

## Round 3

### 1. 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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### 2. 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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### 3. PHYSICS

#### Toss Up: Short Answer

A certain heat engine draws 500 cal/s from a water bath at 27° 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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#### 4. 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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#### 5. MATHEMATICS

Toss Up: Short Answer

What shape is  $X^2+1$

Bonus Answer: parabola

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Bonus: Short Answer

what type of function is  $x+2x$

Bonus Answer: a line

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#### 6. MATHEMATICS

Toss Up: Multiple Choice

What is the slope intercept in the equation  $y = 4x + 3 - 2$

W) 3

X) 1

Y) -2

Z) 2

Toss Up Answer: X

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Bonus: Multiple Choice

If  $3x - y = 12$ , what is  $(8^x) / (2^y)$

W)  $2^{12}$

X)  $4^4$

Y)  $8^3$

Z) Cannot be determined

Bonus Answer: W

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#### 7. MATHEMATICS

Toss Up: Short Answer

What is the 3rd mercentne 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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**8. 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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**9. BIOLOGY****Toss Up: Multiple Choice**

The depression on the coxa where the head of the femur articulates is the...

- W) acetabulum
- X) auricular surface
- Y) iliac crest
- Z) ischial tuberosity

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

The bumps that a person sits on are their...

- W) acetabulums
- X) auricular surfaces
- Y) pubic symphyses
- Z) ischial tuberosities

**Bonus Answer: Z**

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**10. 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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**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. 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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### 13. 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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### 14. 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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### 15. 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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## 16. 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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## 17. 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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## 18. 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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## 19. 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 X 10<sup>-5</sup>**

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## 20. EARTH and SPACE

**Toss Up: Multiple Choice**

Which of the following statements best describes the difference between a galaxy and a nebula?

W) A galaxy consists of stars; a nebula consists of dust and gas.

X) There are two types of nebula, but only one type of galaxy.

Y) A galaxy always emits light; a nebula never emits light.

Z) A galaxy consists of matter; a nebular consists of energy.

**Toss Up Answer: W**

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**Bonus: Short Answer**

What is the plot of luminosity versus surface temperature for stars, discovered independently by two astronomers, called?

**Bonus Answer: Hertzsprung-Russell Diagram (H-R diagram)**

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## 21. EARTH and SPACE

**Toss Up: Multiple Choice**

Which instrument is used to study the composition of stars?

W) sextant

X) spectroscope

Y) seismograph

Z) chronometer

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

An observer viewing the sky through a telescope sees a fuzzy, glowing region in the constellation Orion. The region has an irregular shape, and some stars seem to be shining through it. The observer is most likely viewing a

W) planet

X) comet

Y) meteor

Z) nebula

**Bonus Answer: Z**

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## 22. EARTH and SPACE

**Toss Up: Multiple Choice**

Which observation provides the best evidence that Earth revolves around the Sun?

- W) Stars seen from Earth appear to circle Polaris
- X) Earth's planetary winds are deflected by the Coriolis effect
- Y) The change from high ocean tide to low ocean tide is a repeating pattern
- Z) Different star constellations are seen from Earth at different times of the year.

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the twenty nine and a half day month, from one new Moon phase until the next, called?

**Bonus Answer: synodic month**

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## 23. 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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## 24. 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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## 25. ENERGY

**Toss Up: Multiple Choice**

The world has the least amount of which of the following fuel types?

- W) oil
- X) coal



Y) uranium

Z) there are about the same amount of each of these

**Toss Up Answer: W**

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**Bonus: Short Answer**

What region of the world holds the majority of already discovered oil fields?

**Bonus Answer: The Middle East**

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