AVES



RR 1

TOSS-UP

1) MATH *Short Answer* Identify all of the following three shapes which must have at least one line of symmetry:

1) Trapezoid;

2) Isosceles Triangle;

3) Ellipse.

ANSWER: 2 and 3 [RG]

BONUS

1) MATH *Short Answer* Rohan lists the positive integers less than 100. How many of the written integers contain the digit "3"?

ANSWER: 19 [RG]

TOSS-UP

2) BIOLOGY *Multiple Choice* If flower color exhibits an incomplete dominant inheritance pattern, which of the following phenotypes will not be seen in the offspring population when two heterozygotes are crossed and the two dominant alleles encode for red and blue flower color?

W) White

X) Purple

Y) Red

Z) Blue

ANSWER: W) White [EH]

BONUS

2) BIOLOGY *Multiple Choice* A positive feedback loop would have which of the following types of enzymatic regulation?

W) Competitive inhibition

X) Noncompetitive inhibition

Y) Allosteric inhibition

Z) Allosteric activation

ANSWER: Z) Allosteric activation [EH]

TOSS-UP

3) PHYSICS *Multiple Choice* Which of the following is not an SI unit?

W) Joule

X) Kilogram

Y) Calorie

Z) Second

ANSWER: Y) Calorie [RG]

BONUS

3) PHYSICS *Short Answer* Newton's second law is often written as force equals mass times acceleration when mass is constant. However, a generalization allows for the mass to change, when force is defined to be the change in what quantity over the change in time?

ANSWER: Momentum (Accept: Linear momentum) [RG]

TOSS-UP

4) EARTH AND SPACE *Multiple Choice* Which of the following igneous intrusions is typically largest?

W) Batholith

X) Dike

Y) Laccolith

Z) Sill

ANSWER: W) Batholith [PB]

BONUS

4) EARTH AND SPACE *Short Answer* Order the following three types of fronts by increasing intensity of their associated weather:

1) Cold;

2) Stationary;

3) Warm.

ANSWER: 2, 3, 1 [PB]

TOSS-UP

5) CHEMISTRY *Short Answer* Nitrogen-14 and nitrogen-15 are two different isotopes of nitrogen because they differ in the number of what subatomic particle?

ANSWER: Neutron [RG]

BONUS

5) CHEMISTRY *Multiple Choice* Which of the following quantities does the average kinetic energy of a gas represent?

W) Enthalpy

X) Average velocity

Y) Temperature

Z) Entropy

ANSWER: Y) Temperature [RG]

TOSS-UP

6) MATH *Short Answer* Identify all of the following three statements which are true about prime numbers:

1) There are infinitely many;

2) In every set of 3 consecutive positive integers, at least one is not prime;

3) There are finitely many even primes.

ANSWER: All of them [RG]

BONUS

6) MATH *Short Answer* The second hand of a clock rotates at a distance of 3 centimeters from the center of the clock and completes a revolution in a minute. The minute hand of the same clock rotates at a distance of 4 centimeters from the center and completes a revolution in an hour. How long, in hours, must the minute hand rotate to rotate the same distance as the second hand rotated in an hour?

ANSWER: 45 [RG]

TOSS-UP

7) BIOLOGY *Short Answer* In a cell, exergonic reactions are primarily coupled to endergonic reactions by what high-energy intermediate, which stores energy in the bonds between its phosphate groups?

ANSWER: ATP (Accept: adenosine triphosphate) [EH]

BONUS

7) BIOLOGY *Multiple Choice* The inability for two species of snails to reproduce due to opposite facing shells is an example of what type of prezygotic barrier?

W) Behavioral isolation

X) Gametic isolation

Y) Mechanical isolation

Z) Temporal isolation

ANSWER: Y) Mechanical isolation [EH]

TOSS-UP

8) PHYSICS *Short Answer* A particle starts at rest and accelerates at a constant rate of 3 meters per second squared**.** After 4 seconds, how far did the particle travel?

ANSWER: 24 [RG]

BONUS

8) PHYSICS *Short Answer* An object with mass 10 kilograms is falling and experiencing a drag force of $7v^2$ in SI units where v is its velocity**.** As it falls for an indefinite amount of time, what will its terminal velocity be in meters per second, to the nearest integer?

ANSWER: 4 [RG]

TOSS-UP

9) EARTH AND SPACE *Short Answer* When winds create surface currents away from the shore, cold nutrient rich waters replace warmer surface waters**.** What phenomenon is occurring along the coast?

ANSWER: Upwelling [EH]

BONUS

9) EARTH AND SPACE *Short Answer* Ocean acidification occurs due to a series of reactions within the ocean, beginning when carbon dioxide diffuses into water and reacts to form what compound?

ANSWER: Carbonic acid [PB]

TOSS-UP

10) CHEMISTRY *Short Answer* Connor is given the amount of moles present of a compound. To find the total number of molecules of that compound, he needs to multiply the number of moles by what constant?

ANSWER: Avogadro's constant (Accept: Avogadro's number) [RG]

BONUS

10) CHEMISTRY *Short Answer* The Arrhenius definition of a base states that a base is a compound that dissociates to form what ion?

ANSWER: OH^- (Accept: hydroxide ions) [EH]

TOSS-UP

11) MATH *Multiple Choice* The probability of there being rain on a given day is 2/3. After a large number of days, expressing your answer as a fraction, what does the ratio of the number of days it did not rain to the number of days it did rain approach?

W) 1/3

X) 1/2

Y) 2/3

Z) 1

ANSWER: X) 1/2 [RG]

BONUS

11) MATH *Short Answer* At the store, Rohan finds five books that are each priced a positive integer number of dollars and no two books have the same cost. If the total cost of the books was 90 dollars, what is the largest possible value one of the books could cost?

ANSWER: 80 [RG]

TOSS-UP

12) BIOLOGY *Short Answer* Hershey and Chase determined nucleic acids as the genetic material by observing the replication cycle of what type of virus which only infects prokaryotes?

ANSWER: Bacteriophage (Accept: phage) [EH]

BONUS

12) BIOLOGY *Short Answer* A chimpanzee and a poison dart frog live in the same tropical rainforest. Identify all of the following three ecological groupings, which would be the same for both species:

1) Population;

2) Community;

3) Ecosystem.

ANSWER: 2 and 3 [EH]

TOSS-UP

13) PHYSICS *Short Answer* Identify all of the following 3 changes that would decrease the magnitude of the force between two charged particles:

1) Doubling the charge of one particle and doubling the distance between them;

2) Halving the charge of one particle and halving the distance between them;

3) Halving the charge of one particle and doubling the distance between them.

ANSWER: 1 and 3 [RG]

BONUS

13) PHYSICS *Multiple Choice* Aathma is boiling water in a pot. He notices that heat is being dissipated throughout the pot by moving water. Which of the following best describes the overall direction that warm and cold water move in his pot respectively?

W) Warm water sinks; cold water rises

X) Warm water sinks; cold water does not move

Y) Warm water rises; cold water sinks

Z) Warm water rises; cold water does not move

ANSWER: Y) Warm water rises; cold water sinks [RG]

TOSS-UP

14) EARTH AND SPACE *Short Answer* Order the following three planets from closest to farthest from the Kuiper belt on average:

1) Mars;

2) Neptune;

3) Saturn.

ANSWER: 2, 3 ,1 [EH]

BONUS

14) EARTH AND SPACE *Short Answer* Mercury has an extremely thin atmosphere largely because what stream of charged particles released from the Sun's corona blasted the atmosphere away?

ANSWER: Solar wind [EH]

TOSS-UP

15) CHEMISTRY *Short Answer* What is the name given to a solid formed when a solute dissolved in a solution cannot form any crystals and instead forms a powder?

ANSWER: Precipitate [RG]

BONUS

15) CHEMISTRY *Multiple Choice* Which of the following is not true about a catalyst in a reaction?

W) They decrease the activation energy of the reaction

X) They can speed up both the forward and reverse reactions

Y) They are consumed in the reaction

Z) They are referred to as enzymes when used in a biological context

ANSWER: Y) They are consumed in the reaction [RG]

TOSS-UP

16) MATH *Short Answer* Rohan has 3 colors of pants and 5 colors of shirts. In an outfit, he wears one pants and a shirt. If he doesn't want to wear the black pants and black shirt together, how many distinct outfits can he make?

ANSWER: 14 [RG]

BONUS

16) MATH *Multiple Choice* What is the sum of the number of edges, faces, and vertices in a pentagonal prism?

W) 29

X) 30

Y) 31

Z) 32

ANSWER: Z) 32 [RG]

TOSS-UP

17) BIOLOGY *Short Answer* Unlike angiosperms, which have their seeds enclosed in chambers, what group of plants have naked seeds usually contained in cones?

ANSWER: Gymnosperms [EH]

BONUS

17) BIOLOGY *Multiple Choice* If 100,000 joules of energy is available at the primary producer level, which of the following trophic levels will be represented by 1,000 joules of energy remaining?

W) Primary consumers

X) Secondary consumers

Y) Tertiary consumers

Z) Decomposers

ANSWER: X) Secondary consumers [EH]

TOSS-UP

18) PHYSICS *Short Answer* Two different fluids have the same density, speed, and characteristic length. However, the second fluid has a higher Reynold's number due to a difference in what quantity, which is a fluid's resistance to flow?

ANSWER: Viscosity (Accept: kinematic or dynamic viscosity) [RG]

BONUS

18) PHYSICS *Short Answer* A falling object has reached terminal velocity. Identify all of the following three quantities that decrease as the object continues to fall:

1) Acceleration;

2) Kinetic Energy;

3) Momentum.

ANSWER: None of them [RG]

TOSS-UP

19) EARTH AND SPACE *Short Answer* Certain asteroids never collide with planets because they lie in specific positions where the gravitational forces from the planet and the Sun balance each other out. What is the name of these set of points?

ANSWER: Lagrange points [GG]

BONUS

19) EARTH AND SPACE *Short Answer* Little to no carbon was produced in the early Big Bang because what fusion process was unable to occur effectively due to the incompatible pressure and temperature?

ANSWER: Triple alpha process [RA]

TOSS-UP

20) CHEMISTRY *Short Answer* Identify all of the following four states of matter that have definite volume:

1) Solid;

2) Liquid;

3) Gas;

4) Plasma.

ANSWER: 1 and 2 [EH]

BONUS

20) CHEMISTRY *Multiple Choice* Which of the following laws cannot be derived from the ideal gas law?

W) Boyle's Law

X) Henry's Law

Y) Charles's Law

Z) Gay-Lussac's Law

ANSWER: X) Henry's Law [RG]
