Round 8

TOSS-UP

1) MATH *Short Answer* Given that there are 12 applicants for 2 identical job spots, how many possible pairs of applicants can be selected?

ANSWER: 66

BONUS

1) MATH *Short Answer* Amy, Brian, Collin, and Dylan want to sit in a row of 4 chairs. If Amy and Brian refuse to sit next to each other, and Amy and Collin must sit next to each other, how many ways are there for the 4 people to sit down in the 4 chairs?

ANSWER: 8

TOSS-UP

2) EARTH AND SPACE *Short Answer* What term describes the side of a sand dune without wind?

ANSWER: SLIPFACE

BONUS

2) EARTH AND SPACE *Short Answer* By name or number, state which of the following are types of sand dunes. (1) Parabolic (2) Littoral (3) Star (4) Barchanoid

ANSWER: 1, 3, 4

TOSS-UP

3) CHEMISTRY *Short Answer* How many unpaired electrons does an iron atom in the ground state have?

ANSWER: 4

BONUS

3) CHEMISTRY *Short Answer* Calculate the number of bonding and antibonding electrons in a diatomic oxygen molecule?

ANSWER: 8 AND 4 (DO NOT ACCEPT: 4 AND 8)

TOSS-UP

4) BIOLOGY *Short Answer* What is it called when macrophages leave from the bloodstream into surrounding tissues to fight off infection?

Answer: DIAPEDESIS

BONUS

4) BIOLOGY *Short Answer* What is the molecule in muscle cells that transfers its phosphate to ADP to make ATP?

ANSWER: PHOSPHOCREATINE (ACCEPT: CREATINE PHOSPHATE, PCr)

TOSS-UP

5) ENERGY *Short Answer* What quantity is calculated using the Shannon index in ecology and accounts for species richness and evenness?

ANSWER: (SPECIES) DIVERSITY

BONUS

5) ENERGY *Multiple Choice* According to the theory of island biogeography, which of the following is true?

W) Extinction is likely to occur in larger islands
X) The closer an island is to the mainland, the fewer species it tends to have.
Y) The equilibrium theory uses immigration and extinction rates to determine the diversity of an island.
Z) The rescue effect suggests that lower immigration decreases the chance of extinction.

ANSWER: Y) THE EQUILIBRIUM THEORY USES IMMIGRATION AND EXTINCTION RATES TO DETERMINE THE DIVERSITY OF AN ISLAND.

TOSS-UP

6) BIOLOGY Multiple Choice Which of the following amino acid changes will affect the structure of the protein the least?

W) Replacing glycine with alanine
X) Replacing proline with arginine
Y) Replacing phenylalanine with tryptophan
Z) Replacing asparagine with glutamine

ANSWER: X) REPLACING PROLINE WITH ARGININE

BONUS

6) BIOLOGY Short Answer By name or number, indicate which of the following are NOT intermediates of the Krebs Cycle. (1) malate (2) α-ketoglutarate (3) acetate (4) benzoate (5) succinyl-CoA

ANSWER: 3, 4 (ACCEPT: ACETATE AND BENZOATE)

TOSS-UP

7) EARTH AND SPACE *Short Answer* You are below 1500 m in the South Pacific Ocean. The water is cold, and you pick up some sediment. The sediment is fine and glassy. What type of sediment is it?

ANSWER: SILICEOUS OOZE

BONUS

7) EARTH AND SPACE *Short Answer* You are on the abyssal plain of an ocean. You pick up a brown lump of metal that has precipitated from the water. What is this formation?

ANSWER: MANGANESE NODULE

TOSS-UP

8) PHYSICS *Multiple Choice* What theory in quantum physics is debunked by Bell's Theorem?

W) String Theory
X) Quantum Tunneling
Y) The existence of hidden variables
Z) Quantum Entanglement

ANSWER: Y) THE EXISTENCE OF HIDDEN VARIABLES

BONUS

8) PHYSICS *Short Answer* A photon has a frequency of 1.00×10^{14} Hz **(one times ten to the fourteenth power hertz)**. To the nearest hundredth decimal place, how many joules of energy does the photon have? Give your answer in scientific notation.

ANSWER: 6.63×10^{-20} **(six point six three times ten to the negative twentieth (power))**

TOSS-UP

9) MATH *Multiple Choice* What is the sum of the coefficients of the polynomial $(x + 2)^7$?

W) 334

X) 2187

Y) 128

Z) 2338

ANSWER: X) 2187

BONUS

9) MATH *Short Answer* In how many ways can a 2 by 8 rectangle be tiled with 1 by 2 rectangles? Assume that configurations obtained by reflecting another configuration across a horizontal or vertical axis of symmetry are distinct.

ANSWER: 34

TOSS-UP

10) CHEMISTRY *Multiple Choice* What is the literal meaning of “halogens”?

W) choke-making
X) metal-making
Y) salt-making
Z) ore-making

ANSWER: Y) SALT-MAKING

BONUS

10) CHEMISTRY *Short Answer* Order the following four halogens in terms of increasing electron affinity. 1) Fluorine, 2) Iodine, 3) Chlorine, 4) Bromine

ANSWER: 2,4,1,3 (IODINE, BROMINE, FLUORINE, CHLORINE)

TOSS-UP

11) ENERGY *Multiple Choice* If there is an inelastic collision, which of the following is true?

W) Both kinetic energy and linear momentum are conserved
X) Kinetic energy is conserved but linear momentum is not
Y) Linear momentum is conserved but kinetic energy is not
Z) Neither linear momentum and kinetic energy are conserved

ANSWER: Y) LINEAR MOMENTUM IS CONSERVED BUT KINETIC ENERGY IS NOT

BONUS

11) ENERGY *Short Answer* In an elastic collision, object 2 is at rest and has a mass of 3 kg. Object 1 has a mass of 5 kg and collides with a velocity of 5 m/s. What is the final velocity of object 1, in m/s?

ANSWER: 1.25 M/S

TOSS-UP

12) PHYSICS *Short Answer* What is the wavelength, in meters, of a sound wave that has a frequency of 3,500 hertz and a speed of 350 meters per second?

ANSWER: 0.1 METERS

BONUS

12) PHYSICS *Short Answer* Given that the tension in a string is 20 N, and it has a mass of 1 kg and a length of 5 m, find the speed of the waves in the string, in m/s.

ANSWER: 10 M/S

TOSS-UP

13) BIOLOGY *Short Answer* What is the alternating waves of contraction and relaxation in the smooth muscles lining the canal that enables food digestion even when lying down?

ANSWER: PERISTALSIS

BONUS

13) BIOLOGY *Multiple Choice* Which leukocyte is the first responder and contains granules that have hydrolytic enzymes and antimicrobial enzymes?
W) Basophil
X) Eosinophil
Y) Neutrophil
Z) Monocyte

Answer: Y) NEUTROPHIL

TOSS-UP

14) EARTH AND SPACE *Short Answer* Three tectonic plates meet at a triple junction. One stops spreading and a filled-graben system occurs. What is the name of this failed arm of a triple junction?

ANSWER: AULACOGEN

BONUS

14) EARTH AND SPACE *Short Answer* By name or number, place the following in increasing amount of stress. (1) Recumbent Fold (2) Fault (3) Open Fold (4) Overturned Fold (5) Isoclinal Fold

ANSWER: 3,5,4,1,2 (ACCEPT: OPEN FOLD, ISOCLINAL FOLD, OVERTURNED FOLD, RECUMBENT FOLD, FAULT)

TOSS-UP

15) PHYSICS *Multiple Choice* What type of radiation emits Helium isotopes?

W) Alpha Radiation
X) Beta Radiation
Y) Delta Radiation
Z) Gamma Radiation

ANSWER: W) ALPHA RADIATION

BONUS

15) PHYSICS *Short Answer* Radon-226 decays into Radon-222, an alpha particle, and what subatomic particle?

ANSWER: MUON

TOSS-UP

16) CHEMISTRY *Short Answer* Identify all of the following that would burn green when subjected to a flame test: 1) Lithium, 2) Barium, 3) Calcium, 4) Boron

ANSWER: 2 AND 4 (ACCEPT: BARIUM AND BORON)

BONUS

16) CHEMISTRY *Short Answer* Given that the momentum of an electron is 2 x 10 ^ -10 kg m / s and rounding your answer to the nearest tenth, find the electron's de Broglie wavelength.

ANSWER: 3.3 x 10 ^ -24 meters

TOSS-UP

17) MATH *Short Answer* Two fair coins are tossed and at least one is a head. What is the probability that both coins are heads?

ANSWER: 1/3

BONUS

17) MATH *Short Answer* What is the remainder when $3x^4 - 3x^3 - 20x^2 - 12$ **(three x raised to the fourth minus three x cubed minus twenty x squared minus twelve)** is divided by x+2?

Answer: -28

TOSS-UP

18) BIOLOGY *Short Answer* What kind of nephrons have short loops of Henle and are most entirely confined to the renal cortex?

ANSWER: CORTICAL NEPHRONS

BONUS

18) BIOLOGY *Multiple Choice* What is formed in the last step of a series of reactions triggered by the release of clotting factors from platelets?

W) Formation of thrombin
X) Formation of fibrin
Y) Formation of antithrombin
Z) Formation of collagen fibers

ANSWER: X) FORMATION OF FIBRIN

TOSS-UP

19) EARTH AND SPACE Short Answer If the distance between the Earth and the Sun is 150 million km, then what is the distance in kilometers between the Earth and its L_4 point?

ANSWER: 150 MILLION

BONUS

19) EARTH AND SPACE Multiple Choice Where is the center of mass between the Earth and the moon?

W) At the midpoint between the surface of the Earth and the Moon
X) At the midpoint between the center of the Earth and the Moon
Y) Near the surface of the Earth
Z) In the mantle of the Earth

ANSWER: Z) IN THE MANTLE OF THE EARTH

TOSS-UP

20) CHEMISTRY *Multiple Choice* How many electrons can fit in the fifth principal energy level?

W) 25
X) 50
Y) 100
Z) 110

ANSWER: X) 50

BONUS

20) CHEMISTRY *Short Answer* How many pi bonds are there in a molecule with the formula $CH_3CHCHCH_2CH_3$ **(C H three C H C H C H two C H three)**?

ANSWER: 1

TOSS-UP

21) MATH *Multiple Choice* Which of the following is the area between two concentric circles of radii 11 and 9?

W) 10pi
X) 20pi
Y) 30pi
Z) 40pi

ANSWER: Z) 40pi

BONUS

21) MATH *Short Answer* What is the area of a triangle with perimeter 30 and an inradius of 5?

ANSWER: 75

TOSS-UP

22) PHYSICS *Short Answer* What is the power dissipated in Watts by a 2 Ohm resistor in a circuit with 6 Volts?

ANSWER: 18 (WATTS)

BONUS

22) PHYSICS *Short Answer* Given that 3 identical resistors are connected in parallel in a circuit with a 6 volt battery, and if every 2 seconds 36 joules of energy is dissipated by the circuit, what is the resistance of one of the resistors in Ohms?

ANSWER: 6 OHMS

TOSS-UP

23) EARTH AND SPACE *Multiple Choice* What cell describes the circulation of air in mid-latitudes?

W) Hadley
X) Ferrel
Y) Polar
Z) Equatorial

ANSWER: X) FERREL

BONUS

23) EARTH AND SPACE *Multiple Choice* In Ferrel cells, which of the following is true?

W) Air flows poleward and eastward near the surface
X) Air flows poleward and westward near the surface
Y) Air flows equatorward and eastward near the surface
Z) Air flows equatorward and westward near the surface

ANSWER: W) AIR FLOWS POLEWARD AND EASTWARD NEAR THE SURFACE
