**TOSS-UP**

1) PHYSICS *Short Answer* The potential at a point due to a unit positive charge is found to be V. If the distance between the charge and the point is quadrupled, what is the new value of the potential?

ANSWER: V/4

**TOSS UP**

1) CHEMISTRY *Multiple Choice* The mineral KAlSi3O8 has a net oxidation state of 0. What is the oxidation state of Al in the mineral?

W) 0

X) +2

Y) +3

Z) +4

ANSWER: Y) +3

**TOSS-UP**

2) BIOLOGY *Short Answer* Denote which of the following statements are true of simple columnar epithelial cells.

1: They are a single layer of tall cells. 2: They line most of the digestive track. 3: They function in the absorption and secretion of substances.   
4: Most are ciliated.

ANSWER: 1, 2, 3

**TOSS UP**

2) EARTH AND SPACE SCIENCE *Short Answer* What type of wind, a common occurrence in southern California termed Santa Ana winds, carry high density air from a higher elevation, down a slope under the force of gravity?

ANSWER: KATABATIC WIND

**TOSS-UP**

3) MATH *Short Answer* Convert the number 79 to hexadecimal.

ANSWER: 4F

**TOSS UP**

3) ENERGY *Short Answer* What is the collective name for substances with nuclides which tend to undergo a fission reaction after they capture a slow neutron?

ANSWER: FISSILE MATERIALS

**TOSS-UP**

4) PHYSICS *Short Answer* Gauss’s law for magnetism states that the total magnetic flux through a closed surface is always what value?

ANSWER: ZERO

**TOSS UP**

4) CHEMISTRY *Short Answer* 112 g of an isotope are present at t = 0. At t = 18 minutes, 28 g of isotope remain. What is the half life of the isotope?

ANSWER: 9 MINUTES

**TOSS-UP**

5) BIOLOGY *Short Answer* Name all of the following cranial nerves which are correctly matched with their function.

1: Trochlear- Controls constriction of the pupil   
2: Trigeminal- Sensation in the face   
3: Hypoglossal- Motor function of the tongue 4: Abducens- Controls the opening of the eyelid

ANSWER: 2 and 3

**TOSS UP**

5) EARTH AND SPACE SCIENCE *Short Answer* What class of lava flow, characterized by basaltic lava with a smooth, undulating surface, advances as a series of small lobes and toes, and is prevalent in many Hawaiian volcanoes?

ANSWER: PAHOEHOE

**TOSS-UP**

6) MATH *Multiple Choice* If sn=1+, then which of the following is true?

W) sn diverges to infinity X) sn converges to 0 Y) The limit of n approaching infinity of sn is 1. Z) The limit of n approaching infinity of sn is 0.

ANSWER: Y) THE LIMIT OF N APPROACHING INFINITY OF SN IS 1.

**TOSS UP**

6) ENERGY *Short Answer* What is the process of breaking down a high-molecular-weight substance into a lower molecular weight product, achieved using catalysts and heat?

ANSWER: CRACKING

**TOSS-UP**

7) PHYSICS *Short Answer* Unpolarized light of intensity Io is incident on a polarizer. Calculate, in terms of Io, the intensity of light transmitted through the polarizer.

ANSWER: Io/2

**TOSS UP**

7) CHEMISTRY *Multiple Choice* What is the pH range of phenolphthalein?

W) 3.1-4.4

X) 4.2-6.3

Y) 6.8-8.4  
Z) 8.3-10.0

ANSWER: Z) 8.3-10.0

**TOSS-UP**

8) BIOLOGY *Short Answer* Name the thin tubes which collect bile secreted by the hepatocytes, which merge into the common hepatic duct.

ANSWER: BILE CANALICULI

**TOSS UP**

8) EARTH AND SPACE SCIENCE *Short Answer* What is the cone of debris found near the mouth of a canyon, caused by sporadic rains which pull sediment from a mountain and spreads it over the mountain’s base?

ANSWER: ALLUVIAL FAN

**TOSS-UP**

9) MATH *Multiple Choice* What is the definite integral evaluated from 0 to 1 of the function xex dx?

W) 1 X) -1 Y) e+1 Z) e-1

ANSWER: W) 1

**TOSS UP**

9) ENERGY *Short Answer* What early 20th century prediction states that an ideal black body at thermal equilibrium will emit radiation with infinite power?

ANSWER: ULTRAVIOLET CATASTROPHE

**TOSS-UP**

10) PHYSICS *Short Answer* Name the device which consists of two superconductors, separated by an oxide layer of a few atoms thick, in which electron pairs tunnel through the barrier, giving the device unusual circuit properties.

ANSWER: JOSEPHSON JUNCTION

**TOSS UP**

10) CHEMISTRY *Short Answer* Rank the following elements in increasing order of their reactivity with fluorine:

1: Carbon

2: Lithium

3: Cesium

4: Oxygen

ANSWER: 4, 1, 2, 3

**TOSS-UP**

11) BIOLOGY *Short Answer* What is the hormone disorder caused by high levels of cortisol in the blood, usually caused by taking glucocorticoid drugs, or by tumors that produce cortisol or adrenocorticotropic hormone?

ANSWER: CUSHING’S SYNDROME

**TOSS UP**

11) EARTH AND SPACE SCIENCE *Short Answer* What is another name given to deep ocean circulation, since the density variations that cause it are caused by differences in temperature and salinity?

ANSWER: THERMOHALINE CIRCULATION

**TOSS-UP**

12) MATH *Multiple Choice* At what x coordinate is the tangent to the curve of y=xe-x horizontal?

W) -1 X) 0 Y) 1 Z)1/e

ANSWER: Y) 1

**TOSS UP**

12) ENERGY *Short Answer* What hypothesis first proposed the idea that the solar system

formed out of a rotating cloud of gas and dust?

ANSWER: KANT-LAPLACE HYPOTHESIS

**TOSS-UP**

13) PHYSICS *Short Answer* Denote all of the following statements which are true of the Standard Model of Particle Physics. ☺

1: Color confinement results in quarks being perpetually bound to one another.

2: Leptons can be considered fermions.

3: Quarks have ½ spins.

4: Pions and kaons are classified as mesons.

ANSWER: ALL

**TOSS UP**

13) CHEMISTRY *Short Answer* The epoxidation of propene by peroxyacetic acid yields epoxypropane and what other product?

ANSWER: ACETIC ACID

**TOSS-UP**

14) BIOLOGY *Short Answer* What is the name of the DNA binding protein motif, the first to be recognized, which is composed of two alpha helices connected by a short strand of amino acids?

ANSWER: HELIX TURN HELIX

**TOSS UP**

14) EARTH AND SPACE SCIENCE *Multiple Choice* What process, which relies on supercooling and supersaturation, generates much of the precipitation in the middle latitudes?

W) Koppen Process X) Bergeron Process Y) Condensation Process Z) Cloud Process

ANSWER: X) BERGERON PROCESS

**TOSS-UP**

15) MATH *Short Answer* What is the definite integral from 0 to ½ of the function dx/sqrt(1-x2)?

ANSWER: π/6

**TOSS UP**

15) ENERGY *Short Answer* What is the name of the maximum temperature at which a fluid can exist in both the gas and liquid phases?

ANSWER: CRICONDENTHERM

**TOSS-UP**

16) PHYSICS *Short Answer* Denote which of the following are false regarding thermodynamics.

1: The internal energy of an ideal gas depends only on its temperature.

2: Adiabatic compressions of a gas lead to a drop in temperature.

3: The total entropy change during any reversible cycle is zero.

4: The Boltzmann constant relates kinetic energy of a particle to temperature of the gas.

ANSWER: 1, 3 and 4

**TOSS UP**

16) CHEMISTRY *Short Answer* What law states that an aromatic compound must have 4n+2 electrons in the delocalized p-orbital cloud?

ANSWER: HUCKELS RULE

**TOSS-UP**

17) BIOLOGY *Short Answer* What area of the spleen is composed mostly of lymphocytes suspended on reticular fibers?

ANSWER: WHITE PULP

**TOSS UP**

17) EARTH AND SPACE SCIENCE *Short Answer* What is the name of the huge impact crater found on the asteroid, 4 Vesta, which covers most of its southern hemisphere, and includes possibly the tallest mountain in the solar system?

ANSWER: RHEASILVIA

**TOSS-UP**

18) MATH *Short Answer* What is the name of the formula which established the relationship between trigonometric functions and complex exponential functions?

ANSWER: EULER’S FORMULA

**TOSS UP**

18) ENERGY*Multiple Choice* Which country uses the most solar energy?

W) USA X) Germany Y) Spain Z) China

ANSWER: X) GERMANY

**TOSS-UP**

19) PHYSICS *Multiple Choice* What is the critical angle for a ray of light traveling from a substance with an index of refraction of 2/3, into a substance with an index of refraction of 1/3?

W) 30 degrees

X) 45 degrees

Y) 60 degrees  
Z) 90 degrees

ANSWER: W) 30 DEGREES

**TOSS UP**

19) CHEMISTRY *Short Answer* Denote which of the following statements are true of chemical bonds.

1: Dipole moments are expressed in units of the debye.

2: Methanol is more polar than methane.

3: Esters and amides are carboxylic acid derivatives.

4: A nitrile is a compound containing a cyano group.

ANSWER: ALL

**TOSS-UP**

20) BIOLOGY *Short Answer* Which interleukin, secreted by activated macrophages, promotes both inflammation and T-cell activation, as well as fever?

ANSWER: INTERLEUKIN 1 (IL 1)

**TOSS UP**

20) EARTH AND SPACE SCIENCE *Short Answer* Denote all of the following statements which are true of shield volcanoes.

1: They can be up to 9000 meters high. 2: They are capable of ejecting pyroclastic materials 3: Their magma is composed of basalt.   
4: Mt. Vesuvius is an example of one.

ANSWER: 1 and 3

**TOSS-UP**

21) MATH *Short Answer* What are the non zero vectors of a square matrix, that, after being multiplied by the matrix, remain parallel to the original vector?

ANSWER: EIGENVECTORS

**TOSS UP**

21) ENERGY *Short Answer* What is the term used to describe the amount of radiation from the sun that reaches the earth’s atmosphere, approximately 1370 W/m2?

ANSWER: SOLAR CONSTANT

**TOSS-UP**

22) PHYSICS *Multiple Choice* What is the force experienced by a 5 coulomb charge moving perpendicular to a 10 tesla magnetic field if it is moving at 2 meters/second?

W) 50 Newtons

X) 100 Newtons

Y) 150 Newtons

Z) 200 Newtons

ANSWER: X) 100 NEWTONS

**TOSS UP**

22) CHEMISTRY *Short Answer* What word is used to refer to functional groups on two adjacent carbons in a molecule?

ANSWER: VICINAL

**TOSS-UP**

23) BIOLOGY *Short Answer* What is the name of the condition, common in diabetics, characterized by high levels of glucose in the urine?

ANSWER: GLYCOSURIA

**TOSS UP**

23) EARTH AND SPACE SCIENCE *Multiple Choice* What galaxy type is the Milky Way?

W) Spiral X) Barred Spiral Y) Elliptical Z) Irregular

ANSWER: X) BARRED SPIRAL

**TOSS-UP**

24) MATH *Short Answer* Find the equation of the sphere with center C = (0, 1, -1) and radius r = 4.

ANSWER: x2+(y-1)2+(z+1)2=16

**TOSS UP**

24) ENERGY *Short Answer* If 100 joules of energy are added to a 5 kg substance and its temperature increases by 4 degrees Celsius, what is its specific heat capacity?

ANSWER: 5 J/kg degree Celsius

**TOSS-UP**

25) BIOLOGY *Short Answer* Which family of calcium dependent transmembrane proteins, with an important role in cell adhesion, specifically at cell-cell junctions such as adherens junctions?

ANSWER: CADHERINS

**TOSS UP**

25) CHEMISTRY *Multiple Choice* The mirror image of a carbon with sp2 hybridization is its:

W) Enantiomer  
X) Tautomer  
Y) Diasteromer  
Z) Self

ANSWER: Z) SELF