYGEN

### BONUS

22) Earth and Space – *Short Answer* Identify all of the following three aspects of planetary motion that were included in Copernicus' model of the solar system: 1) The Sun is at the center; 2) Planets have elliptical orbits; 3) The Moon orbits Earth.

ANSWER: 1, 3

### TOSS-UP

23) Biology – *Short Answer* What technique did Rosalind Franklin use to determine the helical structure of DNA?

ANSWER: X-RAY CRYSTALLOGRAPHY (ACCEPT: X-RAY DIFFRACTION, X-RAY DIFFRACTION CRYSTALLOGRAPHY)

### BONUS

23) Biology – *Short Answer* It is hypothesized that humans derived little to no fitness benefit from dogs in the early stages of their domestication. What best describes the symbiotic relationship between these two species at that time?

ANSWER: COMMENSALISM