**TOSS-UP**

1) CHEMISTRY *Multiple Choice* Which of the following single bonds contains the best sigma star acceptor orbital?

W) C-C

X) C-N

Y) C-O

Z) C-F

ANSWER: Z) C-F

**BONUS**

1) CHEMISTRY *Short Answer* What functional group is most commonly used as the protecting group for a carboxylic acid?

ANSWER: ESTER

**TOSS-UP**

2) BIOLOGY *Short Answer* What category of diseases includes diseases such as scrapie in sheep, “mad cow” disease in cattle, and kuru and Creutzfeldt-Jakob disease in humans?

ANSWER: TRANSMISSIBLE SPONGIFORM ENCEPHALOPATHIES (TSEs)

**BONUS**

2) BIOLOGY *Short Answer* What clinical term is given to the abnormal accumulation of fluid within the peritoneal cavity?

ANSWER: ASCITES

**TOSS-UP**

1. 3) PHYSICS *Short Answer* What quantity is denoted by the following expression: eh/4pi m, also represented by the symbol, mu sub B.

ANSWER: BOHR MAGNETON

**BONUS**

3) PHYSICS *Short Answer*  Using Curie’s Law, identify all of the following relationships that would produce a straight line with slope of 1/Curie’s constant.

I. The graph of the quantity of the magnetic field/absolute temperature vs. magnetization.

II. The graph of magnetization vs. the quantity of the magnetic field/absolute temperature.

III. The graph of the quantity of absolute temperature \* magnetization vs. the magnetic field.

IV. The graph of the magnetic field vs. the quantity of magnetization \* temperature.

ANSWER: I AND IV

**TOSS-UP**

4) EARTH AND SPACE SCIENCE *Short Answer* What is the term given to flamelike jets of gas extending upwards into the sun’s chromosphere and lasting 5 to 15 minutes?

ANSWER: SPICULES

**BONUS**

4) EARTH AND SPACE SCIENCE *Short Answer* What is the name of the effect when an electrical conductor rotates and is stirred by convection and it can convert some of the energy flowing outward as convection into a magnetic field?

ANSWER: DYNAMO EFFECT

**TOSS-UP**

5) MATHEMATICS *Short Answer* Consider the following set of parametric equations:

y = 3t^2 + 18t + 7 and x = t^2 + 6t + 17. Calculate dy/dx.

ANSWER: 3

**BONUS**

5) MATHEMATICS *Short Answer* Calculate the absolute value of the area from the intersection of this function with the x and y-axes.

ANSWER: 968/3

**TOSS-UP**

6) ENERGY *Multiple Choice* Which of the following is not a state function?

W) heat

X) enthalpy

Y) entropy

Z) Gibbs free energy

ANSWER: W) HEAT

**BONUS**

6) ENERGY *Short Answer* By name or number, identify all of the following quantities that must be zero if a reaction is at equilibrium in a closed rigid vessel at constant temperature.

I. delta S

II. delta H

III. delta U

IV. delta G

V. delta A

ANSWER: V ONLY

**TOSS-UP**

7) CHEMISTRY *Multiple Choice* Which of the following equilibria will have a Kc value that is more than its Kp value?

W) 2A(g) + B(g) == C(g) + D(g)

X) A(g) + B(g) == 2C(g)

Y) A(s) + B(l) == C(g) + D(aq)

Z) A(g) == B(g) + C(g)

ANSWER: W) 2A(g) + B(g) == C(g) + D(g)

**BONUS**

7) CHEMISTRY *Short Answer* By name or number, identify all of the following four statements that are true about reaction equilibria.

I. If Q is greater than K, the reaction will proceed to the right.

II. In the generic equilibrium A(aq) + B(aq) == C(aq) + D(aq), if D is removed from the reaction container, Q will change to become less than K.

III. In the generic gaseous equilibrium 3A(g) + B(g) == 2C(g), adding the inert gas helium to increase the pressure will shift the equilibrium to the right.

IV. In the generic equilibrium A(aq) + B(aq) == C(aq) for which the forward reaction is endothermic, increasing the temperature will shift the equilibrium to the right.

ANSWER: II AND IV

**TOSS-UP**

8) BIOLOGY *Multiple Choice*  Which of the following INCORRECTLY matches the organism with the total number of chromosomes each cell contains?

W) chimpanzee - 48

1. X) dog - 64

Y) chicken - 78

Z) sugarcane - 80

ANSWER: X) DOG - 64

**BONUS**

8) BIOLOGY *Short Answer* Giving your answer as broad or narrow, identify the range of specificity of each of the following mammalian growth factors: epidermal growth factor, interleukin-2, nerve growth factor, erythropoietin

ANSWER: BROAD, NARROW, NARROW, NARROW

**TOSS-UP**

9) PHYSICS *Short Answer* By name or number, identify all of the following statements that are true about an object starting from rest and accelerating uniformly.

I. Its kinetic energy is proportional to its displacement.

II. Its speed is proportional to the square root of its displacement.

III. Its kinetic energy is proportional to the square of its speed.

IV. Its velocity is proportional to the square of the elapsed time.

ANSWER: I, II AND III

**BONUS**

9) PHYSICS *Multiple Choice* The induced voltage will not be decreased by doing each of the following except:

W) increasing the speed of rotation

X) using a rotating loop with an iron core

Y) using a commutator

Z) moving the north and south poles further apart

ANSWER: Z) MOVING THE NORTH AND SOUTH POLES FURTHER APART

**TOSS-UP**

1. 10) EARTH AND SPACE SCIENCE *Short Answer* By name or number, identify all of the following statements that are true about types of clouds.
2. I. Cirrus clouds are best described as sheets or layers that cover much of the sky.
3. II. Cumulus clouds that undergo vertical development are called cumulonimbus clouds.
4. III. Cumulus clouds are often associated with fair weather.
5. IV. Nimbostratus clouds are some of the highest clouds in the sky.

ANSWER: II and III

**BONUS**

10) EARTH AND SPACE SCIENCE *Short Answer* Answer the following two questions about the outer core.

A) Identify the four elements that make up the vast majority of the outer core.

B) Which one of the following percentages best approximates the mass percentage composition of the element that makes up the most mass in the outer core of the Earth?

W) 55%

X) 65%

Y) 75%

Z) 85%

ANSWER: IRON, NICKEL, SULFUR, OXYGEN; Z) 85%

**TOSS-UP**

11) MATH *Multiple Choice* If the vertices of a triangle are (x,0), (y,8) and (0,0), then the area of the triangle is equivalent to which of the following quantities?

W) 4 \* abs (x)

X) 2 \* abs (y)

Y) abs (xy)

Z) 2 abs (xy)

ANSWER: W) 4 \* abs (x)

**BONUS**

11) MATH *Short Answer* Each term of a sequence, after the first, is inversely proportional to the term preceding it. If the first two terms are 2 and 6, what is the twelfth term?

ANSWER: 6

**TOSS-UP**

12) ENERGY *Short Answer* What is the collective name for fuel made by chemically reacting alcohol with vegetable oils, animal fats, or greases?

ANSWER: BIODIESEL

**BONUS**

12) ENERGY *Short Answer* What process is the collective name for the set of chemical reactions that convert a mixture of carbon monoxide and hydrogen into liquid hydrocarbons?

ANSWER: FISCHER-TROPSCH PROCESS

**TOSS-UP**

13) CHEMISTRY *Multiple Choice* The addition of concentrated sulfuric acid to tert-butanol is a classic example of:

W) an E1 reaction

X) an E2 reaction

Y) a Sn1 reaction

Z) a Sn2 reaction

ANSWER: W) E1 REACTION

**BONUS**

13) CHEMISTRY *Short Answer*  Iodometry, as opposed to iodimetry, is a redox titration based on the appearance and disappearance of iodine when it is reduced to the iodide ion. What is the principal reducing agent used with iodine in iodometry?

ANSWER: THIOSULFATE (accept thiosulfate salts)

**TOSS-UP**

14) BIOLOGY *Multiple Choice* Which of the following is not an example of archaebacteria?

W) methanogens

X) thermophiles

Y) halophiles

Z) sulfur bacteria

ANSWER: Z) SULFUR BACTERIA

**BONUS**

14) BIOLOGY *Short Answer* What rule states that altruistic acts are favored when b/c > 1/r, where b is benefits, c is costs and r is the coefficient of relatedness?

ANSWER: HAMILTON’S RULE

**TOSS-UP**

15) PHYSICS *Short Answer*  By name or number identify all of the following properties of light that are not changed when a beam of light goes obliquely from a rarer to a denser medium.

I. amplitude

II. direction

III. wavelength

IV. frequency

ANSWER: IV ONLY

**BONUS**

15) PHYSICS *Multiple Choice* Consider a wave pattern produced by a vibrating source moving at constant speed. If the source were to accelerate, the wavelength immediately in front of the source would do which of the following?

W) increase only

X) decrease only

Y) first increase and then decrease

Z) first decrease and then increase

ANSWER: X) DECREASE ONLY

**TOSS-UP**

16) EARTH AND SPACE SCIENCE *Short Answer* What is the name for the characteristic landform of the desert, classified as an eroded bedrock surface, that is characterized by broad, gently sloping platforms of bedrock left behind as a mountain front erodes and retreats from its valley?

ANSWER: PEDIMENT

**BONUS**

16) EARTH AND SPACE SCIENCE *Multiple Choice* Consider a piece of apatite and a piece of orthoclase, both in pristine condition. When rubbed against each other, which of the following events would occur?

W) The apatite would be scratched and the orthoclase would remain in pristine condition.

X) The orthoclase would be scratched and the apatite would remain in pristine condition.

Y) The apatite and orthoclase would both remain in pristine condition.

Z) The apatite and orthoclase would both be scratched.

ANSWER: W) THE APATITE WOULD BE SCRATCHED AND THE ORTHOCLASE WOULD REMAIN IN PRISTINE CONDITION

**TOSS-UP**

17) MATH *Multiple Choice* Given that log base a of 5 equals x and log base a of 7 equals y, express log base a of sqroot 1.4 in terms of x and y.

W) xy/2

X) (x-2y)/2

Y) (y+x)/2

Z) (y-x)/2

ANSWER: Z) (y-x)/2

**BONUS**

17) MATH *Short Answer* Identify all of the quadrants that contain the solution set of 3x + 4y < 0

ANSWER: II, III AND IV

**TOSS-UP**

18) ENERGY *Multiple Choice* About what percent of the coal mined in 2009 was lignite?

W) 7%

X) 12%

Y) 17%

Z) 22%

ANSWER: W) 7%

**BONUS**

18) ENERGY *Short Answer* What is the name of a more efficient and safer underground mining method, in which a specifically shielded machine is used to allow a mined-out area to collapse in a controlled manner?

ANSWER: LONGWALL MINING

**TOSS-UP**

19) CHEMISTRY *Short Answer* What is the common name for a compound with a carbonyl group with a hydroxyl group beta to it?

ANSWER: ALDOL

**BONUS**

19) CHEMISTRY *Short Answer* Answer all of the following questions about the relationship between ketones and enols.

1. What specific type of isomers are exemplified in the ketone-enol relationship?
2. Identify which one of the following is true about the stability of ketones in relation to enols:

W) ketones are more stable than enols because the charge is better stabilized in ketones

X) ketones are more stable than enols because the sum of the bond enthalpies of C-H and C=O is greater than the sum of the bond enthalpies of O-H and C=C

Y) enols are more stable than ketones because the charge is better stabilized in enols

Z) enols are more stable than ketones because the sum of the bond enthalpies of O-H and C=C is greater than the sum of the bond enthalpies of C-H and C=O

ANSWER: TAUTOMERS; X

**TOSS-UP**

20) BIOLOGY *Short Answer*  All the members of the oomycetes are either one of two types. Identify these two types.

ANSWER: PARASITES, SAPROBES

**BONUS**

20) BIOLOGY *Short Answer* By name or number, identify all of the following four statements that are true.

I. Class A genes alone specify the sepals.

II. Class A and Class B genes together specify the petals.

III. Class B and Class C genes together specify the stamens.

IV. Class C genes alone specify the carpels.

ANSWER: ALL OF THEM

**TOSS-UP**

21) PHYSICS *Multiple Choice* Since light rays are always diverged by concave lenses, such lenses can only form which of the following types of images?

W) black and white images

X) inverted images

Y) erect images

Z) magnified images

ANSWER: Y) ERECT

**BONUS**

21) PHYSICS *Short Answer* Identify all of the following three methods that would reduce the resistance of a coil of wire to one-half of its value.

I. Cut off one-half of the wire.

II. Reduce the coil’s temperature to one-half of its value.

III. Double the current.

ANSWER: I ONLY

**TOSS-UP**

22) EARTH AND SPACE SCIENCE *Multiple Choice* What class of stars is classified as stars exclusively containing small quantities of metal formed in the Big Band, such as lithium-7?

W) Population I

X) Population II

Y) Population III

Z) Population OIL RIG

ANSWER: Y) POPULATION III

**BONUS**

22) EARTH AND SPACE SCIENCE *Short Answer* What is the term given when the effects of a normal astronomical high tide and a storm surge coincide?

ANSWER: STORM TIDE

**TOSS-UP**

23) MATH *Multiple Choice* If there are known to be 4 broken transistors in a box of 12, and 3 transistors are drawn at random, what is the probability that none of the 3 is broken?

W) 0.255

X) 0.375

Y) 0.556

Z) 0.750

ANSWER: W) 0.255

**BONUS**

23) MATH *Short Answer* Four men, Ram, Gopal, Hanuman and Ganesh line up in a row. What is the probability that Ram is at either end of the row?

ANSWER: ½

**TOSS-UP**

24) ENERGY *Short Answer* : In what order of reactions is the half-life directly proportional to the reactant concentration?

ANSWER: ZERO-ORDER REACTION

**BONUS**

24) ENERGY *Short Answer* What is the name of the following formula: S = k ln W

ANSWER: BOLTZMANN’S FORMULA

**TOSS-UP**

25) CHEMISTRY *Short Answer*  What set of rules are used to assign priorities to atoms in a molecule to assign stereochemistry to that molecule?

ANSWER: CAHN-INGOLD-PRELOG PRIORITY RULES (ACCEPT CIP PRIORITY RULES)

**BONUS**

25) CHEMISTRY *Multiple Choice* In octahedral coordination complexes, what is the collective name given to the dxy, dyz and dxz orbitals of the central atom?

W) t2g orbitals

X) e2 orbitals

Y) t2 orbitals

1. Z) eg orbitals

ANSWER: W) t2g ORBITALS