

### TOSS-UP

1. EARTH AND SPACE *Multiple Choice* Which of the following is not true of plutons?

(W) A pluton that is pushed upwards due to tectonic forces is called a batholith

(X) Examples of batholiths include the Sierra Nevada batholith, Idaho batholith, and lower California batholith

(Y) A sill differs from a dike in that a sill is thicker and is more resistant to weathering than a dike

(Z) A stock is similar to a batholith, except it is smaller

ANSWER: Y

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### TOSS-UP

2. MATH *Multiple Choice* If  $a^b = c^d$ , which of the following is not necessarily true?

(W)  $a^b - c^d = 0$

(X)  $a^b * c^d = (2a)^b$

(Y)  $a^b + c^d = 2 * (a^b)$

(Z)  $\frac{a^b}{c^d} = 1$

ANSWER: X

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### TOSS-UP

3. PHYSICS *Short Answer* Using words or numbers, identify all of the following statements that is or are true of circuit devices:

I. Because the coils are at slightly different potentials, inductors also have capacitance, which affects the inductor's behavior at high frequencies

II. At certain frequencies, inductors begin to behave as resonant circuits, becoming self-resonant

III. Capacitors block alternate current and allow direct current to pass

- IV. According to the thermoelectric effect, a thermoelectric device can create a voltage when there is a temperature gradient between its two ends

ANSWER: I, II, IV

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### TOSS-UP

4. EARTH AND SPACE *Multiple Choice* With 26 in total, this constellation contains more confirmed exoplanets than any other constellation. Its brightest star is Spica, which can be located by following the curve of the Big Dipper to Arcturus in Boötes. This constellation is...

(W) Ursa minor

(X) Virgo

(Y) Capricorn

(Z) Draco

ANSWER: X

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### TOSS-UP

5. MATH *Short Answer* A regular polygon has 9 sides. What is the degree measure of the angle between any two sides?

ANSWER: 140

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### TOSS-UP

6. PHYSICS *Multiple Choice* Which of the following could be an example of asymptotic freedom?

(W) At large radii, the gravitational attraction between two bodies becomes arbitrarily weak

(X) A quark must exchange exactly two gluons with another quark to mediate the strong force

(Y) There is a threshold at which the electrostatic interaction between two bodies becomes extremely small at extremely small radii

(Z) When enough energy is applied, two quarks will readily form a particle-antiparticle pair rather than splitting

ANSWER: W

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### TOSS-UP

7. EARTH AND SPACE *Short Answer* Which extrusive igneous rock composed mainly of olivine and pyroxene contains a very high iron and magnesium content and a very low silica content, and is the dominant rock in the Earth's upper mantle?

ANSWER: PERIDOTITE

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### TOSS-UP

8. MATH *Multiple Choice* A number is called "round" if it contains at least one zero as a digit. How many three-digit numbers are "round"?

(W) 153

(X) 171

(Y) 179

(Z) 215

ANSWER: Z

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### TOSS-UP

9. PHYSICS *Short Answer* Which phenomenon explains why particles with color charge, such as quarks, cannot be isolated, because the energy needed to counteract the potential of the strong nuclear force between such particles is enough to create a particle-antiparticle pair also coupled by the strong force?

ANSWER: COLOR CONFINEMENT

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**TOSS-UP**

10. EARTH AND SPACE *Short Answer* Which active stratovolcano located in the Pacific Northwest of the United States is especially known for its eruption in 1980?

ANSWER: MOUNT SAINT HELENS

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**TOSS-UP**

11. MATH *Short Answer* Using words or numbers, identify all of the following statements that would be true if  $a^2 = b^2$ :

- I.  $a = b$
- II.  $|a| = |b|$
- III.  $|a - b| = 0$

ANSWER: II

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**TOSS-UP**

12. PHYSICS *Multiple Choice* Which of the following is not true?

- (W) Electromagnetic radiation may change the conductivity or resistivity of a material by causing electrons to jump to the conduction band
- (X) The photovoltaic effect describes the generation of electrical voltage when photons are fired on a material
- (Y) The work function of a material is proportional to the energy required by an electron to jump to the next energy level
- (Z) The emission of electrons from a material when exposed to electromagnetic radiation exhibits saturation

ANSWER: Y

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**TOSS-UP**

13. EARTH AND SPACE *Multiple Choice* Which of the following is not true of the CNO cycle?

(W) Unlike the proton-proton chain, it is a catalytic cycle  
(X) It is the dominant cycle in stars that are over 1.3 solar masses  
(Y) It can only occur if the kinetic energy of the protons is high enough to overcome their electrostatic repulsion  
(Z) The CNO cycle occurs at temperatures over  $13 \times 10^6$  K, and its rate increases rapidly with temperature

ANSWER: Y

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**TOSS-UP**

14. MATH *Short Answer* The number 20 has 1 trailing zero. How many trailing zeros does the number 20! have?

ANSWER: 4

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**TOSS-UP**

15. PHYSICS *Short Answer* In special relativity what is the name for the coefficient which describes time dilation, length contraction, and other phenomena, and is a function of the speed of a frame of reference?

ANSWER: LORENTZ FACTOR

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**TOSS-UP**

16. EARTH AND SPACE *Multiple Choice* Which of the following is not true of the movement of P and S waves through the Earth if they are fired from an epicenter?

(W) There are two regions in which P waves cannot be detected

- (X) There is one region in which S waves cannot be detected  
(Y) P waves cannot pass through the Earth's outer core  
(Z) S waves cannot pass through the Earth's inner core

ANSWER: Z

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**TOSS-UP**

17. MATH *Short Answer* Which two numbers are outside the domain of the function  $f(x) = \frac{x}{x^2 - 8x + 12}$ ?

ANSWER: 2 AND 6

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**TOSS-UP**

18. EARTH AND SPACE *Short Answer* Which cloud type is characterized by large dark, rounded masses, usually in groups, lines, or waves, the individual elements being larger than those in altocumulus clouds, and the whole being at a lower altitude, usually below 2,400 m?

ANSWER: STRATOCUMULUS

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**TOSS-UP**

19. MATH *Short Answer* If  $2^{4x+3} = 4^{x-1}$ , what is x?

ANSWER:  $-5\frac{1}{2}$

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**TOSS-UP**

20. EARTH AND SPACE *Multiple Choice* Which of the following is true of stellar classification?

- (W) The M class contains the hottest stars
- (X) O class stars tend to be the most massive
- (Y) A type stars have the strongest hydrogen lines
- (Z) Most main sequence stars are A type stars

ANSWER: Y

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**TOSS-UP**

21. MATH *Short Answer* Six children sit at a circular table. In how many orders can they sit at the table?

ANSWER: 120

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**TOSS-UP**

22. EARTH AND SPACE *Short Answer* Using words or numbers, name all of the following that is or are true of tropical cyclones:

- I. They have a high-pressure center because the evaporation of water around the eye of a volcano results in an increased humidity
- II. They are fueled by a different mechanism than nor'easterlies
- III. They are able to produce high waves and can spawn tornadoes

ANSWER: II, III

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**TOSS-UP**

23. MATH *Multiple Choice* A triangle has sides of length 7, 11, and X. Which of the following cannot be X?

(W) 2

(X) 4

(Y) 8

(Z) 12

ANSWER: W

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**TOSS-UP**

24. EARTH AND SPACE *Short Answer* Order the following 4 stars by their apparent magnitude, from brightest to dimmest: Sirius, Arcturus, Vega, Canopus

ANSWER: SIRIUS, CANOPUS, ARCTURUS, VEGA

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**TOSS-UP**

25. MATH *Short Answer* A square, X, has sides of length  $n$ . Another square, Y, has sides of length  $1.5n$ . How many X can fit into a single Y?

ANSWER: 2.25

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