

## Round 43

### 1. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

An electric vehicle has two stages. If the first stage, the battery, has an efficiency of 90% and the second stage, the inverter, has an efficiency of 80%, calculate the approximate overall efficiency of the vehicle.

Bonus Answer: 72%

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Bonus: Multiple Choice

Which of the following is congruent to  $(n + 1)$  modulus  $n$ ?

W) 0

X) 1

Y)  $n-1$

Z)  $n-2$

Bonus Answer: W

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### 2. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

In the SI system of measure, what is the unit of capacitance?

Bonus Answer: FARAD

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Bonus: Short Answer

How much work in joules is done by friction on a sled weighing 100 newtons during a 10 meter displacement? The coefficient of sliding friction is 0.1.

Bonus Answer: 100

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### 3. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

For the hydrogen atom, which series describes electron transitions to the  $N=1$  orbit, the lowest energy electron orbit?

Bonus Answer: Lyman series

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Bonus: Short Answer

Electric current may be expressed in which one of the following units?

Bonus Answer: coulombs/second

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### 4. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

Radiocarbon is produced in the atmosphere as a result of?

W) collision between fast neutrons and nitrogen nuclei present in the atmosphere

X) action of ultraviolet light from the sun on atmospheric oxygen

Y) action of solar radiations particularly cosmic rays on carbon dioxide present in the atmosphere

Z) lightning discharge in atmosphere

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Nuclear sizes are expressed in a unit named

- W) Fermi
- X) angstrom
- Y) newton
- Z) Tesla

**Bonus Answer: W**

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## 5. PHYSICS

**Writer: Raafiul Hossain**

**Toss Up: Multiple Choice**

The graphs of the two equations  $y = ax^2 + bx + c$  and  $y = Ax^2 + Bx + C$ , such that  $a$  and  $A$  have different signs and that the quantities  $b^2 - 4ac$  and  $B^2 - 4AC$  are both negative,

- W) 1 intersections
- X) 2 intersections
- Y) None
- Z) I do not know

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

For  $x$  greater than or equal to zero and less than or equal to  $2\pi$ ,  $\sin x$  and  $\cos x$  are both decreasing on the intervals

- W)  $(0, \pi/2)$
- X)  $(\pi/2, \pi)$
- Y)  $(\pi, 3\pi/2)$
- Z)  $(3\pi/2, 2\pi)$

**Bonus Answer: X**

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## 6. MATHEMATICS

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

What is the height of an equilateral triangle with side length 4?

- W) 8
- X) 4
- Y)  $2\sqrt{3}$
- Z)  $4\sqrt{3}$

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What is the area of an isosceles right triangle with hypotenuse  $10\sqrt{2}$ ?

**Bonus Answer: 50**

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## 7. MATHEMATICS

**Writer: Ivan Zhang**

**Toss Up: Short Answer**

What number is a factor of  $y^3 + 10y^2 + 123y + 5$ ?

**Bonus Answer:** 1, -1

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**Bonus: Short Answer**

What is the area of an equilateral triangle inscribed in a circle with a radius of 6?

**Bonus Answer:**  $(27\sqrt{3})$

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**8. MATHEMATICS**

**Writer:** Ashneel Das

**Toss Up: Short Answer**

How many non empty subsets are there of the set  $\{1, 2, 6, 9\}$ ?

**Bonus Answer:** 15

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**Bonus: Short Answer**

What are the roots of  $x^4 - 5x^2 + 4$ ?

**Bonus Answer:** 1, -1, 4, -4

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**9. BIOLOGY**

**Writer:** Ivan Zhang

**Toss Up: Multiple Choice**

Which of the following is not an anabolic steroid?

W) Fenestrane

X) Stanozolol

Y) Fortesta

Z) Deca-Durabolin

**Toss Up Answer:** W

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**Bonus: Short Answer**

Which scientist became known as the founder of molecular biology due to their discovery of the spiral structure of proteins?

**Bonus Answer:** Linus Pauling

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**10. BIOLOGY**

**Writer:** Ivan Zhang

**Toss Up: Multiple Choice**

Which of the following conditions causes an autoimmune response to eating glucose?

W) Anaplasmosis

X) Anisakiasis

Y) celiac disease

Z) Candidiasis

**Toss Up Answer:** Y

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**Bonus: Multiple Choice**

What is colony collapse disorder characterized by?

W) The disappearance of many male worker bees

X) The death of the queen bee

Y) The destruction of the honey produced by bees

Z) The destruction of the structure of a bee hive

**Bonus Answer: W**

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## **11. BIOLOGY**

**Writer: Ivan Zhang**

**Toss Up: Multiple Choice**

Which of the following is the most common organic compound on Earth?

- W) chitin
- X) glucose
- Y) phospholipids
- Z) cellulose

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which of the following syndrome occurs in women born with only 1 X chromosome?

- W) Marfan Syndrome
- X) Turner Syndrome
- Y) Prader-Willi syndrome
- Z) Porphyria

**Bonus Answer: X**

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## **12. BIOLOGY**

**Writer: Ivan Zhang**

**Toss Up: Multiple Choice**

Which gland releases the antidiuretic hormone?

- W) pituitary
- X) hypothalamus
- Y) pancreas
- Z) testes

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Which part of the heart functions as a pacemaker?

- W) AV node
- X) S node
- Y) SA node
- Z) SA pacemaker

**Bonus Answer: Y**

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## **13. BIOLOGY**

**Writer: Ivan Zhang**

**Toss Up: Multiple Choice**

Which of the following correctly states the composition of blood?

- W) 45 % RBC, 55% Plasma
- X) 65 % RBC, 25% Plasma
- Y) 85 % RBC, 15% Plasma

Z) 35% RBC, 65% Plasma

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

What is the function of basophils?

- W) to engulf pathogens through phagocytosis
- X) to stimulate inflammation by releasing histamine
- Y) to kill RBCs
- Z) to remove pathogens from RBCs

**Bonus Answer: X**

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## 14. BIOLOGY

**Writer: Aaron Gee**

**Toss Up: Short Answer**

Nitrogenous base that occurs in RNA but not in DNA?

**Bonus Answer: Uracil**

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**Bonus: Short Answer**

Which of the following correctly explains how a favorable genetic trait can increase in frequency in a population?

**Bonus Answer: Natural Selection**

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## 15. BIOLOGY

**Writer: Jason Mohabir**

**Toss Up: Short Answer**

Nitrogen fixation refers to the direct conversion of atmospheric nitrogen gas into:

**Bonus Answer: ammonia**

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**Bonus: Short Answer**

The transformation of nitrates to gaseous nitrogen is accomplished by microorganisms in a series of biochemical reactions. The process is known as:

**Bonus Answer: denitrification**

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## 16. BIOLOGY

**Writer: Jason Mohabir**

**Toss Up: Multiple Choice**

Pine, fir, spruce, cedar, larch and cypress are the famous timber-yielding plants. All these belong to:

- W) angiosperms
- X) gymnosperms
- Y) monocotyledons
- Z) dicotyledons

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

The population of algae in soil is [blank] that of either bacteria or fungi.

- W) generally smaller than
- X) generally greater than

- Y) equal to  
Z) none of these

**Bonus Answer: W**

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## 17. BIOLOGY

**Writer: Jason Mohabir**

**Toss Up: Multiple Choice**

Which of the following is true regarding anthrax:

- W) Anthrax is caused by a virus  
X) Anthrax is highly contagious  
Y) Inhalation anthrax and cutaneous anthrax are caused by separate strains of *Bacillus anthracis*  
Z) Inhalation Anthrax requires infection with a large number of spores

**Toss Up Answer: Z**

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**Bonus: Short Answer**

Give the binomial nomenclature of the pathogen that causes anthrax:

**Bonus Answer: *Bacillus anthracis***

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## 18. CHEMISTRY

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

Which of the following has the highest electronegativity?

- W) Francium  
X) Carbon  
Y) Fluorine  
Z) Oxygen

**Toss Up Answer: Y**

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**Bonus: Short Answer**

How many times faster does hydrogen diffuse through a hole than oxygen?

**Bonus Answer: 4**

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## 19. CHEMISTRY

**Writer: Jason Mohabir**

**Toss Up: Multiple Choice**

The H–C–O bond angle in H<sub>2</sub>C=O (formaldehyde) is approximately:

- W) 90  
X) 109  
Y) 120  
Z) 180

**Toss Up Answer: Y**

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**Bonus: Short Answer**

In which compound does carbon have the highest oxidation state?

1. CH<sub>4</sub>
2. HCN
3. H<sub>2</sub>CO
4. CH<sub>2</sub>Cl<sub>2</sub>

**Bonus Answer: 2. HCN**

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## 20. CHEMISTRY

Writer: Jason Mohabir

Toss Up: Multiple Choice

How many electrons occupy the bonding molecular orbitals of a CN triple bond?

- W) 2
- X) 4
- Y) 6
- Z) 8

Toss Up Answer: Y

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Bonus: Multiple Choice

Which of the following compounds would have the highest boiling point?

- W) CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>CH<sub>3</sub>
- X) CH<sub>3</sub>NH<sub>2</sub>
- Y) CH<sub>2</sub>F<sub>2</sub>
- Z) CH<sub>3</sub>OH

Bonus Answer: Z

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## 21. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

What type of bond is formed between two atoms with an electronegativity difference of 1.0?

- W) Polar Covalent
- X) Nonpolar Covalent
- Y) Ionic
- Z) Hydrogen

Toss Up Answer: W

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Bonus: Short Answer

Of the following, which increase with atomic number in group 5 of the periodic table? 1) Atomic Radius 2) Atomic mass 3) First Ionization Energy

Bonus Answer: 1 and 2

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## 22. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

How many carbon atoms and hydrogen atoms are present in one molecule of hexane?

- W) 6 hydrogen, 14 carbon
- X) 6 carbon, 14 hydrogen
- Y) 6 carbon, 12 hydrogen
- Z) 6 carbon, 10 hydrogen

Toss Up Answer: X

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Bonus: Short Answer

Identify which of the following statements about carbon dioxide are true: 1) It has a molar mass of approximately 44 g/mol 2) It is a polar molecule 3) It has two double bonds

Bonus Answer: 1 and 3

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## 23. EARTH and SPACE

**Writer:** Jessica Titensky

**Toss Up:** Multiple Choice

What is the closest star to earth

W) Sirius

X) Betelgeuse

Y) Alpha proxima

Z) The sun

**Toss Up Answer:** Z

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**Bonus:** Short Answer

What is the closest star to the sun

**Bonus Answer:** Proxima centauri

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## 24. EARTH and SPACE

**Writer:** Andrew Chen (Senior)

**Toss Up:** Multiple Choice

Sedimentary rocks are formed from accumulation of different sediments. What is the term for a rock made by living organisms or composed of materials from life forms?

W) Conglomerate

X) Evaporites

Y) Crystalline

Z) Bioclastic

**Toss Up Answer:** Z

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**Bonus:** Short Answer

Give the following classifications for these sedimentary rocks, breccia, conglomerate, and shale.

**Bonus Answer:** All Clastic sedimentary rocks.

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## 25. EARTH and SPACE

**Writer:** Andrew Chen (Senior)

**Toss Up:** Multiple Choice

Glaciers effect the land through glacial erosion. Different geographies are formed but what is the specific name of the long narrow ridges that show where the glacier was once present?

W) Glacial retreat

X) Drumlins

Y) Glacial erotics

Z) Morianes

**Toss Up Answer:** Z

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**Bonus:** Short Answer

Ice sheets and glaciers expanded to cover large areas of land during the last major glacial epoch. During which time period did this take place?

**Bonus Answer:** Quaternary

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