**ROUND 1**

**TOSS-UP**

1) Physics *– Multiple Choice* A famous principle of fluid mechanics, traditionally attributed as the explanation behind lift on an airplane wing, is named after what scientist?

W) Bernoulli

X) Poiseuille

Y) Rayleigh

Z) Reynolds

ANSWER: W) BERNOULLI

**BONUS**

1) Physics *– Short Answer* A metal disk has a moment of inertia of 5.0 x 10-5 kilogram meters squared. If the disk is rotating with 0.1922 joules ***[jools]*** of kinetic energy, what is the angular speed, in radians per second, of a point on its rim?

ANSWER: 62

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**TOSS-UP**

2) Math *– Short Answer* A geometric sequence has third term 1 and fourth term –3. What is its first term?

ANSWER: 1/9

**BONUS**

2) Math *– Short Answer* If theta equals the arcsine of 0.8, what is the sum of the cotangent of theta and the cosecant of theta?

ANSWER: 2

**TOSS-UP**

3) Biology *– Multiple Choice* Steroids can be classified as which of the following types of biomolecule?

W) Carbohydrate

X) Protein

Y) Lipid

Z) Nucleic Acid

ANSWER: Y) LIPID

**BONUS**

3) Biology *– Short Answer* In the mitochondrial electron transport chain during oxidative

phosphorylation ***[faws-four-il-AY-shun]***, what molecule is the final electron acceptor?

ANSWER: OXYGEN

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**TOSS-UP**

4) Energy *– Multiple Choice* What gas is produced by bacterial decay in landfills?

W) Neon

X) Oxygen

Y) Carbon monoxide

Z) Methane

ANSWER: Z) METHANE

**BONUS**

4) Energy *– Multiple Choice* Researchers at Argonne National Lab used high-energy x-rays to confirm a model of quantum magnetism. Which of the following facilities did they use?

W) Electron Microscopy Center

X) Center for Nanoscale Materials

Y) Advanced Photon Source

Z) Tandem Linear Accelerator

ANSWER: Y) ADVANCED PHOTON SOURCE

**TOSS-UP**

5) Earth and Space *– Multiple Choice* What type of lava can be expected to erupt from ashield volcano, like Kilauea?

W) Andesite

X) Basalt

Y) Dacite

Z) Rhyolite

ANSWER: X) BASALT

**BONUS**

5) Earth and Space *– Short Answer* What is the name for a large depression that forms when the vent of a volcano collapses into a drained magma chamber?

ANSWER: CALDERA

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**TOSS-UP**

6) Chemistry *– Multiple Choice* Which of the following is equivalent to 10 centimeters?

W) 108 nanometers

X) 103 millimeters

Y) 107 micrometers

Z) 102 decimeters

ANSWER: W) 108 NANOMETERS

**BONUS**

6) Chemistry *– Multiple Choice* Which of the following will increase the entropy ***[EN-troh-pee]*** of a system?

W) Decreasing the temperature

X) Changing the phase from a liquid to a solid

Y) Increasing the volume

Z) Decreasing the number of molecules

ANSWER: Y) INCREASING THE VOLUME

**TOSS-UP**

7) Biology *– Multiple Choice* Which of the following best describes why a complete lack of cholesterol is dangerous for cells?

W) Cholesterol maintains membrane fluidity

X) Cholesterol is necessary for all signal transduction

Y) Cholesterol is required for ATP production

Z) Cholesterol protects against DNA degradation

ANSWER: W) CHOLESTEROL MAINTAINS MEMBRANE FLUIDITY

**BONUS**

7) Biology *– Multiple Choice* Which of the following is definitely known about

Australopithecans ***[aw-stral-oh-PITH-eh-cans]***?

W) They had human-sized brains

X) They walked upright

Y) They were 2 meters tall, on average

Z) They were herbivores

ANSWER: X) THEY WALKED UPRIGHT

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**TOSS-UP**

8) Chemistry *– Short Answer* What type of covalent ***[koh-VAY-lent]*** bond, found in amine ***[ah-MEEN]*** oxides, is formed by two electrons from the same atom?

ANSWER: DATIVE (ACCEPT: DIPOLAR OR COORDINATE)

**BONUS**

8) Chemistry *– Short Answer* Identify all of the following three statements that are TRUE of acetic acid:

1) It exists predominately in its monomeric form when dissolved in benzene; 2) It exists predominately in its monomeric form when dissolved in water; 3) It exists predominately in its monomeric form in the gas phase.

ANSWER: JUST 2

**TOSS-UP**

9) Physics *– Short Answer* If a process occurs at constant pressure, what term describes that process?

ANSWER: ISOBARIC

**BONUS**

9) Physics *– Multiple Choice* Tim blows into a hollow cylinder that is open on both ends. It emits a sound at its fundamental frequency, a middle A which is 440 Hertz. Which of the following is closest to the length, in centimeters, of the cylinder?

W) 20

X) 40

Y) 60

Z) 80

ANSWER: X) 40

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**TOSS-UP**

10) Math *– Multiple Choice* Which of the following numbers has a remainder of 1 when it is divided by 7?

W) 62

X) 82

Y) 99

Z) 103

ANSWER: Y) 99

**BONUS**

10) Math *– Short Answer* The graph of *f*(*x*) = the fraction with numerator *x*2 – 5*x* + 6 and denominator *x*2 – 9 has a removable discontinuity at *x* = *a* for some real number *a*. What is the limit as *x* approaches *a* of *f*(*x*)?

ANSWER: 1/6

**TOSS-UP**

11) Energy *– Multiple Choice* Iridates and cuprates ***[KYU-prayts ]*** are being studied at Argonne National Lab because of their potential uses as what?

W) Heavy-ion particle beam fuel

X) Ultra-strong alloys

Y) Megatesla ***[mega-tes-la]*** magnets

Z) High temperature superconductors

ANSWER: Z) HIGH TEMPERATURE SUPERCONDUCTORS

**BONUS**

11) Energy *– Multiple Choice* DOE researchers are studying how hemmorhagic ***[heh-more-AJ-ik]*** fevers suppress the immune system. Which of the following is a viral family being studied?

W) Influenzavirus

X) Poliovirus

Y) Ebolavirus

Z) Virgavirus

ANSWER: Y) EBOLAVIRUS

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**TOSS-UP**

12) Earth and Space *– Multiple Choice* What is the name for the type of mass wasting where perpendicular forces due to freeze-thaw processes in the ground cause soil to lift upwards?

W) Frost Heave

X) Debris Slump

Y) Earth Slide

Z) Soil Sturzstrom

ANSWER: W) FROST HEAVE

**BONUS**

12) Earth and Space *– Short Answer* Which of the seven spectral classes is our Sun classified as?

ANSWER: G

**TOSS-UP**

13) Energy *– Short Answer* Scientists at Oak Ridge National Lab are using Titan in order to study actinide ***[AK-tin-ide]*** chemistry at a molecular level. Identify all of the following three elements that are being studied: 1) Uranium; 2) Thorium ***[THOR-ee-um]***; 3) Neptunium ***[nep-TOO-nee-um]***.

ANSWER: 1, 2, 3 (ACCEPT: ALL OF THEM)

**BONUS**

13) Energy *– Short Answer* DOE researchers, as part of the Daya ***[DIE-ah]*** Bay Collaboration, use sophisticated experiments to observe the reactions going on in nuclear reactors. What particle produced by beta minus decay, other than a proton and an electron, are they observing?

ANSWER: ANTINEUTRINO

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**TOSS-UP**

14) Earth and Space *– Multiple Choice* Walden Pond in Massachusetts is a famous example of a kettle lake. What created Walden pond?

W) Earthquake

X) Glacial activity

Y) A meander cut off to form a lake

Z) Volcanic activity

ANSWER: X) GLACIAL ACTIVITY

**BONUS**

14) Earth and Space *– Multiple Choice* During what eon did visible life start to appear and resulted in abundant fossils?

W) Hadean

X) Archaean

Y) Proterozoic

Z) Phanerozoic

ANSWER: Z) PHANEROZOIC

**TOSS-UP**

15) Math *– Multiple Choice* Which of the following best describes the relationship between the lines with

quations 5*x* + 7*y* = 35 and 28*x* – 20*y* = 35?

W) Parallel

X) Perpendicular

Y) Intersecting but not perpendicular

Z) Coincident

ANSWER: X) PERPENDICULAR

**BONUS**

15) Math *– Short Answer*  A regular hexagon is inscribed in a circle of diameter 16. What is the area of the hexagon?

ANSWER: 96√3

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**TOSS-UP**

16) Physics *– Short Answer* The liquefaction of what gas was recognized in the 1913 Nobel Prize?

ANSWER: HELIUM

**BONUS**

16) Physics *– Short Answer* A 2-liter container is filled with 3 moles of gas at 150 Kelvin. What is the pressure of the gas, in atmospheres, to two significant figures?

ANSWER: 18

**TOSS-UP**

17) Chemistry *– Multiple Choice* Consider the covalent bonding in the molecule acetylene ***[ah-SET-ihl-een]***, and assume that the carbon-carbon axis is the x-axis. What two orbitals on each carbon atom participate in pi bonding?

W) 1s and 2s

X) 2px and 2py

Y) 2s and 2px

Z) 2py and 2pz

ANSWER: Z) 2PY AND 2PZ

**BONUS**

17) Chemistry *– Short Answer* Rank the following three barium salts in terms of increasing water solubility:

1) Barium chlorate; 2) Barium sulfate; 3) Barium hydroxide.

ANSWER: 2, 3, 1

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**TOSS-UP**

18) Biology *– Short Answer* Fish and reptiles are classified under what phylum?

ANSWER: CHORDATA

**BONUS**

18) Biology *– Multiple Choice* Which of the following muscles adducts and rotates the scapula and tilts the chin?

W) Latissimus ***[lah-TIH-sih-mus]*** dorsi

X) Rhomboideus ***[rom-BOY-dee-us]*** major

Y) Subscapularis ***[sub-scap-yoo-LAIR-us]***

Z) Trapezius ***[trah-PEE-zee-us]***

ANSWER: Z) TRAPEZIUS

**TOSS-UP**

19) Physics *– Short Answer* Identify all of the following 3 forms of heat transfer where the rate of heat transfer is independent of the temperature gradient: 1) Conduction; 2) Convection; 3) Radiation.

ANSWER: NONE OF THEM

**BONUS**

19) Physics *– Short Answer* A pool of water and the surrounding air are at thermal equillibrium. Identify all of the following 3 molecular-level properties that are statistically equal between the two substances:

1) Internal energy; 2) Kinetic energy; 3) Velocity.

ANSWER: 2 ONLY

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**TOSS-UP**

20) Biology *– Short Answer* Dental cavities in humans are primarily caused by what genus ***[JEE-nus]*** of bacteria?

ANSWER: STREPTOCOCCUS

**BONUS**

20) Biology *– Short Answer* What structure does Paramecium ***[para-MEE-see-um]*** use to move around?

ANSWER: CILIA

**TOSS-UP**

21) Earth and Space *– Short Answer* After long period of deflation by the wind, a desert will be reduced to a layer of cobble that is resistant to further deflation. What is the term for this cobble?

ANSWER: DESERT PAVEMENT

**BONUS**

21) Earth and Space *– Multiple Choice* Which of the following best describes the origin of Long Island in New York?

W) It arose from the sea due to hotspot activity

X) It was formed when an earthquake drove a sea mount above water

Y) It marks a location where an ocean rift lays

Z) It formed from glacial till during the last Ice Age

ANSWER: Z) IT FORMED FROM GLACIAL TILL DURING THE LAST ICE AGE

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**TOSS-UP**

22) Chemistry *– Short Answer* Identify all of the following three elements that, when inserted into a silicon crystal lattice, would result in a p-type, doped semiconductor: 1) Carbon; 2) Boron; 3) Nitrogen.

ANSWER: 2 (ACCEPT: BORON)

**BONUS**

22) Chemistry *– Short Answer* Identify all of the following three statements that are true of benzene:

1) It is nonpolar; 2) It is aromatic; 3) It is miscible ***[MIH-sih-bul]*** with water.

ANSWER: 1 AND 2

**TOSS-UP**

23) Math *– Short Answer* The mean of a set is 5 numbers is 5. Four of the numbers are 1, 2, 5, and 8. What is the fifth number?

ANSWER: 9

**BONUS**

23) Math *– Short Answer* A task takes a single computer processor 10 days to complete. For this task, each successive processor added in parallel reduces the computation time needed by 50%. How many processors are needed to bring the total computation time for this task to under one hour?

ANSWER: 9