

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 sublime water at standard pressure:

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

ANSWER: Z) 720

(Solution: sublimation is solid \rightarrow vapor; $80 \text{ cal} + 100 \text{ cal} + 540 \text{ cal} = 720 \text{ cal}$)

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 50°F into kelvin:

ANSWER: 283

(Solution: $5/9(50^\circ - 32^\circ) = 10^\circ \text{ C} + 273 = 283 \text{ K}$)

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, $\text{PCl}_{5(\text{gas})} \leftrightarrow \text{PCl}_{3(\text{gas})} + \text{Cl}_{2(\text{gas})}$. 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: $\text{arc/circumference} = n^\circ/360^\circ$; $n = 90^\circ$ or $(8\pi/2\pi 16)(360^\circ) = 90^\circ$)

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:
0°; 10°; 15°; 20°

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 $\text{CuCl}_2 + \text{Na}_2\text{S} \rightarrow \text{CuS} + 2\text{NaCl}$, 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; $15 \text{ amp fuse}/0.9 \text{ amp} = 16.7$ 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: $M_1V_1 = M_2V_2$; $(0.250M)(x) = (0.100M)(500\text{ml})$, $x = 200\text{ ml}$)