TOSS-UP

1) EARTH AND SPACE – *Multiple Choice* What term describes the point in a planet's orbit where it is closest to its sun?

W) Perihelion
X) Aphelion
Y) Perigee
Z) Apogee

ANSWER: W) Perihelion

BONUS

1) EARTH AND SPACE – *Short Answer* Identify which of the following three stellar spectral types are present in the Hertzsprung Gap?

1. A
2. F
3. G

ANSWER: 1, 2, and 3

TOSS-UP

2) BIOLOGY – *Multiple Choice* Which of the following is NOT a keystone species for their respective habitats?

W) Beavers in Wetlands
X) Gorillas in Rainforests
Y) Sharks in Pelagic Waters
Z) Giraffes in Savanna

ANSWER: Z) Giraffes in Savanna

BONUS

2) BIOLOGY – *Short Answer* Which of the following describe a R selected species

1) They only can reproduce at older ages

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2) They die slowly
3) Produce small numbers of offspring
4) Population growth stays within carrying capacity

ANSWER: None of the above

TOSS-UP

3) CHEMISTRY – *Multiple Choice* What is the unit cell type for Zinc Sulfide?

W) Cubic and Simple
X) Cubic and Face Centered
Y) Cubic and Body Centered
Z) Tetragonal and Body Centered

ANSWER: X) Cubic and Face Centered

BONUS

3) CHEMISTRY – *Short Answer* How many chiral centers does 2-bromo-3-chlorobutane have?

ANSWER: 2

TOSS-UP

4) EARTH AND SPACE – *Short Answer* What smaller landform can eventually grow and build up to form a river delta?

ANSWER: Distributary

BONUS

4) EARTH AND SPACE – *Multiple Choice* What happens to a barrier island in the summer?

W) The ocean beach is enlarged due to gentle waves
X) The ocean beach is shrunk due to gentle waves
Y) The ocean beach grows due to high energy waves
Z) the ocean beach is shrunk due to high energy waves

ANSWER: W) The ocean beach is enlarged due to gentle waves

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Commented [1]: so personally i would make this short answer because there's, like, a very common way to say unit cell types (i'm tempted to say this way is objectively correct, but i'm not sure.) i've always seen unit cell types described as e.g. face centered cubic (or FCC)

TOSS-UP

5) PHYSICS – *Multiple Choice* Which of the following~~at~~ is not considered a chaotic system?

W) Plume of Smoke
X) Ocean Turbulence
Y) Two-body Problem
Z) Double Pendulum

ANSWER: Y) Two-body Problem

BONUS

5) PHYSICS – *Short Answer* There is a two planet system whose planets are perfectly spherical. Which of the following changes will result in a change only in the gravitational force between the two planets.

1) A planet suddenly doubles in mass
2) One of the planets becomes hollowed out, but retains its mass.
3) A third planet is introduced

ANSWER: 1 only

TOSS-UP

6) ENERGY – *Short Answer* Researchers at FermiLab utilize the South Pole Telescope to measure cosmic microwave background, or CMB. The problem that describes the presence of isotropy in the temperature of CMB across the sky is known as what?

W) Coronal Heating Problem
X) Final Parsec Problem
Y) Horizon Problem
Z) CMB-Uncertainty Problem

ANSWER: Y) Horizon Problem

BONUS

6) ENERGY – *Short Answer* Researchers at Argonne National Laboratory are studying ways to track and treat Coronavirus while preserving its spread. Which subunit of the spike protein that gives Coronavirus mediates fusion between the viral and host membrane cells?

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Commented [2]: er i don't really understand this sentence/i don't think it's clear what it's asking for

ANSWER: S2 subunit

TOSS-UP

7) BIOLOGY – *Short Answer* When there are fluctuations in the blood pressure a group of receptors balance it out, what is the name for these receptors which can be found in the carotid sinus.

ANSWER: Baroreceptors (Do not accept: stretch receptors)

BONUS

7) BIOLOGY What is the type of cartilage found in between the intervertebral disks?

ANSWER: Fibrocartilage

TOSS-UP

8) MATH – *Short Answer* Convert 21 into base 4.

ANSWER: 111

BONUS

8) MATH – *Short Answer* A triangle has side lengths 5, 6, and 7. If the area is represented by √x (Read as square root of x), what is x?

Commented [3]: no need to do this part--you can just ask for 6rt6

ANSWER: 216

TOSS-UP

9) EARTH AND SPACE SCIENCE – *Short Answer* What phenomenon occurs between the three innermost Galilean moons in which their orbits around the sun become more elliptical?

ANSWER: Laplace Resonance

BONUS

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9) EARTH AND SPACE – *Multiple Choice Question* According to dynamo theory, which of the following reasons is attributed to Mars not having a global magnetic field?

W) A large impact prevented the formation of a magnetic field.
X) The evaporation of oceans led to an overabundance of CO_2.
Y) The core solidified leading to the field disappearing.
Z) A lack of metals in the Mars atmosphere

ANSWER: Y) The core solidified leading to the field disappearing.

TOSS-UP

10) PHYSICS If a circuit has a current of 10 amps and a resistance of 10 ohms, what is the power in watts?

W) 10
X) 100
Y) 1000
Z) 10000

ANSWER: Y) 1000

BONUS

10) PHYSICS – *Short Answer* What is the resistance in ohms of 10 resistors connected in parallel, half with resistance 2 ohms and the other half with resistance 4 ohms?

ANSWER: 4/15

TOSS-UP

11) MATH – *Multiple Choice* Which of the following statements~~at~~ is false of the function y = |x| (Read: "y is equal to the absolute value of x)?

W) The function is continuous for all values of x.
X) The function is differentiable for all values of x.
Y) The integral from -1 to 1 in terms of x is 1.
Z) The derivative at x=1 is 1.

ANSWER: X) The function is differentiable for all values of x

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BONUS

11) MATH – *Short Answer* How many local extrema does a function with derivative f '(x) = x^3+x^2-x-1 have?

ANSWER: 1

TOSS-UP

12) BIOLOGY – *Short Answer* What is the name of the enzyme that removes RNA primers during DNA replication

ANSWER: RNase (Accept: Ribonuclease)

BONUS

12) BIOLOGY – *Multiple Choice* Double positive T cells that have two glycoproteins also known as what?

W) CD4 and CDW
X) CD7 and CD 2
Y) Double positive proteins don't exist
Z) CD4 and CD8

ANSWER: CD4 and CD8

TOSS-UP

13) EARTH AND SPACE – *Short Answer* The concentration of waves onto a specific point due to wave refraction from what geographic feature?

Commented [4]: i don't understand what this is asking for

ANSWER: Headland

BONUS

13) EARTH AND SPACE – *Multiple Choice* Beach starvation is caused by what process?

W) The building of erosion protection technology limiting the sand feeding.
X) The building of a dam along a river that feeds the beach causing less sand to be fed.
Y) The death of coral reefs causing loosening of sand and more backwash.
Z) A tsunami causing large amounts of water to displace large quantities of sand.

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ANSWER: X) The building of a dam along a river that feeds the beach causing less sand to be fed

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TOSS-UP

14) ENERGY – *Multiple Choice* Researchers in the Chemical Diagnostics and Engineering group at Los Alamos National Lab have been developing a characterization and digestion method for uranium nitride fuel for use in reactors and nuclear thermal propulsion. In their research, 47 analytes were labeled as potential impurities. What form of mass spectrometry did they most likely use to calculate percent recoveries for these analytes?

W) Atmospheric pressure chemical ionization mass spectrometry
X) Chemical ionization mass spectrometry
Y) Coupled plasma mass spectrometry
Z) DART mass spectrometry

Commented [5]: if this is what they actually used then i would just describe the procedure and ask for the term

ANSWER: Y) Coupled plasma mass spectrometry

BONUS

14) ENERGY – *Short Answer* Scientists at the Los Alamos National Lab have uncovered methods of using D-wave quantum annealers to calculate the excited electronic states of molecular systems. In this research, what was most likely used as the basis set molecule?

ANSWER: Hydrogen molecule (Accept: H_2 or Hydrogen Gas)

TOSS-UP

15) CHEMISTRY – *Multiple Choice* The equilibrium reaction, $2NO_2 \rightleftharpoons N_2O_4$ (Read as: $2NO_2$ is in equilibrium with N_2O_4), is occurring in a sealed container with a piston lid. If the piston is compressed to decrease pressure, which side of the reaction will be favored?

W) Left
X) Right
Y) Neither
Z) It is impossible to predict

ANSWER: W) Left

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BONUS

15) CHEMISTRY – *Short Answer* Which of the following are Bravais Lattices?

1) Triclinic
2) Uniclimic
3) Orthorhombic
4) Hexagonal
5) Pyramidal

ANSWER: 1) Triclinic, 3) Orthorhombic, AND 4) Hexagonal

TOSS-UP

16) PHYSICS – *Short Answer* *Identify all* ~~Which~~ of the following four forces that are not considered one of the fundamental forces: ~~?~~

1) Gravity
2) Strong force
3) Weak force
4) Electromagnetism

ANSWER: NONE

BONUS

16) PHYSICS – *Short Answer* Let a 10 kg particle be represented by the position function, $p(x)=4x^3+1$. What force will the particle be experiencing at time t=5 given no external forces?

Commented [6]: imo this phrase is confusing because the particle needs to undergo a force to experience acceleration

ANSWER: 1200 N

TOSS-UP

17) MATH – *Multiple Choice* Which of the following combination of side lengths is not possible to create a triangle?

W) 2, 2, 3
X) 3, 4, 5
Y) 4, 5, 9
Z) 3, 3, 2

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ANSWER: Y) 4, 5, 9

BONUS

17) MATH – *Short Answer* Calculate $1^7+2^6+3^5+4^4+5^3+6^2+7^1$.

ANSWER: 732

TOSS-UP

18) BIOLOGY – *Short Answer* If a patient is afflicted with osteoarthritis, what smooth connective tissue at the ends of their joints are damaged?

ANSWER: Articular cartilage (Do not accept: cartilage)

BONUS

18) BIOLOGY — Short AnswerWhat region of the brain do baroreceptors send their signals to?

ANSWER: Medulla Oblongata (Accept: medulla or solitary nucleus)

TOSS-UP

19) MATH Assuming a class had a test average of 55 and a standard deviation of 5 forming a normal distribution, what percent of the students received between a 55 and 60 on the test?

ANSWER: 34%

BONUS

19) MATH What is the cross product of vector (1,2,3) and (3,2,1)

ANSWER: (-4, 8, -4)

TOSS-UP

20) CHEMISTRY – *Short Answer* What is the Van't hoff factor for magnesium phosphate?

ANSWER: 5

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Commented [7]: is there a trick to this or do you straight up have to do addition

Commented [8]: if all this is is calculation then i would advise replacing it

Commented [9]: it's not exactly 34%, so you should make it like "which of the following is closest to the percentage of students that received between a 55 and 60" and have a choice at like 35% or something

BONUS

20) CHEMISTRY – *Multiple Choice* For a face centered cubic unit cell with atoms of radius 2 angstroms, what is the length of an edge in angstroms?

W) 4
X) 8
Y) $(8\sqrt{3})/3$
Z) $4\sqrt{2}$

ANSWER: Z) $4\sqrt{2}$

TOSS-UP

21) PHYSICS – *Multiple Choice* What is the natural phenomena in which waves spread out upon entering a narrow hole or entrance?

W) Diffusion
X) Total Internal Reflection
Y) Diffraction
Z) Refraction

Answer: Y) Diffraction

BONUS

21) PHYSICS – *Short Answer* What is the normal force of a 10 kg resting on a ramp with degree measure 60, assuming g is equal to 10?

Commented [10]: specify which angle this is referring to (e.g. angle to the horizontal)

Answer: 50 N

TOSS-UP

22) ENERGY – *Short Answer* Scientists at the Brookhaven National Lab have been researching the effects of iron-deficiency on plant processes. In what organelle of plant cells is 90% of iron stored?

ANSWER: Chloroplast

BONUS

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22) ENERGY – *Short Answer* Researchers at Oak Ridge National Laboratory are working on technology that helps scientists better understand the human impacts that lead to global warming. What major type of organic compounds, found in refrigerating systems and aerosol sprays, has contributed to the destruction of ozone in the stratosphere?

ANSWER: Chlorofluorocarbons (Accept: CFCs)

TOSS-UP

23) CHEMISTRY – *Short Answer* According to VSEPR Theory, what is the molecular geometry of PCL_5?

ANSWER: Trigonal Bipyramidal

BONUS

23) CHEMISTRY – *Short Answer* Which of the following unit cells have edge lengths that are all the same?

1) Cubic
2) Tetragonal
3) Hexagonal
4) Rhombohedral

ANSWER: 1) Cubic and 4) Rhombohedral

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Commented [11]: this is a little too easy for a bonus

Commented [12]: can we replace one of the crystal questions with something else please there are way too many lol