1. Math toss up multiple choice: Which of the following would not be changed if all of the members of a data set were doubled in size?

W) The standard deviation

X) The mean

Y) The outliers

Z) The skew

Answer: Y

Math bonus short answer: A population of birds has a mean lifetime of 20 years and a standard deviation of 3 years. Humans then infect the birds with a disease which removes 5 years from the birds’ lives with a standard deviation of 4 years removed. After all birds, including new offspring, are infected with the disease, what will the probability be, to the nearest tenth of a percent, that a bird lives for at least 20 years?

Answer: 2.5%

2. Biology toss up multiple choiceWhich of the following is not a characteristic of Hardy-Weinberg equilibrium?

W) A small population size

X) No migration

Y) Random mating

Z) No natural selection

Answer: W

Biology bonus multiple choice: The name for what species refers to the contribution of two different species to a polyploid hybrid, as its origin begins when two different species interbreed and combine their chromosomes?

Answer: Allopolyploid

3. Chemistry toss up multiple choice: In the unbalanced equation

::::C10H12O4S(s) + ::::O2(g) => ::::CO2(g) + ::::SO2(g) + ::::H2O(g), what is the coefficient for O2?

W) 6

X) 7

Y) 12

Z) 14

Answer: Y

Chemistry bonus short answer: A typical polyethylene bag from a grocery store weighs 14.0 g. How many molecules of ethylene, C2H4, 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

4. The graph of resistivity with increasing temperature for a semiconductor is

W) A straight line

X) Concave

Y) Convex

Z) Not continuous in all places

Bonus Physics short answer: Rank the following three circuits in order from highest to lowest current

I. A 1.4 ohm resistor connected to a 1.5 V battery with an internal resistance of .1 ohms

II. A 1.8 ohm resistor connected to a 4 volt battery with a terminal voltage of 3.6 volts but unknown internal resistance

III. An unknown resistor connected to a 12 volts battery with an internal resistance of .2 ohms and a terminal voltage of 11.0 volts.

Answer: III, II, I

5. Earth and Space toss up multiple choice: The brightness of two different stars differ by two magnitudes. What is the approximate intensity ratio between the two stars?

W 3.25

X. 4.25

Y. 5.25

Z. 6.25

Answer: Z

Earth and Space bonus multiple choice: How bright is the star Polaris compared to others in the sky?

W) It is the brightest star

X) It is about the 10th brightest star

Y) It is about the 50th brightest star

Z) It is about the 100th brightest star

Answer: Y

7. Math toss up short answer: A pair of standard dice is rolled. Given that at least one shows a 6, what is the probability that a 12 is rolled?

W) 1/6

X) 1/11

Y) 1/12

Z) 1/36

Answer: X

Math bonus short answer: What is the largest possible dimension n for which an n-dimensional unit cube can fit inside an n-dimensional unit sphere?

Answer: 4

8. Biology toss up multiple choice: Name the type of analysis, by Southern blotting, which is a powerful method for the forensic detection of similarities and differences in DNA samples. This analysis requires only tiny amounts of tissue, only about 1000 cells.

Answer: RFLP

Biology bonus short answer: A paleontologist recovers a small amount of tissue from a 400 year old preserved skin of a dodo. He wishes to compare DNA from the sample with DNA from living birds, but needs to increase the amount of dodo DNA available for testing. Which the following would be most helpful to her?

W) RFLP analysis

X) Polymerase chain reaction , or PCR

Y) Electroporation

Z) Gel Electrophoresis

Answer: X

9. Chemistry toss up multiple choice: Mg(s) + 2 HCl(aq) 􀀀􀀀! MgCl2(aq) + H2(g)

According to the reaction above, how many liters of hydrogen gas would be released upon reaction of 6.00 g of magnesium metal with excess hydrochloric acid at 25.0\_C and 1.00 atm?

W) 3.02 L

X) 6.04 L

Y) 12.1 L

Z) 24.2 L

Answer: X (estimate)

Chemistry bonus short answer: Name all of the following 5 molecules with two unshared pairs of electrons on the central atom.

I. H2S

II. PH3

III. SiH4

IV HCN

V. CS2

Answer: I only

10. Physics toss up multiple choice: A copper wire of square cross section is oriented vertically, with the four sides of the wire facing north, south, east and west. A uniform magnetic field is directed from north to south, and the wire carries current downward. What side of the wire has the highest electric potential?

W) north

X) south

Y) east

Z) west

Answer: east

Physics bonus short answer:An L-R-C series circuit includes a 2 ohm resistor. At t=0 the capacitor charge is 2 micro coulomb. Name all of the following three values of the inductance and capacitance will the charge on the capacitor not oscillate?

I. 3.0 microH 6 micro F R^2>4LC

II. 6 micro H 3 micro F

III. 3 micro H, 3 micro F

Answer: I and III

11. Earth and Space toss up short answer: To the nearest kilometer per second, what is the escape velocity from Earth?  
Answer: 11

Earth and Space bonus short answer: In 1920 a Yugoslavian meteorologist proposed that small changes in earth’s orbit, precession, and inclination greatly affect earth’s climate. What was this hypothesis called?

Answer: Milonkavitch Hypothesis

13. Math toss up short answer: Find the maximum possible value of 7sin(x)+24cos(x)

Answer: 25

Math bonus multiple choice: Find tan(tan-1(5)+tan-1(7)).

Answer: -6/17

14. Biology toss up multiple choice: On average, how much difference is there between the DNA sequences of two people

W) 1 difference per 4 base pairs

X) 1 difference per 10 base pairs

Y) 1 difference per 100 base pairs

Z) 1 difference per 1000 base pairs

Answer: Z

Biology bonus multiple choice: Name all of the following three which Celera carried out in its mapping of the human genome

I. Linkage mapping of each chromosome

II. Extensive physical mapping of each chromosome, starting with large chromosomal fragments

III. DNA sequencing of small fragments and hen assembly of the fragments to determine overall nucleotide sequence

Answer: III only

15. Chemistry toss up short answer: Name all of the following three molecules which have planar configurations.

I. XeO­3

II. CCl4

III. BCl3

Answer: III only

Chemistry bonus short answer: Ionization Energies

for Element Y (kJ/mol)

First 787

Second 1577

Third 3232

Fourth 4356

Fifth 16090

Based on this data, element Y is most likely to

W) Na

X) Mg

Y) Al

Z) Si

Answer: Z (fourth is high)

16. Physics toss up short answer: When light is fired through two slits, it foms a series of bands. What is the distance, in wavelengths, between two neighboring bands?

Answer: ½

Physics bonus short answer: A neon light fixture emits light with the same wavelength as a helium-neon laser. The light emitted by a neon light fixture is which of the following 3 i. spontaneous emission II. Stimulated emission III. Both spontaneous and stimulated emission

17. Earth and Space toss up short answer: What principle states that sediments are deposited uder the influence of gravity as nearly horizontal beds?

The principle of original horizontality

Earth and Space bonus short answer: Giving both first and last name, what person recognized in 1793 that fossils can help us to order the relative ages of sedimentary rocks?

Answer: William Smith

19. Math toss up short answer: Find the sum of all factors of 28.

Answer: 28

Math bonus short answer: Find the sum of all factors of 960?

Answer: 3048

20. Biology toss up short answer: What is another name for the programmed cell death which has been found by lineage analysis of C. elegans to be a crucial part of animal development.  
Answer: apoptosis

Biology bonus multiple choice: Name all of the following four statements which is or are true:

I. A single embryonic stem cell cannot develop into an embryo

II. Homeoboxes, which help homeotic genes direct development, are common to flies and mice

III. Fruit-flu maternal effect genes are also called egg-polarity genes because their products determine the head and tail ends of the egg

IV. If you clone a carrot, all of the progeny plants will look identical

Answer: All but IV

21. Chemistry toss up multiple choice: What volume of 0.300-molar HNO3 is required to neutralize 50.0 milliliters of 0.240-molar Ca(OH)2?

(a) 40.0 mL

(b) 60.0 mL

(c) 80.0 mL

(d) 120. mL

(e) 160. mL

Chemistry bonus multiple choice:

Initial [NO] M Initial [O2] M Initial Rate of Formation of NO2 (M/s)

0.10 0.10 2.5 \* 10^4

0.20 0.40 8.0 \* 10^3

0.40 0.10 1.0 \* 10^3

The initial-rate data in the table above was collected for the reaction shown below. What is the rate law for the formation of NO2(g)?

2 NO(g) + O2(g) 🡺 NO2(g)

(a) Rate = k[NO][O2]

(b) Rate = k[NO]2[O2]

(c) Rate = k[NO][O2]2

(d) Rate = k[NO]2[O2]2

(e) Rate = k[NO]2[O2]1=2

22. Physics toss up multiple choice: Which of the following is possible:

W. An object has greatest moment of inertia through a point other than its center of mass

X) Something with no angular momentum able to turn around in mid-air with no external forces

Y) Angular momentum is added to a system without any net external torque

Z) With no friction, A hollow sphere of some radius and material reaches the bottom of a ramp faster than a ssolid sphere of some other radius and material.

Answer: X

Physics bonus short answer: Your spacecraft is in a low-altitude circular orbit around the earth. Air resistance does negative work on the spacecraft, causing the orbital radius to decrease slightly. What happens to the speed of the spacecraft? Does it I. Remain the same II. Decrease or III. Increase

23. Earth and Space toss up multiple choice: Which of the following periods is the oldest?

W) Cretacious

X) Devonian

Y) Paleogene

Z) Neogene

Answer: X

Earth and Space bonus short answer: If the Earth’s age is thought of as 1 calendar year, where the earth formed on January 1, during what month did the first primitive organisms evolve?

Answer: March: (Accept April)

25. Math toss up short answer: Name all of the following four statements which is or are true about planar graphs:

I. A graph is planar if when it is drawn on paper, no two lines will cross one another

II. The graph where all possible edges are drawn between 4 vertices is planar

III. The graph where all possible edge are drawn between 5 vertices is planar

IV. All nonplanar graphs must contain K5 as a sub graph.

Answer: II only

How many 0’s are at the end of 193! When it is expressed in base 2?

Answer: 190