

Round 7

1. 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

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2. 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)

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3. ENERGY

Toss Up: Multiple Choice

Using current technologies, which of the following sources of energy is nonrenewable?

W) Geothermal

X) Wind

Y) Nuclear

Z) Solar

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following is NOT a fossil fuel?

W) Coal

X) Petroleum

Y) Natural gas

Z) Uranium

Bonus Answer: Z

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4. 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

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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

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5. 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

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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

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6. 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: $F = E \cdot q$)

7. 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

8. 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

9. MATHEMATICS

Toss Up: Multiple Choice

Compute $3C1+4C2+5C3+6C4+7C5$. [3 choose 1 + 4 choose 2 + 5 choose 3 + 6 choose 4 + 7 choose 5]

W) 55

X) 336

Y) 240

Z) 56

Toss Up Answer: W

Bonus: Short Answer

Compute the square root of 5476

Bonus Answer: 74

10. MATHEMATICS

Toss Up: Multiple Choice

Simplify $(\sin 15 \cos 75 - \cos 15 \sin 75) / (\cos 15 \cos 75 + \sin 15 \sin 75)$

W) negative square root of 3

X) 1/2

Y) $-1/2$

Z) square root 6 minus square root 2 all over 2

Toss Up Answer: W

Bonus: Short Answer

Compute $(2+2\sqrt{3}i)^6$. [2+2 times the square root of 3, i to the 6th power]

Bonus Answer: 4096

11. 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

12. 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

13. EARTH and SPACE

Toss Up: Multiple Choice

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

W) Separator

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

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14. 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)

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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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15. 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

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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

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16. 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

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17. BIOLOGY**Toss Up: Multiple Choice**

A product of noncyclic photophosphorylation is

- W) NADPH
- X) water
- Y) carbon dioxide
- Z) ADP

Toss Up Answer: W

Bonus: Multiple Choice

All of the following occur in cyclic photophosphorylation EXCEPT:

- W) Electrons move along an electron transport chain.
- X) Electrons in chlorophyll become excited.
- Y) ATP is produced.
- Z) NADPH is produced.

Bonus Answer: Z

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18. EARTH and SPACE**Toss Up: Short Answer**

What star has the greatest apparent magnitude

Bonus Answer: Sun

Bonus: Multiple Choice

What month can the constellation Orion be most prominent in the southern sky at about 10 pm from mid-northern latitudes

- W) February
- X) March
- Y) December
- Z) July

Bonus Answer: Y

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19. 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 $\frac{1}{6}$ as strong as that on Earth? Round your answer to the first decimal place.

Bonus Answer: 270 kg

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20. EARTH and SPACE

Toss Up: Short Answer

What planet has the most amount of solidified water in our solar system?

Bonus Answer: Earth

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Bonus: Short Answer

How about our solar system?

Bonus Answer: Jupiter

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21. EARTH and SPACE

Toss Up: Short Answer

The $29 \frac{1}{2}$ days it takes the Moon to complete an orbit around the Earth is called a

Bonus Answer: Synodic Month

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Bonus: Short Answer

The time between two successive meridian transits of the Sun as observed from a stationary spot on the Earth's surface is called

Bonus Answer: A day (a solar day)

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22. 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

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Bonus: Short Answer

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

Bonus Answer: Actinium series or Plutonium cascade.

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23. 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)

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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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24. 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 BaSO₄ at 25° C. It is found to contain 4×10^{-5} mole/liter of Ba²⁺ ions. What is the K_{sp} of the BaSO₄ in scientific notation?

Bonus Answer: 1.6×10^{-9}

25. 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
