

## **ROUND 16**

### **TOSS-UP**

- 1) PHYSICS *Multiple Choice* In beta plus decay, which of the following occurs:

- W) a neutron changes to an electron
- X) a neutron changes to a proton
- Y) a proton changes to an electron
- Z) a proton changes to a neutron

ANSWER: Z) A PROTON CHANGES TO A NEUTRON

### **BONUS**

- 1) PHYSICS *Short Answer* An ultrasound machine operates with a frequency of 1.25 megahertz. The sound produced travels in the medium at 1250 meters per second. What is the wavelength of the waves in meters?

ANSWER: .001

(Solution: wavelength =  $v/f = 1250/1.25$  million = .001 m)

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### **TOSS-UP**

- 2) CHEMISTRY *Multiple Choice* Which of the following is the common name for the following compound: toluene with a chlorine molecule on the third carbon

- W) chlorotoluene
- X) o-chlorotoluene
- Y) m-chlorotoluene
- Z) p-chlorotoluene

ANSWER: Y) m-CHLOROTOLUENE (ACCEPT: META-CHLOROTOLUENE)

### **BONUS**

- 2) CHEMISTRY *Short Answer* For the reaction  $HX \rightarrow H^+ + X^-$ , at equilibrium the concentration of HX is 0.1 molar and the concentration of  $X^-$  is 0.005 molar. Calculate the acid dissociation constant of the reaction:

ANSWER:  $2.5 \times 10^{-4}$  (ACCEPT: 0.00025)

(Solution:  $K_a = [A^-][H^+] / [HA]; = (.005)(.005) / 0.1; = 2.5 \times 10^{-4}$ )

### **TOSS-UP**

- 3) BIOLOGY *Short Answer* What are the proper names, respectively, for the cervical vertebrae numbered as C-1 and C-2?

ANSWER: ATLAS AND AXIS

### **BONUS**

- 3) BIOLOGY *Multiple Choice* In a cell that is dedicated to producing large amounts of steroids, which of the following organelles will predominate:

- W) golgi
- X) smooth endoplasmic reticulum
- Y) nucleolus
- Z) peroxisomes

ANSWER: X) SMOOTH ENDOPLASMIC RETICULUM

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### **TOSS-UP**

- 4) ASTRONOMY *Multiple Choice* Spiral galaxies are to stars of all ages as Elliptical galaxies are to:

- W) mostly young stars
- X) mostly old stars
- Y) mostly planetary nebula
- Z) mostly middle aged stars

ANSWER: X) MOSTLY OLD STARS

### **BONUS**

- 4) ASTRONOMY *Short Answer* Ancient Greek estimates of the sizes of the sun and moon and their relative distances from Earth were based on geometrical relationships in what two celestial events?

ANSWER: SOLAR AND LUNAR ECLIPSES

## **TOSS-UP**

- 5) MATH *Multiple Choice* Assuming a parametric distribution, which of the following statistical tests would be most appropriate to find whether 3 or more samples come from the same population:

- W) single tailed t-test
- X) two tailed t-test
- Y) z-test
- Z) ANOVA (pronounced: A-nova)

ANSWER: Z) ANOVA

## **BONUS**

- 5) MATH *Multiple Choice* Which of the following is equivalent to the expression

$$\left( \frac{\sin\theta}{\tan\theta} \right) + \cos\theta ?$$

- W)  $2 \cos \theta$  (read as: 2 times the cosine of theta)
- X)  $2 \sec \theta$  (read as: 2 times the secant of theta)
- Y)  $2 \cosec \theta$  (read as: 2 times the cosecant of theta)
- Z)  $\cos \theta$  (read as: the cosine of theta)

ANSWER: W)  $2 \cos \theta$

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## **TOSS-UP**

- 6) EARTH SCIENCE *Multiple Choice* What term is used for a saddle-shaped mountain pass formed by the enlargement of two opposing cirques until their head walls meet and are broken down:

- W) cliff
- X) col
- Y) scree
- Z) moraine

ANSWER: X) COL

## **BONUS**

- 6) EARTH SCIENCE *Short Answer* Order the following four geological periods from the youngest to the oldest: Silurian, Tertiary, Quaternary, Ordovician

ANSWER: QUATERNARY, TERTIARY, SILURIAN, ORDOVICIAN

## **TOSS-UP**

- 7) GENERAL SCIENCE *Short Answer* Which of the following 5 metals has the lowest electrical conductivity: magnesium; zinc; iron; lead; tin;

ANSWER: LEAD

## **BONUS**

- 7) GENERAL SCIENCE *Multiple Choice* A recent discovery of a hominid skeleton in Portugal has fueled a major argument involving Neanderthal and Homo Sapiens because it might challenge the long held belief that:

- W) weather caused the Neanderthal's demise
- X) Homo Sapiens outcompeted Neanderthals
- Y) disease caused the Neanderthal extinction
- Z) Homo Sapiens and Neanderthals did not interbreed

ANSWER: Z) HOMO SAPIENS AND NEANDERTHALS DID NOT INTERBREED

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## **TOSS-UP**

- 8) COMPUTER SCIENCE *Multiple Choice* In Java, what is the purpose of an interface class:

- W) it provides an abstract base class
- X) it provides a collection of method definitions and constant values
- Y) it provides a way to collect data from a user
- Z) it provides a way to inherit method implementations

ANSWER: X) IT PROVIDES A COLLECTION OF METHOD DEFINITIONS AND CONSTANT VALUES

## **BONUS**

- 8) COMPUTER SCIENCE *Multiple Choice* Popular in the early 1990's, LYNX was a terminal program used primarily for:

- W) text editing
- X) E-mail
- Y) Telnet
- Z) Web surfing

ANSWER: Z) WEB SURFING

### **TOSS-UP**

- 9) PHYSICS *Short Answer* In alpha emission, the decaying atom decreases by what number of neutrons?

ANSWER: 2

### **BONUS**

- 9) PHYSICS *Multiple Choice* Which one of the following has the greatest kinetic energy for an object moving in a straight line path:

- W) an object with a mass of 10 kg and a velocity of 50 m/sec
- X) an object with a mass of 20 kg and a velocity of 40 m/sec
- Y) an object with a mass of 30 kg and a velocity of 30 m/sec
- Z) an object with a mass of 40 kg and a velocity of 20 m/sec

ANSWER: X) AN OBJECT WITH A MASS OF 20 KG AND A VELOCITY OF 40 M/SEC

(Solution:  $KE = \frac{1}{2} \text{mass} \times \text{velocity}^2$ )

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### **TOSS-UP**

- 10) CHEMISTRY *Multiple Choice* The Carnot cycle has four cycles and operates between:

- W) 2 isotherms and 2 adiabatics
- X) 2 isotherms and 2 isostatics
- Y) 2 adiabatics and 2 isostatics
- Z) 2 isotherms and 2 isovolumetrics

ANSWER: W) 2 ISOTHERMS AND 2 ADIABATICS

### **BONUS**

- 10) CHEMISTRY *Short Answer* What is the oxidation number of the chromium atom in  $K_2Cr_2O_7$ ?

ANSWER: +6 (ACCEPT: 6)

(Solution:  $2(+1) + 2(\text{Cr}) + 7(-2) = 0$ ; S = +6)

## **TOSS-UP**

- 11) BIOLOGY *Multiple Choice* Which of the following physiological conditions would most likely result in left ventricular hypertrophy:

- W) decrease in pulmonary pressure
- X) increase in pulmonary pressure
- Y) increase in peripheral systemic blood pressure
- Z) decrease in peripheral systemic blood pressure

ANSWER: Y) INCREASE IN PERIPHERAL SYSTEMIC BLOOD PRESSURE

## **BONUS**

- 11) BIOLOGY *Short Answer* If 1n is haploid, 2n is diploid, and 1s is the DNA content in a haploid genome, then what is the n and s value of a human cell in metaphase two of meiosis?

ANSWER: 2N AND 2S (ACCEPT: 2 AND 2)

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## **TOSS-UP**

- 12) ASTRONOMY *Multiple choice* The companion galaxies of Andromeda, M 32 and NGC 205 are classified as which of the following galaxy type:

- W) dwarf companion
- X) barred
- Y) dwarf elliptical
- Z) seyfert (PRON: see-fert)

ANSWER: Y) DWARF ELLIPTICAL

## **BONUS**

- 12) ASTRONOMY *Short Answer* By what multiple does the brightness of two stars, with apparent magnitudes of -1 and +6, differ?

ANSWER: 631 (ACCEPT: 620 to 640)

## TOSS-UP

13) MATH *Multiple Choice* Which of the following eccentricities describes an ellipse:

- W)  $e = 0$
- X)  $0 < e < 1$
- Y)  $e = 1$
- Z)  $e > 1$

ANSWER: X)  $0 < e < 1$

## BONUS

13) MATH *Short Answer* In terms of  $\pi$ , what is the area of a sector in a circle whose central angle is  $60^\circ$  bounded by two radii of 6?

ANSWER:  $6\pi$

(Solution:  $A = n/360 \times \pi r^2$ ;  $= 60/360 \times 36\pi = 6\pi$ )

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## TOSS-UP

14) EARTH SCIENCE *Multiple Choice* Generally, explosive volcanic eruptions are most likely to have magma that has a relatively:

- W) high temperature
- X) low silica content
- Y) high dissolved-gas content
- Z) low-viscosity

ANSWER: Y) HIGH DISSOLVED-GAS CONTENT

## BONUS

14) EARTH SCIENCE *Multiple Choice* A coral reef would thrive best in which of the following oceanic conditions:

- W) around oceanic zones of nutrient upwelling
- X) clear waters characterized by low nutrient concentrations
- Y) areas with high influxes of land-derived mud and silt
- Z) at latitudes from  $30^\circ$  to  $50^\circ$  North and South

ANSWER: X) CLEAR WATERS CHARACTERIZED BY LOW NUTRIENT CONCENTRATIONS

## **TOSS-UP**

- 15) GENERAL SCIENCE *Multiple Choice* A spider that continues to go through the motions of spinning a cocoon even though it has run out of silk is exhibiting:

- W) a learned behavior
- X) imprinting
- Y) a fixed action pattern
- Z) critical behavior

ANSWER: Y) A FIXED ACTION PATTERN

## **BONUS**

- 15) GENERAL SCIENCE *Multiple Choice* A killer whale is best classified in which trophic level:

- W) primary carnivore
- X) secondary carnivore
- Y) herbivore
- Z) detritivore

ANSWER: X) SECONDARY CARNIVORE

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## **TOSS-UP**

- 16) COMPUTER SCIENCE *Multiple Choice* Which of the following types of files is NOT considered an executable file in the Windows environment:

- W) .ini (read as: dot, i, n, i)
- X) .exe
- Y) .bat
- Z) .com

ANSWER: W) .INI

(Solution: .ini are config files and cannot be executed from a command file)

## **BONUS**

- 16) COMPUTER SCIENCE *Short Answer* Give the Binary, Octal and Hexadecimal equivalents for the decimal number 8:

ANSWER: BINARY = 1000; OCTAL = 10; HEXADECIMAL = 8

**TOSS-UP**

- 17) PHYSICS *Short Answer* In a standing wave of a vibrating string, what is the name of the specific harmonic that corresponds to the first overtone?

ANSWER: SECOND HARMONIC

**BONUS**

- 17) PHYSICS *Short Answer* With regard to the speed at which sound travels in a specific medium at standard temperature and pressure, order the following materials from the SLOWEST to the FASTEST: iron, wood, sea-water, distilled water

ANSWER: DISTILLED WATER, SEA-WATER, WOOD, IRON

(Solution: distilled water~1440 m/sec; sea-water~1560 m/sec; wood~4000 m/sec; iron~5000 m/sec)

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**TOSS-UP**

- 18) CHEMISTRY *Short Answer* First noticed by Faraday in 1857, what is the name for the phenomenon which occurs when light becomes polarized after it is passed through a colloidal suspension?

ANSWER: THE TYNDAL EFFECT

**BONUS**

- 18) CHEMISTRY *Short Answer* Order the following 3 monosaccharides from the smallest to the largest: erythrose, mannose, ribose

ANSWER: ERYTHROSE, RIBOSE, MANNOSE

**TOSS-UP**

19) BIOLOGY *Multiple Choice* One of the main functions of carotenoids in higher plants is to:

- W) protect chlorophyll from damage by ultraviolet light
- X) aid in photorespiration
- Y) prevent interference by accessory pigments
- Z) direct the function of photosystem One

ANSWER: W) PROTECT CHLOROPHYLL FROM DAMAGE BY ULTRAVIOLET LIGHT

**BONUS**

19) BIOLOGY *Short Answer* When alpha ketoglutarate is converted to succinyl CoA, what are the main two coenzymes involved?

ANSWER: COENZYME A AND NAD

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**TOSS-UP**

20) MATH *Short Answer* Of the following 5 angles, which pair of angles are coterminal with one another:  $50^\circ$ ;  $-50^\circ$ ;  $50^\circ + 2(360^\circ)$ ;  $11/3$  rev;  $0^\circ$

ANSWER:  $50^\circ$  AND  $50^\circ + 2(360^\circ)$

**BONUS**

20) MATH *Short Answer* Calculate the following indefinite integral:  $I = \int xe^{2x^2} dx$

ANSWER:  $\frac{1}{4}e^{2x^2} + C$  (or + Constant)

### **TOSS-UP**

- 21) EARTH SCIENCE *Multiple Choice* In meteorology, a center where air spirals outward away from a high-pressure center and designated on weather maps by the letter “H” is called:

- W) cyclonic flow
- X) anticyclonic flow
- Y) a center of convergence
- Z) gradient wind

ANSWER: X) ANTICYCLONIC FLOW

### **BONUS**

- 21) EARTH SCIENCE *Multiple Choice* Which of the following is an example of a marine-based ice sheet:

- W) East Antarctic Ice Sheet
- X) East Greenland Ice Sheet
- Y) West Antarctic Ice Sheet
- Z) Arctic Ice Sheet

ANSWER: Y) WEST ANTARCTIC ICE SHEET

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### **TOSS-UP**

- 22) GENERAL SCIENCE *Multiple Choice* What Norwegian physician in 1873 discovered that a specific bacteria was the cause of leprosy:

- W) Gerhard Hansen
- X) Jacobus van’t Hoff
- Y) Antony Van Leeuwenhoek
- Z) Christian DeDreve

ANSWER: W) GERHARD HANSEN

### **BONUS**

- 22) GENERAL SCIENCE *Short Answer* Order the following 4 ecosystems from the highest percentage of the Earth’s surface to the lowest: temperate grassland; temperate deciduous forest; open ocean; savanna

ANSWER: OPEN OCEAN; SAVANNA; TEMPERATE GRASSLAND; TEMPERATE DECIDUOUS FOREST

### **TOSS-UP**

- 23) PHYSICS *Multiple Choice* The theory that elements such as uranium and thorium went through a series of transmutations was first carefully formulated by:

- W) Planck and Einstein
- X) Einstein and Rutherford
- Y) Curie and Rutherford
- Z) Rutherford and Soddy

ANSWER: Z) RUTHERFORD AND SODDY

### **BONUS**

- 23) PHYSICS *Short Answer* Which ones, if any, of the following will appear to be the same to all observers in all reference frames, regardless of speed: mass, velocity, time, momentum, charge, kinetic energy

ANSWER: CHARGE

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### **TOSS-UP**

- 24) CHEMISTRY *Short Answer* In 1811, what person published a paper that advanced the idea that all gases contain the same number of particles per unit volume?

ANSWER: AVAGADRO (ACCEPT: AVAGADRO'S HYPOTHESIS)

### **BONUS**

- 24) CHEMISTRY *Short Answer* Upon whose work was Avagadro's Hypothesis most directly related?

ANSWER: GAY-LUSSAC

## **TOSS-UP**

- 25) BIOLOGY *Short Answer* The 1,25 form of Vitamin D is formed in what organ?

ANSWER: KIDNEY

## **BONUS**

- 25) BIOLOGY *Multiple Choice* In the double reciprocal Lineweaver-Burke plot of enzyme activity, the presence of an uncompetitive inhibitor will have which of the following effects:

- W) unpredictable effect
- X) decreases the slope and decreases the intercept at the ordinate
- Y) no effect on the slope and increases the intercept at the ordinate
- Z) the slope is inverted and the intercept at the ordinate remains the same

ANSWER: Y) NO EFFECT ON THE SLOPE AND INCREASES THE INTERCEPT AT THE ORDINATE