Middleton Packet 1

TOSS-UP

1) Physics – *Multiple Choice* What equation in physics is used to describe the magnetic field produced by a given current?

W) Biot-Savart
X) Ampere
Y) Maxwell
Z) Clausius-Clapeyron

ANSWER: W) BIOT-SAVART

BONUS

1) Physics – *Short Answer* When a ball is thrown straight up at a speed v the maximum height the ball reaches is h1. When the ball is instead thrown straight upward at 4v the maximum height is h2. What is h2/h1?

ANSWER: 16

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TOSS-UP

2) Chemistry – *Multiple Choice* Which of the following statements regarding an atomic orbital is false?

W) An atomic orbital is a three dimensional shape.
X) The principal quantum number is the quantum number with the largest effect on orbital size.
Y) A subshell consists of a collection of orbitals that have the same first two quantum numbers
Z) The equation for total nodes of an atomic orbital is (n -L-1)

ANSWER: Z) THE EQUATION FOR TOTAL NODES OF AN ORBITAL IS (N-L-1)

BONUS

2) Chemistry – *Short Answer* How many distinct forms of C_3HCl_5 would not be able to display addition reactions?

ANSWER: 1
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TOSS-UP

3) Biology – *Short Answer* What is the name given to the fluid inside of a plant cell's vacuole that primarily consists of water, amino acids, glucose, and more?

ANSWER: CELL SAP

BONUS

3) Biology – *Short Answer* What illness caused by nondisjunction during meiosis causes some females to be born with only one X chromosome and loss of ovarian function?

ANSWER: TURNER SYNDROME (ACCEPT: GONADAL DYSGENESIS)

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TOSS-UP

4) Earth and Space – *Short Answer* Identify all of the following 3 statements that are true of S waves 1) S waves travel through either liquid or solids. 2) P waves travel 60% faster than S waves on average. 3) S waves are energetically favorable moving on the surface of the earth.

ANSWER: 2 ONLY

BONUS

4) Earth and Space – *Multiple Choice* Which of the following distances is closest to that of the radius of the galaxy Andromeda?

W) 100 Light years
X) 1,000 Light years
Y) 10,000 Light years
Z) 100,000 Light years

ANSWR: Z) 100,000 LIGHT YEARS
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TOSS-UP

5) Math – *Short Answer* In a world where pennies do not exist, how many unique cent values under a dollar can be made by nickels, dimes, and quarters?

ANSWER: 20

BONUS

5) Math – *Short Answer* In a game of 2 truths and 1 lie the following statements were given, identify which one of these statements is the lie: 1)Statement 2 is true 2) Statement 3 is false 3) Statement 1 is false.

ANSWER: 3) STATEMENT 1 IS FALSE

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TOSS-UP

6) Physics – *Multiple Choice* Identify all of the following three forces that will never do work on a system? 1) Kinetic Friction 2) Static Friction 3) Normal Force

ANSWER: NONE OF THEM

BONUS

6) Physics – *Short Answer* Cooper pairs in superconductors are what class of composite particles due to their spin?

ANSWER: BOSONS
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TOSS-UP

7) Chemistry – *Multiple Choice* What scientist is credited with the discovery of the 2 resonant structures of benzene in 1865 that contribute the majority to its overall structure?

W) Dewar
X) Kekule
Y) Claus
Z) Lavosier

ANSWER: X) KEKULE

BONUS

7) Chemistry – *Multiple Choice* In lab, you use a 5.00 mL volumetric pipet, a 25.00 mL volumetric flask, and a 250 mL beaker to measure out solutions to make a series of dilutions. The number of significant figures you need in the concentration of the final solution is:

W) 1
X) 2
Y) 3
Z) 4

ANSWER: X) 2

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TOSS-UP

8) Biology – *Multiple Choice* What effect causes reduced genetic variation of a population that split off from a larger original population?

ANSWER: FOUNDER EFFECT

BONUS

8) Biology – *Multiple Choice* In a cross section of a stem of a monocot, how are the vascular bundles arranged?

W) The xylem and phloem form concentric rings
X) The vascular bundles form concentric rings
Y) The xylem and phloem are scattered throughout the stem
Z) The vascular bundles are scattered throughout the stem

ANSWER: Z) THE VASCULAR BUNDLES ARE SCATTERED THROUGHOUT THE STEM
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TOSS-UP

9) Earth and Space – *Multiple Choice* What is the most prominent last stage of an average star's life before it turns into a black dwarf?

ANSWR: WHITE DWARF

BONUS

9) Earth and Space – *Multiple Choice* What is the name for a small hill that is steep on one end and tapered on the other end, where it points towards the direction of ice movement?

ANSWER: DRUMLIN

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TOSS-UP

10) Math – *Short Answer* A right triangle has sides of length x+3, x+10, and x+11. What is the smallest positive value of x possible?

ANSWER: 2

BONUS

10) Math – *Short Answer* An ant is on a vertex of an equilateral triangle with length 5 inches. If the ant wants to get to the middle of the side directly opposite of it, how much of a difference to the nearest inch is it if the ant goes straight across the triangle rather than following the edge of the triangle?

ANSWER: 3
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TOSS-UP

11) Physics – *Short Answer* On square ABCD, each point A, B, C, D has a charge of q. What is the net electric force in Newtons on a test charge in the center of the square?

ANSWER: 0

BONUS

11) Physics – *Multiple Choice* Two charges, +q & -q, are placed a distance away from each other. Which of the following is NOT true regarding the electric field lines?

W) Where there are less lines the electric field will be weaker.
X) The electric field vectors can be added to find the total electric field strength.
Y) +q and -q form an electric dipole
Z) Electric field lines will cross at a maximum field potential.

ANSWER: Z) ELECTRIC FIELD LINES WILL CROSS AT A MAXIMUM FIELD POTENTIAL.

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TOSS-UP

12) Chemistry – *Short Answer* What principle arises from the addition of F block electrons that deviates from expected atomic radii for the predicted atoms?

ANSWER: LANTHANIDE CONTRACTION

BONUS

12) Chemistry – *Short Answer* Which of the following statements is not correct regarding Rydberg's Formula?

W) Rydberg's formula can be expanded to calculate the energy for multi electron systems.
X) If you assume the final energy state for an electron is infinity you will calculate the ionization energy of the atom.
Y) Rydberg's formula only works for single electron systems
Z) Rydberg's formula works towards helping our understanding of emission spectrum.

ANSWER: W) RYDBERG'S FORMULA CAN BE EXPANDED TO CALCULATE THE ENERGY FOR MULTI ELECTRON SYSTEMS
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TOSS-UP

13) Biology – *Short Answer* What pair of almond sized part of the brain is responsible for processing memory and other functions?

ANSWER: AMYGDALA

BONUS

13) Biology – *Short Answer* Silica is a substance that composes what name for an external layer of a diatom?

ANSWER: FRUSTULE

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TOSS-UP

14) Earth and Space – *Multiple Choice* What amorphous sedimentary rock is primarily used for the production of aluminum through the Bayer process?

ANSWER: BAUXITE

BONUS

14) Earth and Space – *Short Answer* How far in meters from the east coast of the United States in the Atlantic Ocean do Nor'easter storms usually form?

W) 6,000 Meters
X) 24,000 Meters
Y) 72,00 Meters
Z) 160,000 Meters

ANSWER: Z) 160,000 Meters
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TOSS-UP

15) Math – *Short Answer* What is the inverse of a 3x3 matrix with first row 1,0,0 second row 0,1,0 and third row 0,0,1.

ANSWER: FIRST ROW 1,0,0 SECOND ROW 0,1,0 AND THIRD ROW 0,0,1 (ACCEPT: IDENTITY MATRIX)

BONUS

15) Math – *Short Answer* How many integer values of n between 1 and 1,000 inclusive does the decimal representation of n/1,400 terminate?

ANSWER: 142

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TOSS-UP

16) Physics – *Short Answer* A charge of 3 microcoulombs is placed in an electric field with an electric field vector of 30000 N/C. Find the force in Newtons felt by the charge q.

ANSWER: 0.09 N

BONUS

16) Physics – *Multiple Choice* If you apply a force to the pedals of your bike and accelerate, the wheels have an angular acceleration. Consider the rim of the back wheel, the things that apply a torque to this rim are

W) The ground
X) The spokes
Y) Both the ground and spokes
Z) Neither the ground or the spoke

ANSWER: Y) BOTH THE GROUNDS AND SPOKES
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TOSS-UP

17) Chemistry – *Multiple Choice* When the molecule Calcium Carbide melts, what bond stays together?

W) Calcium Carbon Bond
X) Carbon Carbon Bond
Y) Calcium Carbide Bond
Z) None of the bonds stays together

ANSWER: X) CARBON CARBON BOND

BONUS

17) Chemistry – *Short Answer* What phenomenon occurs when molecular orbitals of the same symmetry form from the combination of 2s and 2p orbitals that are close enough in energy to further interact, exemplified by C2

ANSWER: SP MIXING

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TOSS-UP

18) Biology – *Multiple Choice* Which of the following is NOT a feature of human embryonic development?

W) Presence of an inner cell mass
X) Formation of a primitive streak
Y) Meroblastic cleavage
Z) Holoblastic cleavage

ANSWER: Y) MEROBLASTIC CLEAVAGE

BONUS

18) Biology – *Multiple Choice* A carotene differs from that of a xanthophyll by:

W) Xanthophyll are oxygen containing carotenoids, while carotene contain aromatic rings.
X) Xanthophyll have 13 degrees of unsaturation while Carotene are straight chain alkanes
Y) Xanthophyll have a more characteristic yellow hue while carotene is more of an orange hue.
Z) Xanthophyll is a derivative of chlorophyll, while carotene is a derivative of carotenoids.

ANSWER: Y) XANTHOPHYLL HAVE A MORE CHARACTERISTIC YELLOW HUE WHILE CAROTENE IS MORE OF AN ORANGE HUE.
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TOSS-UP

19) Earth and Space – *Short Answer* What effect arises from the apparent change of position of something based on a different line of sight?

ANSWER: PARALLAX

BONUS

19) Earth and Space – *Multiple Choice* Which of the following is the name for glacial outburst flood triggered by geothermal heating and volcanism?

W) Plinian
X) Oranunai
Y) Jokulhlaup
Z) Cryovolcanism

ANSWER: Y) JOKULHLAUP

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TOSS-UP

20) Math – *Short Answer* Simplify: Sin(x) + sin(pi-x)

ANSWER: 2SIN(X)

BONUS

20) Math – *Short Answer* What is the definite integral from 0 to 2 of ln(x)/x dx and indefinite integral of ln(x)/x dx?

ANSWER: - infinity, $\ln(x)^2/2+C$
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TOSS-UP

21) Physics – *Short Answer* Identify all of the following statements that are true for an object in static equilibrium 1) All forces acting on the object are equal 2) The net force of the system is 0 3) The static friction force is equivalent to the normal force.

ANSWER: 2 ONLY

BONUS

21) Physics – *Multiple Choice* What is the spatial dimension for the Dirac Spin matrices?

W) 2x3
X) 3x2
Y) 4x4
Z) 5x5

ANSWER: Y) 4X4

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TOSS-UP

22) Biology – *Short Answer* What type of speciation arises from the evolution of a new species from a surviving ancestral species while both of the species continue to reside in the same region?

ANSWER: SYMPATRIC SPECIATION

BONUS

22) Biology – *Multiple Choice* What type of glial cell is responsible for creating myelin sheaths in the central nervous system?

W) Oligodendrocytes
X) Schwann cells
Y) Astrocytes
Z) Microglia

ANSWER: W) OLIGODENDROCYTES
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TOSS-UP

23) Chemistry – *Short Answer* In lab, you use a 5.00 mL volumetric pipet, a 25.00 mL volumetric flask, and a 250 mL beaker to measure out solutions to make a series of dilutions. The number of significant figures you need in the concentration of the final solution is:

W) 1
X) 2
Y) 3
Z) 4

ANSWER: X) 2

BONUS

23) Chemistry – *Short Answer* What is the coordination number and number of atoms per unit cell for a hexagonal closest packed?

ANSWER: 12, 6