TOSS-UP

1) Chemistry – *Multiple Choice* Which one of the following are condensation polymers?

W) Polystyrene
X) Polyvinyl Chloride
Y) Polytetrafluoroethylene
Z) Polyester

ANSWER: Z) POLYESTER

BONUS

1) Chemistry – *Short Answer* What value is the difference between the estimated heat capacity of an ideal gas under constant pressure and the estimated heat capacity of an ideal gas at constant volume?

ANSWER: Ideal Gas Constant

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

2) Biology – *Short Answer* What is the scientific name for the plant widely regarded as the "plant model organism", also known as thale cress?

ANSWER: *Arabidopsis thaliana*

BONUS

2) Biology – *Multiple Choice* Mesophyll cells, which are located within plant leaves and have a high chloroplast population, come in two varieties. What are the names of these two varieties?

W) Spongy and Rigid
X) Smooth and Rough
Y) Spongy and Palisade
Z) Palisade and Porous

ANSWER: Y) Spongy and Palisade

Commented [1]: this ones ok, tho you should prolly name a specific polyester since all the other ones listed have one specific monomer

Commented [2]: wording is slightly convoluted. It's generally good practice to include the question and the pronoun near the beginning (i.e. "What value" or "what number").

Commented [3R2]: good content tho

Commented [4]: General comment about the bio: Although biosys is great, we don't want too much of it. Go for more biochem/mol bio and a+p
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

3) Math – *Short answer* John is picking his clothes for the day. He has four pairs of socks, three pairs of pants, two shirts, and five hats. How many possible outfits can he make?

ANSWER: 120

BONUS

3) Math – *Short Answer* Find the roots of: $x^3 - 4x^2 + 5x - 2$

ANSWER: 1 and 2

~~~~~~

TOSS-UP

4) Earth and Space – *Multiple Choice* What is the process in a tropical cyclone when the outer eyewall contracts on the inner eyewall, forming a larger, more consolidated eyewall?

W) Eyewall choking cycle
X) Double eyewall cycle
Y) Eyewall replacement cycle
Z) Multi-eyewall cycle

ANSWER: Y) Eyewall replacement cycle

BONUS

4) Earth and Space – *Short Answer:* Identify all of the following three statements that are true of Io, a moon of Jupiter.

1) It is the highest density moon in the Solar System.
2) It contains glaciers at the poles.
3) It has an orbital period of less than three days.

ANSWER: 1 AND 3
~~~~~~

TOSS-UP

5) Biology – *Multiple Choice* The insides of an organism are lined with water filtering choanocytes, which are linked with amoebocytes, which help deliver nutrients throughout the organism's body. Which phylum is this organism a member of?

W) Platyhelminthes
X) Cnidaria
Y) Echinodermata
Z) Porifera

ANSWER: Z) PORIFERA

BONUS

5) Biology – *Multiple Choice* Which of the following is NOT true of members of the phylum Cnidaria?

W) They display polymorphism.
X) They are free floating and have no nervous system.
Y) They have a gastrovascular cavity in their body that is used to digest food.
Z) Their embryos show indirect development.

ANSWER: X) They are free floating and have no nervous system.

~~~~~~

TOSS-UP

6) Physics – *Multiple Choice* What is the fifth derivative of the position vector?

W) Jerk
X) Snap
Y) Jounce
Z) Crackle

ANSWER: Z) CRACKLE

BONUS

6) Physics – *Short Answer* Approximating Coulomb's constant to be $9 \cdot 10^9$ Newtons • meters^2 / C^2, if two charges separated 10^4 meters apart have charges 4 and 3 Coulombs, what is the electric force between the two charges?

ANSWER: 1080 N

TOSS-UP

Commented [5]: please don't ask this?

Commented [6R5]: agreed

Commented [7]: a quick way for exponents, use ctrl+, or ctrl+. for super/subscript. it will make a good difference. Also, for units such as newtons and meters, spell them out completely instead of using N and m.

Commented [8R7]: this difficulty can be elevated a bit. if you need inspiration, ask yourself (or google), what happens when a charge moves?
~~~~~~

7) Earth and Space Science – *Multiple Choice* Which one of these is NOT a primary diagnostic (dai·uhg·naa·stuhk) property of a mineral?

W) Elasticity
X) Streak
Y) Specific Gravity
Z) Luster

ANSWER: W) ELASTICITY

BONUS

7) Earth and Space Science – *Short Answer* A moon orbits on the border of a ring, helping to define the ring's limit. Another moon orbits within a ring, clearing a small gap within said ring. What type of moon would these moons be designated as?

ANSWER: SHEPHERD MOON

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

8) Math – *Multiple Choice* Which of the following quadrilaterals is never cyclic?

W) Rectangle
X) Isosceles Trapezoid
Y) Kite
Z) Non-square Rhombus

ANSWER: Z) NON-SQUARE RHOMBUS

BONUS

8) Math – *Multiple Choice* Where do the lines with the equations $y = 5x + 2$ and $6x + 4y = 3$ intersect

W) Two tangents
X) Two secants that intersect outside the circle
Y) A tangent and a secant that intersect outside the circle
Z) The lines containing two intersecting chords

ANSWER: Z) THE LINES CONTAINING TWO INTERSECTING CHORDS

Commented [9]: Something about a circle missing
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

9) Earth and Space – *Short Answer* What type of volcano is the steepest towards the crater?

ANSWER: STRATOVOLCANO (ACCEPT: COMPOSITE VOLCANO)

BONUS

9) Earth and Space – *Multiple Choice* What is the process when the minimum pressure in a low pressure system drops 24 millibars in 24 hours?

W) Tropical cyclogenesis
X) Extratropical transition
Y) Bombogenesis
Z) Rapid deepening

ANSWER: Y) BOMBOGENESIS

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

10) Biology – *Multiple Choice* Which of the following is the name of the era that contains the Ediacaran biota, and is characterized by the development of primitive predator-prey relationships between organisms?

W) Precambrian
X) Neoproterozoic
Y) Neopaleozoic
Z) Cambrian

ANSWER: X) NEOPROTEROZOIC

BONUS

10) Biology – *Multiple Choice* What type of signalling occurs when a cell secretes signal molecules that are limited to diffusing locally, triggering responses in surrounding cells only?

ANSWER: PARACRINE
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

11) Earth and Space – *Short Answer* The Charlie-Gibbs Fracture Zone, found along the Mid-Atlantic Ridge, includes two of what type of tectonic plate boundary?

ANSWER: TRANSFORM FAULT BOUNDARY (ACCEPT: TRANSFORM FAULT)

BONUS

11) Earth and Space – *Short Answer* What is the name of the transition zone between the mantle and the core?

ANSWER: D DOUBLE PRIME LAYER

Commented [10]: A good idea, can be made more exciting though. Not an emergency to change tho.

~~~
~~~

TOSS-UP

13) Physics – *Multiple Choice* A ball with mass 5 kg moves at 6 m/s towards a second stationary ball. The perfectly elastic collision sends the first ball back at 2 m/s, while the first ball shoots forward at 20 m/s. What is the mass in kilograms of the second ball?

W) 0.5
X) 1
Y) 2
Z) 4

ANSWER: Y) 2

BONUS

13) Physics – *Multiple Choice* The gravitational force and potential energy at the surface of a planet with radius r are F1 and U1, respectively. What are the gravitational force and gravitational potential energy, F2 and U2, respectively, at the surface of a planet with radius 2*r that has the same mass density?

W) F2 = 2F1, U2 = U1
X) F2 = 2F1, U2 = 4U1
Y) F2 = F1, U2 = U1
Z) F2 = F1, U2 = 4U1

ANSWER: X) F2 = 2F1, U2 = 4U1

~~~~~~

TOSS-UP

14) Earth and Space – *Multiple Choice* Noctilucent clouds are rare clouds seen only during certain times of night. How many kilometers above sea level are noctilucent clouds typically formed?

Commented [11]: seems a bit obscure

W) 15
X) 55
Y) 80
Z) 110

ANSWER: Y) 80

BONUS
~~~~~~

14) Earth and Space – *Multiple Choice* Which of the following minerals is NOT a member of the feldspar family?

W) Anorthite
X) Amazonite
Y) Aquamarine
Z) Albite

ANSWER: Y) Aquamarine

~~~~~~
~~~~~~

TOSS-UP

15) Biology – *Multiple Choice* Glycolysis is the first step of aerobic cellular respiration. How many ATP molecules does this process use and produce, respectively?

W) 3 used, 1 produced
X) 3 used, 4 produced
Y) 2 used, 4 produced
Z) 1 used, 2 produced

ANSWER: Y) 2 USED, 4 PRODUCED

BONUS

15) Biology – *Short Answer* *What is the name of*~~Name~~ the heart fixture that delays signals sent from the SA node by approximately 0.09 seconds.

ANSWER: ATRIOVENTRICULAR NODE (ACCEPT: AV NODE)

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

16) Math – *Short Answer* There are two sets of the same textbook. Each set is divided into two different volumes. Two volumes are randomly selected. What is the probability that the two volumes form a set of textbooks?

ANSWER: ⅔

BONUS

16) Math – *Short Answer* Find the area of a right triangle with a 30 degree angle with hypotenuse 20

ANSWER: $50 \times \sqrt{3}$

Commented [12]: fix wording, kind of hard to understand

Commented [13]: a bit closer to toss up difficulty. Perhaps this is a good start for a 3D geometry problem?
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

17) Chemistry – *Short Answer* Identify all of the following molecules that can form hydrogen bonds: 1) NH4+, 2) HCl, 3) CHCl3.

ANSWER: 3 ONLY

BONUS

Chemistry - *Multiple Choice* Aqua regia is used to dissolve gold. It contains hydrochloric acid and nitric acid. Why is nitric acid needed to dissolve gold?

W) Nitric acid is needed to form complex ions with gold so that hydrochloric acid can dissolve them.
X) Nitric acid converts various metals into their nitrate salts, which are highly insoluble in water, but dissolves readily in an acidic solution.
Y) Nitric acid prevents the chlorine in hydrochloric acid from forming complex ions with the gold by bonding with the chlorine, which leads to gold's dissolution.
Z) Nitric acid converts various metals into their nitrate salts, which are highly soluble in the aqua regia solution.

ANSWER: Z) NITRIC ACID CONVERTS VARIOUS METALS INTO NITRATE SALTS, WHICH ARE HIGHLY SOLUBLE IN THE AQUA REGIA SOLUTION.

Commented [14]: kind of have to talk about the fact that nitric acid oxidizes gold.

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

18) Chemistry – *Short Answer* What is the entropy of a perfect crystalline structure at 0 Kelvin?

ANSWER: 0

BONUS

18) Chemistry – *Multiple Choice* A reaction that is endothermic and endergonic is spontaneous at what temperatures?

Commented [15]: I don't think you can answer this question without mentioning the sign of deltaS.

W) All temperatures
X) High temperatures
Y) Low temperatures
Z) Never spontaneous

ANSWER: X
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~

TOSS-UP

19) Earth and Space– *Short Answer* What is the process in which debris is turned into sedimentary rock?

ANSWER: LITHIFICATION

BONUS

19) Earth and Space – *Multiple Choice* Approximately how many times hotter is the core of the sun than its photosphere?

W) 750
X) 1500
Y) 2500
Z) 7000

ANSWER: Y) 2500

~~~~~~

TOSS-UP

20) Energy – *Multiple Choice* Scientists at Fermilab National Laboratory are bringing together astrophysics and particle physics to study dark matter. Approximately what percentage of the universe is dark matter?

W) 15
X) 27
Y) 59
Z) 68

ANSWER: X) 27

BONUS

20) Energy – *Short Answer* What is the name of the process that recovers sulfur from the gaseous hydrogen sulfide in natural gas?

ANSWER: CLAUS PROCESS

Commented [16]: repeat from blair A
~~~~~~

TOSS-UP

21) Chemistry– *Short Answer* The graph of 1/[A] vs time for a reaction is linear. What is the half life for this reaction?

ANSWER: $1/(k[A]_0)$

BONUS

21) Chemistry – *Short Answer* Find the pH of a solution with a [OH-] of sqrt(10).

ANSWER: 13.5

~~~~~~

TOSS-UP

22) Math – *Short Answer* To the nearest integer, calculate the square root of 36,000

ANSWER: 190

BONUS

22) Math– *Short Answer* What is the (x, y) coordinate of the vertex of the function $\frac{1}{e^x} + e^x$?

ANSWER: (0, 2)

Commented [17]: you should specify to say it in terms of k and A_0, or give values of those constants and ask for a numerical value.
~~~~~~

TOSS-UP

23) Biology - *Multiple Choice* Which period spawned such a great variety of fish that it is commonly referred to as the Age of Fishes?

W) Ediacaran
X) Cambrian
Y) Pennsylvanian
Z) Devonian

ANSWER: Z) DEVONIAN

BONUS

23) Biology - *Short Answer* Which subdivision of arthropoda do scorpions and spiders belong to?

ANSWER: CHELICERATA

Commented [18]: closer to ess content; i would replace this