

Round 7

1. ENERGY

Toss Up: Multiple Choice

What is one advantage to geothermal energy?

W) Low cost

X) Can be built anywhere

Y) Doesn't produce any hazardous chemicals

Z) Will never run out of steam

Toss Up Answer: W

Bonus: Short Answer

In an internal combustion engine, what is the name of the device that ignites the fuel?

Bonus Answer: Spark plug

2. PHYSICS

Toss Up: Multiple Choice

A constant force acting on a body experiencing no change in its environment will give the body:

W) constant acceleration

X) constant speed

Y) constant velocity

Z) zero acceleration

Toss Up Answer: W

Bonus: Multiple Choice

What is the MOST common term for the inwardly directed force exerted on an object to keep the object moving in a circle?

W) Centripetal Acceleration

X) Friction

Y) Normal Force

Z) Centripetal Force

Bonus Answer: Z

3. CHEMISTRY

Toss Up: Multiple Choice

Most non-metals are

W) paramagnetic

X) ferromagnetic

Y) diamagnetic

Z) antiferromagnetic

Toss Up Answer: Y

Bonus: Short Answer

It is hard to find temperatures at which oils and fats boil because before they boil, they begin to break down. What is the name of this point?

Bonus Answer: Smoke Point

4. CHEMISTRY

Toss Up: Multiple Choice

Polystyrene is produced by which of the following reactions:

- W) free radical vinyl polymerization from the monomer styrene
- X) metallocene catalysis polymerization
- Y) graft copolymerization
- Z) butadiene polymerization

Toss Up Answer: W

Bonus: Short Answer

What general term describes a substance whose electrons are all spin-paired and that are weakly repelled by magnetic fields?

Bonus Answer: Diamagnetic

5. PHYSICS

Toss Up: Multiple Choice

Which of the following explains what happens when a negatively charged rod is held to the metal conductor of a leaf electroscope?

- W) The leaves close because electrons flow from the rod to the electroscope, resulting in a net negative charge in the electroscope.
- X) The leaves close because electrons flow from the electroscope to the rod, resulting in a net positive charge in the electroscope.
- Y) The leaves open because electrons flow from the rod to the electroscope, resulting in a net negative charge in the electroscope.
- Z) The leaves open because electrons flow from the electroscope to the rod, resulting in a net positive charge in the electroscope.

Toss Up Answer: Y

Bonus: Short Answer

A positive charge of +5.3 Coulombs is placed in an electric field of 420. Newtons per Coulomb. Find the magnitude of the force the charge experiences in this electric field, rounded to two significant figures.

Bonus Answer: 2200 N (Explanation: $F = E \cdot q$)

6. BIOLOGY

Toss Up: Multiple Choice

All of the following are examples of substances found in bacteria or archaea EXCEPT:

- W) peptidoglycan
- X) flagellin
- Y) chitin
- Z) phycobilin

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following groups of organisms lacks motility?

- W) Cellular slime molds
- X) Ciliates
- Y) Dinoflagellates
- Z) Apicomplexans

Bonus Answer: Z

7. CHEMISTRY

Toss Up: Short Answer

What principle states that an electron will occupy the lowest energy orbital that can receive it?

Bonus Answer: Aufbau Principle

Bonus: Short Answer

What is the name of the radioactive decay chain for uranium-235?

Bonus Answer: Actinium series or Plutonium cascade.

8. BIOLOGY

Toss Up: Multiple Choice

All of the following are examples of evolution EXCEPT:

- W) mutations in an individual
- X) changes in an allele frequency in a population
- Y) changes in an allele frequency in a species
- Z) adaptive radiation

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following generates the formation of adaptations?

- W) Genetic drift
- X) Mutations
- Y) Gene Flow
- Z) Natural Selection

Bonus Answer: Z

9. MATHEMATICS

Toss Up: Multiple Choice

Which of the following is not a group?

- W) the integers under multiplication
- X) the integers under addition
- Y) the symmetries of a regular n-gon
- Z) the permutations of integers between 1 and n

Toss Up Answer: W

Bonus: Short Answer

find the smallest positive solution to the following congruences.

x congruent to 3 mod 13

x congruent to 8 mod 11

Bonus Answer: x=107

Also accept: 107

10. CHEMISTRY

Toss Up: Short Answer

What material is used in a flame test to filter out light from yellow flames?

Bonus Answer: Cobalt glass (accept smalt or cobalt blue glass)

Bonus: Short Answer

What is the name for the effect that describes why under certain conditions, hot water will freeze faster than cold water?

Bonus Answer: The Mpemba effect

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11. PHYSICS

Toss Up: Short Answer

Which of the following units are a measure of magnetic field strength?

- 1 - Gauss
- 2 - Tesla
- 3 - Weber
- 4 - Henry

Bonus Answer: 1,2 (Gauss, Tesla)

Bonus: Multiple Choice

If the axle of a wheel is moving at a velocity of v , what is the instantaneous velocity of the top of the wheel?

- W) $-2v$
- X) 0
- Y) v
- Z) $2v$

Bonus Answer: Z

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12. CHEMISTRY

Toss Up: Multiple Choice

Which one of these metals doesn't produce a red flame in a flame test?

- W) Rubidium
- X) Strontium
- Y) Cesium
- Z) Lithium

Toss Up Answer: Y

Bonus: Short Answer

A solution contains some BaSO_4 at 25°C . It is found to contain 4×10^{-5} mole/liter of Ba^{2+} ions. What is the K_{sp} of the BaSO_4 in scientific notation?

Bonus Answer: 1.6×10^{-9}

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13. PHYSICS

Toss Up: Short Answer

What color is a mirror?

Bonus Answer: green

Bonus: Short Answer

Using $g = 10 \text{ m/s}^2$, given the weight of an object is 2700 Newtons, what is the mass of the object on the Moon, if its gravitational force is $1/6$ as strong as that on Earth? Round your answer to the first decimal place.

Bonus Answer: 270 kg

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14. EARTH and SPACE

Toss Up: Short Answer

Which planet in the solar system has the greatest albedo?

Bonus Answer: Venus

Bonus: Multiple Choice

What gas is most abundant in the troposphere of Venus?

- W) Carbon dioxide
- X) Nitrogen
- Y) Sulfur dioxide
- Z) Methane

Bonus Answer: W

15. CHEMISTRY

Toss Up: Multiple Choice

Which of the following molecules has a lewis structure that is a resonance hybrid?

- W) C₂H₆
- X) HBr
- Y) SO₂
- Z) CH₄

Toss Up Answer: Y

Bonus: Short Answer

What mass of HCL dissolved to make a 1 liter solution will give a PH of 1? Give your answer in grams rounded to the nearest hundredth.

Bonus Answer: 0.37

16. MATHEMATICS

Toss Up: Multiple Choice

MULTIPLE CHOICE: tossup

For an infinite sequence of numbers a_0, a_1, \dots , which of the following best describes the polynomial $P(x) = \sum_{i=0}^{\infty} a_i x^i$.

- W) Reimann-Zeta function
- X) Generating function
- Y) Newtonian series
- Z) Tchebychev polynomial

Toss Up Answer: X

Bonus: Short Answer

In the Pell equation $x^2 - 3y^2 = 1$ the smallest solution is $x=2$ and $y=1$. The next smallest solution is $x=7$ and $y=4$. Compute the third smallest solution.

Bonus Answer: $x=26, y=15$

Also accept (26,15)

17. BIOLOGY

Toss Up: Multiple Choice

Genetic variation can be introduced into bacteria by all of the following methods EXCEPT:

- W) transfer of DNA between bacteria through pili
- X) mutation
- Y) transformation

Z) DNA amplification

Toss Up Answer: Z

Bonus: Multiple Choice

An mRNA actively being translated in the cytoplasm would have all of the following EXCEPT:

- W) a poly-A tail
- X) a 5' (read as 5 prime) cap
- Y) exons
- Z) introns

Bonus Answer: Z

18. EARTH and SPACE

Toss Up: Short Answer

Order the following structures by descending concentration of stars:

1. Globular cluster
2. Arms of the Milky Way
3. Bulge of the Milky Way
4. Halo of the Milky Way

Bonus Answer: 1, 3, 2, 4

Bonus: Short Answer

What stellar Population is most common in globular clusters?

Bonus Answer: Population II (accept "2")

19. BIOLOGY

Toss Up: Multiple Choice

The inheritance of skin color in humans is an example of which of the following?

- W) pleiotropy
- X) codominance
- Y) epistasis
- Z) polygenic inheritance

Toss Up Answer: Z

Bonus: Multiple Choice

A human genetic defect that is caused by nondisjunction of the sex chromosomes is

- W) sickle-cell disease
- X) hemophilia
- Y) red-green color blindness
- Z) Turner syndrome

Bonus Answer: Z

20. MATHEMATICS

Toss Up: Short Answer

which of the following are true about the number and nature of the roots of the polynomial

$$x^3 - 29x^2 + 229x$$

- I. 0 is a root
- II. There must be a real, positive root
- III. There must be three real roots

Bonus Answer: I

Bonus: Short Answer

Solve the following linear system of equations in 3 variables:

$$2x + y + 4z = 9$$

$$-x + 2y + 5z = -11$$

$$5x + 3y + 3z = -4$$

Bonus Answer: $x=4, y=-11, z=3$

Also accept (4, -11, 3)

21. BIOLOGY

Toss Up: Multiple Choice

If a cell has 46 chromosomes at the beginning of mitosis, then at anaphase there would be a total of

- W) 23 chromatids
- X) 23 chromosomes
- Y) 46 chromosomes
- Z) 92 chromosomes

Toss Up Answer: Z

Bonus: Multiple Choice

All of the following statements are true EXCEPT:

- W) spindle fibers are composed largely of microtubules.
- X) centrioles consist of nine triplets of microtubules arranged in a circle.
- Y) all eukaryotic cells have centrioles
- Z) many of the microtubules in a spindle apparatus attach to kinetochores of chromosomes

Bonus Answer: Y

22. MATHEMATICS

Toss Up: Short Answer

In Triangle ABC the angle bisector of A intersects BC at D. Given $AB=9$, $AC=21$, and $DB=15$, compute DC.

Bonus Answer: 35

Bonus: Short Answer

In triangle ABC, $AB=14$, $AC=13$, and $BC=15$. Let the incenter be I. Compute CI in simplest radical form.

Bonus Answer: square root of 65

23. EARTH and SPACE

Toss Up: Multiple Choice

What is defined to be the distance from the Sun, to a body whose stellar parallax is one arcsecond?

- W) astronomical unit
- X) Schwarzschild radius
- Y) parsec

Z) light-second

Toss Up Answer: Y

Bonus: Multiple Choice

An amateur astronomer observes a star over the course of a year and finds that from January 1 to June 1, the star's position on the celestial sphere shifts by 3 arcseconds. How far is the star from the Earth, to the nearest tenth of a parsec?

- W) 3
- X) 0.3
- Y) 1.5
- Z) 0.7

Bonus Answer: Z

24. EARTH and SPACE

Toss Up: Short Answer

After reaching what mass can a white dwarf no longer remain stable?

Bonus Answer: The Chandrasekhar Limit

Bonus: Short Answer

What is the pressure that prevents the gravitational collapse of a stable white dwarf?

Bonus Answer: Electron degeneracy pressure

25. EARTH and SPACE

Toss Up: Multiple Choice

What is the name for the apparent line dividing night and day

- W) Seperator
- X) Day-Night Meridian
- Y) Terminator
- Z) Prime Meridian

Toss Up Answer: Y

Bonus: Short Answer

What Gas Giant emits the least amount of energy?

Bonus Answer: Uranus
