

ROUND 1

TOSS-UP

6) MATH Multiple Choice Which of the following best represents the conversion of the rectangular coordinates (3, 4) into polar coordinates?

W) (5, 370)

X) (370, 5)

Y) (5, 530)

Z) (530, 5)

ANSWER: Y) (5, 530)

BONUS

6) MATH Short Answer Evaluate $\int_0^1 \sqrt{3x^2 + 6x} \, dx$ [the integral from the square root of 2 to the 3 times the square root of 2 of the quantity 3 x squared plus 6 dx] in simplest radical form.

ANSWER:

TOSS-UP

15) PHYSICS Multiple Choice Which of the following particles has an electric charge of zero?

W) Electron

X) Quark

Y) Gluon

Z) Muon

ANSWER: Y) GLUON

BONUS

15) PHYSICS Short Answer A swimming pool water pump draws about 4.2 amperes when connected to 240 volts. If energy costs 10 cents per kilowatt hour, what is the bill to the nearest cent for running the pump continuously for 1 day?

ANSWER: \$2.42 (ACCEPT: 242 CENTS)

TOSS-UP

1) CHEMISTRY Multiple Choice Which of the following transition metals has the smallest atomic radius?

W) Nickel

X) Iron

Y) Scandium

Z) Cadmium

ANSWER: W) NICKEL

BONUS

1) CHEMISTRY Short Answer Consisting of a fatty acid chain attached through an amide linkage to sphingosine [SFING-guh-seen], what is the fundamental structural unit common to all sphingolipids?

ANSWER: CERAMIDE

TOSS-UP

16) MATH Multiple Choice If the surface area of a cube is 96 square units, which of the following is the length of a diagonal of a face of the cube?

W) 4

X) $4\sqrt{2}$

Y) $4\sqrt{3}$

Z) $16\sqrt{2}$

ANSWER: X) $4\sqrt{2}$

BONUS

16) MATH Short Answer Determine the largest possible real domain of $y = \sqrt{x-1}$ [y equals

the fraction with numerator the square root of the quantity x minus 1 and denominator the square root of the quantity x squared minus 1].

ANSWER: $x > 1$

TOSS-UP

17) CHEMISTRY Short Answer What element has the following four characteristics: 1) it occurs naturally only in combination with other elements in minerals; 2) it is used primarily as a hardening agent in alloys; 3) its dust is highly toxic, and 4) it is an alkaline [AL-kuh-lyn] earth metal.

ANSWER: BERYLLIUM

BONUS

17) CHEMISTRY Short Answer Identify all of the following four compounds that are ionic: 1) sodium sulfate, 2) methane, 3) ammonium chloride, 4) beryllium iodide.

ANSWER: 1 AND 3 (ACCEPT: SODIUM SULFATE AND AMMONIUM CHLORIDE)

TOSS-UP

13) BIOLOGY Short Answer Which gas was in short supply in the Earth's atmosphere prior to the evolution of the citric acid cycle?

ANSWER: OXYGEN

BONUS

13) BIOLOGY Multiple Choice Neurons can communicate with each another at synapses via synaptic vesicles. Which of the following does NOT participate in communication at these sites?

W) Neurotransmitter

X) Gated channels

Y) ATP dependent channels

Z) Acetylcholine [uh-seet-l-KOH-leen]

ANSWER: Y) ATP DEPENDENT CHANNELS

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TOSS-UP

23) CHEMISTRY Short Answer At -78° Celsius, dry ice changes directly from a solid to a gas.

What is this process called?

ANSWER: SUBLIMATION

BONUS

23) CHEMISTRY Multiple Choice Which of the following is the formula for n-Octadecanoic acid?

W) $C_6H_{12}O_6$

X) $C_{18}H_{36}COOH$

Y) $C_{17}H_{35}COOH$

Z) $C_{16}H_{32}COOH$

ANSWER: Y) $C_{17}H_{35}COOH$

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TOSS-UP

23) PHYSICS Multiple Choice An unpowered open truck is coasting horizontally with a constant velocity along a frictionless track underneath a grain bin when grain falls vertically into the truck, partly filling it as it moves along. Which of the following will happen to the horizontal momentum of the truck with the accumulating grain?

W) It will decrease

X) It will increase

Y) It will stay the same

Z) It will first increase and then decrease

ANSWER: Y) IT WILL STAY THE SAME

BONUS

23) PHYSICS Short Answer A mass is suspended by two springs of equal length connected in parallel. The mass stretches the springs by a distance A beyond their equilibrium length. The springs are rearranged to be connected in series, so that now the mass stretches the springs by a distance B beyond their equilibrium length. By number, identify which of the following is true:

1) A is greater than B, 2) A is less than B, 3) A and B are the same distance.

ANSWER: 2

TOSS-UP

13) BIOLOGY Multiple Choice Which of the following best describes blood?

W) It is a specialized type of cell found in blood vessels

X) It is a type of cell formed in the bone marrow

Y) It is a kind of connective tissue in which red and white blood cells are suspended in plasma

Z) It is a kind of epithelial tissue [ep-uh-THÉE-lee-al]

ANSWER: Y) IT IS A KIND OF CONNECTIVE TISSUE IN WHICH RED AND WHITE BLOOD CELLS ARE SUSPENDED IN PLASMA

BONUS

13) BIOLOGY Short Answer Valproic acid and trapoxin are inhibitors of what class of enzymes that regulate gene expression by altering chromatin accessibility?

ANSWER: HDAC (ACCEPT: HISTONE DEACETYLASES; DO NOT ACCEPT: HAT)

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23) PHYSICS Short Answer Three masses are arranged at the vertices of an equilateral triangle and are connected by springs along the edges of the equilateral triangle. How many normal modes for vibration does this mass-spring system have?

ANSWER: THREE

BONUS

23) PHYSICS Short Answer When a charged particle moves in a dielectric medium at a speed greater than the speed of light in that medium, what kind of radiation do the atoms in the medium emit?

ANSWER: CHERENKOV

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TOSS-UP

8) EARTH AND SPACE Short Answer The presence of what molecule causes temperatures to increase with increasing altitude in the stratosphere?

ANSWER: OZONE (ACCEPT: O₃)

BONUS

8) EARTH AND SPACE Multiple Choice At which of the following locations would an observer find the greatest force due to the Earth's gravity?

W) North Pole

X) Tropic of Cancer

Y) Tropic of Capricorn

Z) Equator

ANSWER: W) NORTH POLE

TOSS-UP

24) BIOLOGY Short Answer What is the common name of the unicellular organism that has the following characteristics: 1) it has chloroplasts and can make its own food; 2) it can also ingest food from its environment; 3) it usually lives in ponds or puddles; 4) it moves by a flagellum; 5) it has an eyespot that detects light.

ANSWER: EUGLENA

BONUS

24) BIOLOGY Multiple Choice The gram stain can be used to distinguish between different prokaryotes [proh-KAR-ee-ohts] based on which of the following?

W) Glucose metabolism

X) Flagella

Y) Lactose metabolism

Z) Cell wall morphology

ANSWER: Z) CELL WALL MORPHOLOGY

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ANSWER: $x > 1$

TOSS-UP

9) PHYSICS Multiple Choice An object of mass m sits on a flat table. The Earth pulls on the object with force mg . Which of the following is the corresponding reaction force?

- W) The table pushing down on the floor with force mg
- X) The object pushing down on the table with force mg
- Y) The object pulling upward on the Earth with force mg
- Z) The table pushing up on the object with force mg

ANSWER: Y) THE OBJECT PULLING UPWARD ON THE EARTH WITH FORCE mg

BONUS

9) PHYSICS Short Answer A projectile is fired from a gun at an angle of 45° with respect to the horizontal. Given 9.8 meters per second squared as the acceleration due to gravity, and neglecting air resistance, what are the magnitude and direction of the acceleration of the projectile when it reaches its maximum height?

ANSWER: 9.8 METERS PER SECOND SQUARED, DOWNWARD (ACCEPT: -9.8 METERS PER SECOND SQUARED)

TOSS-UP

16) MATH Short Answer If the graph of $y = (x - 2)^2 - 3$ [y equals open parenthesis x minus 2 close parenthesis squared minus three] is translated 5 units up and 2 units to the right, what is the vertex of the new parabola obtained?

ANSWER: (4, 2)

BONUS

16) MATH Short Answer Solve _____ for x in standard form.

ANSWER: _____ i

TOSS-UP

2) BIOLOGY Multiple Choice Which of the following is the mechanism of action of most insecticides?

- W) Blocking oxygen intake
- X) Disrupting nerve function
- Y) Preventing digestion
- Z) Stopping DNA synthesis

ANSWER: X) DISRUPTING NERVE FUNCTION

BONUS

2) BIOLOGY Short Answer What is the general name for integral membrane proteins that directly couple the energy of ATP hydrolysis to the movement of molecules against their concentration gradient?

ANSWER: PRIMARY ACTIVE TRANSPORTERS (ALSO ACCEPT: DIRECT ACTIVE TRANSPORT; DO NOT ACCEPT: ACTIVE TRANSPORTERS, SECONDARY ACTIVE TRANSPORTERS)

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