Winter Break Round

TOSS UP

1. ESSC *Short Answer* What is the boundary that the northeast trade winds and the southeast trade winds meet along called?

ANSWER: INTERTROPICAL CONVERGENCE ZONE

BONUS

1. ESSC *Short Answer* Name the cells as described by the three-cell model of atmospheric circulation from northern most cell to cell closest to the equator.

ANSWER: POLAR, FERREL, HADLEY

TOSS-UP

1. ESSC *Short Answer* Name all of the following three choices about tornadoes that are true:
2. A hook-shaped echo seen on a Doppler Radar indicates the possible presence of a tornado.
3. Within multi-vortex tornadoes, the smaller whirls are called micro vortices
4. A rising, spinning column of air within a thunderstorm is called a mesocyclone.

ANSWER: 1 AND 2

BONUS

1. ESSC *VISUAL* Observe the diagram on glaciers:

1. Name Features 1 through 6.

2. Traces of water can be seen on Feature 6. What are these water features called?

3. If the glacier seen here were to flow out onto a larger, relatively flat plain, what type of glacier would be created?

ANSWER: 1. 1: HORN, 2. CIRQUE, 3. ARETE, 4. LATERAL MORAINE, 5. MEDIAL MORAINE, 6. OUTWASH PLAIN; 2. BRAIDED STREAMS; 3. PIEDMONT GLACIER

TOSS UP

1. ESSC *Short Answer* What type of unconformity results when in which the upper beds overlie metamorphic or igneous rock?

ANSWER: NONCONFORMITY

BONUS

1. ESSC *Visual* Observe the diagram on intrusions:

1. Name Features 1, 3, 4, 5, and 7.

2. What type of volcano is seen in this diagram?

3. Indicate whether features 1 – 7 are discordant or concordant.

ANSWER: 1. 1: LACCOLITH, 3. BATHOLITH, 4. DIKE, 5. SILL, 7. LOPOLITH; 2. COMPOSITE CONE or STRATOVOLCANO; 3. 1: CONCORDANT, 2. DISCORDANT, 3. DISCORDANT, 4. DISCORDANT, 5. CONCORDANT, 6. DISCORDANT, 7. CONCORDANT

TOSS-UP

1. ESSC  *Short Answer* The discovery of what phenomenon led to the abandonment of the steady-state theory in 1965?

ANSWER: COSMIC BACKGROUND RADIATION

1. ESSC *Visual* Examine the Hertzsprung Russel diagram to answer the following questions about stars.

1. Indicate whether the following stars would go in the top-left, top-right, bottom-left, or bottom-right of the diagram: Arcturus, Antares, Bellatrix, Barnard’s Star.

2. For each of the previous stars named, indicate which constellation they can be found in.

3. What is the name of the predicted region on the HR diagram that indicates when a star becomes first visible as a pre-main sequence object?

ANSWER: 1. ARCTURUS: TOP LEFT, ANTARES: TOP LEFT, BELLATRIX: TOP RIGHT, BARBARD’S STAR: BOTTOM LEFT; 2.ARCTURUS: BOOTES, ANTARES: SCORPIUS, BELLATRIX: ORION, BARBARD’S STAR: OPHIUCHUS; 3. BIRTHLINE

TOSS-UP

1. MATH *Multiple Choice* A yellow box contains 8 items, 3 of which are defective. A green box contains five items, two of which are defective. If an item is drawn at random from each box, what is the probability both items will be nondefective?

W. 3/20

X. 3/8

Y. 5/13

Z. 8/13

ANSWER: X. 3/8

BONUS

1. MATH *Short Answer* Name one of the two mathematicians who initiated the modern study of set theory in the 1870s.

ANSWER: GEORG CANTOR or RICHARD DEDEKIND

TOSS-UP

4. MATH *Short Answer* Which test for statistical significance would be used to test the difference between two sample means?

ANSWER: STUDENT’S T-TEST

BONUS

4. MATH *Short Answer* What shape does a probability density function of a student’s t-test assume?

ANSWER: BELL

TOSS-UP

5. MATH *Multiple Choice* What is the range of the following function: y = x^/-2/3?

W. y<0

X. y>0

Y. y≤0

Z. y ≥0

ANSWER: X. y>0

BONUS

1. MATH *Short Answer* Give the equation of the vertical asymptote of the quantity 2x – 1 times the quantity x + 3 all divided by the quantity x+3 squared?

ANSWER: y = 2

TOSS-UP

1. MATH *Multiple Choice* In terms of pi, what is the volume of the region between the two concentric spheres with radii of 2 and 5.

W. 24pi

X. 86pi

Y. 125pi

Z. 156pi

ANSWER: Z. 156PI

BONUS

1. MATH *Short Answer* A right circular cone with a base radius of 4 is inscribed in a sphere with a radius of 5. Give the ratio of the volume of the cone to the volume of the sphere. Give your ratio in integer form.

ANSWER: 32:125

TOSS-UP

1. MATH *Multiple Choice* In the geometric sequence, 1, 2, 4…, what is the 13th term?

W. 24

X. 1024

Y. 4096

Z. 8192

ANSWER: Y. 4096

BONUS

1. MATH *Short Answer* Given the geometric sequence 1, 2, 4…, find the sum of the first 13 terms.

ANSWER: 8191

TOSS-UP

1. BIOL *Multiple Choice* Which of the following definitions of species does not account for organisms that reproduce asexually?

W. Biological

X. Morphological

Y. Ecological

Z. Phylogenetic

ANSWER: W. BIOLOGICAL

BONUS

1. BIOLOGY *VISUAL* Answer the following questions concerning speciation.

1. a. What type of speciation is occurring in the first picture?

b. What type of speciation is occurring in the second picture?

2. What specific type of speciation results in organisms whose ranges only overlap in a narrow contact zone and are immediately adjacent to each other?

3. What specific type of speciation results in organisms whose ranges are adjacent, but do not overlap due to a natural barrier separating them?

ANSWER: 1. a. ALLOPATRIC SPECIATION, b. SYMPATRIC SPECIATION; 2. PARAPATRIC SPECIATION; 3. PERIPATRIC SPECIATION

TOSS-UP

1. BIOL *Short Answer* In embryo development of a plant, what term is given to the thread of cells that anchors the embryo to the parent plant?

ANSWER: SUSPENSOR

BONUS

1. BIOL *VISUAL* Answer the following questions concerning flowers?

1. Name Objects 1-5.

2. Objects 3 and 4 together make what part of the plant?

3. What are elements of the perianth, including sepals and petals, specifically called when all segments of the perianth are undifferentiated?

ANSWER: 1. 1. STIGMA, 2. STYLE, 3. ANTHER, 4. FILAMENT, 5. PETAL; 2. STAMEN; 3. TEPAL

TOSS-UP

1. BIOL *Short Answer* This water-soluble vitamin is often found in nuts, meats, and grains. An deficiency of this vitamin can cause gastric problems, nervous disorders, and significant liver damage. It is a component of coenzymes NAD+ and NADP+. What is this vitamin?

ANSWER: NIACIN (B3)

BONUS

1. BIOL *Short Answer* Which part of the large intestine is especially large in herbivores due to the need to ferment ingested material?

ANSWER: CECUM

TOSS-UP

1. BIOL *Short Answer* By name or number, give all of the following that are true about regulation of gene expression?
2. The operator, the promoter, and the genes they control make up the operon.
3. The repressor binds to the operator and blocks the attachment of DNA polymerase to the promoter.
4. Tryptophan can function as a corepressor by cooperating with a repressor protein.
5. An inducer works by inactivating a repressor.

ANSWER: 1, 2, and 4

BONUS

1. BIOL *Short Answer* What is the name for the cluster of proteins that assemble on the promoter sequence on the upstream end of the gene?

ANSWER: TRANSCRIPTION INITIATION COMPLEX

TOSS-UP

1. CHEM *Multiple Choice* Which of the following crystals is incorrectly paired?

W. Crystalline cesium chloride is a ionic crystal

X. Graphite is a covalent crystal

Y. Sodium chloride is a molecular crystal

Z. Crystalline gallium is a metallic crystal.

ANSWER: Y. SODIUM CHLORIDE IS A MOLECULAR CRYSTAL

BONUS

1. CHEM *VISUAL* Answer the followings questions about a chemical process:

1. What is the chemical process that is shown in this picture?

2. What catalyst are the starting materials heated in the presence of?

ANSWER: 1. OSTWALD PROCESS; 2. PLATINUM-RHODIUM

TOSS-UP

1. CHEM *Multiple Choice* Which quantum number accounts for the average distance of the electron from the nucleus in a particular orbital?

W. Principal Quantum number

X. Angular Momentum Quantum Number

Y. Magnetic quantum number

Z. Electron Spin Quantum Number

ANSWER: W. PRINCIPAL QUANTUM NUMBER

BONUS

1. CHEM *Visual* Answer the following questions on atomic orbitals.

1. What is the name given to the type of drawings shown here.

2. Label objects A-G as designating s, p, or d orbitals.

3. Which quantum number corresponds to the different orientations of the orbitals?

ANSWER: 1. BOUNDARY SURFACE DIAGRAM; 2. A: D, B: S, C: S, D: S E: D F: P, G: P; 3. magnetic quantum number

TOSS-UP

1. CHEM *Short Answer* By name or number, give all of the following that are true about stereochemistry.

1. The cis and trans isomers of coordination compounds generally have similar colors, melting points, and dipole moments.

2. Isomers that are not superimposable with their mirror images are called chiral.

3. The optical isomers of a compound have identical physical and chemical properties.

ANSWER: 2 AND 3

BONUS

1. CHEM *Short Answer* What is the name for a mixture that has equal amounts of left- and right-handed enantiomers of a chiral molecule?

ANSWER: RACEMIC MIXTURE

TOSS-UP

1. CHEMISTRY *Multiple Choice* What is the term used to describe the ability of a chemical element to form long chain-like structures via covalent bonds called, such as those prominently displayed in carbon compounds?

W. Catenation

X. Concatenation

Y. Polymeration

Z. Procatenation

ANSWER: W. CATENATION

BONUS

1. CHEMISTRY *Short Answer* The end result of coal gasification, a process utilized to convert coal to a gaseous form, can be used as a clean fuel. What is this clean gaseous fuel called?

ANSWER: SYNGAS (accept: SYNTHETIC GAS)

TOSS-UP

1. PHYS *Multiple Choice* Lenz’s law is an electrical restatement of which conservation law?

W. momentum

X. angular momentum

Y. mass

Z. energy

ANSWER: Z. ENERGY

BONUS

1. PHYS *VISUAL* Answer the following questions:

1. Which scientist used both of the devices shown here?

2. In the set-up on the right, if object A is moved in or out of object B, what will be detected by object G?

3. Whose version of the law that is demonstrated in the experiment on the right is recognized as part of Maxwell’s equations?

ANSWER: 1. FARADAY; 2. CURRENT; 3. OLIVER HEAVISIDE

TOSS-UP

17. PHYS *Multiple Choice* A gas is allowed to expand at a constant temperature from a volume of 100 cubic centimeters to a volume of 400 cubic centimeters. If the original pressure of the gas was 4 atmospheres, what will be the new pressure?

1. 1 atmosphere
2. 16 atmospheres
3. 76 centimeters of mercury
4. 100 pascals

ANSWER: X. 16 ATMOSPEHERES

**BONUS**

17. PHYS *Visual* – Answer the following questions concerning a process that occurs in stars.

1. What is the name of this process?

2. Identify A-D.

3. What is thought to be emitted instead of gamma rays in the final step of the process?

ANSWER: 1. TRIPLE ALPHA PROCESS, A. ALPHA PARTICLE, B. GAMMA RAY, C. Be8. D. C12; 3. ELECTRON AND POSITRON

TOSS-UP

1. PHYS *Multiple Choice* An electron moves at a constant speed at right angles to a uniform flux. If the flux density were doubled, the force on the electon would be?

W. unaffected

X. halved

Y. doubled

Z. quadrupled

ANSWER: Y. DOUBLED

BONUS

1. PHYS *Short Answer* An emf of 0.05 volts is induced in a wire when it moves at right angles to a uniform magnetic field with a speed of 5 meters per second. If the length of the wire is 10 centimeters, what is the flux density, in teslas?

ANSWER: 0.1

TOSS-UP

1. PHYS *Multiple Choice* Which of the following quarks has the highest rest energy?

W. Top

X. Bottom

Y. Charmed

Z. Strange

ANSWER: W. TOP

BONUS

1. PHYS *Short Answer* In which famous Illinois national laboratory run by the US Department of Energy was the first top quark discovered?

ANSWER: FERMI NATIONAL ACCELERATOR LABORATORY (accept : FERMILAB)

TOSS-UP

1. ESSC *Short Answer* When gravity and pressure balance in a star, what state is the star said to be in?

ANSWER: HYDROSTATIC EQUILIBRIUM

BONUS

1. ESSC *Short Answer* A spinning neutron star converts some of its energy into electromagnetic energy and a powerful outflow of high-speed particles. What is this outflow called?

ANSWER: PULSAR WIND

TOSS-UP

1. ESSC *Multiple Choice* Who, in the 1920s, proposed that spiral nebulae were just nearby nebulae inside of the Milky Way star system?

W. William Parsons

X. Immanuel Kant

Y. Heber Curtis

Z. Harlow Shapley

ANSWER: Z. HARLOW SHAPLEY

BONUS

1. ESSC *Short Answer* Which famous astronomer resolved the so-called Shapely-Curtis Debate over spiral nebulae?

ANSWER: EDWIN HUBBLE

TOSS-UP

1. BIO *Multiple Choice* Introns in prokaryotes are found in only tRNA and which one of the following?

W. mRNA

X. pre-mRNA

Y. snRNA

Z. rRNA

ANSWER: Z. rRNA

BONUS

1. BIO *Short Answer* The presence of introns in a gene can facilitate the evolution of new and potentially useful proteins in a process called what?

ANSWER: EXON SHUFFLING

TOSS-UP

1. BIO *Multiple Choice* The contraction of which part of the cardiovascular system results in blood being pumped to the lungs via the pulmonary arteries?

W. Right Ventricle

X. Right Atrium

Y. Left Ventricle

Z. Left Atrium

ANSWER: W. RIGHT VENTRICLE

BONUS

1. BIO *Short Answer* Oxygen poor blood from the head, neck, and arms is channeled into which part of the circulatory system?

ANSWER: SUPERIOR VENA CAVA