

5

1. Physics

Toss Up: Short Answer

The speedometer in your car tells you what

Toss Up Answer: instantaneous speed

Bonus: Short Answer

Projectile 'A' is fired at an angle of 50° above the horizontal; projectile 'B' is fired with the same speed at an angle of 40° above the horizontal. Assuming level ground and negligible air resistance, what is true about range and height of both objects?

Bonus Answer: A' will reach a smaller height and have a greater range than 'B'.

=====

2. Chemistry

Toss Up: Short Answer

Which group of elements has the lowest ionization energy?

Toss Up Answer: Alkali metals

Bonus: Short Answer

What are the elements in group 15 called?

Bonus Answer: Pnictogens

=====

3. Earth and Space Science

Toss Up: Short Answer

What is the angle of insolation?

Toss Up Answer: The angle at which light hits the earth.

Bonus: Multiple Choice

Which of the following locations can have an angle of insolation of 90 degrees?

W) 20 degrees N

X) 40 degrees N

Y) 60 degrees N

Z) 30 degrees S

Bonus Answer: W

=====

4. Mathematics

Toss Up: Short Answer

Find the integral of $2x^3 + 2$ with respect to x in simplest terms.

Toss Up Answer: $(x^4)/2 + 2x$

Bonus: Multiple Choice

Which of the following is a conic section?

W) Cylinder

X) Triangle

Y) Hyperbola

Z) Asymptote

Bonus Answer: Y

5. Biology

Toss Up: Multiple Choice

A female lizard washes ashore on an island after riding a floating log for hundreds of miles across the sea. She is the only member of her species to have ever made it to the island. After arriving, she lays 20 fertile eggs that hatch and form the basis of a lizard population on the island. Which of the following is NOT a likely result?

- W) The new island population will have less genetic diversity than the ancestral population.
- X) Mutation will add new alleles to the new population and thus increase its genetic diversity over time.
- Y) There will be little or no gene exchange between the new population and the ancestral population.
- Z) The new island population will have greater genetic diversity than the ancestral population.

Toss Up Answer: Z

Bonus: Multiple Choice

Loss of heterozygosity can be caused by all of the following EXCEPT:

- W) genetic drift.
- X) positive frequency-dependent selection.
- Y) heterozygote advantage.
- Z) inbreeding.

Bonus Answer: Y

6. Earth and Space Science

Toss Up: Short Answer

what is a front?

Toss Up Answer: boundary between two air masses

Bonus: Short Answer

How does a cold front form?

Bonus Answer: cold air moves in and pushes warm air up

7. Mathematics

Toss Up: Multiple Choice

Which of the following best characterizes every transcendental number?

- W) Irrational
- X) A linear combination of e or π in which the coefficients are non-zero
- Y) A real number that is not a root of any non-zero polynomial with rational coefficients
- Z) e or π

Toss Up Answer: W

Bonus: Short Answer

Which of the following numbers are transcendental numbers: 1) e ; 2) $\sqrt{2}$; 3) i^i ; 4) π ?

Bonus Answer: e , i^i , π [Accept any permutation of 1, 3, and 4]

8. Earth and Space Science

Toss Up: Short Answer

What comet was the first one recognized by astronomers to be periodic, with a period of roughly 76 years?

Toss Up Answer: Halley's Comet

Bonus: Short Answer

Located between the A and B rings of Saturn, what famous region stretches 4800 km and is characterized by a lack of material?

Bonus Answer: Cassini Division

=====

9. Biology

Toss Up: Multiple Choice

Pine, fir, spruce, cedar, larch and cypress are the famous timber-yielding plants. All these belong to:

- W) angiosperms
- X) gymnosperms
- Y) monocotyledons
- Z) dicotyledons

Toss Up Answer: X

Bonus: Multiple Choice

The population of algae in soil is [blank] that of either bacteria or fungi.

- W) generally smaller than
- X) generally greater than
- Y) equal to
- Z) there are no algae in soil

Bonus Answer: W

=====

10. Physics

Toss Up: Short Answer

If the acceleration is always perpendicular to an object's velocity, what can be deduced about the object's motion?

Toss Up Answer: It is circular motion.

Bonus: Short Answer

If the acceleration of an object is opposite its velocity, what can be said about the object's velocity over time? Assume that the direction of the velocity is positive.

Bonus Answer: It is decreasing.

=====

11. Earth and Space Science

Toss Up: Short Answer

The Ring of Fire surrounds which ocean?

Toss Up Answer: Pacific Ocean

Bonus: Multiple Choice

What kind of volcano is Mauna Loa?

- W) cone
- X) shield
- Y) subglacial
- Z) stratovolcano

Bonus Answer: X

=====

12. Chemistry

Toss Up: Multiple Choice

What does Pauli's Exclusion Principle state?

- W) Electrons of an atom must have the same spin
- X) No two electrons of an atom travel in the same orbital
- Y) no two electrons in an atom can be at the same time in the same state or configuration
- Z) Electrons can switch spin automatically

Toss Up Answer: Y

Bonus: Short Answer

What law states that electrons in the same orbitals reorganize themselves to maximize spin?

Bonus Answer: Hund's law

=====

13. Mathematics

Toss Up: Short Answer

What is the sum of the interior angles of a nonagon?

Toss Up Answer: 1260 degrees

Bonus: Short Answer

How many edges does an octahedral prism have?

Bonus Answer: 24 edges

=====

14. Earth and Space Science

Toss Up: Short Answer

What is the shape of the path planets take around the sun?

Toss Up Answer: Elliptical

Bonus: Short Answer

Name three of the closest stars to Earth, not including the Sun.

Bonus Answer: Three of the following: Proxima Centauri, Alpha Centauri A, Alpha Centauri B, Barnard, Wolf, Luyten, Sirius

=====

15. Biology

Toss Up: Multiple Choice

Which one of these is an enzyme?

- W) Inositol
- X) Lyase

- Y) Alanine
- Z) Butyric Acid

Toss Up Answer: X

Bonus: Multiple Choice

Which molecule is not involved in the C3 Calvin cycle?

- W) OAA
- X) RuBP
- Y) G3P
- Z) PGA

Bonus Answer: W

=====

16. Mathematics

Toss Up: Short Answer

What is the smallest even triangular number?

Toss Up Answer: 6

Bonus: Multiple Choice

If p and q are inversely proportional, and p = 7 when q = 24, then find p when q =12.

- W) 3.5
- X) 7
- Y) 12
- Z) 14

Bonus Answer: Z

=====

17. Physics

Toss Up: Multiple Choice

A Newton is equal to which of the following?

- W) w) kilogram-meter per second
- X) x) meter per second squared
- Y) y) kilogram-meter per second squared
- Z) z) kilogram per meter-second

Toss Up Answer: Y

Bonus: Short Answer

Work is what type of quantity?

Bonus Answer: Scalar quantity.

=====

18. Biology

Toss Up: Short Answer

Select all of the following ways in which the mucosal epithelia protect the body against disease.

- 1) act as a barrier
- 2) trap pathogens
- 3) secrete antimicrobial peptides

Toss Up Answer: 1, 2, 3

Bonus: Multiple Choice

Which of the following is not involved in the innate immune defense of the intestinal tract?

- W) beta-defensins
- X) alpha-defensins
- Y) commensal bacteria
- Z) cryptidins

Bonus Answer: W

=====

19. Mathematics

Toss Up: Short Answer

If the capstone is taken off the Great Pyramid of Giza, then it is no longer a pyramid but a what?

Toss Up Answer: A frustum

Bonus: Multiple Choice

Which one of these is Euclid's parallel postulate?

- W) If a line intersects one of two parallel lines, both of which are coplanar with the original line, then it will also intersect with the other line.
- X) If a line segment intersects two straight lines forming two interior angles on the same side that sum to less than two right angles, then the two lines, if extended indefinitely, meet on the side on which the angles sum to less than two right angles.
- Y) In a plane, given a line and a point not on it, exactly one line parallel to the given line can be drawn through the point.
- Z) For any acute angle A and any point D in the interior of angle A, there exists a line through D and not through A which intersects both sides of angle A.

Bonus Answer: X

=====

20. Biology

Toss Up: Short Answer

Where in the DNA are short tandem repeats usually located?

Toss Up Answer: Accept introns OR noncoding DNA

Bonus: Short Answer

Why do DNA molecules travel through the gel in gel electrophoresis?

Bonus Answer: DNA has a negative charge

=====

21. Chemistry

Toss Up: Multiple Choice

Which of the following has the largest ionic radius?

- W) Li
- X) Be
- Y) Na
- Z) Mg

Toss Up Answer: Y

Bonus: Short Answer

Why does Oxygen have a smaller atomic radius than boron?

Bonus Answer: Effective nuclear charge
=====

22. Physics

Toss Up: Multiple Choice

There is a 4kg block at rest. It spontaneously explodes into two pieces traveling in opposite directions. One piece weighing 1 kilogram travels to the left at 4 m/s. What direction and speed was the other block traveling in?

- W) 4/3 m/s to the left
- X) 3/4 m/s to the right
- Y) 4/3 m/s to the right
- Z) 4 m/s to the left

Toss Up Answer: Y

Bonus: Multiple Choice

Under small velocities, objects that collide do not conserve their total energy. However, under relativistic velocities, collisions always conserve their total energy. Why is this so?

- W) Under relativistic velocities, mass and energy are interchangeable, and since mass can't be destroyed, neither can initial nor final energy.
- X) Under small velocities, the frictional force during collision felt by two objects is large, whereas under relativistic velocities, the frictional force is negligible and energy is conserved.
- Y) Under relativistic velocities, objects obtain relativistic masses which makes them gain more mass and makes up the lost energy in a regular collision.
- Z) Under small velocities, particles lose parts of their masses while in motion, leading to a loss of energy after collision.

Bonus Answer: W
=====

23. Chemistry

Toss Up: Multiple Choice

What kind of process is the loss of electrons?

- W) electrolysis
- X) thermodynamically favored
- Y) reduction
- Z) oxidation

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following metals does not react with water to produce hydrogen?

- W) Zn
- X) Li
- Y) Ca
- Z) Na

Bonus Answer: W

=====

24. Physics

Toss Up: Multiple Choice

Aaron, whose mass is 45 kilograms, is riding his 5.0 kilogram skateboard down the sidewalk with a constant speed of 6.0 meters per second when he rolls across a 10.0 meter long patch of sand on the pavement. The sand provides force of friction of 6.0 newtons. What is Aaron's speed in meters per second as he emerges from the sand?

W) 0

X) 1.8

Y) 3.8

Z) 5.8

Toss Up Answer: Z

Bonus: Short Answer

Which of the following contains a scalar quantity? Force, energy, or acceleration?

Bonus Answer: Energy

=====

25. Chemistry

Toss Up: Multiple Choice

According to VSEPR theory, which of the following molecules DOES NOT have a trigonal pyramidal geometry?

W) NH_3 (read as: Ammonia)

X) BF_3 (read as: Barium trifluoride)

Y) XeF_3 (read as: Xenon trifluoride)

Z) PCl_3 (read as: Phosphorus trichloride)

Toss Up Answer: X

Bonus: Short Answer

By name of number, which of the following molecules have a bent molecular structure?

1. SO_2

2. CO_2

3. OF_2

Bonus Answer: SO_2 and OF_2 (accept 1 and 3)

=====