**TOSS-UP**

1) CHEMISTRY *Multiple Choice* How many unique compounds have the formula C3H8O?

W) 1

X) 2

Y) 3

Z) 4

ANSWER: Y) 3

**VISUAL BONUS**

1) CHEMISTRY *Short Answer* In the visual displayed, results of an experiment to determine the rate law of a reaction are given to you. The rate law of this reaction has the following form: rate = k times the concentration of iodide to the x power times the concentration of iodate to the y power times the concentration of hydrogen ions to the z power. Calculate the sum x+y+z.

ANSWER: 5

**TOSS-UP**

2) BIOLOGY *Short Answer* What pathogen causes typhoid fever in humans?

ANSWER: SALMONELLA TYPHI

**VISUAL BONUS**

2) BIOLOGY *Short Answer* Identify all missing parts of this euglenoid with the following word bank: basal body, chloroplast, paramylon granule, stigma and nucleus

ANSWER: A – STIGMA; B – BASAL BODY; C – NUCLEUS, D – CHLOROPLAST; E – PARAMYLON GRANULE

**TOSS-UP**

1. 3) PHYSICS *Short Answer* A charged particle is placed in an electric field E. If the charge on the particle is doubled by what factor is the force exerted on the particle by field E changed?

ANSWER: 2

**VISUAL BONUS**

3) PHYSICS *Short Answer*  Answer all of the following questions about the diagram shown.

1. What is the name for this kind of diagram?
2. What kind of radiation is occurring here?
3. Identify the blue wavy line A and the green wavy line B.

ANSWER: FEYNMAN DIAGRAM; GLUON RADIATION; A – PHOTON; B - GLUON

**TOSS-UP**

4) EARTH AND SPACE SCIENCE *Short Answer* What is the collective name for asteroids with orbits that carry them into the inner solar system?

ANSWER: APOLLO-AMOR OBJECTS (ACCEPT: APOLLO OBJECTS OR AMOR OBJECTS)

**VISUAL BONUS**

4) EARTH AND SPACE SCIENCE *Short Answer* Answer the following two questions about the galaxy pictured.

A) Identify the galaxy as irregular, barred spiral, spiral or elliptical.

B) Give the Messier number for this galaxy.

ANSWER: BARRED SPIRAL; M83

**TOSS-UP**

5) MATHEMATICS *Short Answer* By name or number, identify all of the following 3 equations that have graphs consisting of two perpendicular lines.

I. xy = 0

II. abs (y) = abs (x)

III. abs (xy) = 1

ANSWER: I AND II

**VISUAL BONUS**

5) MATHEMATICS *Short Answer* In the visual, you have been provided with a function and a matrix. Find the slope of the function at the x-value given by the determinate of the matrix.

ANSWER: 148

**TOSS-UP**

6) ENERGY *Multiple Choice* By name or number, identify all of the following four that are not state functions.

I. work

II. heat

III. enthalpy

IV. entropy

ANSWER: I AND II

**VISUAL BONUS**

6) ENERGY *Short Answer* Identify the types of coal labeled A and B, respectively.

ANSWER: A: LIGNITE; B: BITUMINOUS COAL

**TOSS-UP**

7) CHEMISTRY *Multiple Choice* The formation of which of the following would drive forward a double displacement reaction?

W) Na2CO3

X) PbI2

Y) Ca(NO3)2

Z) MgCl2

ANSWER: X) PbI2

**VISUAL BONUS**

7) CHEMISTRY *Short Answer* Answer the following two questions about the titration curve provided.

1. Identify the analyte as a weak acid, strong acid, weak base or strong base.
2. This curve was given as result of an experiment to find the formality of HCl. In this experiment a 12.5 mL solution was titrated with a 0.10 F solution of NaOH. Given the results, find the formality of the HCl solution.

ANSWER: STRONG ACID; 0.20 F

**TOSS-UP**

8) BIOLOGY *Short Answer*  By name or number, identify all of the following three features that are unique to meiosis and are not present in mitosis.

I. synapsis

II. homologous recombination

III. reduction division

ANSWER: ALL OF THEM

**VISUAL BONUS**

8) BIOLOGY *Short Answer* Using the following four words as a word bank, identify all of the missing parts of this lobster: swimmerets, cephalic groove, cheliped, rostrum

ANSWER: A – CHELIPED; B – SWIMMERETS; C – CEPHALIC GROOVE; D - ROSTRUM

**TOSS-UP**

9) PHYSICS *Short Answer* By name or number, identify all of the following three choices that can appreciably deflect cathode rays?

I. An electric field

II. A nearby stationary magnet

III. A magnetic field

ANSWER: I, II AND III

**BONUS**

9) PHYSICS *Multiple Choice* An electromotive force of 0.003 colts is induced in a wire when it moves at right angles to a uniform magnetic field with a speed of 4.0 meters per second. If the length of wire in the field is 15 centimeters, what is the flux density, in teslas?

W) 0.003

X) 0.005

Y) 6

Z) 12

ANSWER: X) 0.005 (emf = BLv)

**TOSS-UP**

1. 10) EARTH AND SPACE SCIENCE *Short Answer* What category of rocks specifically describes rocks that are made up of fragments of earlier rocks cemented together by heat and pressure, such as many moon rocks?

ANSWER: BRECCIAS

**VISUAL BONUS**

10) EARTH AND SPACE SCIENCE *Short Answer* Answer the following two questions about the diagram in the picture.

1. What is the name of this diagram?
2. What three properties of galaxies are related in this diagram?

ANSWER: GALAXY COLOR-MAGNITUDE DIAGRAM; ABSOLUTE MAGNITUDE, LUMINOSITY AND MASS

**TOSS-UP**

11) MATH *Multiple Choice* A cylindrical bar of metal has a base radius of 2 and a height of 9. It is melted down and reformed into a cube. Which of the following is the closest to the length of a side of this cube?

W) 2.32

X) 3.84

Y) 4.84

Z) 5.32

ANSWER: Y) 4.84

**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 commercial process involves the extraction of alumina from bauxite?

ANSWER: BAYER PROCESS

**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* Consider the following equilibrium: 2SO2(g) + O2(g) == 2SO3(g) for which the forward reaction is exothermic. By name or number, identify all of the following five methods that will increase the amount of SO3 in the container.

I. Decreasing the volume of the container.

II. Increasing the temperature.

III. Decreasing the temperature.

IV. Adding helium to increase the pressure.

V. Adding O2 into the container.

ANSWER: I, III AND V

**VISUAL BONUS**

13) CHEMISTRY *Short Answer*  The beaker on the left contains a solution of potassium chromate, or K2CrO4. Upon addition of hydrochloric acid, the solution changes to an orange color, shown in the right hand beaker. Answer the following two questions about this situation.

1. What forms in the beaker on the right that causes the solution to be orange?
2. Give the balanced, net ionic equation for the reaction that changes the solution from yellow to orange.

ANSWER: DICHROMATE ION (Cr2O7 2-); 2H+ + 2CrO4 2- == Cr2O7 2- + H2O

**TOSS-UP**

14) BIOLOGY *Multiple Choice* In ponds and lakes, what zone serves as the hope for attached algae and insect herbivores?

W) littoral zone

X) limnetic zone

Y) profundal zone

Z) photic zone

ANSWER: W) LITTORAL ZONE

**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*  Light, with a frequency f, is incident on a photoemissive metal. It is observed that electrons are emitted with both minimal and maximum kinetic energies. By name or number, identify all of the following four actions that can be done to increase the maximum kinetic energy of the emitted electrons.

I. Increase the intensity of the incident light

II. Increase the frequency of the incident light

III. Decrease the frequency of the incident light

IV. Decrease the work function by using a different wave function

ANSWER: II AND IV

**BONUS**

15) PHYSICS *Multiple Choice* In the Rutherford scattering experiments, the trajectory of the alpha particles was in the shape of a what?

W) hyperbola

X) parabola

Y) circle

Z) ellipse

ANSWER: W) HYPERBOLA

**TOSS-UP**

16) EARTH AND SPACE SCIENCE *Short Answer* What are the beads of visible light around the rim of the moon at the beginning and end of a total solar eclipse commonly referred to as?

ANSWER: BAILY’S BEADS

**VISUAL BONUS**

16) EARTH AND SPACE SCIENCE *Short Answer* Answer all of the following questions about the image.

I. What is the common name for this nebula?

II. What is the Messier number for this object?

III. Which spiral arm of the Milky Way contains this?

IV. What event caused the formation of this object?

ANSWER: CRAB NEBULA; M1; PERSEUS ARM; SUPERNOVA

**TOSS-UP**

17) MATH *Multiple Choice* The graph of f(x) = 10/(x^2 – 10x + 25) has a vertical asymptote at x =

W) 0 only

X) 5 only

Y) 10 only

Z) 0 and 5 only

ANSWER: X) 5 ONLY

**BONUS**

17) MATH *Short Answer* Find the length of the major axis of the ellipse given by 3x^2 + 2y^2 – 6x + 8y – 1 = 0

ANSWER: 2 sqroot (6)

**TOSS-UP**

18) ENERGY *Multiple Choice* Which of the following is done in the commercial production of ammonia to maximize yield?

W) synthesis conducted at very high temperatures

X) synthesis conducted at very high pressures

Y) synthesis conducted at very low pressures

Z) synthesis conducted in presence of helium gas

ANSWER: X) SYNTHESIS CONDUCTED AT VERY HIGH PRESSURES

**BONUS**

18) ENERGY *Short Answer* What is the name for the systems that geothermal power plants utilize to clean the air of hydrogen sulfide and other gases?

ANSWER: SCRUBBER SYSTEMS

**TOSS-UP**

19) CHEMISTRY *Short Answer* What overall order reaction is characterized with having a half-life that is inversely proportional to reactant concentration?

ANSWER: SECOND ORDER

**VISUAL BONUS**

19) CHEMISTRY *Short Answer* In the visual, you have been given a reaction mechanism for a well known method of creating double bonds between carbons. Answer the following two questions.

1. What is the name of this reaction?
2. The formation of what bond in this reaction is the most exothermic, and as such, thermodynamically drives the reaction forward?

ANSWER: WITTIG REACTION; P = O

**TOSS-UP**

20) BIOLOGY *Short Answer*  What hormone, located on chromosome 7 in humans, is a 16 kDa protein hormone that plays a key role in regulating energy intake and energy expenditure?

ANSWER: LEPTIN

**BONUS**

20) BIOLOGY *Short Answer* By name or number, identify all of the following three choices that are examples of polymers.

I. cellulose

II. nylon

III. starch

ANSWER: ALL OF THEM

**TOSS-UP**

21) PHYSICS *Multiple Choice* Two parallel slits are 1.0 \* 10^-3 meters apart. The light passing through them has a wavelength of 5.4 \* 10^-7 meters. It falls on a viewing screen 2.0 meters away from the slits. Approximately what is the distance, in meters, between the central bright band and the first band next to it?

W) 1.1 \* 10^-3

X) 2.1 \* 10^-3

Y) 3.0 \* 10^-3

Z) 3.6 \* 10^-3

ANSWER: W) 1.1 \* 10^-3

**BONUS**

21) PHYSICS *Short Answer* Slowbro is standing in an elevator that falls with a constant negative acceleration. By name or number, identify all of the following four statements that are true of the force she exerts on the floor of the elevator.

I. It is equal to her weight

II. It is equal to less than her weight

III. It is equal to more than her weight

IV. Its actual value is dependent on the elevator’s acceleration

ANSWER: II AND IV

**TOSS-UP**

22) EARTH AND SPACE SCIENCE *Multiple Choice* Which of the following pair of words would best complete the following statement: Below the tropopause, temperature \_\_\_\_\_\_ with altitude. Above the tropopause, temperature \_\_\_\_\_\_ with increasing altitude.

W) increases; increases

X) decreases; decreases

Y) increases; decreases

Z) decreases; increases

ANSWER: Z) DECREASES; DECREASES

**BONUS**

22) EARTH AND SPACE SCIENCE *Short Answer* What noble gas is present in highest concentration in dry air at sea level?

ANSWER: ARGON

**TOSS-UP**

23) MATH *Multiple Choice* A recent survey reported that 60 percent of the students at a high school are girls and 65 percent of girls at this high school play a sport. If a student at this high school were selected at random, what is the probability that the student is a girl who does not play a sport?

W) 0.21

X) 0.39

Y) 0.61

Z) 0.79

ANSWER: Y) 0.61

**BONUS**

23) MATH *Short Answer* What law, theory or conjecture states that no arrangement of equally sized spheres filling space has a greater average density than the cubic-close packed or hexagonal close-packed structure, 74%?

ANSWER: KEPLER CONJECTURE

**TOSS-UP**

24) ENERGY *Short Answer* : By name or number, identify all of the following five states that are in the top five for top hydropower producing states in 2009.

I. California

II. Washington

III. Oregon

IV. New York

V. Alabama

ANSWER: ALL OF THEM

**BONUS**

24) ENERGY *Short Answer* What country is the world leader in installed capacity of solar hot water systems?

ANSWER: CHINA

**TOSS-UP**

25) CHEMISTRY *Short Answer*  What equation is often used to approximate the pH of a buffer solution, utilizing the ratio of the concentration of the base to the concentration of the acid in a buffer?

ANSWER: HENDERSON-HASSELBACH EQUATION

**BONUS**

25) CHEMISTRY *Multiple Choice* Applying Fajan’s Rules, which of the following statements is true about AlCl3 and AlF3?

W) AlCl3 has more covalent character than AlF3

X) AlCl3 has more ionic character than AlF3

Y) AlCl3 has the same amount of covalent character as AlF3

1. Z) AlCl3 has the same amount of ionic character as AlF3

ANSWER: W) AlCl3 HAS MORE COVALENT CHARACTER THAN AlF3