TOSS-UP

1) Earth and Space – *Multiple Choice*   Which of the following geologic intervals went from 2.6 million years ago to approximately 12,000 years ago, and is commonly referred to as the Ice Age?

W) Holocene
X) Neogene
Y) Paleogene
Z) Pleistocene *[PLY-stoh-seen]*

ANSWER: Z) PLEISTOCENE

BONUS

1) Earth and Space – *Short Answer*   Identify all of the following three statements that are true of the supercontinent Pangaea *[pan-JEE-ah]*: 1) What is now North America was adjacent to what is now Africa; 2) What is now India was adjacent to what is now Asia;
3) What is now Australia was adjacent to what is now Antarctica.

ANSWER: 1, 3

2) Energy – *Short Answer*   Scientists at Lawrence Berkeley National Lab are studying how sorghum withstands arid conditions. One adaptation is that during drought, sorghum will reduce symbiotic connections with fungi that penetrate the cortical root cells of the plant. What is the term for this structure?

ANSWER: MYCORRHIZA (ACCEPT: ARBUSCULAR MYCORRHIZA)

BONUS

2) Energy – *Short Answer*   Scientists are using the Advanced Photon Source to understand P-glycoprotein, a channel responsible for many forms of drug resistance. Identify all of the following three types of organisms that contain P-glycoprotein: 1) Bacteria; 2) Mammals; 3) Fungi.

ANSWER: ALL

3) Life Science – *Multiple Choice*   Which of the following terms refers to signals that are secreted by glands into the bloodstream, and have effects on distant organs?

W) Paracrine *[para-krin]*
X) Autocrine *[auto-krin]*
Y) Exocrine *[EX-oh-krin]*
Z) Endocrine *[EN-doh-krin]*

ANSWER: Z) ENDOCRINE

BONUS

3) Life Science – *Short Answer*   Place the following three evolutionary history events in chronological order: 1) Cambrian explosion; 2) First mammals appear; 3) First flowering plants appear.

ANSWER: 1, 2, 3

4) Math – *Short Answer*   What is the slope of a line perpendicular to the line that contains the points (4, 4) and (10, 11)?

ANSWER: –6/7

BONUS

4) Math – *Short Answer*   What are the coordinates of the image of the point (–2, 5) when rotated 180 degrees about the point (6, –8)?

ANSWER: (14, –21) (ACCEPT: $x = 14$ AND $y = -21$)

5) Physical Science – *Short Answer*   By what factor is the gravitational force between two objects multiplied if the distance between them is tripled?

ANSWER: 1/9

BONUS

5) Physical Science – *Short Answer*   A sample of an ideal gas has a volume of 10 liters at 27 degrees Celsius. If all other factors remain constant, at how many degrees Celsius would the gas have a volume of 5 liters?

ANSWER: NEGATIVE 123

6) Earth and Space – *Multiple Choice*   Consider a Sun-like star that has been fusing hydrogen for 5 billion years. Which of the following best describes the distribution of hydrogen and helium in the star?

W) The core is mostly hydrogen, with helium primarily on the surface of the star
X) The core is mostly helium, with little hydrogen elsewhere in the star
Y) The core is mostly helium and the percentage of the star that is hydrogen rises with increasing distance from the core
Z) The star is entirely hydrogen

ANSWER: Y) THE CORE IS MOSTLY HELIUM AND THE PERCENTAGE OF THE STAR THAT IS HYDROGEN RISES WITH INCREASING DISTANCE FROM THE CORE

BONUS

6) Earth and Space – *Short Answer*   Identify all of the following three statements that are true of interstellar dust: 1) Blue light is preferentially absorbed by interstellar dust; 2) Dust grains tend to be very spherical; 3) Dust clouds are typically around 273 kelvins.

ANSWER: 1

7) Energy – *Multiple Choice*   Scientists supported by the Department of Energy are using supervised learning to classify genetic data. "Supervised learning," in this case, means which of the following?

W) A researcher must classify the training data, which the model then learns
X) A researcher must watch the model as it is classifying the data
Y) There is no distinction between training and hold-out data
Z) The hold-out data is gathered under supervision

ANSWER: W) A RESEARCHER MUST CLASSIFY THE TRAINING DATA, WHICH THE MODEL THEN LEARNS

BONUS

7) Energy – *Multiple Choice*   Scientists at the Joint BioEnergy Institute are studying plants that produce poly-hydroxy-butyrate *[BYOO-tur-ate]*. What type of polymer is this?

W) Polyamide *[poly-AM-ide]*
X) Polyethylene
Y) Polystyrene *[poly-STYE-reen]*
Z) Polyester

ANSWER: Z) POLYESTER

8) Life Science – *Short Answer*   The fluid-mosaic model is a representation of the structure and behavior of what cell structure?

ANSWER: PLASMA MEMBRANE (ACCEPT: CELL MEMBRANE)

BONUS

8) Life Science – *Multiple Choice*   Which of the following best characterizes the material that is presented by antigen-presenting cells to T cells?

W) Short peptides
X) Protein domains
Y) RNA sequences
Z) DNA sequences

ANSWER: W) SHORT PEPTIDES

9) Math – *Short Answer*   What is $35^2 - 33^2$?

ANSWER: 136

BONUS

9) Math – *Short Answer*   The first term of a geometric sequence is one, and the second is 3/4. When the sum of the first 5 terms of the sequence is written as a mixed fraction, what is the fractional part?

ANSWER: 13/256

10) Physical Science – *Short Answer*   Butyric *[byoo-TEER-ik]* acid can condense with ethanol to produce an ester and what other molecule?

ANSWER: WATER (ACCEPT: H_2O)

BONUS

10) Physical Science – *Short Answer*   Rank the following three metals in order of most spontaneous to least spontaneous of oxidization of the metal: 1) Calcium; 2) Mercury; 3) Zinc.

ANSWER: 1, 3, 2

11) Earth and Space – *Short Answer*   What layer of Earth lies below the lithosphere *[LITH-oh-sfeer]* and consists of rock that undergoes plastic deformation?

ANSWER: ASTHENOSPHERE

BONUS

11) Earth and Space – *Short Answer*   Identify all of the following three statements regarding reefs and volcanic islands that are true: 1) Fringing reefs typically form before barrier reefs; 2) Atolls typically form before barrier reefs; 3) Atolls are the first reefs to form around active volcanos.

ANSWER: 1

12) Energy – *Short Answer*   Scientists at Lawrence Berkeley National Lab are studying materials in which neighboring spins are aligned in opposite directions. What is the term for the type of magnetism these materials demonstrate?

ANSWER: ANTIFERROMAGNETISM

BONUS

12) Energy – *Short Answer*   Scientists at Lawrence Berkeley National Lab are studying magnetars. Identify all of the following three statements that are true of magnetars: 1) They are a type of neutron star; 2) They may be the source of soft gamma ray repeaters; 3) They spin very slowly compared to main-sequence stars.

ANSWER: 1, 2

13) Life Science – *Short Answer*   What effect is a form of genetic drift that occurs when a population declines to a very low number, then rebounds?

ANSWER: BOTTLENECK EFFECT (ACCEPT: POPULATION BOTTLENECK, GENETIC BOTTLENECK)

BONUS

13) Life Science – *Multiple Choice*   Which of the following interactions is the best example of commensalism?

W) A cleaner fish eats parasites from a larger fish
X) An oak tree blocks the sunlight of a nearby sapling
Y) A wasp lays its eggs inside of a caterpillar
Z) A dung beetle eats the feces of a buffalo

ANSWER: Z) A DUNG BEETLE EATS THE FECES OF A BUFFALO

14) Math – *Short Answer*   In the set of integers from 1 through 21, inclusive, let *A* be the set of those that are odd, and let *B* be the set of those that are multiples of 5. How many elements are in *A* union *B*?

ANSWER: 13

BONUS

14) Math – *Short Answer*   A 3-by-3-by-3 cube is made of 14 red unit cubes and 13 blue unit cubes pasted together. What is the minimum possible visible surface area of the large cube that is colored red?

ANSWER: 20

15) Physical Science – *Short Answer*   What is the adjective for a thermodynamic process that occurs without transferring heat or mass between the system and its surroundings?

ANSWER: ADIABATIC

BONUS

15) Physical Science – *Short Answer*   A certain energy level in an atom can contain up to 32 electrons. How many subshells does this energy level possess?

ANSWER: 4