ROUND 3

TOSS-UP

1) Chemistry *Multiple Choice* Which of the following functional groups has the carbon atom in an sp^3 hybridized state?

W) Alcohol
X) Ketone
Y) Aldehyde
Z) Amide

ANSWER: W) Alcohol

BONUS

1) Chemistry *Short Answer* Cracking of hydrocarbons results in the formation of what functional group?

ANSWER: Alkene

TOSS-UP

2) Math *Short Answer* What is the second derivative of $5x^2$ at x = 5?

ANSWER: 10

BONUS

2) Math *Short Answer* Find the sum of the arithmetic series with first term 5, last term 37, and common difference 4.

ANSWER: 189

TOSS-UP

3) Physics *Short Answer* A 1 kilogram block slides frictionlessly down a hill with height 5 meters, what is its final velocity in meters per second, rounded to the nearest integer, when it reaches the bottom?

ANSWER: 10

BONUS

3) Physics *Short Answer* Name all of the following that are true of the torque vector. 1) It is equivalent to the cross product of force and radius 2) It points in the same direction as angular acceleration 3) It is the dot product of moment of inertia and angular acceleration

ANSWER: 1 and 2

TOSS-UP

4) Biology *Short Answer* What secondary messenger has an inverse relation to the concentration of glucose within a cell?

ANSWER: cyclic AMP or cyclic Adenosine monophosphate

BONUS

4) Biology *Short Answer* What water-soluble vitamin helps in the process of collagen synthesis?

ANSWER: Vitamin C (Accept: Ascorbic Acid)

TOSS-UP

5) Earth and Space *Short Answer* What type of front occurs when a cold front overtakes a warm front?

ANSWER: Occluded Front

BONUS

5) Earth and Space *Short Answer* What is the name for the depth within an ocean in which the temperature begins to change greatly?

ANSWER: Thermocline

TOSS-UP

6) Math *Short Answer* How many edges are there on a hexagonal prism?

ANSWER: 18

BONUS

6) Math *Short Answer* What is the volume of a cone with a slant height of 13, and a diameter of 10?

ANSWER: 100π

TOSS-UP

7) Chemistry *Short Answer* What is the bond order of the diatomic ion N_2^{2+}

ANSWER: 2

BONUS

7) Chemistry *Multiple Choice* Which of the following solvents would be most effective in dissolving benzene?

W) Water
X) Propanoic Acid
Y) Cyclohexane
Z) Ethanol

ANSWER: Y) Cyclohexane

TOSS-UP

8) Earth and Space *Multiple Choice* Decreasing a star's magnitude by 1 would be closest to multiplying its brightness by which of the following numbers?

W) 2.5
X) 10
Y) 25
Z) 100

ANSWER: W) 2.5

BONUS

8) Earth and Space *Multiple Choice* Which of the following star colors has the shortest lifetime?

W) White
X) Blue
Y) Red
Z) Yellow

ANSWER: X) Blue

TOSS-UP

9) Biology *Multiple Choice* Which of the following nucleotide base pairs is a purine?

W) Cytosine
X) Adenine
Y) Uracil
Z) Thymine

ANSWER: X) Adenine

BONUS

9) Biology *Short Answer* The presence of what two base pairs of DNA provides the most stability within DNA's structure?

ANSWER: Cytosine and Guanine (in any order)

TOSS-UP

10) Physics *Short Answer* What is the impulse required to change a 7 kilogram object's velocity from 4 meters per second to 10 meters per second?

ANSWER: 42

BONUS

10) Physics *Short Answer* What is the constant pressure heat capacity of a monatomic ideal gas, in terms of the ideal gas constant?

ANSWER: 5/2 R

TOSS-UP

11) Earth and Space *Multiple Choice* Which of the following periods of geological time is the oldest?

W) Ordivician
X) Permian
Y) Jurassic
Z) Devonian

ANSWER: W) Ordivician

BONUS

11) Earth and Space *Multiple Choice* Which of the following rocks is not coarse-grained?

W) Granite
X) Diorite
Y) Dacite
Z) Basalt

ANSWER: Z) Basalt

TOSS-UP

12) Chemistry *Multiple Choice* Which of the following gases has the greatest root mean square speed at 200 Kelvin?

W) Oxygen
X) Helium
Y) Neon
Z) Fluorine

ANSWER: X) Helium

BONUS

12) Chemistry *Short Answer* How many hydrogens are there in 4-ethyl octane?

ANSWER: 22

TOSS-UP

13) Biology *Short Answer* What is the name for the channel protein that primarily facilitates the diffusion of water?

ANSWER: Aquaporin

BONUS

13) Biology *Short Answer* What is the term for the type of speciation that occurs when two species become geographically isolated from one another?

ANSWER: Allopatric Speciation

TOSS-UP

14) Physics *Multiple Choice* The muon and 3 neutrinos are part of the 6 leptons in the standard model. What are the other two?

W) Electron and Proton
X) Neutron and Proton
Y) Electron and Tauon
Z) Electron and Photon

ANSWER: Y) Electron and Tauon

BONUS

14) Physics *Short Answer* What is the normal force exerted on a block with a mass of 6 kilograms on a slope with an angle of 60 degrees to the horizontal?

ANSWER: 30

TOSS-UP

15) Math *Short Answer* What is the base 10 numeral 54 in base 7?

ANSWER: 105

BONUS

15) Math *Short Answer* What is the unit vector that points in the same direction as the vector <2, 7, -9>?

ANSWER: $< \frac{\sqrt{134}}{67}, \frac{7\sqrt{134}}{134}, -\frac{9\sqrt{134}}{134} >$

TOSS-UP

16) Biology *Short Answer* In which organelle does oxidative phosphorylation occur?

ANSWER: Mitochondrion

BONUS

16) Biology *Multiple Choice* What contribution do two cysteine amino acids provide in the tertiary structure of a protein?

W) Disulfide bridges
X) Ionic Bonding
Y) Hydrophobic interactions
Z) Hydrophilic interactions

ANSWER: W) Disulfide bridges

TOSS-UP

17) Math *Short Answer* What is the expected value of the sum of two dice that are rolled?

ANSWER: 7

BONUS

17) Math *Short Answer* How many edges exist on a dodecahedron?

ANSWER: 30

TOSS-UP

18) Physics *Short Answer* Rounded to the nearest tenth, what is the maximum height of a ball that is thrown upwards at 9.8 meters per second?

ANSWER: 4.9 meters

BONUS

18) Physics *Multiple Choice* Which of the following factors does not play a role in the period of a physical pendulum?

W) Moment of Inertia
X) Length
Y) Rigidity
Z) Mass

ANSWER: Y) Rigidity

TOSS-UP

19) Chemistry *Short Answer* Rank the following 3 ions in terms of increasing atomic radius. 1) Sodium cation 2) Magnesium cation 3) Fluorine Anion

ANSWER: 2, 1, 3

BONUS

19) Chemistry *Multiple Choice* Which of the following carboxylic acid derivatives is the most stable?

W) Acid anhydride
X) Acid Chloride
Y) Ester
Z) Amide

ANSWER: Z) Amide

TOSS-UP

20) Earth and Space *Short Answer* What planet has the highest eccentricity?

ANSWER: Mercury

BONUS

20) Earth and Space *Multiple Choice* In a telescope, you see what appears to be a cloud of gas that is illuminated blue. What type of nebula are you most likely seeing?

W) Emission nebula
X) Reflection nebula
Y) Dark nebula
Z) Balmer Nebula

ANSWER: X) Reflection Nebula

TOSS-UP

21) Math *Multiple Choice* Which of the following types of matrices cannot be multiplied together?

W) A 2 by 3 and a 3 by 4
X) A 6 by 4 and a 6 by 4
Y) A 4 by 2 and a 2 by 4
Z) A 3 by 3 and a 3 by 3

ANSWER: X) A 6 by 4 and a 6 by 4

BONUS

21) MATH *Short Answer* What is the product of the two complex numbers 3 + 4i and 6 + 7i?

ANSWER: -10 + 45i

TOSS-UP

22) Chemistry *Short Answer* What is the oxidation state of the oxygen atom in methanol?

ANSWER: -2

BONUS

22) Chemistry *Short Answer* Name all of the following types of reactions that would obey Zaitsev's rule. 1) SN1 2) SN2 3) E1 4) E2

ANSWER: 3 and 4

TOSS-UP

23) Earth and Space *Short Answer* What is the name for the dark, vesicular rock that commonly makes up cinder cones?

ANSWER: Scoria

BONUS

23) Earth and Space *Short Answer* What is the name for the process in which the ground begins to behave in a fluid like manner, often as a result of earthquakes?

ANSWER: Liquefaction