1. Math multiple choice toss up: If three dice are rolled, what is the probability that the numbers shown will be one 2, one 4, and one 6?

W) 1/216

X)1/108

Y)1/54

Z)1/36

Answer: Z

2. Math short answer bonus: How many dice must be rolled so that there is a greater than 50% chance that there will be at least one 6?

Answer: 4

3. Physics short answer toss up: What is the name of the series of transitions in a hydrogen atom to the n=1 level?

Answer: Lyman Series

4. Physics short answer bonus: An object is thrown from the surface of the earth with a speed of 30 m/s at an angle of 45 degrees to the horizontal. 1. How long does it take for the object to hit the ground? 2. What is the speed of the ball when it hits the ground?

Answer: 1. 3sqrt2 seconds 2. 30 m/s

5. Earth and Space toss up multiple choice: Which of the following fossils was not found in the Rancho La Bre tar pits in Los Angeles?

W) saber-toothed cat

X) dire wolf

Y) wooly mammoth

Z) giant ground sloth

Answer: wooly mammoth

6. Earth and Space short answer bonus: What is the name of a slow-moving extensive cyclone which forms in subtropical latitudes during the winter season?

Answer: kona cyclone (kona storm)

7. Biology multiple choice toss up: Cells do not catabolize carbon because

W) Its double bonds are too stable to be broken

X) CO2 has fewe bonding electrons than other organic compounds

Y) The carbon atom is already completely reduced

Z) Most of the available electron energy was released by the time the CO2 was formed

Answer: Z

8. Biology short answer bonus: What chemical characteristic of oxygen accounts for its function in cellular respiration?

Answer: (High) Electronegativity

9. Chemistry short answer toss up: What is the oxidation number for carbon in carbon dioxide?

Answer: +4

10. Chemistry short answer bonus: Which of the following is or are true about solubility?

I. As temperature increases, solubility of a solid in a liquid tends to increase

II. As pressure increases, solubility of a solid in a liquid tends to decrease

III. As temperature increases, solubility of a gas in a liquid tends to increase

IV. A pressure increases, solubility of a gas in a liquid tends to remain constant

Answer: 1 only

11. Math multiple choice toss up: Which of the following is not a Pythagorean triple which includes 12?

W) 5,12,13

X) 9,12,15

Y) 12,16,20

Z) 6,9,12

Answer: Z

12. Math short answer bonus: Little red riding hood wants to bring water to her grandmother. To deliver the water, Red must start at her house, walk to a nearby river to get the water, and then walk from the river to her grandmother’s house. If Red lives 3 miles away from the river, her grandmother lives 9 miles away from the river on the same side, and the two houses are 5 miles apart along the river, what is the length of the shortest path Red can take to deliver the water?

Answer: 13 (miles)

13. Physics multiple choice toss up: What is the name for the phenomenon where a particle, when encountering a potential barrier, emerges on the other side without any loss of kinetic energy?

Answer: Tunneling

14. Physics multiple choice bonus: The temperature of a surface is doubled. By what factor does its heat current increase?

W) 2

X) 4

Y) 8

Z) 16

15. Math multiple choice toss up: What is the name of the number with a continued fraction of all ones?

Answer: phi (Accept (1+sqrt5)/2)

16. Math short answer bonus: Which of the following three statements are benefits of continued fractions to represent numbers over a standard base system?

I. All irrational but not transcendental numbers have a repeating continued fraction, but in a standard base system there is no way to distinguish between algebraic irrationals and transcendentals.

II. There is only one way to represent any real number as a continued fraction, but some numbers have multiple representations in standard base systems

III. All rationals have a finite continued fraction, but some rationals have infinite representations in a standard base system

Answer: 3

17. Biology toss up multiple choice: Despite the difference ins tructure of plants and animals, they share some basic similarities in development such as

W) The importance of cell and tissue movements

X) The importance of selective cell enlargement

Y) The retention of meristematic tissues in the adult

Z) Master regulatory genes that encode DNA-binding proteins

Answer: Z

18 Biology multiple choice bonus: Absence of bicoid mRNA from a Drosophila egg leads to the absence of anterior larval body parts and mirror-image duplication of posterior parts. This is evidence that the bicoid gene

W) Is an inducer

X) contains a homeobox

Y) is a morphogen

Z) is a transcription factor

Answer: Y

19. Chemistry toss up short answer: Classify the following three molecules as polar or nonpolar

I. F2

II. CO2

III NH3

Answer: nonpolar, nonpolar, polar

20. Chemistry bonus short answer: To the nearest liter, what volume of oxygen at STP can be formed from .5 moles of potassium chlorate. Use the conversion of 22.4 liters per mole.

Answer: 17 liters

21. Math short answer toss up: What is the sum of the coefficients in (x+1)^10?

Answer: 1024

22. Math short answer bonus: What is (3+sqrt7)^4 to the nearest integer?

1016

23. Physics short answer toss up: What is the name for the splitting of atomic energy levels and the associated spectral lines when the atoms are placed in a magnetic field?  
Answer: Zeeman effect

24. Physics multiple choice bonus: Approximately what is the ratio between the gyromagnetic ratio for electron spin than for orbital angular momentum?

W) They are about the same

X) The orbital angular momentum is about twice as high as the electron spin angular momentum

Y) The electron spin angular momentum is about twice as high as the orbital angular momentum

Z) The electron spin angular momentum is about four times as high as the orbital angular momentum

Answer: Y

1. Math toss up multiple choice: How many factors does the number 210 have?

W) 8

X) 12

Y) 16

Z) 20

Answer: 16

2. Math bonus short answer: A number has x factors. The number times 2 has 3x factors, the number times 3 has 4x factors, the number times 5 has 5x factors, and the number times any other prime has 2x factors. Find x.

Answer: 24

3. Physics toss up short answer: In a series motor, the rotor is connected in series with the electromagnetic that produces the magnetic field. If the electromotive force is 70 volts, there is a current of 5 Amperes, and a internal resistance of 10 ohms, what is the potential difference between the two terminals?

Answer: 120 Volts

4. Physics bonus short answer: Which of the following four statements is or are true:

I. The equivalent resistance of a 4 ohm resistor and a 2 ohm resistor connected in series in 6 ohms.

II. The equivalent resistance of a 2 ohm, a 3 ohm, and a 4 ohm resistor connected in parallel is 15/7 ohms

III. The equivalent capacitance of a 3 farad, a 5 farad, and a 7 farad capacitor connected in series is 15 farads

IV. The equivalent capacitance of 10 capacitors all connected in parallel with capacitances of 20 Farads each is 2 Farads.  
Answer: I only

5. Biology toss up short answer: What is the name for the physical processes that give an organism its shape? The word means “creation of form”.

Answer: Morphogenesis

6. Biology bonus multiple choice: Which of the following ideas is common to both darwin’s and Lamarck’s theories of evolution?

W) Adaptation results from differential reproductive success

X) Evolution drives organisms to greater and greater complexity

Y) Evolutionary adaptation results from interactions between organisms and their environments

Z) Adaptation results from the use and disuse of anatomical structures

Answer: Y

7. Chemistry toss up short answer: A child at ground level, 20 degrees Celsius and 1 ATM, lets go of a 4 liter balloon. The balloon rises to where the new temperature is 10 degrees Celsius and the pressure is .94 ATM. What is the new volume of the balloon to 2 significant figures?

Answer: 4.1 Liters

8. Chemistry bonus multiple choice: A polyethylene bag from a store weighs 14.0 g. How many moles of ethylene must be polymerized to make such a bag?

W) 8.43 \* 1024

X) 1.20 \*1024

Y) 6.02 \* 1023

Z) 3.01 \* 1023

Answer: Z

9. Earth and space toss up multiple choice: What is the difference between porosity and permeability?  
W) Porosity is percent pore space while permeability is total pore space

X) Porosity is total pore space while permeability is percent pore space

Y ) Porosity is percent pore space while permeability is rate of motion of the water

Z) Porosity is the rate of motion of the water while permeability is percent pore space  
Answer: Y

10. Put the following three items in order of increasing hydraulic conductivity

I. Gravel

II. Sand

III. Clay

IV. Till

Answer: Clay, till, sand, gravel

11. Math toss up short answer: The first term in an arithmetic sequence is 2. The sum of the first 10 terms of the sequence is 5. The sum of the next 10 terms is -5. What is the sum of the next 10 terms of the sequence?

Answer: -15

12. Math bonus multiple choice: how many pairs of positive integers are there whose harmonic mean is equal to 6.

W) 2

X) 3

Y) 4

Z) 6

Answer: 3

13 Physics toss up short answer: An object is thrown at an angle of 15 degrees from the horizontal with a speed of 30 meters per second. Calculate the speed of the object when it his the ground?

Answer: 30 meters per second

14. Physics bonus multiple choice: A particle in a box with length L is in the nth energy level. What is the average value of its x-component of momentum px?

W) nh/2L

X) (sqrt2/2)nh/L

Y) 1/(2sqrt2)nh/L

Z) 0

Answer: Z

15. Biology toss up multiple choice: Which of the following four structures or components is or ore part of the plant’s apoplast?

I. The lumen of a xylem vessel

II. The lumen of a sieve tube

III. The cell wall of a posophyll cell

IV. The cell wall of a transfer cell

Answer: I,III,and IV (All but II)

16. Biology bonus multiple choice: A plant cell with a solute potential of -.65 MPa maintains a constant volume when it is bathed in a solution with a solute potential of -.3 MPA and is in an open container. Which of the following is true about the cell.

W) The cell has a pressure potential of +.65 MPa

X) The cell has a water potential of -.65 MPa

Y) The cell has a pressure potential of +.35 MPa

Z) The cell has a pressure potential of -.35 MPa

Answer: Y

17. Chemistry toss up multiple choice: What is the pH of a 5.0\*10^-14 M NaOH solution?

W) 9.7

X) 10.7

Y) 11.7

Z) 12.7

Answer: W

18. Chemistry bonus short answer: The pH of a .20 molar acetic acid solution is found to be 2.88. Calculate the ionization constant for acetic acid to two significant figures. Express your answer in scientific notation.

Answer: 1.7\*10^-5

19. Earth and Space toss up multiple choice: What pH is rain water?

W) 4-5

X) 6-7

Y) 7-8

Z) 9-10

Answer: W

20. Earth and Space bonus short answer: What are two types of units that are used to measure turbidity:

Answer: Nephelometric turbidity units, Jackson turbidity units (NTUs, JTUs)

21. Math toss up multiple choice: How many times less likely is a string of 50 heads while flipping a coin than a head followed by an alternating sequence of heads and tails?

Answer: 1

22. In a town, 30% of the people are short. 20% of the people who are short do Science Bowl. 40% of the people who are tall do Science Bowl. Two people are selected at random from the Science bowl Team. What is the probability that one is short and one is tall (Assume that there are enough science bowlers and enough people in the town that the chances of each of these two people being short or tall are independent)

Answer: 84/289

23. Physics toss up multiple choice: If you leave your refrigerator door open, which of the following will happen?

W) The room will get colder

X) The room will get warmer

Y) The temperature of the room will stay the same

Z) The temperature of the room will go up and then down

Answer: X

24. Physics bonus short answer: What form of the second law of thermodynamics states that it is impossible for a system to undergo a process in which it absorbs heat from a reservoir at a single temperature and converts the heat completely into mechanical work, with the system ending in the same state in which it began?

Answer: Kelvin-Planck