

ROUND 6

TOSS-UP

16) ENERGY Multiple Choice Which of the following statements about coal is true?

W) Over 50% of the coal mined in the United States is bituminous [by-TOO-muh-nuhs]

X) Lignite [LIG-nyt] has the highest energy content of all coal varieties

Y) Anthracite [AN-thruh-syt] contains approximately 25% carbon

Z) Lignite has a very low moisture content

ANSWER: W) OVER 50% OF THE COAL MINED IN THE UNITED STATES IS BITUMINOUS

BONUS

16) ENERGY Short Answer The United States utilizes two different types of commercial nuclear power plants: BWRs and PWRs. What is the full term for which BWR is the abbreviation?

ANSWER: BOILING WATER REACTOR

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TOSS-UP

8) EARTH AND SPACE Short Answer Name the three quantities that can completely describe any black hole.

ANSWER: SPIN, MASS, CHARGE (ACCEPT: ANGULAR MOMENTUM OR ANGULAR VELOCITY INSTEAD OF SPIN)

BONUS

8) EARTH AND SPACE Multiple Choice Which of the following is the dominant cooling mechanism in a core-collapse supernova?

W) X-rays and gamma-rays

X) Synchrotron emission

Y) Neutrinos

Z) Electron evaporation

ANSWER: Y) NEUTRINOS

TOSS-UP

7) BIOLOGY Multiple Choice Which of the following is true of enzymes?

- W) They increase the activation energy of metabolic reactions
- X) They have active sites that bind to specific substrate molecules
- Y) They are made of chitin [KY-tin] protein
- Z) They generally act on a variety of substrate molecules

ANSWER: X) THEY HAVE ACTIVE SITES THAT BIND TO SPECIFIC SUBSTRATE MOLECULES

BONUS

7) BIOLOGY Multiple Choice Which of the following branches of science deals with study of the life and phenomena of inland standing waters, especially lakes and ponds?

- W) Limnology [lim-NOL-uh-jee]
- X) Hydrology
- Y) Ichthyology [ik-thee-OL-uh-jee]
- Z) Ecology

ANSWER: W) LIMNOLOGY

TOSS-UP

14) EARTH AND SPACE Multiple Choice The curve that the position of the Sun at noon traces on the sky over the course of a year most closely resembles which of the following?

- W) Line
- X) Figure 8
- Y) Ellipse
- Z) Circle

ANSWER: X) FIGURE 8

BONUS

14) EARTH AND SPACE Multiple Choice Which of the following should NEVER occur?

- W) Mercury at inferior conjunction
- X) Venus at opposition
- Y) Mars at eastern quadrature
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ANSWER: X) VENUS AT OPPOSITION

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ANSWER: W) LIMNOLOGY

TOSS-UP

6) ENERGY Short Answer What is the term for a device used to determine or measure the presence of electrostatic charges?

ANSWER: ELECTROSCOPE

BONUS

6) ENERGY Short Answer What is the efficiency of an appliance whose useful energy output is 5 joules and wasted energy is 20 joules?

ANSWER: 20%

TOSS-UP

2) BIOLOGY Short Answer In eukaryotic cells, the citric acid cycle takes place in what cellular organelle?

ANSWER: MITOCHONDRIA

BONUS

2) BIOLOGY Multiple Choice Which of the following is NOT characteristic of eudicots [yoo-DY-kots]?

W) Flower parts in multiples of 4 or 5

X) Taproot

Y) Two cotyledons [kot-l-EED-ns]

Z) Pollen granules with one opening

ANSWER: Z) POLLEN GRANULES WITH ONE OPENING

TOSS-UP

5) CHEMISTRY Multiple Choice Which of the following bonds is the longest in length?

- W) Fluorine-fluorine
- X) Chlorine-chlorine
- Y) Bromine-bromine
- Z) Iodine-iodine

ANSWER: Z) IODINE-IODINE

BONUS

5) CHEMISTRY Multiple Choice Ozonolysis [oh-zuh-NOL-uh-sis] cleaves which of the following?

- W) Carbon-carbon double bonds in alkenes [AL-keens]
- X) Carbon-carbon bonds in alkanes
- Y) Oxygen-oxygen bonds
- Z) Bonds between carbon and hydrogen

ANSWER: W) CARBON-CARBON DOUBLE BONDS IN ALKENES

TOSS-UP

24) MATH Multiple Choice The lines $y = (a - 5)x + 5$ [y equals open parentheses a minus 5 close parentheses x plus 5] and $y = -2x + 7$ are perpendicular if a equals which of the following?

- W) $-2/9$
- X) $9/2$
- Y) 5
- Z) $11/2$

ANSWER: Z) $11/2$

BONUS

24) MATH Short Answer For a function $f(x)$, suppose that you know that $f(-1) = -2$ and that $f(3) = 2$. What would you need to know about f in order to invoke the Intermediate Value Theorem to conclude that there is at least one zero of f on $[-1, 3]$ [the closed interval from negative 1 to 3]?

ANSWER: f IS CONTINUOUS ON $[-1, 3]$ (ACCEPT: f IS CONTINUOUS ON THE INTERVAL)

TOSS-UP

18) ENERGY Multiple Choice Rectifiers are used in computers and other appliances to do which of the following?

- W) Convert direct current to alternating current
- X) Convert alternating current to direct current
- Y) Provide a steady amount of power at all times
- Z) Reduce the energy consumption of an appliance

ANSWER: X) CONVERT ALTERNATING CURRENT TO DIRECT CURRENT

BONUS

18) ENERGY Short Answer When inductors are present in circuits with alternating currents, what type of power do they consume?

ANSWER: REACTIVE

TOSS-UP

17) PHYSICS Short Answer A person standing on a scaffold lowers an object with a weight of 250 newtons by means of a rope, at constant speed. If the weight of the rope is negligible, what is the force in newtons that the person exerts on the rope?

ANSWER: 250

BONUS

17) PHYSICS Short Answer Relative to the ground, how many joules of potential energy does a 1000 newton boulder have at the top of a 5 meter ledge, relative to the bottom of the ledge and given g as 10 meters per second squared?

ANSWER: 5000

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W) Ethyl acetate

X) Diethyl ether

Y) Acetic acid

Z) Acetic anhydride

ANSWER: Y) ACETIC ACID

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14) CHEMISTRY Multiple Choice Which of the following best explains the relative acidity of carboxylic acids?

W) Resonance-stabilized conjugate base

X) Long O-H bond length

Y) Polar covalent O-H bond

Z) sp²-hybridized carbonyl carbon

ANSWER: W) RESONANCE-STABILIZED CONJUGATE BASE

TOSS-UP

13) EARTH AND SPACE Multiple Choice Which of the following classes of stars does NOT have radiative zones?

W) A

X) G

Y) M

Z) O

ANSWER: Y) M

BONUS

13) EARTH AND SPACE Multiple Choice Under which of the following circumstances does ocean depth affect ocean wave motion?

W) When ocean depth falls below half the wavelength of a wave

X) When the ocean wave has a period exceeding 20 seconds

Y) When the ocean waves are impacted by tides

Z) When the ocean floor has high relief, regardless of the depth

ANSWER: W) WHEN OCEAN DEPTH FALLS BELOW HALF THE WAVELENGTH OF A WAVE

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Y) Horizontal

Z) Vertical

ANSWER: X) PERPENDICULAR

BONUS

16) MATH Short Answer Providing your answers as fractions in lowest terms, what are the x-intercepts of the graph of $y = 12x^2 - 5x - 2$?

ANSWER: $2/3$ AND $-1/4$

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5) PHYSICS Multiple Choice The acceleration of an object that is in free fall in a vacuum is which of the following?

W) Proportional to the mass of the object

X) Proportional to the inverse of the mass of the object

Y) Independent of the mass of the object

Z) Equal to the product of force and mass

ANSWER: Y) INDEPENDENT OF THE MASS OF THE OBJECT

BONUS

5) PHYSICS Short Answer What is the name of the phenomenon that explains why the surface of water might look like a mirror when viewed from underwater?

ANSWER: TOTAL INTERNAL REFLECTION (ACCEPT: REFRACTION PAST THE CRITICAL ANGLE)

TOSS-UP

6) EARTH AND SPACE Multiple Choice Which of the following is a sedimentary rock that forms as a result of precipitation during evaporation of seawater?

W) Conglomerate

X) Gypsum

Y) Basalt

Z) Shale

ANSWER: X) GYPSUM

BONUS

6) EARTH AND SPACE Multiple Choice The gemstones ruby and sapphire are a part of which of the following mineral groups?

W) Carbonates

X) Oxides

Y) Sulfates

Z) Silicates

ANSWER: X) OXIDES