

ROUND 8

TOSS-UP

20) ENERGY Multiple Choice What does it mean when a wind generator has a cut-in speed of 3 meters per second?

W) It won't produce any power unless the wind speed is lower than 3 meters per second

X) It will stop producing power at 3 meters per second to protect itself from breaking

Y) It will produce the maximum power at 3 meters per second

Z) It won't produce any power unless the wind speed is higher than 3 meters per second

ANSWER: Z) IT WON'T PRODUCE ANY POWER UNLESS THE WIND SPEED IS HIGHER THAN 3 METERS PER SECOND

BONUS

20) ENERGY Short Answer Nuclides, such as U-235 and Pu-239, are often used as fuel in light water nuclear reactors. These isotopes are considered both fissile and fissionable because they are capable of undergoing fission after capturing what type of neutrons?

ANSWER: THERMAL (ACCEPT: SLOW)

TOSS-UP

17) PHYSICS Multiple Choice Tripling the power output from a speaker emitting a single tone will result in an increase in sound intensity in decibels that is closest to which of the following?

W) 0.3

X) 2

Y) 4

Z) 5

ANSWER: Z) 5

BONUS

17) PHYSICS Short Answer When subjected to a potential difference of 100 volts, a parallel-plate capacitor builds up a charge on one plate of 0.2 coulombs. Providing your answer to the nearest thousandth, what is this capacitor's capacitance in farads?

ANSWER: 0.002

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-THEE-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)

TOSS-UP

22) MATH Short Answer What is the value of i^4 ?

ANSWER: 1

BONUS

22) MATH Multiple Choice The hyperbola with equation $\frac{y^2}{16} - \frac{x^2}{9} = 1$ possesses which of the following characteristics?

W) It opens left and right and has asymptotes $y = \frac{4}{3}x$ and $y = -\frac{4}{3}x$

X) It opens up and down and has asymptotes $y = \frac{4}{3}x$ and $y = -\frac{4}{3}x$

Y) It opens left and right and has asymptotes $y = \frac{3}{4}x$ and $y = -\frac{3}{4}x$

Z) It opens up and down and has asymptotes $y = \frac{3}{4}x$ and $y = -\frac{3}{4}x$

ANSWER: X) IT OPENS UP AND DOWN AND HAS ASYMPTOTES $y = \frac{4}{3}x$ AND $y = -\frac{4}{3}x$

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TOSS-UP

3) PHYSICS Multiple Choice If an ideal gas performs work on its surroundings, then which of the following must be true?

W) Its pressure increases

X) Its volume increases

Y) Its temperature increases

Z) Its internal energy decreases

ANSWER: X) ITS VOLUME INCREASES

BONUS

3) PHYSICS Multiple Choice A 90 kilogram fullback running north at 10 meters per second is tackled by a 120 kilogram linebacker running south at 4 meters per second in a perfectly inelastic collision. Which of the following is the velocity in meters per second of the players after the collision?

W) 3 south

X) 3 north

Y) 2 south

Z) 2 north

ANSWER: Z) 2 NORTH

TOSS-UP

16) EARTH AND SPACE Multiple Choice Which of the following is NOT necessary for a cloud to form?

- W) Saturated air
- X) Water vapor
- Y) High altitude
- Z) High humidity

ANSWER: Y) HIGH ALTITUDE

BONUS

16) EARTH AND SPACE Multiple Choice Which of the following is NOT a symptom of desertification?

- W) Lowering of the water table
- X) Decreased rate of erosion
- Y) Increased salinity in natural waters and soils
- Z) Progressive destruction of vegetation

ANSWER: X) DECREASED RATE OF EROSION

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

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

13) EARTH AND SPACE Multiple Choice Which of the following is the average approximate length of time in years between Earth's magnetic pole reversals?

W) 3

X) 300

Y) 3,000

Z) 300,000

ANSWER: Z) 300,000

BONUS

13) EARTH AND SPACE Short Answer What is the name given to the type of stream that flows only during wet periods?

ANSWER: INTERMITTENT (ACCEPT: EPHEMERAL)

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TOSS-UP

10) MATH Short Answer If each side of a rectangle is increased by 10%, by what percentage is its area increased?

ANSWER: 21 (ACCEPT: 21%)

BONUS

10) MATH Short Answer Express [the quantity 1 plus 2 i divided by the quantity 4 minus 5 i] in standard $a + bi$ form.

ANSWER: $-6/41 + (13/41)i$ [DO NOT ACCEPT: $(-6 + 13i)/41$]

TOSS-UP

15) CHEMISTRY Multiple Choice Ethylene [ETH-uh-leen] has which of the following?

W) 2 pi bonds

X) 2 sigma bonds and 1 pi bond

Y) 3 sigma bonds

Z) 5 sigma bonds and 1 pi bond

ANSWER: Z) 5 SIGMA BONDS AND 1 PI BOND

BONUS

15) CHEMISTRY Short Answer What is the electron-pair geometry for ICl_4^- - [eye C L 4 minus]?

ANSWER: OCTAHEDRAL

TOSS-UP

23) CHEMISTRY Short Answer At -78°C , 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) $\text{C}_6\text{H}_{12}\text{O}_6$

X) $\text{C}_{18}\text{H}_{36}\text{COOH}$

Y) $\text{C}_{17}\text{H}_{35}\text{COOH}$

Z) $\text{C}_{16}\text{H}_{32}\text{COOH}$

ANSWER: Y) $\text{C}_{17}\text{H}_{35}\text{COOH}$

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?

ANSWER: (-4, -1)

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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)

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TOSS-UP

20) ENERGY Short Answer What energy barrier must a chemical reaction pass in order to proceed?

ANSWER: ACTIVATION ENERGY

BONUS

20) ENERGY Short Answer One proposed geoengineering mechanism that could be used to mitigate increased atmospheric carbon dioxide levels is called iron seeding and involves spreading large quantities of iron over the surface of the ocean. What is the name of the organism that would grow as a result, leading to carbon sequestration [see-kwes-TRAY-shuhn]?

ANSWER: PLANKTON (ACCEPT: PHYTOPLANKTON)

TOSS-UP

7) BIOLOGY Short Answer What modified base in the anticodon's wobble position can base pair with uracil [YOOR-uh-sil], cytosine [SY-tuh-seen] or adenine [AD-n-eeen] in the third position of an mRNA codon?

ANSWER: INOSINE

BONUS

7) BIOLOGY Multiple Choice Kearns-Sayre Syndrome is caused by a mutation on a gene in the mitochondrial [my-tuh-KON-dree-uhl] DNA. Both males and females can have the disease, but the disease can only be transmitted to a child by the mother, never the father. Why is this so?

W) The gene is on the X chromosome, and females are XX

X) The sperm that fertilizes the egg contributes only its chromosomes and none of its mitochondria

Y) The mutant protein is only active in the egg, not the sperm

Z) The disease is sex-limited

ANSWER: X) THE SPERM THAT FERTILIZES THE EGG ONLY CONTRIBUTES ITS CHROMOSOMES AND NONE OF ITS MITOCHONDRIA

TOSS-UP

3) PHYSICS Multiple Choice The electron transitions responsible for the generation of light have durations on the order of 10^{-8} seconds. Which of the following best represents the natural linewidth in hertz of the resulting visible light?

W) 10^{-8}

X) 3

Y) 108

Z) 1016

ANSWER: Y) 108

BONUS

3) PHYSICS Multiple Choice Which of the following types of thermometer is based on the difference in the voltage induced by a temperature gradient in two metals?

W) Beckman

X) Silicon band gap

Y) Thermistor

Z) Thermocouple

ANSWER: Z) THERMOCOUPLE

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TOSS-UP

18) EARTH AND SPACE Multiple Choice Which of the following theories describes the random movement of small particles in the atmosphere?

W) Diffusion

X) Reynolds number

Y) Brownian motion

Z) Kinetic

ANSWER: Y) BROWNIAN MOTION

BONUS

18) EARTH AND SPACE Short Answer Igneous [IG-nee-uhs] rocks and magmas are classified into four main compositional groups: ultramafic, mafic, intermediate, and felsic, based on the content of what chemical compound?

ANSWER: SILICA