

DOUBLE ELIMINATION – ROUND 3

TOSS-UP

1) MATH *Short Answer* Assuming that a and b are non-negative, simplify $\sqrt{72a^4b^3}$ [**the square root of the quantity 72 a to the fourth b cubed**].

ANSWER: $6a^2b\sqrt{2b}$

BONUS

1) MATH *Short Answer* If x , y , and z are three consecutive integers with $x < y < z$, evaluate the product $(x - y)(x - z)(y - z)$ [**open parenthesis x minus y close parenthesis open parenthesis x minus z close parenthesis open parenthesis y minus z close parenthesis**].

ANSWER: -2

TOSS-UP

2) PHYSICAL SCIENCE *Multiple Choice* Light passes through a rectangular slit in a box and produces a small spot of light on a screen at the back of the box. What is located between the slit in the box and the screen?

- W) A concave lens
- X) A convex lens
- Y) A prism
- Z) A flat piece of glass

ANSWER: X) A CONVEX LENS

BONUS

2) PHYSICAL SCIENCE *Short Answer* A ball moving at an initial velocity of 10 meters per second strikes head-on a similar ball initially sitting at rest. Both balls have the same mass and the collision is perfectly elastic. What are the respective speeds of the initially moving and initially stationary ball in meters per second after the collision?

ANSWER: 0, 10

TOSS-UP

3) GENERAL SCIENCE *Multiple Choice* Which of the following is forbidden by the Pauli exclusion principle?

- W) Neutrons in a nucleus out-numbering the protons
- X) Triple ionization of the lanthanide **[LAN-thuh-nyd]** series
- Y) The sharing of more than one electron by any two atoms
- Z) Two electrons in the exact same state in an atomic shell

ANSWER: Z) TWO ELECTRONS IN THE EXACT SAME STATE IN AN ATOMIC SHELL

BONUS

3) GENERAL SCIENCE *Multiple Choice* Which of the following electron configurations represents an excited state energy level?

- W) [He]2s²2p⁵
- X) [He]2s²2p⁴3s¹
- Y) [Ne]3s²
- Z) [Ne]3s²3p⁶

ANSWER: X) [He]2s²2p⁴3s¹

TOSS-UP

4) EARTH AND SPACE *Short Answer* What is the hottest planet in our solar system, by surface temperature?

ANSWER: VENUS

BONUS

4) EARTH AND SPACE *Multiple Choice* Consider ocean water underlying sea ice with cold air above the sea ice. The rate at which heat flows out of ocean water is which of the following?

- W) Directly proportional to the temperature difference between the air and the water
- X) Directly proportional to the thickness of the ice layer
- Y) Constant once ocean water reaches -5° Celsius
- Z) Increased by the snow cover on top of the ice

ANSWER: W) DIRECTLY PROPORTIONAL TO THE TEMPERATURE DIFFERENCE BETWEEN THE AIR AND THE WATER

TOSS-UP

5) LIFE SCIENCE *Multiple Choice* What is the ultimate purpose of the Calvin cycle?

- W) To convert carbon dioxide into sugars
- X) To convert waste products to oxygen
- Y) To convert sugars, fatty acids, and amino acids into ATP
- Z) To separate water into hydrogen and oxygen

ANSWER: W) TO CONVERT CARBON DIOXIDE INTO SUGARS

BONUS

5) LIFE SCIENCE *Multiple Choice* Which of the following fish exhibit protandry and are all male when hatched?

- W) Clownfish
- X) Platy
- Y) Tarpon
- Z) Indigo hamlet

ANSWER: W) CLOWNFISH

TOSS-UP

6) ENERGY *Multiple Choice* Who is considered the originator of alternating current in electricity transmission systems?

- W) Thomas Edison
- X) Nils Bohr
- Y) Albert Einstein
- Z) Nikola Tesla

ANSWER: Z) NIKOLA TESLA

BONUS

6) ENERGY *Short Answer* Order from least to greatest the following four U.S. methane emissions by source for 2009: 1) natural gas systems, 2) landfills, 3) petrochemical production, 4) abandoned underground coal mines.

ANSWER: 3, 4, 2, 1 (ACCEPT: PETROCHEMICAL PRODUCTION, ABANDONED UNDERGROUND COAL MINES, LANDFILLS, NATURAL GAS SYSTEMS)

TOSS-UP

7) MATH *Short Answer* Providing your answer in scientific notation, simplify the quotient $\frac{240,000}{2 \times 10^{-6}}$ **[240 thousand over open parenthesis 2 times 10 to the power of negative 6 close parenthesis].**

ANSWER: 1.2×10^{11}

BONUS

7) MATH *Short Answer* The sum of six integers is what percentage of the average of the six integers?

ANSWER: 600%

TOSS-UP

8) PHYSICAL SCIENCE *Multiple Choice* At a particular temperature T and pressure P, carbon dioxide is in the vapor phase. Which of the following is NOT possible if the pressure of the vapor is increased while the temperature stays the same?

- W) The vapor remains a vapor
- X) The vapor enters the compressible liquid phase
- Y) The vapor enters the solid phase without entering the liquid phase first
- Z) The vapor enters the solid phase and then enters the liquid phase

ANSWER: Z) THE VAPOR ENTERS THE SOLID PHASE AND THEN ENTERS THE LIQUID PHASE

BONUS

8) PHYSICAL SCIENCE *Multiple Choice* Which of the following is true of periodic trends?

- W) The smaller the atom, the greater the ionization energy
- X) The larger the electronegativity, the smaller the ionization energy
- Y) Elements with the highest metallic character are located at the upper left corner of the periodic table
- Z) The process of removing an electron from an atom is always exothermic

ANSWER: W) THE SMALLER THE ATOM, THE GREATER THE IONIZATION ENERGY

TOSS-UP

9) GENERAL SCIENCE *Multiple Choice* Which of the following is the most usable form of nitrogen for non-leguminous [*non li-GYOO-muh-nuhs*] plants?

- W) Ammonia
- X) Nitrogen gas
- Y) Nitrites
- Z) Nitrates

ANSWER: Z) NITRATES

BONUS

9) GENERAL SCIENCE *Multiple Choice* A block is being pulled up a ramp by a rope. The block experiences friction against the surface of the ramp. How many forces in total are acting on the block?

- W) 2
- X) 3
- Y) 4
- Z) 5

ANSWER: Y) 4

TOSS-UP

10) EARTH AND SPACE *Multiple Choice* The tails of comets always do which of the following?

- W) Point away from the Sun
- X) Point towards the Sun
- Y) Point away from their direction of travel
- Z) Point in their direction of travel

ANSWER: W) POINT AWAY FROM THE SUN

BONUS

10) EARTH AND SPACE *Multiple Choice* Which of the following is true about the 2012 North Atlantic hurricane season?

- W) Two of the tropical storms occurred before the official June 1 beginning of hurricane season
- X) Four major hurricanes, categories 3 through 5, struck the East Coast
- Y) The exceptionally weak jet stream over the eastern portion of the nation could not push hurricanes off the East Coast
- Z) El Niño proved to be a major influence in suppressing overall storm activity

ANSWER: W) TWO OF THE TROPICAL STORMS OCCURRED BEFORE THE OFFICIAL JUNE 1 BEGINNING OF HURRICANE SEASON

TOSS-UP

11) LIFE SCIENCE *Multiple Choice* Which of the following animals would NOT be classified in the phylum **[FY-luhm]** cnidaria **[ny-DAIR-ee-uh]**?

- W) Portuguese man-of-war
- X) Ostrich plume hydroid
- Y) Aggregating anemone **[uh-NEM-uh-nee]**
- Z) Long-spined sea urchin

ANSWER: Z) LONG-SPINED SEA URCHIN

BONUS

11) LIFE SCIENCE *Short Answer* What is the name for viruses that infect only organisms in the domain *Bacteria*?

ANSWER: BACTERIOPHAGES (ACCEPT: PHAGES)

TOSS-UP

12) ENERGY *Multiple Choice* Trophic levels describe energy flow in an ecosystem. Which of the following statements about trophic levels is NOT true?

- W) Every organism's trophic level is determined by its feeding behavior
- X) Every organism's trophic level remains the same throughout its life span
- Y) Energy flows from primary producers to consumers
- Z) Some plants can be consumers

ANSWER: X) EVERY ORGANISM'S TROPHIC LEVEL REMAINS THE SAME THROUGHOUT ITS LIFE SPAN

BONUS

12) ENERGY *Multiple Choice* Compared to other methods of electricity production, hydroelectric power possesses all EXCEPT which of the following advantages?

- W) Low power cost
- X) Lack of air pollution
- Y) Flood prevention
- Z) Low environmental impact in case of disaster

ANSWER: Z) LOW ENVIRONMENTAL IMPACT IN CASE OF DISASTER

TOSS-UP

13) MATH *Short Answer* Evaluate $\cos 60^\circ (\sin 45^\circ)$ [*cosine of 60 degrees times sine of 45 degrees*].

ANSWER: $\frac{\sqrt{2}}{4}$

BONUS

13) MATH *Short Answer* In a class of 29 children, 20 children have a dog and 15 have a cat. What are the minimum number and maximum number, respectively, of children that could have both a dog and a cat?

ANSWER: MINIMUM 6, MAXIMUM 15

TOSS-UP

14) PHYSICAL SCIENCE *Multiple Choice* Which of the following is NOT true regarding radioactive decay?

- W) In gamma decay, no transmutation occurs
- X) Different isotopes of the same element will decay at the same rate
- Y) Radioactive decay may cause an atom to lose protons or neutrons
- Z) Radioactive decay is a process by which unstable atoms emit ionizing particles

ANSWER: X) DIFFERENT ISOTOPES OF THE SAME ELEMENT WILL DECAY AT THE SAME RATE

BONUS

14) PHYSICAL SCIENCE *Short Answer* A seismograph measures a wave that compresses and dilates the Earth as it travels. The seismograph has measured what type of wave?

ANSWER: PRIMARY (ACCEPT: COMPRESSIONAL, P)

TOSS-UP

15) MATH *Short Answer* What is the sum of the exterior angles of a triangle, one at each vertex?

ANSWER: 360°

BONUS

15) MATH *Short Answer* What is the length in units of the longest diagonal of a cube whose edge measures 5 units?

ANSWER: $5\sqrt{3}$

TOSS-UP

16) EARTH AND SPACE *Multiple Choice* How fast does the Sun rotate?

- W) Every 24 hours
- X) Every 31 days
- Y) Every 27 days
- Z) The Sun does not rotate

ANSWER: Y) EVERY 27 DAYS

BONUS

16) EARTH AND SPACE *Multiple Choice* Aerobraking is a method that can be used to slow a spacecraft down by having it drag through a planet's atmosphere. Why couldn't NASA use this method for the MESSENGER spacecraft?

- W) Mercury is too close to the Sun
- X) Mercury's atmosphere has too much corrosive methane in it
- Y) Mercury has little to no atmosphere
- Z) Mercury has insufficient gravity to permit it

ANSWER: Y) MERCURY HAS LITTLE TO NO ATMOSPHERE

TOSS-UP

17) LIFE SCIENCE *Multiple Choice* While dissecting a plant in your botany class, which of the following tissues would you NOT see?

- W) Epidermis
- X) Xylem [**ZY-luhm**]
- Y) Ectoderm [**EK-tuh-durm**]
- Z) Sclerenchyma [**skli-RENG-kuh-muh**]

ANSWER: Y) ECTODERM

BONUS

17) LIFE SCIENCE *Multiple Choice* In order to begin the digestive process, which of the following menu items would require the most salivary amylase?

- W) Spaghetti
- X) Green salad
- Y) Steamed clams
- Z) Fillet of fish

ANSWER: W) SPAGHETTI

TOSS-UP

18) GENERAL SCIENCE *Multiple Choice* Which of the following can NOT produce genetic variation in a bacterial population?

- W) Transduction
- X) Transformation
- Y) Meiosis [**my-OH-sis**]
- Z) Conjugation

ANSWER: Y) MEIOSIS

BONUS

18) GENERAL SCIENCE *Multiple Choice* All except which of the following are true of both mitochondria [**my-tuh-KON-dree-uh**] and chloroplasts?

- W) Both have their own genetic material separate from the cell nucleus
- X) Both divide at the same time as the cells in which they are found
- Y) Both use chemiosmosis to power energy conversions
- Z) Both reproduce through binary fission

ANSWER: X) BOTH DIVIDE AT THE SAME TIME AS THE CELLS IN WHICH THEY ARE FOUND

TOSS-UP

19) MATH *Short Answer* Determine the value of the function $\left(\frac{f}{g}\right)(4)$ [**f over g of 4**], if $f(x) = x^2 + 2x$ and $g(x) = 3x - 5$.

ANSWER: 24/7 (ACCEPT: 3 3/7)

BONUS

19) MATH *Multiple Choice* If 150% of $5c$ is b , what percentage of $2b$ is c ?

- W) $5\frac{1}{2}\%$
- X) $6\frac{2}{3}\%$
- Y) 15%
- Z) 75%

ANSWER: X) $6\frac{2}{3}\%$

TOSS-UP

20) PHYSICAL SCIENCE *Multiple Choice* Seismographs, used to keep track of earthquakes, use which of the following variables to measure earthquakes?

- W) The amplitude and frequency of water waves
- X) The rotational motion of the recording drum
- Y) The differential motion between two vibrating structures
- Z) The differential motion between a free mass and a supporting structure anchored to the ground

ANSWER: Z) THE DIFFERENTIAL MOTION BETWEEN A FREE MASS AND A SUPPORTING STRUCTURE ANCHORED TO THE GROUND

BONUS

20) PHYSICAL SCIENCE *Short Answer* Light with a frequency of 7.5×10^{14} hertz strikes a plate. What is this light's wavelength, to the nearest 100 nanometers?

ANSWER: 400

TOSS-UP

21) GENERAL SCIENCE *Multiple Choice* Humans cannot completely digest plants because we cannot break down their cell walls. Which of the following is an enzyme you would expect to be present in an herbivore?

- W) Amylase [**AM-uh-lays**]
- X) Cellulase
- Y) Pepsin
- Z) Chymotrypsin [**ky-moh-TRIP-sin**]

ANSWER: X) CELLULASE

BONUS

21) GENERAL SCIENCE *Multiple Choice* Which of the following is NOT an adaptation for deep-diving marine mammals?

- W) Increased extremity blood circulation
- X) Muscles containing high concentrations of myoglobin [**my-uh-GLOH-bin**]
- Y) Bradycardia [**brad-i-KAHR-dee-uh**]
- Z) Apneustic breathing [**ap-NOO-stik**]

ANSWER: W) INCREASED EXTREMITY BLOOD CIRCULATION

TOSS-UP

22) EARTH AND SPACE *Multiple Choice* Which of the following statements regarding Saturn is NOT true?

- W) It has a 29-year orbit around the Sun
- X) Its rotational axis is tilted 27° with respect to the orbital plane
- Y) Its seasons are about twice as long as corresponding seasons on Earth
- Z) Its rings are aligned with its equator

ANSWER: Y) ITS SEASONS ARE ABOUT TWICE AS LONG AS CORRESPONDING SEASONS ON EARTH

BONUS

22) EARTH AND SPACE *Short Answer* You are an astronaut on the space station looking down on the city of Seattle at night. You can see a few city lights but it is quite cloudy below. What method of remote sensing would you most likely use due to these conditions?

ANSWER: RADAR

TOSS-UP

23) LIFE SCIENCE *Multiple Choice* Sharks do not have a swim bladder. What major organ controls buoyancy in sharks?

- W) Gallbladder
- X) Liver
- Y) Spiral organ
- Z) Lungs

ANSWER: X) LIVER

BONUS

23) LIFE SCIENCE *Multiple Choice* Aerobic organisms fuel their metabolism by reducing molecular oxygen through respiration. Some organisms are able to undergo anaerobic respiration, where another oxidized molecule is substituted for oxygen. Which of the following would be a good substitute for oxygen in anaerobic respiration?

- W) Sulfite
- X) Sulfoxide
- Y) Sulfate
- Z) Sulfide

ANSWER: Y) SULFATE

TOSS-UP

24) ENERGY *Short Answer* According to the American Council for an Energy-Efficient Economy in 2007, renewable energy is one pillar of sustainable energy. What is the other pillar?

ANSWER: ENERGY EFFICIENCY

BONUS

24) ENERGY *Multiple Choice* Which of the following statements is NOT true about the Itaipu Dam?

- W) It is the largest operating hydroelectric facility in the world in terms of annual energy generation
- X) It is a binational undertaking
- Y) In 2009, the dam was damaged by a storm, temporarily blacking out the entire country of Paraguay
- Z) Its maximum height is equivalent to a 65-story building

ANSWER: Y) IN 2009, THE DAM WAS DAMAGED BY A STORM, TEMPORARILY BLACKING OUT THE ENTIRE COUNTRY OF PARAGUAY

TOSS-UP

25) LIFE SCIENCE *Short Answer* A wild population of daisies exists where flowers are either white (rr) [**little r little r**] or red (RR) [**big R big R**]. Assuming that bees cross pollinate equally well between white and red flowers as they pollinate white or red flowers directly, what genotypes would you expect to be present in year 2?

ANSWER: RR, rr, Rr

BONUS

25) LIFE SCIENCE *Multiple Choice* Which of the following can NOT be classified in the class Cephalopoda [**sef-uh-luh-POD-uh**]?

- W) Squid
- X) Cuttlefish
- Y) Nudibranch
- Z) Chambered nautilus

ANSWER: Y) NUDIBRANCH