

ROUND 3

TOSS-UP

9) CHEMISTRY Multiple Choice Which of the following catabolic pathways liberates carbon dioxide?

W) Electron transport

X) Glycolysis [gly-KOL-uh-sis]

Y) Citric acid cycle

Z) Cori cycle

ANSWER: Y) CITRIC ACID CYCLE

BONUS

9) CHEMISTRY Short Answer If one mole of a substance with a molar mass of 20 is burned at constant pressure and 800 kilojoules of energy is released as heat, what is the standard enthalpy change, in kilojoules, when a 5-gram sample of this substance is burned at constant pressure?

ANSWER: -200 (MUST INCLUDE NEGATIVE SIGN IN ANSWER)

TOSS-UP

7) CHEMISTRY Short Answer In carbon dioxide, what is the formal charge on the central atom?

ANSWER: 0

BONUS

7) CHEMISTRY Multiple Choice Good nucleophiles [noo-kee-uh-FYLS], which promote substitution instead of elimination reactions, tend to be which of the following?

W) Weak bases

X) Strong bases

Y) Weak acids

Z) Strong acids

ANSWER: W) WEAK BASES

TOSS-UP

13) EARTH AND SPACE Multiple Choice Construction of habitable structures on the Moon hinges upon the discovery of which of the following vital resources on the Moon?

W) Carbon

X) Helium

Y) Water

Z) Iron

ANSWER: Y) WATER

BONUS

13) EARTH AND SPACE Multiple Choice The Sun's magnetic field, also called the interplanetary magnetic field, extends to at least which of the following?

W) 0.5 au

X) Neptune

Y) Pluto

Z) Asteroid belt

ANSWER: Y) PLUTO

TOSS-UP

23) PHYSICS Multiple Choice A wire of radius A carries a uniform current I . The total magnetic energy per unit length contained within the wire is which of the following?

W) Proportional to A^2

X) Proportional to A

Y) Independent of A

Z) Zero

ANSWER: Y) INDEPENDENT OF A

BONUS

23) PHYSICS Multiple Choice The period of a mass bouncing on a spring is measured in the reference frame of an observer as T . If the system were instead moving past the observer with a velocity of $0.8c$, which of the following is closest to the period she would observe?

W) $0.44T$

X) $0.6T$

Y) $1.7T$

Z) $1.9T$

ANSWER: Y) $1.7T$

TOSS-UP

4) MATH Multiple Choice Which of the following is equivalent to $\sin 24^\circ \cos 17^\circ + \cos 24^\circ \sin 17^\circ$ [sine of 24 degrees times cosine of 17 degrees plus cosine of 24 degrees times sine of 17 degrees]?

W) Sine of 7°

X) Cosine of 41°

Y) Sine of 41°

Z) Tangent of 41°

ANSWER: Y) SINE OF 41°

BONUS

4) MATH Short Answer Solve for x : $5 + \sqrt{x + 7} = x + 7$ [5 plus the square root of the quantity x plus 14 equals x plus 7].

ANSWER: 2 (DO NOT ACCEPT: -5)

TOSS-UP

15) PHYSICS Multiple Choice The root mean square voltage of a sinusoidal AC coupled circuit is approximately equal to its maximum value multiplied by which of the following?

W) 0.5

X) 0.7

Y) 1.4

Z) 1.7

ANSWER: X) 0.7

BONUS

15) PHYSICS Short Answer In one cycle, a heat engine exhausts 3000 joules of heat while performing 1500 joules of work. What is its percentage of efficiency to the tenths place?

ANSWER: 33.3%

TOSS-UP

20) MATH Short Answer In terms of a, b, c, and d, what is the slope of the line $3x + 2by = cd$?

ANSWER: $-\frac{3}{2b}$

BONUS

20) MATH Multiple Choice Which of the following points lies in the solution set for the system of two inequalities: $2y - x \geq -6$ and $2y - 3x < -6$?

W) (-4, -1)

X) (3, 1)

Y) (0, -3)

Z) (4, 3)

ANSWER: X) (3, 1)

TOSS-UP

20) MATH Short Answer Convert 420 degrees to radians as an improper fraction in terms of pi.

ANSWER: $7\pi/3$

BONUS

20) MATH Short Answer The midpoint of segment AB is (1.5, -3). The coordinates of point A are (7, -5); what are the coordinates of point B?

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TOSS-UP

20) EARTH AND SPACE Short Answer The North Star today is Polaris. In the time of the Babylonians, it was Thuban. What is the reason for this change?

ANSWER: PRECESSION OF THE EQUINOXES (ACCEPT: PRECESSION OR AXIAL PRECESSION)

BONUS

20) EARTH AND SPACE Short Answer What kind of telescope mount requires motion along only one axis to track a celestial object?

ANSWER: EQUATORIAL

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TOSS-UP

7) BIOLOGY Short Answer The fossil record of European black bears provides evidence of adaptive selection. In a population of black bears, identify the specific type of adaptive selection which would allow the average size of European black bears to increase after periods of glaciation but later decrease in size as interglacial periods warmed.

ANSWER: DIRECTIONAL (DO NOT ACCEPT: DIVERSIFYING)

BONUS

7) BIOLOGY Short Answer What is the common name of the large species of lizard found in Indonesia whose unusual size is attributed to island gigantism?

ANSWER: KOMODO DRAGON

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15) BIOLOGY Multiple Choice Which of the following statements best describes the thermodynamic effect of an enzyme on the reaction it catalyzes?

W) The energy level of the reactants is decreased in the presence of the enzyme

X) The activation energy of the reaction is decreased

Y) The activation energy of the reaction is increased

Z) The ΔG [delta-G] between products and reactants is decreased

ANSWER: X) THE ACTIVATION ENERGY OF THE REACTION IS DECREASED

BONUS

15) BIOLOGY Short Answer What recessive, life-threatening disorder affects the cells that produce mucus, sweat, and digestive juices, rendering secretions thick and sticky?

ANSWER: CYSTIC FIBROSIS (ALSO ACCEPT CF OR MUCOVISCIDOSIS)

TOSS-UP

2) BIOLOGY Multiple Choice During the process of protein synthesis, what is the function of the TATA box and on what type of nucleic acid is it found?

W) Where DNA replication begins, found on the DNA template

X) Where transcription begins, found on the DNA

Y) Where translation begins, found on the mRNA

Z) Where elongation begins, found on the tRNA

ANSWER: W) WHERE DNA REPLICATION BEGINS, FOUND ON THE DNA TEMPLATE

BONUS

2) BIOLOGY Short Answer By number, identify all of the following five choices that are effects of stimulation of the sympathetic divisions of the autonomic nervous systems: 1) constricts eye pupil; 2) relaxes bronchi [BRONG-kee]; 3) stimulates saliva secretion; 4) inhibits urination; 5) stimulates norepinephrine [nohr-ep-uh-NEF-rin] release.

ANSWER: 2, 4, 5

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TOSS-UP

5) CHEMISTRY Multiple Choice How many total atoms are contained within a body-centered orthorhombic [ohr-thuh-ROM-bik] unit cell?

W) 2

X) 3

Y) 4

Z) 6

ANSWER: W) 2

BONUS

5) CHEMISTRY Short In kilojoules per mole to the nearest whole number, what is the total bond energy for ethane, assuming that the carbon-hydrogen bond energy is 413 kilojoules per mole and the carbon-carbon bond energy is 348 kilojoules per mole?

ANSWER: 2826

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TOSS-UP

8) EARTH AND SPACE Multiple Choice Which of the following layers of the atmosphere allows AM radio stations to transmit over great distances at night?

W) Ionosphere [eye-ON-uh-sfeer]

X) Stratosphere

Y) Thermosphere

Z) Troposphere

ANSWER: W) IONOSPHERE

BONUS

8) EARTH AND SPACE Multiple Choice Which of the following steps in atoll formation is the most mature?

W) Erupting volcanic island

X) Lagoon

Y) Volcanic island with barrier reef

Z) Volcanic island with fringing reef

ANSWER: X) LAGOON

TOSS-UP

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ANSWER: $7 \frac{2}{3}$

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