

## 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 =  $v/f = 1250/1.25 \text{ million} = .001 \text{ m}$ )

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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  $\text{HX} \rightarrow \text{H}^+ + \text{X}^-$ , at equilibrium the concentration of HX is 0.1 molar and the concentration of  $\text{X}^-$  is 0.005 molar. Calculate the acid dissociation constant of the reaction:

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

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

### 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  $(\frac{\sin\theta}{\tan\theta}) + \cos\theta$  ?
- 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)  $2 \operatorname{cosec} \theta$  (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:  $KE = 1/2 \text{ mass} \times \text{velocity}^2$ )

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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:  $2(+1) + 2(Cr) + 7(-2) = 0$ ;  $S = +6$ )

**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 ketogluterate 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:  $50^\circ$ ;  $-50^\circ$ ;  $50^\circ + 2(360^\circ)$ ;  $1\frac{1}{3}$  rev;  $0^\circ$

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

### BONUS

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

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 DeDuve

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