

## Round 7

### 1. 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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### 2. 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**

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#### 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:  $F = E \cdot q$ )**

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### 3. 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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**4. PHYSICS**

**Toss Up: Short Answer**

What color is a mirror?

**Bonus Answer: green**

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**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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**5. 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**

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**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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**6. 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**

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**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**

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**7. 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**

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**Bonus: Short Answer**

Compute the square root of 5476

**Bonus Answer: 74**

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**8. 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**

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**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**

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**9. 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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**10. 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**

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**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**

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## 11. 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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## 12. 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**

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**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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### 13. BIOLOGY

#### Toss Up: Multiple Choice

A product of noncyclic photophosphorylation is

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

**Toss Up Answer: W**

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#### 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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### 14. CHEMISTRY

#### Toss Up: Multiple Choice

Most non-metals are

- W) paramagnetic
- X) ferromagnetic
- Y) diamagnetic
- Z) antiferromagnetic

**Toss Up Answer: Y**

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#### 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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### 15. 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**

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#### 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**

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### 16. 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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## 17. 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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## 18. 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**

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**Bonus: Short Answer**

A solution contains some  $\text{BaSO}_4$  at  $25^\circ \text{C}$ . It is found to contain  $4 \times 10^{-5}$  mole/liter of  $\text{Ba}^{2+}$  ions. What is the  $K_{sp}$  of the  $\text{BaSO}_4$  in scientific notation?

**Bonus Answer:  $1.6 \times 10^{-9}$**

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## 19. CHEMISTRY

**Toss Up: Multiple Choice**

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

W)  $\text{C}_2\text{H}_6$

X)  $\text{HBr}$

Y)  $\text{SO}_2$

Z)  $\text{CH}_4$

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What mass of  $\text{HCl}$  dissolved to make a 1 liter solution will give a  $\text{pH}$  of 1? Give your answer in grams rounded to the nearest hundredth.

**Bonus Answer: 0.37**

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## 20. EARTH and SPACE

**Toss Up: Short Answer**

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

**Bonus Answer: The Chandrasekhar Limit**

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**Bonus: Short Answer**

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

**Bonus Answer: Electron degeneracy pressure**

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**21. 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**

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**Bonus: Short Answer**

What Gas Giant emits the least amount of energy?

**Bonus Answer: Uranus**

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**22. EARTH and SPACE**

**Toss Up: Short Answer**

What star has the greatest apparent magnitude

**Bonus Answer: Sun**

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**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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**23. 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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**24. EARTH and SPACE**

**Toss Up: Short Answer**

The 29 ½ 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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## 25. 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**

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### 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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