TOSS-UP

1) Physics – *Multiple Choice* An electron beam is directed in the positive y direction. If a magnetic field is applied in the negative x direction, in what direction will the beam be deflected?

W) Positive x
X) Negative y
Y) Positive z
Z) Negative z

ANSWER: Z) NEGATIVE Z [LY, WESTVIEW]

BONUS

1) Physics – *Short Answer* To an observer at rest, a particle is moving at 0.28c. What is the ratio of the particle's energy to its rest mass in terms of c?

ANSWER: 25/24 c^2 (ACCEPT: 25/24) [LY, SBST]

TOSS-UP

2) Biology – *Multiple Choice* In an interrupted mating experiment between an Hfr cell and an F^- [READ: F MINUS] cell, which of the following describes the most probable resulting statuses of the two cells?

W) F^+ and F^-
X) Hfr and F^+
Y) Hfr and Hfr
Z) Hfr and F^-

ANSWER: Z) HFR AND F^- [JH, BACTERIA]

BONUS

2) Biology – *Short Answer*. What is the effective population size of a population containing 420 peacocks and 210 peahens where all individuals are breeding?

ANSWER: 560 [JH, PEACOCKS]

TOSS-UP

3) Math – *Multiple Choice* Suppose a function satisfies the equation $f(x + y) = f(x) + f(y)$ for all real numbers x and y. Which of the following statements must be true about the function f?

W) f(x) is linear
X) f(x) is continuous
Y) f(x) is monotonous
Z) f(x) has a root at x = 0

ANSWER: Z) f(x) HAS A ROOT AT x = 0 [GW, Functions]

BONUS

3) Math – *Short Answer* Find the limit as n goes to infinity of the fraction with numerator the n-th root of n! (***n factorial***) and denominator n.

ANSWER: 1/e [GW, Logs/Exponents]

TOSS-UP

4) Earth and Space – *Multiple Choice* Which of the following statements is NOT true regarding roche moutonnees?

W) Plucking occurs on the lee side
X) Abrasion occurs on the stoss side
Y) The less steep side of roche moutonnees dips towards the direction of glacial movement
Z) Roche moutonnees are strictly erosional structures

ANSWER: Y) THE LESS STEEP SIDE OF ROCHE MOUTONNEES DIPS TOWARDS THE DIRECTION OF GLACIAL MOVEMENT [LY, SBST]

BONUS

4) Earth and Space – *Multiple Choice* Which of the following phyllosilicates is commonly known as magnesium mica?

W) Annite
X) Phlogopite
Y) Siderophyllite
Z) Muscovite

ANSWER: X) PHLOGOPITE [LY, LEX]

TOSS-UP

5) Chemistry – *Multiple Choice* Which of the following amino acids is best able to function as a hydrogen bond acceptor under normal bodily conditions?

W) Tyrosine

X) Valine
Y) Methionine
Z) Isoleucine

ANSWER: W) TYROSINE [LY, idk]

BONUS

5) Chemistry – *Short Answer* Consider a beaker containing a saturated solution of silver sulfide, with some solid remaining at the bottom. Identify all of the following 3 changes to the system that would allow more silver sulfide to be dissolved: 1) Addition of ammonia; 2) Addition of sodium hydroxide; 3) Addition of more solid silver sulfide.

ANSWER: 1 ONLY [LY, NEWTOWN]

TOSS-UP

6) Energy – *Short Answer* Researchers probably sometimes use programming languages? Identify all of the following four languages that are statically typed: 1) C++; 2) Java; 3) Javascript; 4) Python.

ANSWER: 1 AND 2 [GW, Types/CS]

BONUS

6) Energy – *Short Answer* Scientists at Ames National Lab are using X-ray crystallography to study the structure of the small peptide pro-opiomelanocortin, or POMC. Identify all of the following 3 hormones that are derived from POMC: 1) ACTH; 2) Thyroxine; 3) MSH.

ANSWER: 1 AND 3 [LY, R10]

TOSS-UP

7) Physics – *Short Answer* A compound machine is made from the combination of a lever with efficiency 0.8 and a screw with efficiency 0.6. If 100 Joules of work is inputted into the system, how much work will be lost to external forces?

ANSWER: 52 [LY, R10]

BONUS

7) Physics – *Short Answer* A bouncy ball is dropped from a height of 3 meters. Each time it bounces, it loses a third of its kinetic energy. What is the total vertical distance it will travel before it comes to rest?

ANSWER: 15 [LY, SBST]

TOSS-UP

8) Biology – *Multiple Choice* Which of the following describes the difference in the number of action potentials and the location of peak basilar membrane vibration of a 60 decibel, 400 Hz tone compared to a 100 decibel, 200 Hz tone?

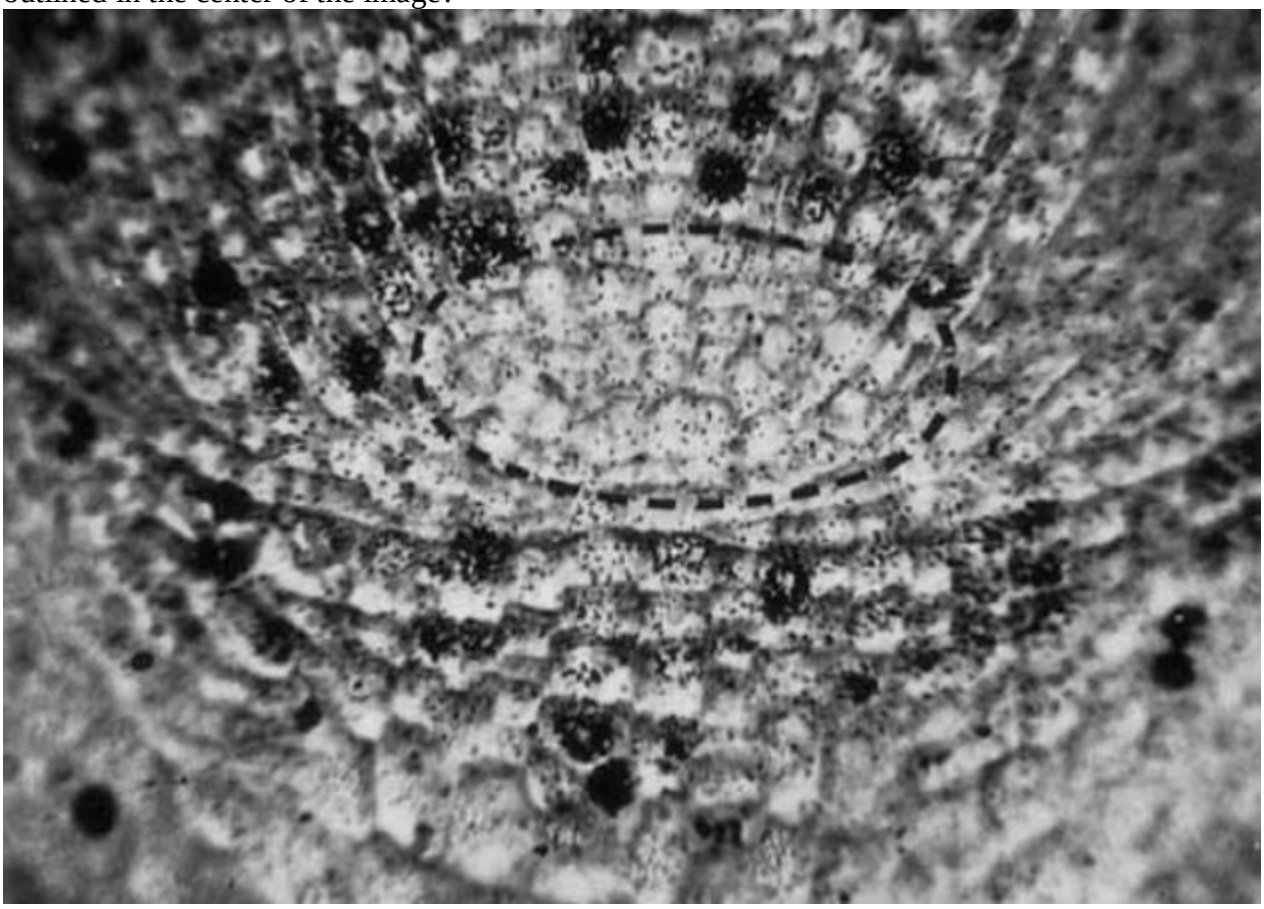
W) Fewer action potentials, closer to the oval window
X) Fewer action potentials, further from the oval window
Y) More action potentials, closer to the oval window
Z) More action potentials, further from the oval window

ANSWER: W) FEWER ACTION POTENTIALS, CLOSER FROM THE OVAL WINDOW [JH, EARS]

VISHWAL BONUS

8) Biology – *Short Answer* In an experiment, a root was grown in a medium containing radioactively labeled thymidine for one day. Answer the following two questions regarding the image from the experiment: 1) Which canonical root zone is shown in the image: the zone of maturation, elongation, or cell division? 2) What is the term given to the oval-shaped region

outlined in the center of the image?



ANSWER: 1) ZONE OF CELL DIVISION; 2) QUIESCENT CENTER [JH, CENTERS]

TOSS-UP

9) Math – *Short Answer* Joe has 8 flexible bars of unit length. What is the area of the largest possible region he can enclose with these bars?

ANSWER: 16 OVER PI [LY, cringe]

BONUS

9) Math – *Short Answer* The Pell numbers are defined by P sub 0 equals 0, P sub 1 equals 1, and P sub n equals 2 times P sub n-1 plus P sub n-2. As n approaches infinity, what is the limit of the ratio of P sub n+1 to P sub n?

ANSWER: ROOT 2 PLUS 1 [LY, SEQS]

TOSS-UP

10) Earth and Space – *Short Answer* Order the following 3 clastic rock types in terms of increasing quartz to clay ratio: 1) Quartz arenite; 2) Greywacke; 3) Siltstone.

ANSWER: 3, 2, 1 [LY, SBST]

BONUS

10) Earth and Space – *Short Answer* To one significant figure and in scientific notation, what is the radius of the innermost stable circular orbit of a massive particle around a nonrotating black hole with mass 9 times 10 to the 24th kilograms?

ANSWER: 4 TIMES 10 TO THE NEGATIVE 2 [LY, so cringe man]

TOSS-UP

11) Chemistry – *Multiple Choice* Which of the following statements is correct regarding the selectivity of the Diels-Alder reaction?

W) The endo product is both thermodynamically and kinetically favored
X) The exo product is both thermodynamically and kinetically favored
Y) The endo product is thermodynamically favored while the exo product is kinetically favored
Z) The exo product is thermodynamically favored while the endo product is kinetically favored

ANSWER: Z) THE EXO PRODUCT IS THERMODYNAMICALLY FAVORED WHILE THE ENDO PRODUCT IS KINETICALLY FAVORED [LY, R10]

BONUS

11) Chemistry – *Short Answer* When calculating lattice energy, what material-specific constant accounts for the arrangement of ions in the lattice?

ANSWER: MADELUNG CONSTANT [LY, NEWTOWN]