ROUND 9

TOSS-UP

1) PHYSICS *Multiple Choice* Which of the following is the magnitude of the focal length of a spherically curved convex mirror in air, where *R* stands for the radius of curvature:

W) R divided by 1.22
X) R divided by 2
Y) R divided by 1.5
Z) R times 4

ANSWER: X) R DIVIDED BY 2

BONUS

1) PHYSICS *Short Answer* An emergency floodlight draws 1 ampere from its battery pack. How many coulombs will flow through the light in 4 hours?

ANSWER: 14,400

TOSS-UP

2) CHEMISTRY *Multiple Choice* About how many calories per gram will it take to sublimate water at standard pressure:

W) 180
X) 360
Y) 540
Z) 720

ANSWER: Z) 720

(Solution: sublimation is solid → vapor; 80 cal + 100 cal + 540 cal = 720 cal)

BONUS

2) CHEMISTRY *Multiple Choice* A Buchner (read as: BYOU-kh-ner) funnel is a piece of laboratory glassware often used in chemistry labs for which of the following procedures:

W) combustion
X) filtration
Y) centrifugation
Z) distillation

ANSWER: X) FILTRATION

TOSS-UP

3) BIOLOGY *Multiple Choice* Which of the following tissues is most directly responsible for the growth in height of a tree:

W) apical meristem
X) shoot terminus
Y) terminal cambial
Z) cambium terminus

ANSWER: W) APICAL MERISTEM

BONUS

3) BIOLOGY *Short Answer* What specific cells and how many of them border each stomal pore?

ANSWER: GUARD CELLS; 2

TOSS-UP

4) MATH *Multiple Choice* If $e^{\frac{x}{5}} = 30$, which of the following is the value of x, assuming that the natural log of 2 = 0.7, and the natural log of 15 = 2.7:

W) 15
X) 16
Y) 17
Z) 18

ANSWER: Y) 17

(Solution: $x/5 = \ln 15 + \ln 2 = 3.4$; $x/5 = 3.4$; $x = 17$)

BONUS

4) MATH *Short Answer* If the area of a regular pentagon is 280 square centimeters, what is the length, in centimeters, of each side if the apothem is 16 centimeters?

ANSWER: 7

(Solution: $A = \frac{1}{2}$ ap; $280 = \frac{1}{2}(16)(p)$; $p = 35/5 = 7$ cm)

TOSS-UP

5) EARTH SCIENCE *Multiple Choice* Tree growth is often very stunted and gnarly at the tree line of high mountains in North America. Known as Krummholz formations, this is primarily caused by:

W) winds
X) subsidence
Y) lowered atmospheric pressure
Z) low sunlight levels

ANSWER: W) WINDS

BONUS

5) EARTH SCIENCE *Multiple Choice* Which of the following is generally NOT true of the alpine versus arctic tundra biomes:

W) alpine tundra does not contain permafrost whereas arctic tundra does contain permafrost
X) alpine tundra is warmer and has a longer growing season than arctic tundra
Y) alpine tundra has a lower species diversity than arctic tundra
Z) alpine tundra has less severe winters than arctic tundra

ANSWER: Y) ALPINE TUNDRA HAS A LOWER SPECIES DIVERSITY THAN ARCTIC TUNDRA

TOSS-UP

6) GENERAL SCIENCE *Short Answer* Name 2 of the following 4 choices that are the 2 main logical reasoning methods used in science: inductive; synthetic; observational; deductive

ANSWER: INDUCTIVE; DEDUCTIVE

BONUS

6) GENERAL SCIENCE *Short Answer* To the nearest whole number, convert 50ºF into kelvin:

ANSWER: 283

(Solution: 5/9(50º – 32º) = 10º C + 273 = 283 K)

TOSS-UP

7) ASTRONOMY *Multiple Choice* Which of the following is NOT true:

W) the star Sirius at its brightest has an apparent magnitude of about negative 1.5
X) metal-rich stars sometimes have planets
Y) typical binoculars allow observation of stars with apparent magnitudes of about 9.0
Z) the Sun has an apparent magnitude of about negative 12

ANSWER: Z) THE SUN HAS AN APPARENT MAGNITUDE OF ABOUT NEGATIVE 12

(Solution: the Sun's apparent magnitude is –26.73)

BONUS

7) ASTRONOMY *Multiple Choice* Astronomers will often refer to certain stars as low metal content stars. In this sense astronomers consider metals as any element:

W) heavier than helium
X) heavier than carbon
Y) heavier than copper
Z) heavier than iron

ANSWER: W) HEAVIER THAN HELIUM

TOSS-UP

8) PHYSICS *Multiple Choice* Which of the following MOST directly determines the permittivity of a material:

W) ability of the material to magnetize
X) electrical susceptibility
Y) electrical insulation capacity
Z) electrical conductivity

ANSWER: X) ELECTRICAL SUSCEPTIBILITY

BONUS

8) PHYSICS *Short Answer* What are the SI units for permittivity?

ANSWER: FARADS PER METER

TOSS-UP

9) CHEMISTRY *Multiple Choice* Which of the following is one of the main reasons why oxygenates are used as gasoline additives:

W) allow for more complete combustion
X) decrease sulfur buildup in engine pistons
Y) prevent water condensation in stored fuels
Z) corrosion inhibition

ANSWER: W) ALLOW FOR MORE COMPLETE COMBUSTION

BONUS

9) CHEMISTRY *Short Answer* Consider the following equilibrium reaction, $PCl_{5(gas)} \leftrightarrow PCl_{3(gas)} + Cl_{2(gas)}$. If a 2 mole sample of PCl_5 dissociates to give 0.2 moles of Cl_2 at equilibrium, find the molar amounts, to the 1st decimal place, of PCl_5 at equilibrium:

ANSWER: 1.8

(Solution: 2 – 0.2 = 1.8)

TOSS-UP

10) BIOLOGY *Short Answer* During what phase of meiosis-one do homologous chromosomes exchange genetic information?

ANSWER: PROPHASE-ONE (ACCEPT: PROPHASE)

BONUS

10) BIOLOGY *Short Answer* Order the following 3 choices from the EARLIEST stage to the LATEST stage of ovarian follicle development, and identify which of the structures is typically the LARGEST: secondary follicle; corpus luteum; corpus albicans

ANSWER: SECONDARY FOLLICLE; CORPUS LUTEUM; CORPUS ALBICANS; LARGEST = CORPUS LUTEUM

TOSS-UP

11) MATH *Short Answer* A circle has a diameter of 32 meters. Find the degree measure of the central angle of a sector of the circle if its arc length measures 8π meters:

ANSWER: 90

(Solution: arc/circumference = $n^o/360^o$; n = 90^o or $(8\pi/2\pi16)(360^o) = 90^o$)

BONUS

11) MATH *Short Answer* Find the sum of the first 10 terms of the arithmetic sequence whose first three terms are 7, 11, and 15:

ANSWER: 250

TOSS-UP

12) EARTH SCIENCE *Multiple Choice* Which of the following is the most common type of ocean tide throughout the world and is the type found along the U.S. Pacific coast:

W) diurnal
X) semidiurnal
Y) mixed
Z) zonal

ANSWER: Y) MIXED

BONUS

12) EARTH SCIENCE *Multiple Choice* In which of the following regions of the world's oceans are you most likely to find the greatest uniformity in density changes with increasing depth:

W) equator
X) tropics
Y) high latitudes
Z) desert latitudes

ANSWER: Y) HIGH LATITUDES

(Solution: at high polar latitudes, change is nearly constant)

TOSS-UP

13) GENERAL SCIENCE *Multiple Choice* Which of the following is a jaw-less fish:

W) lungfish
X) catfish
Y) lamprey
Z) sturgeon

ANSWER: Y) LAMPREY

BONUS

13) GENERAL SCIENCE *Short Answer* In the northern hemisphere, name all of the following 4 northern degree latitudes that will experience a 12-hour length of day during the vernal equinox: 0º; 10º; 15º; 20º

ANSWER: ALL

TOSS-UP

14) ASTRONOMY *Short Answer* As a comet approaches the Sun, most of its icy substances are released during what phase change process?

ANSWER: SUBLIMATION

BONUS

14) ASTRONOMY *Multiple Choice* During which of the following orbital arrangements can a transit occur for the planet Venus:

W) opposition
X) greatest eastern elongation
Y) superior conjunction
Z) inferior conjunction

ANSWER: Z) INFERIOR CONJUNCTION

TOSS-UP

15) PHYSICS *Short Answer* What is the general term for the process of making different types of semiconductors by adding slight amounts of impurities into the silicon matrix?

ANSWER: DOPING

BONUS

15) PHYSICS *Short Answer* What specific type of semiconductor is produced by doping silicon with arsenic?

ANSWER: N-TYPE

TOSS-UP

16) CHEMISTRY *Multiple Choice* The reaction $CuCl_2 + Na_2S \rightarrow CuS + 2NaCl_2$, is an example of what class of chemical reaction:

W) synthesis
X) single replacement
Y) double replacement
Z) decomposition

ANSWER: Y) DOUBLE REPLACEMENT

BONUS

16) CHEMISTRY *Short Answer* Name all of the following 4 species that contain an odd number of electrons: O_2^{1-}; O_2^{2-}; SO_2; CO

ANSWER: O_2^{1-}

TOSS-UP

17) BIOLOGY *Multiple Choice* Which of the following is the most common term for an area of primitive cells in plants where active cell division occurs:

W) meristem
X) ground tissue
Y) primary cells
Z) germinal tissue

ANSWER: W) MERISTEM

BONUS

17) BIOLOGY *Short Answer* What is the layer typically found between 2 plant cell walls of adjoining plant cells which is composed of pectin?

ANSWER: MIDDLE LAMELLA

TOSS-UP

18) MATH *Short Answer* What is the name for the test that can be used to visually determine whether or not a relation defined by a graph represents a function?

ANSWER: VERTICAL LINE TEST (ACCEPT: VERTICAL LINE)

BONUS

18) MATH *Short Answer* Find the x and y intercepts of the line passing through the point (4, 8) that is perpendicular to the line $3x - 6y - 12 = 0$:

ANSWER: X-INTERCEPT = (8, 0) (ACCEPT: 8); Y-INTERCEPT = (0, 16) (ACCEPT: 16)

TOSS-UP

19) EARTH SCIENCE *Multiple Choice* Which of the following is a medium or coarse-grained rock that consists primarily of plagioclase feldspar and pyroxene and is essentially the plutonic equivalent of basalt:

W) diorite
X) rhyolite
Y) andesite
Z) gabbro

ANSWER: Z) GABBRO

BONUS

19) EARTH SCIENCE *Multiple Choice* Scoria is most typically described as having which of the following textures:

W) phaneritic
X) fragmental
Y) porphyritic
Z) vesicular

ANSWER: Z) VESICULAR

TOSS-UP

20) GENERAL SCIENCE *Multiple Choice* Blepharitis (read as: bleff-ah-rye-tis) in humans is an inflammation of the:

W) urinary bladder
X) eyelid
Y) fingernail
Z) tongue

ANSWER: X) EYELID

BONUS

20) GENERAL SCIENCE *Multiple Choice* Which of the following is a principal component of a siderite meteorite:

W) neptunium
X) carbon
Y) iron
Z) erbium

ANSWER: Y) IRON

TOSS-UP

21) ASTRONOMY *Short Answer* Which 2 of the following 4 factors most directly determine the apparent visual magnitude of a star: distance from Earth; intrinsic brightness; color; age

ANSWER: DISTANCE FROM EARTH; INTRINSIC BRIGHTNESS

BONUS

21) ASTRONOMY *Short Answer* What 2 characteristics of Uranus are most commonly noted as the reasons why Uranus was not discovered until the late 1700's?

ANSWER: APPARENT MAGNITUDE; ORBITAL PERIOD (ACCEPT: BRIGHTNESS or MAGNITUDE)

TOSS-UP

22) PHYSICS *Short Answer* In the electrolysis of water, if the production of each molecule of oxygen requires 4 units of electricity, each hydrogen molecule will require how many units of electricity?

ANSWER: 2

BONUS

22) PHYSICS *Short Answer* What is the maximum number of 100-watt light bulbs that can run on a 110-volt residential circuit protected by a 15-amp fuse without blowing the fuse?

ANSWER: 16

(Solution: 100W/110 = 0.9 amps; 15 amp fuse/0.9 amp = 16.7 or 16 bulbs)

TOSS-UP

23) CHEMISTRY *Short Answer* What are the 2 alkenes (read as: al-KEENS) with the shortest carbon chains and lowest molecular weights?

ANSWER: ETHYLENE; PROPYLENE (ACCEPT: ETHENE; PROPENE)

BONUS

23) CHEMISTRY *Short Answer* Arrange the following 4 metals in order of increasing reactivity in dilute HCl: zinc; aluminum; gold; calcium

ANSWER: GOLD; ZINC; ALUMINUM; CALCIUM

TOSS-UP

24) BIOLOGY *Short Answer* Which one of basic plant cell types has a primary and secondary cell wall that is dead when mature?

ANSWER: SCLERENCHYMA

BONUS

24) BIOLOGY *Short Answer* Name all of the following 4 plants that produce seeds: cycads; ferns; mosses; conifers

ANSWER: CYCADS; CONIFERS

TOSS-UP

25) CHEMISTRY *Short Answer* What is the general name for a substance that facilitates a chemical reaction by providing an alternative reaction pathway with a lower activation energy while remaining unaltered?

ANSWER: CATALYST

BONUS

25) CHEMISTRY *Short Answer* You need to prepare 500 milliliters of a 0.100 molar NaOH solution from a 0.250 molar solution. What volume, in milliliters, of the 0.250 molar solution must be diluted to 500 milliliters?

ANSWER: 200

(Solution: $M_1V_1 = M_2V_2$; $(0.250M)(x) = (0.100M)(500ml)$, $x = 200$ ml)