

## Round 27

### 1. PHYSICS

#### Toss Up: Multiple Choice

An object oscillates with equation  $x = 2\cos(5\pi t)$  (READ AS: x equals 2 times cosine of open parentheses 5 PI times t close parentheses). What is the frequency of the oscillation?

- W) 0.5
- X) 1
- Y) 2.5
- Z) 4

Toss Up Answer: Y

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#### Bonus: Multiple Choice

An LC circuit consists of a 5 henry inductor and a 20 farad capacitor connected to a battery in a series circuit. What is the frequency of the oscillation of the current in the circuit?

- W)  $0.05/\pi$  (0.05/PI)
- X)  $0.1/\pi$  (0.1/PI)
- Y)  $2/\pi$  (2/PI)
- Z)  $3/\pi$  (3/PI)

Bonus Answer: W

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### 2. EARTH and SPACE

#### Toss Up: Multiple Choice

How are rocks sorted in water erosion?

- W) Sorted, rounded, smooth
- X) Not sorted, rounded, smooth
- Y) Not sorted, not rounded, smooth
- Z) Not sorted, not rounded, not smooth

Toss Up Answer: W

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#### Bonus: Short Answer

U shaped valleys are made by what type of agent of erosion?

Bonus Answer: Glaciers.

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### 3. BIOLOGY

#### Toss Up: Short Answer

The flow of what ion allows ATP synthase to synthesize ATP?

Bonus Answer: H<sup>+</sup>, hydrogen ion, proton

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#### Bonus: Short Answer

Which cellular structures oxygen to oxidize complex molecules to produce a by-product of hydrogen peroxide?

Bonus Answer: Peroxisome

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### 4. CHEMISTRY

#### Toss Up: Short Answer

What is the last element of the periodic table to occur naturally on Earth?

Bonus Answer: Plutonium, element 94

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Bonus: Short Answer

Which element is most abundant in the entire Earth?

**Bonus Answer:** Iron (do not accept Oxygen, that's just the crust)

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## 5. MATHEMATICS

**Toss Up: Short Answer**

Given a rectangular box with side lengths of 5, 5, and 5, what is the surface area of the box?

**Bonus Answer:** 150 units squared (ACCEPT: 150)

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**Bonus: Multiple Choice**

The length, in inches, of a box is 3 inches less than twice its width, in inches. Which of the following gives the length, L inches, in terms of the width, W inches, of the box?

W)  $L = .5W + 3$

X)  $L = W - 3$

Y)  $L = 2W + 3$

Z)  $L = 2W - 3$

**Bonus Answer:** Z

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## 6. CHEMISTRY

**Toss Up: Short Answer**

Using noble gas abbreviation, what is the electron configuration of a silver atom?

**Bonus Answer:** [Kr]  $4d^{10} 5s^1$

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**Bonus: Short Answer**

What is the most electropositive element in group 1A?

**Bonus Answer:** Francium

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## 7. MATHEMATICS

**Toss Up: Short Answer**

What is the probability of rolling a even number on an 8 sided die labeled 1 through 8?

**Bonus Answer:**  $1/2$

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**Bonus: Short Answer**

What is the probability of rolling an even number on an 8 sided die labeled 1 through 8 and rolling an odd number on a 7 sided die labeled 1 through 7 in simplest fractional form?

**Bonus Answer:**  $2/7$

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## 8. PHYSICS

**Toss Up: Short Answer**

An electron travels 45 degrees north of east in a magnetic field which points 45 degrees west of north. In what direction does the magnetic force acting on the electron points?

**Bonus Answer:** Down

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**Bonus: Short Answer**

A 2C charge travels through a magnetic field  $B = 6i + 15j + 9k$  with velocity  $v = 2i + 5j + 3k$ . What is the magnetic force acting on the charge?

**Bonus Answer:** 0

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## 9. EARTH and SPACE

**Toss Up: Multiple Choice**

Given the following choices chose the one that best presents the layers of the earth's atmosphere from lowest to highest altitude.

- W) Thermosphere, Mesosphere, Stratosphere, Troposphere
- X) Mesosphere, Thermosphere, Stratosphere, Troposphere
- Y) Troposphere, Stratosphere, Mesosphere, Thermosphere
- Z) Stratosphere, Troposphere, Thermosphere, Mesosphere

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

There are various different particle sizes when dealing with sediments. What is the approximate particle size range of sand?

- W) 2 - 4 mm
- X) 1/16 - 2 mm
- Y) 1/256 - 1/16 mm
- Z) 4 - 64 mm

**Bonus Answer: X**

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## 10. MATHEMATICS

**Toss Up: Multiple Choice**

What trigonometric ratio is equal to  $1/2$ ?

- W)  $\sin 60$
- X)  $\sin 30$
- Y)  $\cos 30$
- Z)  $\sin 30$  degrees

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the probability of rolling a 1 on 3 die rolls?

**Bonus Answer: 1/216**

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## 11. PHYSICS

**Toss Up: Multiple Choice**

A 5 kg ball is ejected from a spring and it rolls 8m up a frictionless incline at 30 degrees before coming to a stop. Assuming that  $g = 10 \text{ m/s}^2$  (READ AS 10 meters per second squared) and that the spring constant is 100N/m, how far does the spring has to be compressed initially?

- W) 1m
- X) 2m
- Y) 4m
- Z) 6m

**Toss Up Answer: X**

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**Bonus: Short Answer**

The potential energy of a 1kg particle is represented by  $U(x,y,z) = 2xy + 3z^2$  (READ AS: U of x, y, z equals 2xy plus 3 z squared). What is the magnitude of the force acting on the particle at position (0,4,1)?

**Bonus Answer: 10 N**

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## 12. BIOLOGY

**Toss Up: Short Answer**

What type of tissue are the urinary bladder comprised of?

**Bonus Answer: Transitional epithelium**

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**Bonus: Short Answer**

The walls of the heart consist of three layers. What is the middle layer called, which is also the main layer that allows the heart's muscular contractions?

**Bonus Answer: Myocardium**

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### 13. PHYSICS

**Toss Up: Short Answer**

An octave is a music interval of what ratio of frequency?

**Bonus Answer: 2:1**

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**Bonus: Short Answer**

From 440 Hertz to what Hertz would be one octave?

**Bonus Answer: 880 Hertz**

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### 14. MATHEMATICS

**Toss Up: Short Answer**

By words or number, name all of the following 3 statements that are TRUE for the function,  $f(x) = -3x^2 - 2x - 2 = 0$ :

- 1) there are no real zeros
- 2) the graph is a parabola opening downward
- 3) the graph has no x-intercepts

**Bonus Answer: All or 1,2,3**

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**Bonus: Short Answer**

Factor the following expression completely over integers:  $x^4 - 16$

**Bonus Answer:  $(x - 2)(x + 2)(x^2 + 4)$**

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### 15. EARTH and SPACE

**Toss Up: Multiple Choice**

Which of the following is the mantle thought to be made up of?

- W) coal
- X) peridotite
- Y) granite
- Z) conglomerate

**Toss Up Answer: X**

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**Bonus: Short Answer**

In hours and minutes, how long will it take for the tidal pattern to change from high tide to low tide and back to high tide?

**Bonus Answer: 24 hours 50 minutes**

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### 16. CHEMISTRY

**Toss Up: Short Answer**

A stable suspension of fine particles in a liquid is called a:

**Bonus Answer: colloid**

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**Bonus: Multiple Choice**

Which of the following compounds is used as a fuel additive in what is commonly known as "dry gas" by solubilizing water to reduce its contamination in gasoline?

W) isooctane

X) glycerol

Y) MTBE

Z) isopropyl alcohol

**Bonus Answer: Z**

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## 17. BIOLOGY

**Toss Up: Short Answer**

What types of macromolecules to lipase break down?

**Bonus Answer: Lipids**

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**Bonus: Short Answer**

What lobe of the brain is associated with vision?

**Bonus Answer: Occipital Lobe**

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## 18. CHEMISTRY

**Toss Up: Short Answer**

What term describes the process when a solid phase changes directly to the gas phase?

**Bonus Answer: Sublimation**

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**Bonus: Short Answer**

The angle between any two boron-hydrogen bonds in a boron trihydride molecule is how many degrees?

**Bonus Answer: 120 degrees**

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## 19. PHYSICS

**Toss Up: Short Answer**

Which greek letter is used to denote shear stress?

**Bonus Answer: tao**

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**Bonus: Short Answer**

Which greek letter is sued to denote coefficient of viscosity?

**Bonus Answer: mu**

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## 20. CHEMISTRY

**Toss Up: Short Answer**

List the following atoms in order of increasing electronegativity: flourine, chlorine, and bromine

**Bonus Answer: Flourine**

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**Bonus: Short Answer**

Which element has the highest electronegativity?

**Bonus Answer: Flourine**

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## 21. BIOLOGY

**Toss Up: Short Answer**

What muscle of the respiratory system regulates primarily regulates breathing?

**Bonus Answer: Diaphragm**

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**Bonus: Short Answer**

What protein catalyzes the reaction of carbon dioxide with water to form bicarbonate ion and hydrogen ion?

**Bonus Answer: Carbonic anhydrase**

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**22. BIOLOGY**

**Toss Up: Multiple Choice**

Theodore Engelmann performed a famous experiment with filamentous algae and aerobic bacteria. What was he trying to find out about photosynthesis?

- W) action spectrum
- X) absorption spectrum
- Y) electromagnetic spectrum
- Z) spectrophotometric range

**Toss Up Answer: W**

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**Bonus: Short Answer**

What metallic atom is at the center of the light-absorbing head of a chlorophyll molecule?

**Bonus Answer: Magnesium**

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**23. BIOLOGY**

**Toss Up: Short Answer**

What is the process of electrons being shuttled between Photosystem I and the cytochrome complex called?

**Bonus Answer: cyclic electron flow**

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**Bonus: Multiple Choice**

In linear electron flow during the light reactions, electrons shuttled by Plastocyanin reduce what molecule?

- W) P700
- X) P680
- Y) Plastoquinone
- Z) Ferredoxin

**Bonus Answer: W**

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**24. BIOLOGY**

**Toss Up: Multiple Choice**

Which of these is not an abiotic factor that influences climate?

- W) Sunlight
- X) Precipitation
- Y) Wind
- Z) Bodies of water

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What type of population distribution characterizes human populations?

**Bonus Answer: Clumped distribution (Accept clumped)**

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**25. BIOLOGY**

**Toss Up: Short Answer**

What individual cell structure comprises polysomes?

**Bonus Answer: Ribosome**

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**Bonus: Short Answer**

What is the complementary RNA for [read slowly] CAGGGTAC?

**Bonus Answer: GUCCCAUG**

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