

## ROUND 17

### TOSS-UP

1) BIOLOGY *Short Answer* Riboflavin is to FAD as Pantothenate is to:

ANSWER: CoA (pronounced: Kho-A) (ACCEPT: COENZYME A)

### BONUS

1) BIOLOGY *Short Answer* Order the following 4 objects from the smallest to the largest: the diameter of a DNA molecule, a Rickettsia, a ribosome, a methionine molecule

ANSWER: A METHIONINE MOLECULE, THE DIAMETER OF A DNA MOLECULE, A RIBOSOME, A RICKETTTSIA

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### TOSS-UP

2) PHYSICS *Short Answer* In 1851, Thomson independently rediscovered the idea of absolute zero by extrapolating from the law most commonly known as?

ANSWER: CHARLES LAW

### BONUS

2) PHYSICS *Multiple Choice* If an astronaut traveling at 25% of the speed of light passes a 10 meter long satellite, what length will the astronaut get for a measure of the satellite:

W) 1.75 meters

X) 0.87 meters

Y) 8.66 meters

Z) 9.68 meters

ANSWER: Z) 9.68 METERS

(Solution:  $L^1 = L \sqrt{1-V^2} = 10 \text{ meters} \times \sqrt{1-.25} = 9.68 \text{ meters}$ )

### TOSS-UP

3) CHEMISTRY *Short Answer* What is the name for one of the most central concepts of chemical equilibria, which states that a change in one of the variables that describes a system at equilibrium produces a shift in the position of the equilibrium that counteracts the effect of the change:

ANSWER: LECHATelier'S PRINCIPLE

### BONUS

3) CHEMISTRY *Short Answer* Using electrophoresis at a pH of 6.0, which two of the following 5 amino acids would move fastest to the cathode: arginine, glutamic acid, glycine, alanine, lysine

ANSWER: LYSINE, ARGININE

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### TOSS-UP

4) ASTRONOMY *Multiple Choice* What form of diffraction grating has very fine lines ruled much farther apart than other gratings, giving it a much higher resolution, but over a narrow wavelength band:

- W) airy disc grating
- X) campo grating
- Y) Doppler grating
- Z) eschelle grating

ANSWER: Z) ESCELLE GRATING

### BONUS

4) ASTRONOMY *Short Answer* The solar neutrino detector in Lead, South Dakota, was originally constructed to contain about 100,000 gallons of what chemical?

ANSWER: C<sub>2</sub>CL<sub>4</sub> (ACCEPT: TETRACHLOROETHYLENE)

### TOSS-UP

5) MATH *Multiple Choice* The total distance traveled, given by the equation  $f(t_1)\Delta t + f(t_2)\Delta t + \dots + f(t_n)\Delta t$ , (read as:  $f$  of  $t$  sub 1,  $\Delta t$ , +  $f$  of  $t$  sub 2,  $\Delta t$ , + all values up to  $f$  of  $t$  sub  $n$ ,  $\Delta t$ ), for which  $f$  is an increasing function, can be used to find which of the following between the values  $t = a$  and  $t = b$ :

- W) right-hand sum
- X) left-hand sum
- Y) upper bound
- Z) endless bound

ANSWER: W) RIGHT-HAND SUM

### BONUS

5) MATH *Short Answer* Find the derivative of the following equation:  $y = 2^x + 2 \times 3^x$

ANSWER:  $\ln 2(2^x) + 2 \ln 3(3^x)$

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### TOSS-UP

6) EARTH SCIENCE *Multiple Choice* A major break through in the development of plate tectonic theory occurred in the late 1960s with sea floor mapping by:

- W) satellite imagery
- X) magnetic characteristics
- Y) aerial photography
- Z) water depth by soundings

ANSWER: X) MAGNETIC CHARACTERISTICS

### BONUS

6) EARTH SCIENCE *Short Answer* Order the following three types of magma based on their viscosity, starting with the least viscous: rhyolitic, basaltic, andesitic

ANSWER: BASALTIC, ANDESITIC, RHYOLITIC

### TOSS-UP

7) GENERAL SCIENCE *Multiple Choice* Which of the following is TRUE for the f-number in a typical camera lens:

- W) the larger the f-number, the more light reaches the film
- X) the larger the f-number, the greater the depth of field
- Y) the smaller the f-number, the lesser the light reaches the film
- Z) the smaller the f-number, the greater the depth of field

ANSWER: X) THE LARGER THE F-NUMBER, THE GREATER THE DEPTH OF FIELD

### BONUS

7) GENERAL SCIENCE *Multiple Choice* Which of the following has been most effectively implicated in Alzheimer's disease:

- W) glutamic oxygenase
- X) aluminum toxicosis
- Y) amyloid-beta precursor protein
- Z) poor diet

ANSWER: Y) AMYLOID-BETA PRECURSOR PROTEIN

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### TOSS-UP

8) COMPUTER SCIENCE *Multiple Choice* Which of the following algorithms is the most efficient:

- W) Insertion Sort
- X) Selection Sort
- Y) Quick Sort
- Z) Merge Sort

ANSWER: Z) MERGE SORT

### BONUS

8) COMPUTER SCIENCE *Short Answer* C programs typically go through 6 phases to be executed. Order the following 6 phases from initial to final development: preprocess; compile; load; link; edit; execute

ANSWER: EDIT; PREPROCESS; COMPILE; LINK; LOAD; EXECUTE

**TOSS-UP**

9) BIOLOGY *Multiple Choice* Select the hormone NOT CORRECTLY paired with its target:

- W) MSH and epidermal melanocytes
- X) ACTH and adrenal gland
- Y) TSH and thyroid parafollicular C cells
- Z) LH and maturing follicles

ANSWER: Y) TSH AND THYROID PARAFOLLICULAR C CELLS

**BONUS**

9) BIOLOGY *Short Answer* Using the following single stranded DNA, give the corresponding messenger RNA sequence:

(Pronunciation: please give a brief pause at each hyphen between the reading of each three letters)  
TAC - GGA - GGG - GCA - CCC - TAT - TTA

ANSWER: AUG - CCU - CCC - CGU - GGG - AUA - AAU (must be exact)

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**TOSS-UP**

10) PHYSICS *Short Answer* What did Roentgen accidentally discover when he noticed a platinocyanide coated paper began to glow?

ANSWER: X-RAYS

**BONUS**

10) PHYSICS *Multiple Choice* Given Planck's constant is  $6.6 \times 10^{-34}$  Joule-seconds, what is the de Broglie wavelength of a 0.15 kilogram onion traveling at 20 meters per second:

- W)  $3.3 \times 10^{-35}$  meters
- X)  $3.3 \times 10^{-34}$  meters
- Y)  $2.2 \times 10^{-34}$  meters
- Z)  $2.2 \times 10^{-35}$  meters

ANSWER: Y)  $2.2 \times 10^{-34}$  METERS

(Solution:  $6.6 \times 10^{-34} \div 0.15 \text{ Kg} \times 20 \text{ m/sec} = 2.2 \times 10^{-34} \text{ m}$ )

**TOSS-UP**

11) CHEMISTRY *Short Answer* What is the molecular formula for the conjugate base of the following Brønsted-Lowry acid:  $\text{HPO}_4^{2-}$

ANSWER:  $\text{PO}_4^{3-}$

**BONUS**

11) CHEMISTRY *Short Answer* To 2 decimal places, calculate how many moles of air are in a 4.0 liter tank at 1 atmosphere of pressure and at a temperature of 300K:

ANSWER: 0.17 (ACCEPT: 0.16 MOLES)

(Solution:  $n = PV/RT$ ;  $= (1\text{atm})(4\text{L})/0.08\text{L}\cdot\text{atm}/\text{K}\cdot\text{mol}(300\text{K})$ ;  $= 0.166\text{moles}$ )

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**TOSS-UP**

12) ASTRONOMY *Multiple Choice* Which of the following eyepieces consists of two plano-convex lenses with their flat sides towards the eye and a field stop between them:

- W) Huygens
- X) Ramsden
- Y) Kellner
- Z) Orthoscopic

ANSWER: W) HUYGENS

**BONUS**

12) 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**

13) MATH *Short Answer* In the graph of a curve such as the cosecant curve, the straight vertical line to which the curve moves closer and closer is called what:

ANSWER: ASYMPTOTE

**BONUS**

13) MATH *Short Answer* Calculate the following indefinite integral:  $I = \int (2x^2 + 3)^3 dx$

ANSWER:  $\frac{1}{16}(2x^2 + 3)^4 + C$

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**TOSS-UP**

14) EARTH SCIENCE *Short Answer* If all seismic waves leave the earthquake focus at the same instant, which seismic wave will typically be recorded by as seismograph second?

ANSWER: S-WAVE (ACCEPT: SECONDARY OR SHEAR WAVES)

**BONUS**

14) EARTH SCIENCE *Multiple Choice* In miles per second, the typical velocity of an S-wave near the Earth's surface is which of the following:

- W) 3.7
- X) 2.2
- Y) 9.7
- Z) 0.6

ANSWER: X) 2.2

**TOSS-UP**

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

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

ANSWER: Z) DETRITIVORE

**BONUS**

15) GENERAL SCIENCE *Multiple Choice* Which of the following best describes why Citrus Canker is such a large threat to Florida's citrus industry:

- W) canker scales blemish the fruit
- X) it causes early fruit drop
- Y) it rapidly kills the trees
- Z) the fruit rot before they are ready to harvest

ANSWER: X) IT CAUSES EARLY FRUIT DROP

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**TOSS-UP**

16) COMPUTER SCIENCE *Multiple Choice* In C programming, what enables programs to simulate call by reference, and to create and manipulate dynamic data structures, such as linked lists and queues:

- W) pointers
- X) controllers
- Y) processors
- Z) streams

ANSWER: W) POINTERS

**BONUS**

16) COMPUTER SCIENCE *Multiple Choice* Which of the following is NOT a legal tag in HTML:

- W) span
- X) code
- Y) pic
- Z) link



ANSWER: Y) PIC

**TOSS-UP**

17) BIOLOGY *Multiple Choice* Which of the following is well-suited for staining nuclear material and most bacterial outer surfaces:

- W) methylene blue
- X) crystal violet
- Y) eosin
- Z) safranin

ANSWER: Y) EOSIN

(Solution: methylene blue, crystal violet and safranin are cationic while eosin is anionic)

**BONUS**

17) BIOLOGY *Short Answer* Order the following intermediates as they would progress through the citric acid cycle: citrate, oxaloacetate, succinyl CoA, alpha ketogluterate

ANSWER: OXALOACETATE, CITRATE, ALPHA KETOGLUTERATE, SUCCINYL COA

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**TOSS-UP**

18) PHYSICS *Short Answer* What principal, enunciated in 1927, was to that date the most direct challenge to the deterministic nature of the universe?

ANSWER: HEISENBERG'S UNCERTAINTY PRINCIPAL (ACCEPT: INDETERMINANCY PRINCIPAL)

**BONUS**

18) PHYSICS *Short Answer* What three elemental isotopes are typically considered the starting points of the three, main, naturally-occurring radioactive decay series?

ANSWER: U-238, U-235, TH-232 (ACCEPT: URANIUM-238, URANIUM-235, THORIUM- 232)

### TOSS-UP

19) CHEMISTRY *Short Answer* The aldohexoses have 4 asymmetric carbon atoms and can therefore exist as how many stereoisomers?

ANSWER: 16

(Solution:  $2^4=16$ )

### BONUS

19) CHEMISTRY *Short Answer* Calculate the molecular weight of an ether if a 500 milliliter flask is filled with 0.6 grams of the gas at 300K and at a pressure of 380 mmHg:

ANSWER: 60G/MOL (ACCEPT: 60)

(Solution:  $n = \frac{PV}{RT}$ ;  $n = 0.0104\text{mol}$ ;  $0.6\text{g}/0.01\text{mol} = 60\text{g/mol}$ )

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### TOSS-UP

20) ASTRONOMY *Short Answer* In degrees, what is the declination of the sun at the equinox?

ANSWER: 0

### BONUS

20) ASTRONOMY *Multiple Choice* To a stargazer living in Northern Michigan, a star that lies almost exactly on the celestial equator, such as sigma Orionis, will do which of the following:

- W) spend 12 hours above the horizon and 12 hours below
- X) rise in the north and set in the south
- Y) cannot be seen
- Z) its diurnal path is cut by the horizon into unequal parts

ANSWER: W) SPEND 12 HOURS ABOVE THE HORIZON AND 12 HOURS BELOW

### TOSS-UP

21) MATH *Short Answer* Named after a German mathematician, what type of bottle has one surface with no edges and thus neither an outside nor an inside?

ANSWER: KLEIN BOTTLE (ACCEPT: KLEIN)

### BONUS

21) MATH *Short Answer* If  $\sin \theta = \frac{\sqrt{3}}{2}$  and  $\theta$  terminates in Quadrant II of the Cartesian coordinate system, in a unit circle find  $\cos \theta$ :

ANSWER: -1/2 (ACCEPT: -0.5) (answer must be negative)

(Solution:  $r^2 = x^2 + y^2$ ;  $1^2 = x^2 + (\sqrt{3}/2)^2$ ;  $x^2 = 1/4$ ;  $x = 1/2$ ; negative for Quad II)

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### TOSS-UP

22) EARTH SCIENCE *Multiple Choice* Oxygen and nitrogen molecules in the atmosphere preferentially scatter light of shorter wavelengths causing the sky to appear blue owing to what type of scattering:

- W) Rayleigh
- X) Mie
- Y) Crepuscular
- Z) parallel

ANSWER: W) RAYLEIGH

### BONUS

22) EARTH SCIENCE *Short Answer* Calculate the percent relative humidity of air at 20°C with a partial pressure of water of 0.50 kilo-Pascals if liquid water has a vapor pressure of 2.00 kilo-Pascals at that temperature:

ANSWER: 25%

(Solution: actual VP/saturation VP =  $0.5/2 = 25\%$ )

**TOSS-UP**

23) BIOLOGY *Short Answer* Which germ layer in mammals is predominantly responsible for forming the skeletal system?

ANSWER: MESODERM

**BONUS**

23) 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 somatic human cell in metaphase of mitosis?

ANSWER:  $4N$  AND  $4S$  (ACCEPT: 4 AND 4)

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**TOSS-UP**

24) CHEMISTRY *Short Answer* What common disaccharide is composed of two glucose residues?

ANSWER: MALTOSE

**BONUS**

24) CHEMISTRY *Short Answer* Which two of the following 5 amino acids contain nonpolar R groups? serine, glutamine, leucine, tyrosine, phenylalanine

ANSWER: LEUCINE, PHENYLALANINE

### **TOSS-UP**

25) PHYSICS *Short Answer* What is the most common scientific name for the form of radiation that is emitted when relativistic electrons are forced to travel through a curved trajectory in a magnetic field?

ANSWER: SYNCHROTRON RADIATION

### **BONUS**

25) PHYSICS *Short Answer* The Department of Energy's Brookhaven National Lab is the home of the RHIC, which is world's highest energy particle collider. What do the letters R, H, I, and C each respectively stand for?

ANSWER: RELATIVISTIC HEAVY ION COLLIDER