

## Round 3

### 1. CHEMISTRY

#### Toss Up: Multiple Choice

The number of degrees of freedom of a triatomic molecule is:

- W) 1
- X) 3
- Y) 6
- Z) 9

**Toss Up Answer: Z**

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#### Bonus: Short Answer

The internal energy of an ideal gas depends on which of the following: temperature, pressure, volume.

**Bonus Answer: Temperature**

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### 2. CHEMISTRY

#### Toss Up: Multiple Choice

If the molecules in a tank of hydrogen have the same rms speed as the molecules in a tank of oxygen, we may be sure that:

- W) the pressures are the same
- X) the hydrogen is at the greater pressure
- Y) the temperatures are the same
- Z) the oxygen is at the higher temperature

**Toss Up Answer: Z**

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#### Bonus: Multiple Choice

The number of degrees of freedom of a rigid diatomic molecule is

- W) 2
- X) 3
- Y) 4
- Z) 5

**Bonus Answer: Z**

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### 3. BIOLOGY

#### Toss Up: Multiple Choice

Two bones that have prominent epicondyles are the...

- W) radius and ulna
- X) femur and humerus
- Y) femur and scapula
- Z) tibia and radius

**Toss Up Answer: X**

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#### Bonus: Multiple Choice

The radial notch is found on the..

- W) ulna
- X) radius
- Y) carpals
- Z) humerus

**Bonus Answer: W**

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## **4. PHYSICS**

### **Toss Up: Multiple Choice**

A transverse traveling sinusoidal wave on a string has a frequency of 100Hz, a wavelength of 0.040m, and an amplitude of 2.0mm. The maximum velocity in m/s of any point on the string is

- W) 0.2
- X) 1.3
- Y) 4
- Z) 15

**Toss Up Answer: X**

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### **Bonus: Multiple Choice**

The time required for a small pulse to travel from A to B on a stretched cord shown is NOT altered by changing

- W) the linear mass density of the cord
- X) the length between A and B
- Y) the shape of the pulse
- Z) the tension in the cord

**Bonus Answer: Y**

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## **5. CHEMISTRY**

### **Toss Up: Multiple Choice**

An adiabatic process for an ideal gas is represented on a p-V diagram by:

- W) a horizontal line
- X) a vertical line
- Y) a hyperbola
- Z) none of these

**Toss Up Answer: Z**

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### **Bonus: Multiple Choice**

Evidence that molecules of a gas are in constant motion is:

- W) winds exert pressure
- X) two gases interdiffuse quickly
- Y) warm air rises
- Z) gases are easily compressed

**Bonus Answer: X**

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## **6. ENERGY**

### **Toss Up: Multiple Choice**

Oil, coal, and natural gas supply what percent of energy used in the US?

- W) 10
- X) 35
- Y) 55
- Z) 90

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

A permeable rock that contains hydrocarbon fluids and gasses is called:

- W) An oil trap
- X) A source bed
- Y) An oil reservoir
- Z) An oil pocket

**Bonus Answer: Y**

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## 7. PHYSICS

**Toss Up: Multiple Choice**

Find the angular frequency of oscillations in a LC circuit if the total inductance is 2 henry and the total capacitance is 8 farad.

- W)  $1/4$
- X)  $1/2$
- Y)  $1/3$
- Z)  $1/5$

**Toss Up Answer: W**

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**Bonus: Short Answer**

An LC circuit has an inductance of 20mH and a capacitance of 5.0  $\mu\text{F}$ . At time

$t = 0$  the charge on the capacitor is 3.0  $\mu\text{C}$  and the current is 7.0mA. The total energy in joules is:

**Bonus Answer:  $9.0 \times 10^{-7}$  (accept equivalent forms)**

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## 8. PHYSICS

**Toss Up: Short Answer**

A certain heat engine draws 500 cal/s from a water bath at  $27^\circ \text{C}$  and transfers 400 cal/s to a reservoir at a lower temperature. The efficiency of this engine is:

**Bonus Answer: 20%**

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**Bonus: Multiple Choice**

An Carnot refrigerator runs between a cold reservoir at temperature  $T_C$  and a hot reservoir at temperature  $T_H$ . You want to increase its coefficient of performance. Of the following, which change results in the greatest increase in the coefficient? The value of  $\Delta T$  is the same for all changes.

- W) Raise the temperature of the hot reservoir by  $\Delta T$
- X) Raise the temperature of the cold reservoir by  $\Delta T$
- Y) Lower the temperature of the hot reservoir by  $1/2 \Delta T$  and raise the temperature of the cold reservoir by  $1/2 \Delta T$
- Z) Lower the temperature of the cold reservoir by  $\Delta T$

**Bonus Answer: X**

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## 9. EARTH and SPACE

**Toss Up: Multiple Choice**

The time between two successive passages of the Sun across a given meridian is called a

- W) civil day
- X) conventional day
- Y) mean solar day
- Z) solar day

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the time from when a star crosses an observers meridian until the same star next crosses the observer's meridian called?

**Bonus Answer: sidereal day**

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## **10. EARTH and SPACE**

**Toss Up: Multiple Choice**

The best evidence of Earth's nearly spherical shape is obtained through

- W) telescopic observations of other planets
- X) photographs of Earth from an orbiting satellite
- Y) observations of the Sun's altitude made during the day
- Z) observations of the Moon made during solar eclipses

**Toss Up Answer: X**

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**Bonus: Short Answer**

Earth's spherical shape "bulges" very slightly at the Equator and is very slightly "flattened" at the poles. What is this shape called?

**Bonus Answer: oblate spheroid**

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## **11. BIOLOGY**

**Toss Up: Multiple Choice**

The part of the scapula that articulates with the humerus is the...

- W) acromion process.
- X) glenoid fossa.
- Y) infraspinous fossa.
- Z) supraspinous fossa.

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

The clavicle articulates with what two bones?

- W) scapula and sternum
- X) humerus and vertebra
- Y) humerus and sternum
- Z) scapula and vertebra

**Bonus Answer: W**

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## **12. MATHEMATICS**

**Toss Up: Short Answer**

What is the 3rd merenne prime?

**Bonus Answer: 31**

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**Bonus: Multiple Choice**

How many terms does the 15th integral of  $\sin x \, dx$  have?

- W) 1
- X) 2
- Y) 15

Z) 16

**Bonus Answer: Z**

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### 13. CHEMISTRY

#### Toss Up: Multiple Choice

Which of the following is not a reason for the use of nitrogen in many explosives?

- W) these explosives form gases, which expand
- X) the bond between two nitrogen atoms is very strong
- Y) these explosives form toxic compounds such as cyanide
- Z) nitrogen is widely available

**Toss Up Answer: Y**

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#### Bonus: Multiple Choice

Which of the following is closest to the bond angle in ammonia?

- W) 120 degrees
- X) 109.5 degrees
- Y) 107 degrees
- Z) 100 degrees

**Bonus Answer: Y**

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### 14. MATHEMATICS

#### Toss Up: Multiple Choice

Given two attempts, what is the probability of getting a multiple choice question correct, if there are 5 choices?

- W) 1:3
- X) 1:4
- Y) 2:3
- Z) 2:4

**Toss Up Answer: Y**

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#### Bonus: Multiple Choice

What percentage of data falls within 2 standard deviations of the mean, assuming a normal distribution?

- W) 34.10%
- X) 47.70%
- Y) 68.20%
- Z) 95.40%

**Bonus Answer: Z**

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### 15. BIOLOGY

#### Toss Up: Multiple Choice

In the sacrum, the landmark that separates the abdominal cavity from the pelvic cavity is the...

- W) alae
- X) median sacral crest
- Y) sacral promontory
- Z) sacral foramina

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Of the 12 pairs of ribs, how many pair(s) is/are vertebrochondral?

- W) 7
- X) 5
- Y) 3
- Z) 6

**Bonus Answer: Y**

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## 16. MATHEMATICS

**Toss Up: Short Answer**

What is the relationship between the surface area and the volume of a sphere?

**Bonus Answer: The surface area is the derivative of the volume/ the volume is the integral of the surface area when the constant is 0**

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**Bonus: Multiple Choice**

When the inner diagonal of a cube is 7 times root 3 inches, what is the surface area of the cube?

- W) 216 square inches
- X) 294 square inches
- Y) 343 square inches
- Z) 512 square inches

**Bonus Answer: X**

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## 17. MATHEMATICS

**Toss Up: Short Answer**

What is  $(1000! + 999!)/(998!)$ ?

**Bonus Answer: 999,999**

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**Bonus: Short Answer**

What is the first number with 5 distinct prime factors?

**Bonus Answer: 2,310**

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## 18. PHYSICS

**Toss Up: Multiple Choice**

Which of the following is NOT a state variable?

- W) Work
- X) Heat
- Y) Entropy
- Z) Pressure

**Toss Up Answer: W**

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**Bonus: Short Answer**

During an isobaric process, 80 joules of work is done on the surroundings by the gas. How much energy is added in joules?

**Bonus Answer: 200 joules**

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## 19. EARTH and SPACE

**Toss Up: Multiple Choice**

Which observation provides the best evidence that Earth rotates?

- W) The position of the planets among the stars changes during the year.
- X) The location of the constellations in relationship to Polaris changes from month to month.
- Y) The length of the shadow cast by a flagpole at noontime changes from season to season.
- Z) The direction of swing of a freely swinging pendulum changes during the day.

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Earth's axis of rotation is tilted twenty three and a half degrees from a line perpendicular to the plane of its orbit. What would be the result if the tilt was increased to thirty three and a half degrees?

- W) an increase in the amount of solar radiation received by Earth.
- X) colder winters and warmer summers in New York State
- Y) less difference between winter and summer temperatures in New York State
- Z) shorter days and longer nights at the Equator

**Bonus Answer: X**

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**20. BIOLOGY**

**Toss Up: Multiple Choice**

The internal gelatinous portion of the intervertebral disk is called the...

- W) nucleus pulposus
- X) pedicle
- Y) inferior articular process
- Z) annulus fibrosus

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

The region of the vertebral column that is most susceptible to herniated disks is the...

- W) cervical region
- X) sacral region
- Y) lumbar region
- Z) coccygeal region

**Bonus Answer: Y**

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**21. BIOLOGY**

**Toss Up: Multiple Choice**

The openings between vertebrae through which spinal nerves exit from the spinal cord are...

- W) transverse foramina
- X) intervertebral foramina
- Y) vertebral foramina
- Z) spinal foramina

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

The vertebral arch...

- W) consists of two laminae and two pedicles
- X) is anterior to the body of the vertebra
- Y) is the passageway for the vertebral arteries
- Z) is present only in the cervical vertebrae

**Bonus Answer: W**

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## 22. EARTH and SPACE

**Toss Up: Multiple Choice**

Earth is farthest from the Sun during the Northern Hemisphere's summer, and Earth is closest to the Sun during the Northern Hemisphere's winter. During which season in the Northern Hemisphere is Earth's orbital velocity greatest?

- W) Winter
- X) Spring
- Y) Summer
- Z) Fall

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Which information about a nearby star must be known to determine its distance from an observer?

- W) size
- X) color
- Y) temperature
- Z) parallax

**Bonus Answer: Z**

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## 23. CHEMISTRY

**Toss Up: Multiple Choice**

Which of the following is more soluble in ethanol than in water?

- W) I<sub>2</sub>
- X) HCl
- Y) AgNO<sub>3</sub>
- Z) NH<sub>3</sub>

**Toss Up Answer: W**

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**Bonus: Short Answer**

Reactions of which order are typically associated with catalysts?

**Bonus Answer: zeroth**

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## 24. CHEMISTRY

**Toss Up: Multiple Choice**

Which one of the following has the greatest tendency to lose an electron?

- W) Zn
- X) Cl<sup>-</sup>
- Y) Br<sub>2</sub>
- Z) A mixture of PbSO<sub>4</sub> and H<sub>2</sub>O

**Toss Up Answer: W**

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**Bonus: Short Answer**



The wavelength of yellow light is 600 nanometers. What is the wavelength in centimeters: (use scientific notation

**Bonus Answer:**  $6.0 \times 10^{-5}$

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## 25. EARTH and SPACE

**Toss Up: Short Answer**

What month does earth's perihelion occur in?

**Bonus Answer:** January

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**Bonus: Multiple Choice**

What is the name of the supercontinent that formed about 600 million years ago, just before Pangaea?

W) Pannotia

X) Ur

Y) Laurentia

Z) Columbia

**Bonus Answer:** W

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