THUMB: SINGLE ELIMINATION 1

1) Chemistry – *Multiple Choice* Tollen's reagent is most commonly used to detect which of the following organic functional groups?

W) Alcohol
X) Aldehyde
Y) Carboxylic Acid
Z) Amine

ANSWER: X) Aldehyde [DS]

2) Biology – *Short Answer* The glycerol-3-phosphate shuttle and the malate-aspartate shuttle are used in the transport of what molecule in and out of the mitochondria, which functions as a cofactor in central metabolism?

ANSWER: NADH or NAD+ [SY]

3) Math – *Short Answer* Compute the integral from x=-5 to x= 5 of the function f(x)=sin(4x)+x^3+5x **(f of x equals the sine of open parenthesis four x close parenthesis, plus x cubed, plus five x)**

ANSWER: 0 [AX]

4) Earth and Space – *Short Answer* Meteor impacts leave craters. Arrange the following three deposits from increasing distance from the center of an impact crater in general: 1) Impact breccia 2) Glass 3) Ash

ANSWER: 2, 1, 3 [FJ]

5) Physics – *Short Answer* Identify all of the following three types of scattering during which momentum is conserved: 1) Compton scattering 2) Raman scattering 3) Rayleigh scattering

ANSWER: All [FJ]

6) Chemistry – *Short Answer* By name or number, identify all of the following FOUR anions that evolve gaseous carbon dioxide upon contact with a strong acid: 1) Phosphate 2) Bicarbonate 3) Nitrate 4) Carbonate

ANSWER: 2 and 4 [DS]

7) Biology – *Short Answer* Aryan is identifying non-functional genes in his angiosperms. After growing his plants, he notices that the plants produced no stamens nor petals, while producing exclusively sepals and carpels. If the plant adheres to the ABC hypothesis of flower formation, identify all of the following genes which must be non-functional: 1) A 2) B 3) C

ANSWER: 2 only

8) Math – *Multiple Choice* Sean the mad scientist wants to design an experiment with two groups that he knows are different in a way that maximizes the chances of finding a statistically significant result. Which of the following set of changes would make it easiest to reject the null hypothesis?

W) Decreasing the sample size and decreasing the alpha level
X) Decreasing the sample size and increasing the alpha level
Y) Increasing the sample size and decreasing the alpha level
Z) Increasing the sample size and increasing the alpha level

ANSWER: Z) Increasing the sample size and increasing the alpha level [AX]

9) Earth and Space – *Multiple Choice* Which of the following minerals does NOT belong to the same crystal system as the tasty mineral galena?

W) Fluorite
X) Halite
Y) Calcite
Z) Pyrite

ANSWER: Y) Calcite [FJ]

10) Physics – *Short Answer* Sean Yu drops an orange on the surface of Earth and later drops another orange on a rocketship in space accelerating at 9.8 meters per second squared. He notices that both oranges fall the same way. This is a demonstration of what physical principle?

ANSWER: Equivalence principle [FJ]

11) Chemistry – *Multiple Choice* Which of the following colors does cobalt dye silicon dioxide based glass?

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

ANSWER: W) Blue [DS]

12) BIology – *Short Answer* By name or number, order the following FOUR components of blood by decreasing percent composition by volume: 1) Water 2) Plasma proteins 3) Erythrocytes 4) Leukocytes

Answer: 1 3 2 4

13) Math – *Short Answer* The THUMB moderators have created a new math term called thumbless, meaning the square root of a number equals the number of factors it has. Identify all of the three following numbers that are thumbless. 1) 1 2) 4 3) 9

ANSWER: 1, 3 [AX]

14) Earth and Space – *Short Answer* Identify all of the following three types of moraines that are sorted: 1) Lateral 2) Ground 3) Terminal

ANSWER: None [FJ]

15) Physics – *Short Answer* Austin gets tired of his monkeys screeching and decides to throw one to space at a speed of 9c/41. Austin watches for 123 minutes as the monkeys ascend. To the nearest minute, how long has passed in the monkey's frame of reference?

ANSWER: 120 [AX]

16) Chemistry – *Short Answer* [READ AT A MODERATE PACE, ENFORCE STALLS, CALL STALL IF PLAYER PAUSES ANSWER >3 sec]
Give the full balanced chemical equation for the double displacement reaction of nickel two chloride and sodium hydroxide to produce nickel two hydroxide and sodium chloride.

ANSWER: NiCl2+2NaOH yields Ni(OH)2+2NaCl (ACCEPT answers with the reactants in any order and products in any order, and synonyms of "yields", AND ACCEPT answers without parenthesis) [AlX, DS]

17) Biology – *Multiple Choice* In a population that divides resources among multiple niches, individuals that specialize in a single niche tend to have higher fitness. This type of niche partitioning leads to which of the following types of selection?

W) Stabilizing
X) Directional
Y) DIsruptive
Z) Balancing

ANSWER: Y) Disruptive [FJ]

18) Math – *Multiple Choice* Alex is weird and likes strange pythagorean triples. Which of the following groups of side lengths do NOT form a pythagorean triple?

W) 7, 24, 25
X) 20, 21, 29
Y) 14, 28, 35
Z) 28, 45, 33

ANSWER: Y) 14, 28, 35 [AX]

19) Earth and Space – *Short Answer* Through the capture of what particles do the s and r processes produce heavy nuclei?

ANSWER: Neutron [FJ]

20) Physics – *Short Answer* A lightbulb draws 500 milliamps of current from a 8V battery. If the resistance is then changed to 10 Ohms and the electric potential stays constant, then in milliamps, how much does the current in the lightbulb increase?

ANSWER: 300 [AX]

21) Chemistry – *Short Answer* What is the major product in the elimination reaction of ethanol with a sulfuric acid catalyst under constant heating?

ANSWER: Ethylene or Ethene [AlX] [DS] [SY]

22) Biology – *Multiple choice* Sean was testing an old gram stain kit to make sure none of the reagents are expired. He stains a sample of bacteria confirmed to be E. coli. After completing the staining procedure correctly, Sean notices the bacteria are visibly stained the wrong color. Which of the following reagents has definitely expired?

W) Alcohol
X) Crystal violet
Y) Iodine
Z) Safranin

ANSWER: W) Alcohol [SY]

23) Math – *Short Answer* Rank the following 3 geometric series by increasing total sum: 1) First term 16, third term 4 2) First term 27, second term 9 3) First term 32, common ratio 1/4

ANSWER: 1, 2, 3 [AX]

24) Earth and Space – *Short Answer* Neglecting interstellar effects, what is the distance modulus of a star located 10 parsecs away from Earth?

ANSWER: 0 [FJ]

25) Physics – *Short Answer* Haiyue is traveling around the Sun with a positive total energy. Identify all of the following three orbits that Haiyue could be in: 1) Circular 2) Parabolic 3) Hyperbolic

ANSWER: 3 only [FJ]