

ROUND 13

TOSS-UP

1) **BIOLOGY** *Short Answer* What is the common name for the 27-carbon lipid whose synthesis is in part regulated by HMG CoA (read as: H, M, G, koh, A) reductase and is the basic starting point for estrogen synthesis?

ANSWER: CHOLESTEROL

BONUS

1) **BIOLOGY** *Multiple Choice* Which of the following is NOT true regarding ribosomes:

- W) they are about 20 nanometers in diameter
- X) eukaryotic ribosomes are slightly larger than prokaryotic ribosomes
- Y) mitochondrial ribosomes have 40S (read as: forty S) small subunits
- Z) they are found in chloroplasts

ANSWER: Y) MITOCHONDRIAL RIBOSOMES HAVE 40S SMALL SUBUNITS

TOSS-UP

2) **CHEMISTRY** *Multiple Choice* Which of the following has a melting point of 185°C and readily dissolves in water at room temperature, but is NOT an electrolyte:

- W) NaCl
- X) decane
- Y) methane
- Z) sucrose

ANSWER: Z) SUCROSE

BONUS

2) **CHEMISTRY** *Short Answer* Give the systematic chemical name for the following ionic compound: $\text{Cr}_2(\text{SeO}_4)_3$

ANSWER: CHROMIUM(III) SELENATE

TOSS-UP

3) PHYSICS *Multiple Choice* Which of the following BEST describes the Balmer series:

- W) a series of quantum numbers indicating certain energy levels
- X) hydrogen atom spectral line emission
- Y) a sequence of elements that are produced chronologically in supernovae
- Z) the energy spectrum of the early universe

ANSWER: X) HYDROGEN ATOM SPECTRAL LINE EMISSION

BONUS

3) PHYSICS *Short Answer* According to the Standard Model of Particle Physics, through what force would the top quark decay?

ANSWER: WEAK FORCE (ACCEPT: WEAK or WEAK INTERACTION)

TOSS-UP

4) MATH *Short Answer* Express 600° in radians as a reduced fraction in terms of π :

ANSWER: $\frac{10\pi}{3}$

BONUS

4) MATH *Short Answer* Giving your answers in terms of π and in inches squared, find the total surface area of a closed right circular cone whose altitude is 8 inches and radius is 6 inches:

ANSWER: 96π

(Solution: $l^2 = 8^2 + 6^2$, $l = 10$ in; $LSA = \pi rl = \pi(6)(10) = 60\pi$; $SA = LA + B = 60\pi + \pi(6)^2 = 96\pi \text{ in}^2$)

TOSS-UP

5) EARTH SCIENCE *Multiple Choice* Which of the following is the single most important factor that generally sets a northern limit to tree growth, such as in the areas of transition between taiga and tundra in Alaska:

- W) high-winter winds
- X) lack of summer warmth
- Y) lack of spring moisture
- Z) lack of soil nutrients

ANSWER: X) LACK OF SUMMER WARMTH

BONUS

5) EARTH SCIENCE *Multiple Choice* Which of the following is NOT true of an El Nino:

- W) when an El Nino is present, fish are less abundant off the west coast of South America
- X) El Ninos typically come along every 4 to 5 years
- Y) during a peak El Nino, strong high pressure will be present in the eastern Pacific with lower pressure to the west
- Z) El Nino affects global weather patterns

ANSWER: Y) DURING A PEAK EL NINO, STRONG HIGH PRESSURE WILL BE PRESENT IN THE EASTERN PACIFIC WITH LOWER PRESSURE TO THE WEST

(Solution: during peak strong high pressure is in the western Pacific with lower pressure to the east, setting up an easterly wind flow)

TOSS-UP

6) GENERAL SCIENCE *Short Answer* Pitchblende is one of the main ores of what element?

ANSWER: URANIUM

BONUS

6) GENERAL SCIENCE *Short Answer* Order the following 3 temperature values from the COOLEST to the WARMEST: 32°C; 85°F; 310 K

ANSWER: 85°F; 32°C; 310 K

TOSS-UP

7) ASTRONOMY *Multiple Choice* The BEST explanation of why population I (read as: one) stars have a higher proportion of elements heavier than helium than population II (read as: two) stars, is because Population I stars are:

- W) younger than population II stars
- X) older than population II stars
- Y) usually closer to planetary nebula than population II stars
- Z) often found near H-I (read as: H, one) regions

ANSWER: W) YOUNGER THAN POPULATION II STARS

BONUS

7) ASTRONOMY *Short Answer* How many sidereal minutes are in 7.5 sidereal hours?

ANSWER: 450

TOSS-UP

8) BIOLOGY *Multiple Choice* Which of the following is NOT true of globular proteins in mammals:

- W) most are soluble in water
- X) some serve as transport molecules in the plasma
- Y) plasma enzymes typically have an optimal operating pH of about 6.8 to 7.0
- Z) most protein hormones are globular

ANSWER: Y) PLASMA ENZYMES TYPICALLY HAVE AN OPTIMAL OPERATING PH OF ABOUT 6.8 TO 7.0

BONUS

8) BIOLOGY *Short Answer* During photorespiration, the plant enzyme RuBisCO (read as: rue-BIS-ko) will bind what molecular substance rather than carbon dioxide?

ANSWER: OXYGEN (ACCEPT: O₂)

TOSS-UP

9) CHEMISTRY *Multiple Choice* Which of the following is a substance whose molecular and empirical formulas are NOT the same:

- W) benzene
- X) water
- Y) ammonia
- Z) sulfur dioxide

ANSWER: W) BENZENE

BONUS

9) CHEMISTRY *Multiple Choice* Which of the following is a molecule with a square pyramidal molecular geometry around its central atom:

- W) PCl_5
- X) ClF_5
- Y) XeF_4
- Z) SF_6

ANSWER: X) ClF_5

(Solution: PCl_5 = trigonal bipyramidal; XeF_4 = square planar; SF_6 = octahedral)

TOSS-UP

10) PHYSICS *Multiple Choice* Which of the following has the lowest refractive index at STP:

- W) diamond
- X) water
- Y) dry air
- Z) a perfect vacuum

ANSWER: Z) A PERFECT VACUUM

BONUS

10) PHYSICS *Short Answer* Rounded to the nearest hundred joules, how much work is done in pulling a sled across a pond for 3 meters with 100 newtons of force, with a rope that makes a 45° angle with the pond?

ANSWER: 200

(Solution: $w = F \times d \times \cos \text{angle} = 100\text{N} \times 3 \text{ m} \times 0.7071 = 212.13$)

TOSS-UP

11) MATH *Short Answer* Find the center of the circle given by the following equation:
 $x^2 + y^2 + 4x + 16y + 3 = 0$

ANSWER: (-2, -8)

BONUS

11) MATH *Short Answer* What are the coordinates of the vertex in the graph of the following equation: $y = 4x^2 + 8x - 5$

ANSWER: (-1, -9)

(Solution: $x = -b/2a = -8/2(4) = -1$; $y = 4(-1)^2 + 8(-1) - 5 = -9$)

TOSS-UP

12) EARTH SCIENCE *Multiple Choice* Which of the following is a fine-grained silica-rich sedimentary rock that is made primarily of microcrystalline quartz:

- W) shale
- X) potash
- Y) dolostone
- Z) chert

ANSWER: Z) CHERT

BONUS

12) EARTH SCIENCE *Multiple Choice* Which of the following is a foliated metamorphic rock composed of very fine-grained mica:

- W) marble
- X) phyllite
- Y) quartzite
- Z) schist

ANSWER: X) PHYLLITE

(Solution: marble = non-foliated; quartzite = non-foliated; schist = well-developed foliation)

TOSS-UP

13) GENERAL SCIENCE *Multiple Choice* The largest deposits of diatomite, or diatomaceous earth, are typically found in which of the following regions of the U.S.:

- W) western
- X) eastern
- Y) midwest
- Z) southern

ANSWER: W) WESTERN

(Solution: most formed in shallow lakes and marine environments)

BONUS

13) GENERAL SCIENCE *Multiple Choice* Diatomite, or diatomaceous earth, is readily available in the U.S. and is used primarily for which of the following functions:

- W) soil improvement
- X) crushed stone
- Y) filtering agent
- Z) lubricant

ANSWER: Y) FILTERING AGENT

TOSS-UP

14) ASTRONOMY *Multiple Choice* Which of the following is closest to the range for the Balmer series:

- W) microwave
- X) infrared through UV
- Y) UV to soft x-ray
- Z) visible light to UV

ANSWER: Z) VISIBLE LIGHT TO UV

BONUS

14) ASTRONOMY *Short Answer* Choosing from upper right, lower right, lower left, and upper left, in what area of the Hertzsprung Russell diagram will the Sun end its life?

ANSWER: LOWER LEFT

TOSS-UP

15) BIOLOGY *Multiple Choice* Which of the following is most directly responsible for the colloid osmotic pressure in humans that acts to retain fluid in the vascular system:

- W) albumin
- X) sodium ions
- Y) calcium ions
- Z) potassium ions

ANSWER: W) ALBUMIN

BONUS

15) BIOLOGY *Multiple Choice* Which of the following is NOT true of the most common form of DNA:

- W) it is a right-handed helix
- X) it has 3.4 nanometers between each successive nucleotide base of the same strand
- Y) the strands are considered anti-parallel
- Z) each strand has a 3-prime phosphate and a 5-prime hydroxyl at opposite ends

ANSWER: Z) EACH STRAND HAS A 3-PRIME PHOSPHATE AND A 5-PRIME HYDROXYL AT OPPOSITE ENDS

TOSS-UP

16) CHEMISTRY *Multiple Choice* An organic compound with the formula C_6H_{14} is an:

- W) alkane
- X) alkene
- Y) alkyne
- Z) arene

ANSWER: W) ALKANE
(Solution: alkanes = C_nH_{2n+2})

BONUS

16) CHEMISTRY *Multiple Choice* Which of the following gases has the highest effusion rate through a pinhole opening from one compartment to another and at room temperature:

- W) argon
- X) CO_2
- Y) SO_2
- Z) helium

ANSWER: Z) HELIUM

TOSS-UP

17) PHYSICS *Multiple Choice* Which of the following did J. J. Thompson use that primarily led him to conclude that electrons were basic particles of atoms and carried electric charge:

- W) a compass and batteries
- X) a solenoid
- Y) cathode ray tubes
- Z) electromagnets

ANSWER: Y) CATHODE RAY TUBES

BONUS

17) PHYSICS *Short Answer* Consider a satellite that is a uniform sphere rotating about its axis. What is its moment of inertia, giving your answer in scientific notation and in kilogram meters squared, if it has a mass of 10,000 kilograms and a diameter of 200 meters?

ANSWER: 4×10^7

(Solution: $I = (2/5)(10,000 \text{ Kg})(100\text{m})^2 = 40,000,000 \text{ kg.m}^2$)

TOSS-UP

18) MATH *Short Answer* For the function $f(x) = \frac{1}{x}$, what is $f'(5)$ (read as: f prime of 5)?

ANSWER: $\frac{-1}{25}$

(Solution: $f'(5) = \frac{-1}{5^2} = \frac{-1}{25}$)

BONUS

18) MATH *Short Answer* An object is launched straight up from the ground with an initial velocity of 176 feet per second. What is the height of the object above the ground, in feet, 2 seconds into the flight?

ANSWER: 288

(Solution: $P(t) = -16t^2 + 176t$; $P(2) = -16(4) + 352 = 288 \text{ ft}$)

TOSS-UP

19) EARTH SCIENCE *Multiple Choice* Meteorologists think of wind as circulation patterns which are divided into 4 “scales of motion”. A land-breeze circulation is grouped into which of the following categories:

- W) mesoscale
- X) microscale
- Y) medium scale
- Z) synoptic

ANSWER: X) MICROSCALE

BONUS

19) EARTH SCIENCE *Multiple Choice* If the air temperature is 0°F and the wind speed is 10 miles per hour, which of the following is closest to the wind chill, in degrees Fahrenheit:

- W) 10
- X) 0
- Y) -10
- Z) -20

ANSWER: Z) -20

TOSS-UP

20) GENERAL SCIENCE *Multiple Choice* Which of the following anthropogenic air pollutants is the major contributor to reduced visibility in most regions of the U.S., excluding fires and dust:

- W) elemental carbon
- X) hydrogen sulfide
- Y) sulfate particles
- Z) lead

ANSWER: Y) SULFATE PARTICLES

BONUS

20) GENERAL SCIENCE *Short Answer* What is the most common name for the edible vegetable oil that is derived from cultivars of rapeseed plants and is low in erucic acid?

ANSWER: CANOLA OIL (ACCEPT: CANOLA)

TOSS-UP

21) ASTRONOMY *Short Answer* Giving your answer in decimal form, what would the “Z” value be if a distant celestial object were shifted towards longer wavelengths by 40% of the original wavelength?

ANSWER: 0.4

BONUS

21) ASTRONOMY *Short Answer* If a planet had an orbital period of 11.2 years, what is the length of its orbital semi-major axis, in astronomical units rounded to the nearest whole number?

ANSWER: 5

(Solution: $d^3 = p^2$; $d^3 = (11.2)^2$; $d^3 = 125.4$; $d = 5$)

TOSS-UP

22) BIOLOGY *Short Answer* Name all of the following 3 choices that are chemoautotrophs: *Nitrosomonas* (read as: nitro-so-MOAN-us) *Paramecium*; *Volvox*

ANSWER: NITROSOMONAS

BONUS

22) BIOLOGY *Short Answer* From what vitamin is the electron carrier FAD (read as: F, A, D) derived?

ANSWER: RIBOFLAVIN (ACCEPT: VITAMIN B2)

TOSS-UP

23) CHEMISTRY *Short Answer* Name all of the following 3 concentration units that are temperature-dependent: molal (read as: moe-LAHL); molarity; normality

ANSWER: MOLARITY; NORMALITY

BONUS

23) CHEMISTRY *Short Answer* Calculate the enthalpy of vaporization, in kilojoules, of water at 25°C and 1 atmosphere. Assume the standard enthalpy of formation of liquid water is -286 kilojoules and the standard enthalpy of formation of water gas is -242 kilojoules:

ANSWER: 44

(Solution: $\Delta H^\circ_{\text{reaction}} = \sum n_p \Delta H_f^\circ(\text{products}) - \sum n_r \Delta H_f^\circ(\text{reactants}) = [-242 - (-286)] = +44.0 \text{ kJ}$)

TOSS-UP

24) PHYSICS *Short Answer* What was the most sensitive device Coulomb used to measure the electric forces between pith balls?

ANSWER: TORSION BALANCE

BONUS

24) PHYSICS *Short Answer* Order the following 3 choices from the MOST penetrating through a thin sheet of cardboard to the LEAST: beta rays; alpha rays; x-rays

ANSWER: X-RAYS; BETA RAYS; ALPHA RAYS

TOSS-UP

25) **BIOLOGY** *Short Answer* What is the most common name for the histone octamer used in the coiling and packing of DNA and regulation of gene expression?

ANSWER: NUCLEOSOMES

BONUS

25) **BIOLOGY** *Short Answer* Name all of the following 4 organelles that are bounded by a double membrane: nucleus; mitochondrion; lysosome; chloroplast

ANSWER: NUCLEUS; MITOCHONDRION; CHLOROPLAST
(ACCEPT: ALL BUT LYSOSOME)