Assorted Lightning Round, RR-Early DE Difficulty

1. CHEMISTRY *Multiple Choice* For a given reaction, \*ΔH\* ***[delta H]*** is positive and \*ΔS\* ***[delta S]*** is negative. In which of the following temperature limits is the reaction spontaneous?

W) Not spontaneous at any temperature

X) Spontaneous at only high temperatures

Y) Spontaneous at only low temperatures

Z) Spontaneous at all temperatures

ANSWER: W) Not spontaneous at any temperature

2. BIOLOGY *Multiple Choice* Following a stroke that affects the left cerebral hemisphere in an elderly female patient, the patient has halting speech, poor articulation and loss of the ability to write. The patient can still read and understand speech. A PET scan would reveal damage to which of the following parts of the brain?

W) Wernicke’s area

X) Amygdala ***[uh-MIG-duh-luh]***

Y) Broca’s area

Z) Thalamus ***[THAL-uh-muhs]***

ANSWER: Y) Broca’s area

3. CHEMISTRY *Short Answer* According to the VSEPR model, what is the electron pair geometry and molecular geometry of xenon ***[ZEE-non]*** difluoride?

ANSWER: Trigonal Bipyramidal AND Linear, respectively

4. MATH *Short Answer* A regular decagon with a perimeter of 40 units has an area of 40*k* square units. Find its apothem.

ANSWER: 2*k*

5. BIOLOGY *Short Answer* Identify all of the following four digestive enzymes that are produced by the human pancreas: 1) Carboxypeptidase ***[kahr-bok-see-PEP-ti-days]***, 2) Lactase, 3) Chymotrypsin ***[ky-moh-TRIP-sin]***, 4) Amylase ***[AM-uh-lays]***.

ANSWER: 1, 3, 4

6. PHYSICS *Multiple Choice* A mass is suspended from the ceiling by two ropes. Rope 1 makes a larger angle with the horizontal than Rope 2 does. Which of the following statements is true about the tension in the ropes?

W) The tensions in the ropes are equal  
X) The tension in Rope 1 is greater than the tension in Rope 2  
Y) The tension in Rope 2 is greater than the tension in Rope 1   
Z) The tension in Rope 2 is zero  
  
ANSWER: X) The tension in Rope 1 is greater than the tension in Rope 2

7. BIOLOGY *Multiple Choice* Which of the following animals uses a vomeronasal organ?

W) Crocodile

X) Garter snake

Y) Toad

Z) House fly

ANSWER: X) Garter snake

8. CHEMISTRY *Multiple Choice* Which of the following compounds is insoluble in water?

W) Potassium acetate

X) Aluminum sulfide

Y) Lithium carbonate

Z) Magnesium sulfate

ANSWER: X) Aluminum sulfide

9. PHYSICS *Multiple Choice* There are crossed electric and magnetic fields given, respectively, by \*5.0 X 106\* newtons per coulomb in the *x* direction and 0.5 tesla in the *y* direction. A proton traveling in the positive *z* direction experiences zero resultant force due to these fields. Which of the following is the speed of the proton in meters per second?

W) \*107\*

X) \*2.5 x 106\*

Y) \*106\*

Z) \*10-7\*

ANSWER: W) \*107\*

10. CHEMISTRY *Multiple Choice* The Henderson-Hasselbalch equation can provide the percent dissociation of a weak acid. When the pH is equal to \*p*K*a\*, the weak acid is which of the following?

W) 99% dissociated

X) 75% dissociated

Y) 50% dissociated

Z) 25% dissociated

ANSWER: Y) 50% dissociated

11. BIOLOGY *Multiple Choice* According to the theory of blood groups, which of the following statements is NOT TRUE?

W) Type O blood contains no agglutinins

X) Agglutinins are antibodies

Y) Type A blood contains antibodies for type B antigens

Z) Rh factor is a type of antigen found in human blood

ANSWER: W) TYPE O BLOOD CONTAINS NO AGGLUTININS

12. CHEMISTRY *Multiple Choice* Which of the following substances is soluble in carbon tetrachloride?

W) Formaldehyde **[for-MAL-duh-hyd]**

X) Bromine

Y) Ammonia

Z) Sodium chloride

ANSWER: X) Bromine

13. EARTH AND SPACE *Multiple Choice* The metallicity of globular clusters is generally which of the following?

W) Less than that of the Sun

X) Comparable to that of the Sun

Y) Greater than that of the Sun

Z) Too variable between globular clusters to make any definitive conclusions

ANSWER: W) Less than that of the Sun

14. MATH *Multiple Choice* Solve the following equation for \**x\*:* \*\* ***[the quantity x minus 9 to the power of two thirds equals 16]***.

W) \*73\*

X) \* 73\*

Y) \*73\* and \*-55\*

Z) \*\*

ANSWER: Y) \*73\* and \*-55\*

15. PHYSICS *Multiple Choice* Which of the following is true about the magnetic field inside an ideal infinite solenoid?

W) It increases linearly as the radius of the solenoid increases

X) It is zero

Y) It is uniform

Z) It decreases continuously along its axis

ANSWER: Y) It is uniform

16. EARTH AND SPACE *Multiple Choice* How is it known that the engine powering active galactic nuclei, or AGN, must be at most several hundred AU in size?

W) AGN that have been spatially resolved indicate that they cannot be any larger

X) The timescale on which gas is observed to cool is comparable to the sound crossing time of several hundred AU

Y) The timescale on which AGN vary is the light crossing time of several hundred AU

Z) The orbits of stars around AGN are only several hundred AU in diameter

ANSWER: Y) The timescale on which AGN vary IS the light crossing time of several hundred AU

17. ENERGY *Short Answer* By number, identify all of the following four statements regarding energy systems that are true: 1) Aerobic and anaerobic distinction is made depending on whether carbon dioxide is produced in the production of energy; 2) Both aerobic and anaerobic energy systems use substrate phosphorylation to synthesize ATP; 3) Energy systems differ from each other with respect to the rate and the duration of energy production; 4) Lactic acid is produced during energy production by the high energy phosphate system.

ANSWER: 2 AND 3

18. ENERGY *Short Answer* Rank the following four locations in terms of evaporative cooling effectiveness, from worst to best: 1) Portland, Oregon; 2) New York City, New York; 3) Tucson, Arizona; 4) Boise, Idaho.

ANSWER: 1, 2, 4, 3 (ACCEPT: PORTLAND, OREGON; NEW YORK CITY, NEW YORK; BOISE, IDAHO; TUCSON, ARIZONA)

19. EARTH AND SPACE *Multiple Choice* Which of the following is the name of the law that quantitatively describes one-dimensional water flow in saturated soils?

W) Ohm’s

X) Fick’s

Y) Fourier’s

Z) Darcy’s

ANSWER: Z) Darcy’s

20. PHYSICS *Short Answer* Give, by name or number, all of the following statements that are TRUE of Ampere’s law: 1) The magnetic field a distance *r* from a straight current-carrying wire falls as the first power of *r*, 2) The number of turns in a solenoid is independent of magnetic field strength, 3) Two wires carrying currents in opposite directions attract.

ANSWER: 1 ONLY

21. ENERGY *Multiple Choice* Which of the following statements regarding the Haber process is TRUE?

W) The catalyst used is a mix of platinum and rhodium

X) The reaction is run at the temperature of 25 degrees

Y) Ammonia produced is used to produce nitric acid in the Ostwald process

Z) Nitrogen reactant is obtained from organic compounds in soil

ANSWER: Y) AMMONIA PRODUCED IS USED TO PRODUCE NITRIC ACID IN THE OSTWALD PROCESS

22. MATH *Short Answer* What is the determinant of the 2 by 2 matrix \*\* ***[row one includes 2 and negative 3, and row 2 includes negative 8 and negative 4]***?

ANSWER: -32

23. MATH *Multiple Choice* Which of the following represents the solution in degrees of the equation \*4sin2*x* = 1\* in the open interval from 0° to 180°?

W) 30°  
X) 30°, 60°  
Y) 30°, 150°  
Z) 60°, 120°

ANSWER: Y) 30°, 150°

24. ESSC *Multiple Choice* What type of interstellar medium component is hot and dense, can be recognized through its distinctive H-alpha lines, and can promote star formation?

W) HI clouds

X) HII clouds

Y) coronal gas

Z) molecular gas

ANSWER: X) HII clouds

25. BIOLOGY *Multiple Choice* In which of the following locations does human blood have the highest oxygen concentration?

W) Pulmonary artery

X) Pulmonary vein

Y) Right atrium

Z) Capillaries in fingers

ANSWER: X) Pulmonary vein