

## ROUND 17

### TOSS-UP

1) PHYSICAL SCIENCE *Multiple Choice* J. J. Thomson primarily used what instrument to discover electrons:

- W) cathode ray tube
- X) torsion balance
- Y) interferometer
- Z) mass spectrometer

ANSWER: W) CATHODE RAY TUBE

### BONUS

1) PHYSICAL SCIENCE *Multiple Choice* In the early 20<sup>th</sup> century, physicists were unknowingly fissioning uranium by which of the following methods:

- W) bombardment with neutrons
- X) combining heavy isotopes of plutonium
- Y) exposing uranium to high temperatures
- Z) exposing heavy elements to immense pressure using explosive devices in heavy-walled containment vessels

ANSWER: W) BOMBARDMENT WITH NEUTRONS

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### TOSS-UP

2) EARTH SCIENCE *Multiple Choice* It is the fate of all lakes and ponds on Earth to eventually become dry lands, bogs, marshes, or fens, through a process called:

- W) fossilization
- X) eutrophication
- Y) mineralization
- Z) oligotrophy

ANSWER: X) EUTROPHICATION

### BONUS

2) EARTH SCIENCE *Short Answer* Which one of the following 4 terms does not belong with the others: zone of accumulation; zone of wastage; snow line; frontal wedging

ANSWER: FRONTAL WEDGING

(Solution: frontal wedging is a meteorological term, others are glacial terms)

**TOSS-UP**

3) MATH *Multiple Choice* The formula,  $SA = s^2 + 2sl$ , where  $s$  is one side of the base and  $l$  is the slant height, is used to calculate the surface area of which of the following:

- W) right circular cone
- X) right pentagonal prism
- Y) rectangular solid
- Z) right square pyramid

ANSWER: Z) RIGHT SQUARE PYRAMID

**BONUS**

3) MATH *Short Answer* Giving your answer rounded to the 1<sup>st</sup> decimal place, find the 9<sup>th</sup> term in the geometric sequence with first three terms: 0.1, 0.2, 0.4...

ANSWER: 25.6

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**TOSS-UP**

4) GENERAL SCIENCE *Multiple Choice* Which of the following was determined in 2007 to be the cause of hundreds of pet deaths because of pet food contamination:

- W) aspartame
- X) stevia
- Y) melamine
- Z) carrageenan

ANSWER: Y) MELAMINE

**BONUS**

4) GENERAL SCIENCE *Multiple Choice* Melamine is sometimes illegally added to food products in order to increase the apparent content of:

- W) protein
- X) carbohydrate
- Y) enzymes
- Z) B vitamins

ANSWER: W) PROTEIN

### TOSS-UP

5) LIFE SCIENCE *Multiple Choice* Which of the following techniques was used by Meselson and Stahl to separate samples of DNA that contained different amounts of DNA labeled with a heavy isotope and a light isotope of nitrogen in their experiments on DNA replication:

- W) reverse osmosis
- X) dialysis
- Y) centrifugation
- Z) liquid chromatography

ANSWER: Y) CENTRIFUGATION

### BONUS

5) LIFE SCIENCE *Short Answer* Name all of the following 4 proteins that are soluble in water: collagen; hemoglobin; insulin; DNA polymerase

ANSWER: HEMOGLOBIN; INSULIN; DNA POLYMERASE  
(ACCEPT: ALL BUT COLLAGEN)

(Solution: structural proteins are generally insoluble. Globular proteins, which include enzymes, are soluble...any protein with an "ase" suffix is typically an enzyme)

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### TOSS-UP

6) PHYSICAL SCIENCE *Short Answer* What is the maximum number of covalent bonds between any 2 carbon atoms?

ANSWER: 3

### BONUS

6) PHYSICAL SCIENCE *Short Answer* The density of an organic solvent is 600 grams per milliliter. What is the mass, in kilograms, of the solvent if it fills a container that measures 3 centimeters by 4 centimeters by 10 centimeters?

ANSWER: 72

(Solution:  $(600 \text{ g/cm}^3)(3 \text{ cm} \times 4 \text{ cm} \times 10 \text{ cm})(1 \text{ Kg}/1000 \text{ g}) = 72 \text{ Kg}$ )

**TOSS-UP**

7) EARTH SCIENCE *Multiple Choice* Which of the following is a semi-permanent high pressure system that sits over the Atlantic Ocean during summer:

- W) South Atlantic High
- X) Floridian High
- Y) North American High
- Z) Bermuda High

ANSWER: Z) BERMUDA HIGH

**BONUS**

7) EARTH SCIENCE *Multiple Choice* Which of the following BEST describes the air circulation pattern above the Bermuda or Azores high in the northern hemisphere in August:

- W) air spiraling into the center in a clockwise direction
- X) air spiraling out from the center in a clockwise direction
- Y) air spiraling into the center in a counter-clockwise direction
- Z) air spiraling out from the center in a counter-clockwise direction

ANSWER: X) AIR SPIRALING OUT FROM THE CENTER IN A CLOCKWISE DIRECTION

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**TOSS-UP**

8) MATH *Short Answer* What is the second term in the binomial expansion of  $(a + b)^5$ ?

ANSWER:  $5a^4b$

**BONUS**

8) MATH *Short Answer* Provide the prime factors over the integers for the following expression:  
 $16x^2 - 25y^4$

ANSWER:  $(4x - 5y^2)(4x + 5y^2)$

### TOSS-UP

9) GENERAL SCIENCE *Short Answer* Giving your answer as A, B, C, or D, what is a fat-soluble vitamin that is a central component for healthy vision and is important in the transduction of light to the retina, sometimes referred to as “night-vision”?

ANSWER: A

### BONUS

9) GENERAL SCIENCE *Multiple Choice* The glycemic index is an index that is used to directly predict the rate at which ingested food in the human diet will increase which of the following levels in the blood:

- W) sugar
- X) lipid
- Y) oxygen
- Z) carbon dioxide

ANSWER: W) SUGAR

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### TOSS-UP

10) LIFE SCIENCE *Multiple Choice* In which of the following stages in the life of an average dividing cell would it spend most of its time:

- W) mitosis
- X) interphase
- Y) cytokinesis
- Z) karyokinesis

ANSWER: X) INTERPHASE

### BONUS

10) LIFE SCIENCE *Multiple Choice* Which of the following BEST describes the chemical makeup of a human chromosome:

- W) 100% DNA
- X) about 99% DNA and 1% protein
- Y) about 50% DNA and 50% protein
- Z) about 1% DNA and 99% protein

ANSWER: Y) ABOUT 50% DNA AND 50% PROTEIN

**TOSS-UP**

11) PHYSICAL SCIENCE *Multiple Choice* Which of the following is most accurate regarding the force of gravity:

- W) it is caused by the weight of an object
- X) it is cannot travel through a vacuum
- Y) it theoretically acts over unlimited distances
- Z) it is caused by the strong nuclear force within atoms

ANSWER: Y) IT THEORETICALLY ACTS OVER UNLIMITED DISTANCES

**BONUS**

11) PHYSICAL SCIENCE *Multiple Choice* Which of the following BEST explains whether a U.S. quarter will accelerate down an inclined plane faster than a silver ring of the same diameter, assuming both roll without slipping:

- W) the ring accelerates faster because it has less inertia
- X) the ring will accelerate slower because all its mass in the outer rim
- Y) the quarter will accelerate faster because it has more mass
- Z) the quarter will accelerate at the same rate as the ring since both have the same diameter

ANSWER: X) THE RING WILL ACCELERATE SLOWER BECAUSE ALL ITS MASS IN THE OUTER RIM

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**TOSS-UP**

12) GENERAL SCIENCE *Short Answer* Rounded to the nearest whole number, how many degrees is the Moon inclined with respect to the orbit of the Earth about the Sun?

ANSWER: 5

**BONUS**

12) GENERAL SCIENCE *Multiple Choice* In the Hertzsprung-Russell diagram, where would Blue Giants be found:

- W) upper left
- X) upper right
- Y) lower left
- Z) lower right

ANSWER: W) UPPER LEFT

### TOSS-UP

13) EARTH SCIENCE *Multiple Choice* Which of the following are the first clearly identifiable fossils from the Precambrian Era which can still be found living along beaches of Shark Bay in western Australia:

- W) echinoderms
- X) trilobites
- Y) sharks
- Z) stromatolites

ANSWER: Z) STROMATOLITES

### BONUS

13) EARTH SCIENCE *Multiple Choice* The law of superposition is used by geologists to predict which of the following properties of a rock:

- W) its relative age
- X) its absolute age
- Y) its radiometric age
- Z) its chemical composition

ANSWER: W) ITS RELATIVE AGE

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### TOSS-UP

14) MATH *Multiple Choice* The graph of which of the following equations passes through quadrants one and two:

- W)  $x - 2 = 0$
- X)  $y = x^2$
- Y)  $x = 5y$
- Z)  $y + 3 = 0$

ANSWER: X)  $y = x^2$

### BONUS

14) MATH *Short Answer* Paul is getting dressed for graduation. He has 2 choices of pants, 3 choices of shirts, and 4 choices of shoes. How many different wardrobes consisting of pants, shirts and shoes are possible?

ANSWER: 24

### TOSS-UP

15) LIFE SCIENCE *Multiple Choice* Which of the following will most likely occur for a bacteria that is an obligate or strict anaerobe (read as: an-AYE-robe) when grown in a test tube of nutrient agar that remains undisturbed :

- W) all the bacteria immediately die
- X) the bacteria only grow against the walls of the test tube
- Y) the bacteria only grow at the top of the test tube
- Z) the bacteria only grow at the bottom of the test tube

ANSWER: Z) THE BACTERIA ONLY GROW AT THE BOTTOM OF THE TEST TUBE

### BONUS

15) LIFE SCIENCE *Multiple Choice* Which of the following molecules primarily functions to carry electrons from one place to another inside a cell:

- W) NAD<sup>+</sup>
- X) ATP
- Y) UTP
- Z) pyruvic acid

ANSWER: W) NAD<sup>+</sup>

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### TOSS-UP

16) PHYSICAL SCIENCE *Multiple Choice* Which of the following is a strong acid since it ionizes almost completely in water:

- W) NaCl
- X) LiOH
- Y) H<sub>2</sub>CO<sub>3</sub>
- Z) H<sub>2</sub>SO<sub>4</sub>

ANSWER: Z) H<sub>2</sub>SO<sub>4</sub>

### BONUS

16) PHYSICAL SCIENCE *Short Answer* By words or numbers, name all of the following 3 choices that obey an inverse square law:

- 1) gravitational force and distance
- 2) the size of an object and its density
- 3) the intensity of a light source and the distance between the source and detector

ANSWER: 1 AND 3

**TOSS-UP**

17) GENERAL SCIENCE *Short Answer* What astronomical unit for distance is derived from the parallax of one second of arc?

ANSWER: PARSEC

**BONUS**

17) GENERAL SCIENCE *Multiple Choice* How many light-seconds are in a light-year:

- W) 300,000
- X) 360,000
- Y) 1,314,000
- Z) 31,557,600

ANSWER: Z) 31,557,600

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**TOSS-UP**

18) EARTH SCIENCE *Multiple Choice* The greenhouse effect is produced primarily by the re-emission of which of the following by the atmosphere:

- W) visible light
- X) UV light
- Y) infrared radiation
- Z) sensible heat

ANSWER: Y) INFRARED RADIATION

**BONUS**

18) EARTH SCIENCE *Multiple Choice* Which of the following is a human-made gas that, if released into the atmosphere, can directly act to destroy ozone in the stratosphere:

- W) chlorofluorocarbon
- X) carbon dioxide
- Y) methane
- Z) hydrogen cyanide

ANSWER: W) CHLOROFLUOROCARBON

### TOSS-UP

19) MATH *Multiple Choice* Which of the following is the best example of a graph of ordered pairs that directly shows how much one variable is directly affected by another:

- W) box-and-whiskers plot
- X) scatter plot
- Y) histogram
- Z) pie chart

ANSWER: X) SCATTER PLOT

### BONUS

19) MATH *Short Answer* A balanced coin is flipped 4 times. What is the probability, as a fraction in lowest terms, of obtaining the exact order of tail, tail, head, head?

ANSWER:  $\frac{1}{16}$

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### TOSS-UP

20) LIFE SCIENCE *Short Answer* From what embryonic germ layer are skeletal bones primarily derived?

ANSWER: MESODERM

### BONUS

20) LIFE SCIENCE *Short Answer* Progressing from the outside to the inside, what are the 3 basic embryonic germ layers in vertebrates?

ANSWER: ECTODERM; MESODERM; ENDODERM

**TOSS-UP**

21) PHYSICAL SCIENCE *Short Answer* Leona swims directly across a river at 4 kilometers per hour and the river has a current of 5 kilometers per hour. To the nearest whole number, what is Leona's total velocity, in kilometers per hour?

ANSWER: 6

**BONUS**

21) PHYSICAL SCIENCE *Short Answer* Which 2 of the following 4 atomic properties primarily account for the magnetic behavior of an iron magnet: electron spin; neutron number; atomic charge; electron orbit

ANSWER: ELECTRON SPIN; ELECTRON ORBIT

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**TOSS-UP**

22) EARTH SCIENCE *Short Answer* Giving your answer as north, south, east, or west, surface winds normally blow FROM what direction at 70° to 80° north latitude?

ANSWER: EAST

(Solution: polar easterlies)

**BONUS**

22) EARTH SCIENCE *Short Answer* Arrange the following 4 choices in order of INCREASING specific gravity: quartz; hematite; gypsum; silver

ANSWER: GYPSUM; QUARTZ; HEMATITE; SILVER

**TOSS-UP**

23) GENERAL SCIENCE *Short Answer* What stellar cataclysm resulted in the formation of the Crab nebula?

ANSWER: SUPERNOVA

**BONUS**

23) GENERAL SCIENCE *Short Answer* Name all of the following 4 elements that are produced in supernova and NOT by stars with masses similar to the Sun: helium; carbon; oxygen; copper

ANSWER: COPPER

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**TOSS-UP**

24) MATH *Short Answer* In a right triangle, the ratio of the length of the side opposite an angle to the length of the hypotenuse describes what trigonometric function?

ANSWER: SINE

**BONUS**

24) MATH *Short Answer* If the volume of a sphere is  $36\pi$  centimeters, find its radius, in centimeters:

ANSWER: 3

(Solution:  $V = \frac{4}{3}\pi r^3$ ;  $36\pi = \frac{4}{3}\pi r^3$ ,  $r = 3$  cm)

### **TOSS-UP**

25) LIFE SCIENCE *Short Answer* Name all of the following 4 elements that are found in DNA and NOT proteins: sulfur; nitrogen; oxygen; phosphorus

ANSWER: PHOSPHORUS

### **BONUS**

25) LIFE SCIENCE *Short Answer* What radioactive isotope did Hershey and Chase use to label the capsid protein of bacteriophage in the pivotal experiment supporting the theory that genetic information was carried in the DNA?

ANSWER: SULFUR 35 (ACCEPT: S-35)