1. PHYSICS: *Short Answer:* As neutrinos propagate through space, they often oscillate between the three known types. By name or number, identify all of the following three conditions that affect the probability of detecting a certain neutrino flavor

1. energy of the neutrino

2. distance travelled

3. initial flavor of neutrino

2. EARTH AND SPACE SCIENCE: *Multiple Choice:* Which of the following elements was NOT synthesized during big bang nucleosynthesis

W) Beryllium

X) Lithium

Y) Helium

Z) Hydrogen

ANSWER: W) Beryllium

3. BIOLOGY: *Short Answer:* Identify the following four reproductive barriers as being either prezygotic or postzygotic

1. reduced hybrid viability

2. mechanical isolation

3. hybrid breakdown

4. gametic isolation

ANSWER 1 post 2 pre 3 post 4 pre

4. CHEMISTRY: *Multiple Choice:* Which of the following molecules does not have d2sp3 hybridization in its central atom?

W) XeF4

X) BrF5

Y) SF6

Z) ClF3

ANSWER: Z

5. ENERGY: *Short Answer:* By name or number, identify all of the following three characteristics that are desirable for the fuel in radioactive isotope generators

1. element releases large quantities of beta radiation

2. long half life on the order of decades

3. low density

ANSWER: 2 AND 3

6. MATHEMATICS: *Multiple Choice:* Let n be an integer that is a multiple of the numbers 2, 3, and 7. Which of the following quantities represents the next largest integer that is also a multiple of those numbers?  
W) n+42

X) n+14

Y) n+3

Z) n+2

ANSWER:W) n+42

7. PHYSICS: *Multiple Choice:* A viscous fluid is being pushed through a pipe open at both ends from a force at the left side. It exits the pipe at the right side. Where in the pipe is fluid's velocity the greatest?

W) right end, center of the cross-section of the pipe

X) left end, center of the cross-section of the pipe

Y) right end, wall of the pipe

Z) left end, wall of the pipe

ANSWER: X) left end, center of the cross-section of the pipe

8. EARTH AND SPACE SCIENCE: *Short Answer:* Which of the following structural traps does

NOT accumulate oil and gas?

W) salt dome

X) anticline

Y) syncline

Z) fault

ANSWER: Y) SYNCLINE

9. BIOLOGY: *Short Answer:* Order the following four biologic events in chronological order:

1. diversification of early vascular plants

2. Cambrian explosion

3. rise of gymnosperms as dominant plant species

4. domination of angiosperms

ANSWER: 2, 1, 3, 4

10. CHEMSITRY: *Short Answer:* When tert-butyl bromide is mixed with water, tert-butanol

forms, along with a bromine and hydronium ion. It is found that if the concentration of tert butyl

bromideis doubled, the reaction rate doubles, while if the concentration of water is doubled, the

rate remains constant. What type of substitution reaction is this?

ANSWER: SN1

11. ENERGY: *Short Answer:* What American geophysicist presented a paper in 1956, in which

he described his namesake theory which states that for any oil-producing geographical oil

producing region, rates of production tend to follow a bell-shaped curve?

ANSWER: HUBBERT

12. MATHEMATICS: *Short Answer:* What is the limit as x approaches NEGATIVE infinity of

the fraction with numerator x cubed times open parenthesis x to the fifth plus one closed

parenthesis, and denominator x cubed times open parenthesis 2x squared plus two closed

parenthesis.

ANSWER: NEGATIVE INFINITY

13. PHYSICS: *Short Answer:* In room-temperature air, the note middle C has an approximate wavelength of 1.3 meters. Two speakers, both playing middle C in phase are placed such that when the sound is recorded, the volume is much less than either of the two speakers. What is the minimum distance to two significant figures and in meters that the speakers are offset from each other by?

ANSWER: 0.65 METERS

14. EARTH AND SPACE SCIENCE: *Multiple Choice:* A pile of which of the following

unconsolidated materials would have the highest angle of repose?

W) angular pebbles

X) water-saturated fine sand

Y) water-saturated coarse sand

Z) water-saturated dry sand

ANSWER: W) angular pebbles

15. BIOLOGY: *Multiple Choice:* Which of the following groups of animals is the most closely

related to birds?

W) lizards and snakes

X) crocodilians

Y) saurischian dinosaurs

Z) ornithischian dinoscaurs

ANSWER: Y) saurischian dinosaurs

16. CHEMISTRY: *Short Answer:* What is the order of a reaction that yields a straight line when

time is graphed on the x-axis and concentration of the reactant is graphed on the y-axis?

ANSWER: 0th ORDER

17. ENERGY: *Multiple Choice:* Thermite is a pyrotechnic composition of a metal powder and

oxide which undergoes a highly exothermic redox reacion. Which of the following compounds is

commonly used as the oxidizer in thermite mixtures?

W) aluminum

X) titanium

Y) boron

Z) boron III oxide

ANSWER: Z) boron III oxide

18. MATHEMATICS: *Short Answer:* What is the domain of the function f given my f(x) equals the fraction with numerator square root of the quantity x squared minus four and denominator x - 3?

ANSWER: All x greater than or equal to absolute of two and not equal to three

19. PHYSICS: *Multiple Choice:* An particle with charge negative 0.5 Coulomb and travelling at

1 m/s to the right on the x-axis encounters a magnetic field with strength 2 Tesla oriented in the

xy plane that makes an angle of 30 degrees with the positive x-axis. What is the magnitude and

direction of the force on the particle?

W) 1 Newton, positive z-axis

X) 0.5 Newton, positive z-axis

Y) 1 Newton, negative z-axis

Z) 0.5 Newton, negative z-axis

ANSWER: X

20. EARTH AND SPACE SCIENCE: *Short Answer:* What phenomenon is observed when land

masses previously covered by ice sheets subsequently rise after the melting of the ice, and affects

areas such as the Great Lakes and northern Europe?

ANSWER: isostatic rebound

21. BIOLOGY: *Multiple Choice:* Which of the following organisms is NOT a member of the

domain eukarya?

W) chlamydia

X) euglena

Y) trypanosomes

Z) leishmania

ANSWER: W) CHLAMYDIA

22. CHEMISTRY: *Multiple Choice:* Consider the hypothetical reaction A gas plus B gas yields 4C gas, for which the equilibrium constant at STP is 1 x 10^-4. Which of the following statements is true about the reaction?

W) the change in entropy is negative

X) the reaction is spontaneous at low temperatures

Y) the change in enthalpy is positive

Z) the reaction tends towards products

ANSWER: Y

23. ENERGY: *Short Answer:* What is the most stable isotope of uranium?

ANSWER: U 238

24. MATHEMATICS: *Short Answer:* John has some amount of apples, and Suzie has two

melons. If one of Suzie's melons weighs ten times as much as one of John's apples, the combined

weight of the fruit is 20 pounds, and there are 22 pieces of fruit in total, what is the weight of one

apple?

ANSWER: 0.5 pounds

25. EATH AND SPACE SCIENCE: *Short Answer:* The Fujita scale is a scale for rating tornado

intensity, based primarily on the damage inflicted on structures and vegetation. What is the

highest ranking a tornado can be assigned using this scale?

ANSWER: F-5