

TOSS-UP

1. BIOLOGY *Multiple Choice* Which of the following types of blood vessels has the lowest blood velocity?

(W) Artery
(X) Arteriole
(Y) Capillary
(Z) Vein

ANSWER: Y

TOSS-UP

2. CHEMISTRY *Short Answer* Which specific type of molecular orbital is caused by two atomic orbitals that are “out of phase” and repulsive, and destabilize the molecule as a whole?

ANSWER: ANTIBONDING PI ORBITAL

TOSS-UP

3. PHYSICS *Multiple Choice* Which of the following is not true of induction in electromagnetics?

(W) A magnetic field is induced by a changing electric field
(X) An electric field is induced by a changing magnetic field
(Y) The direction of an induced magnetic field is determined by the right-hand rule
(Z) The direction of an induced magnetic field is in the same direction of the flux of the electric field

ANSWER: Z

TOSS-UP

4. MATH *Short Answer* How many integers are there that satisfy the equation $x^2 - 2x + 1 = 0$?

ANSWER: 0

TOSS-UP

5. EARTH AND SPACE SCIENCE *Multiple Choice* Hematite varies in its color, but its streak is always:

(W) Black

(X) Red

(Y) Brown

(Z) Gray

ANSWER: X

TOSS-UP

6. ENERGY *Multiple Choice* In 2011, most U.S. fuel imports were in which form?

(W) Coal

(X) Natural gas

(Y) Petroleum

(Z) Ethanol

ANSWER: Y

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7. BIOLOGY *Short Answer* Using words or numbers, indicate all of the following which are inhibitors of phosphofructokinase: ATP, AMP, citrate, NADH

ANSWER: ATP, CITRATE

TOSS-UP

8. CHEMISTRY *Multiple Choice* Which of the following molecular geometries has the greatest bond angle?

(W) Trigonal planar
(X) Pentagonal bipyramidal
(Y) Trigonal bipyramidal
(Z) Tetrahedral

ANSWER: W

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9. PHYSICS *Short Answer* According to general relativity, objects accelerating as a result of this interaction are actually following a straight path through spacetime as a result of spacetime being curved by matter and energy. Name this interaction.

ANSWER: GRAVITY

TOSS-UP

10. MATH *Multiple Choice* Which of the following theorems of vector calculus guarantees that the double integral of the gradient over the bounding surface is equal to the triple integral of the divergence over the volume?

(W) Stokes' theorem
(X) Divergence theorem
(Y) Green's theorem
(Z) Cauchy's Theorem

ANSWER: X

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11. EARTH AND SPACE SCIENCE *Short Answer* To an observer, the moon appears to wobble as it shifts through its lunar phases. What is the name of this phenomenon?

ANSWER: LIBRATION

TOSS-UP

12. ENERGY *Multiple Choice* During respiration, what percent of the chemical energy harvested from glucose is lost as heat?

(W) 10%

(X) 30%

(Y) 50%

(Z) 90%

ANSWER: Y

TOSS-UP

13. BIOLOGY *Multiple Choice* Which of the following hormones slows plant growth?

(W) Abscissic Acid

(X) Ethylene

(Y) Gibberellin

(Z) Brassinosteroids

ANSWER: W

TOSS-UP

14. CHEMISTRY *Multiple Choice* Which of the following groups is the most reactive in an SN1 nucleophilic substitution?

(W) Methyl

- (X) Ethyl
- (Y) Propyl
- (Z) Butyl

ANSWER: W

TOSS-UP

15. PHYSICS *Short Answer* If the frequency of the first harmonic is 440 Hz, what is the frequency of the third harmonic?

ANSWER: 1320 HZ

TOSS-UP

16. MATH *Multiple Choice* What is the determinant of the following 2 by 2 matrix: $\begin{pmatrix} -2 & 1 \\ 5 & -3 \end{pmatrix}$

- (W) -11
- (X) -1
- (Y) 1
- (Z) 11

ANSWER: Y

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17. EARTH AND SPACE SCIENCE *Multiple Choice* During the June solstice, in which of the following areas is insolation the greatest?

- (W) Equator
- (X) Tropic of cancer
- (Y) Tropic of capricorn
- (Z) The poles

ANSWER: X

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18. ENERGY *Short Answer* In which type of thermodynamic process is there no heat transfer between the system and the surrounding environment?

ANSWER: ADIABATIC

TOSS-UP

19. BIOLOGY *Multiple Choice* Which of the following best explains why plants such as grasses have vertical rather than horizontal leaves?

(W) Vertical leaves increase the surface area for absorption of sunlight

(X) Vertical leaves increase carbon dioxide intake in the stomata

(Y) Vertical leaves minimize the amount of sunlight and prevent damage from its rays

(Z) Vertical leaves enables grasses to use their stems for photosynthesis

ANSWER: Y

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20. CHEMISTRY *Short Answer* Which type of crystal lattice has one lattice point in the center in addition to the eight corner points?

ANSWER: BODY-CENTERED CUBIC

TOSS-UP

21. PHYSICS *Short Answer* Which constant in fluid dynamics gives a ratio between inertial and viscous forces and can be used to determine the amount of turbulence?

ANSWER: REYNOLD'S NUMBER

TOSS-UP

22. MATH *Short Answer* In which quadrants is the curve $y = x + \sin x$ found?

ANSWER: I AND III

TOSS-UP

23. EARTH AND SPACE SCIENCE *Multiple Choice* When moving from the equator to the poles, the height of the tropopause:

(W) Increases

(X) Decreases

(Y) Does not change

(Z) Fluctuates rapidly between increasing and decreasing

ANSWER: X

TOSS-UP

24. ENERGY *Multiple Choice* Which of the following is not an essential characteristic of an enzyme?

(W) It lowers the activation energy of a reaction

(X) It is made of protein

(Y) It has an active site

(Z) It is not consumed during the reaction

ANSWER: X

TOSS-UP

25. BIOLOGY *Multiple Choice* If a particular genetic disorder is more common among females than males, then it is most likely

(W) Sex-linked recessive

(X) Sex-linked dominant

(Y) Autosomal recessive

(Z) Autosomal dominant

ANSWER: X
