

## Round 19

### 1. CHEMISTRY

Writer: Seiji Yawata

Toss Up: Multiple Choice

The last electron of lanthanum enters in the:

- W) d orbital
- X) s orbital
- Y) p orbital
- Z) f orbital

Toss Up Answer: W

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Bonus: Multiple Choice

Which of the following is true for B<sub>3</sub>N<sub>3</sub>H<sub>6</sub>

- W) Its name is Nitroborane
- X) All the atoms are sp-hybridised
- Y) It has 3 lone pairs of electrons
- Z) It is isostructural with benzene

Bonus Answer: Z

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### 2. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of these is not a viral disease?

- W) Dutch elm disease
- X) Yellow fever
- Y) Mumps
- Z) Rubella

Toss Up Answer: W

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Bonus: Short Answer

In which viral reproductive cycle is the viral DNA incorporated into the host DNA?

Bonus Answer: Lysogenic

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### 3. EARTH and SPACE

Writer: Prangon Ghose

Toss Up: Short Answer

What is the name of the largest volcanic mountain on Mars?

Bonus Answer: Olympus Mons

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Bonus: Short Answer

Which spacial event marks the beginning of spring in the Northern Hemisphere

Bonus Answer: Vernal Equinox (Accept: Spring Equinox)

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### 4. BIOLOGY

Writer: Siam Muquit

Toss Up: Short Answer

What does the Shannon Index quantify?

Bonus Answer: Biodiversity of a community (accept similar responses)

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**Bonus: Short Answer**

What would be the Simpson's Index value for a population with infinite biodiversity?

**Bonus Answer: 0**

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**5. EARTH and SPACE**

**Writer: Yevgeniy Gorbachev**

**Toss Up: Short Answer**

What is the most geologically active object in the solar system and why?

**Bonus Answer: Io, because of tidal forces from Jupiter, Europa, Ganymede, and Callisto.**

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**Bonus: Short Answer**

What is Io's surface primarily composed of?

**Bonus Answer: Silicates and sulfur compounds.**

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**6. CHEMISTRY**

**Writer: Seiji Yawata**

**Toss Up: Multiple Choice**

Which of the following is the most acidic?

W) o-methoxy benzoic acid

X) benzoic acid

Y) m-methoxy benzoic acid

Z) p-methoxy benzoic acid

**Toss Up Answer: W**

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**Bonus: Short Answer**

What is the equivalent weight of HNO<sub>3</sub> in the reaction: Cu reacts with HNO<sub>3</sub>, forming Cu(NO<sub>3</sub>)<sub>2</sub>, NO and water.

**Bonus Answer: 84**

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**7. PHYSICS**

**Writer: William Xiang**

**Toss Up: Multiple Choice**

A standard 1-kg mass is attached to a compressed spring and the spring is released. If the mass initially has an acceleration of 5.6m/s<sup>2</sup>, the force of the spring has a magnitude of:

W) 0N

X) 2.8N

Y) 5.6N

Z) 11.2N

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

A 42-kg man stands in an elevator that has a downward acceleration of 3.4m/s<sup>2</sup>. The force exerted by him on the floor is about:

W) 12N

X) 270N

Y) 340N

Z) 412N

**Bonus Answer: X**

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## 8. MATHEMATICS

**Writer:** Calvin Aw

**Toss Up:** Short Answer

Compute the number of diagonals in a convex 30-sided polygon.

**Bonus Answer:** 435

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**Bonus:** Short Answer

Find the number of way 30 people can shake hands if each person shakes hands with everyone else, excluding themselves.

**Bonus Answer:** 435

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## 9. PHYSICS

**Writer:** Shantanu Jha

**Toss Up:** Multiple Choice

What Irish physicist, living from 1805-1865, made important contributions to classical mechanics optics and algebra?

W) William Parsons

X) William Hamilton

Y) Francis Beaufort

Z) George Boole

**Toss Up Answer:** X

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**Bonus:** Multiple Choice

What is generated by a Van de Graff generator?

W) Static Charge

X) Current

Y) Nuclear Decay

Z) Radiation

**Bonus Answer:** W

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## 10. EARTH and SPACE

**Writer:** Mohammed Haque

**Toss Up:** Multiple Choice

How many moons does Neptune have?

W) 22

X) 34

Y) 14

Z) 12

**Toss Up Answer:** Y

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**Bonus:** Multiple Choice

What is Saturn's atmosphere mostly composed of?

W) Helium

X) Ammonia

Y) Hydrogen

Z) Carbon

Bonus Answer: Y

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## 11. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What fuel is mostly used in a nuclear power-generation station?

Bonus Answer: Uranium-235 (Do not accept: Uranium or Uranium-238)

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Bonus: Multiple Choice

Dark energy and dark matter comprise approximately how much of the known universe?

W) 50%

X) 75%

Y) 95%

Z) 99%

Bonus Answer: Y

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## 12. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

In interval notation, find the domain of  $\frac{1}{\sqrt{x^2+5x+4}} \geq 0$  (1 over the square root of  $x^2+5x+4$  is greater than or equal to 0.)

Bonus Answer:  $(-\infty, -4) \cup (-1, \infty)$

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Bonus: Short Answer

If  $x^2+7x-5=0$ , find  $(\sqrt{1} + \sqrt{2})^2$

Bonus Answer: 49

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## 13. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What is the magnitude of the magnetic force on a point charge with a charge of 1 Coulomb and velocity of 2 meters per second traveling perpendicular to a magnetic field of 2 Tesla?

W) -1 Newtons

X) -2 Newtons

Y) 2 Newtons

Z) 4 Newtons

Toss Up Answer: Z

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Bonus: Short Answer

What is the name of the force that is the combination of electric and magnetic force on a point charge due to electromagnetic fields?

Bonus Answer: Lorentz Force

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## 14. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

Which of the following the derivative with the highest degree?

W)  $X^2$  (x squared)

X) 20

Y) 104

Z) 3x

**Toss Up Answer: W**

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**Bonus: Short Answer**

Find  $y' = dy/dx$  for  $x^3 + y^3 = 4$ . (x cubed + y cubed)

**Bonus Answer:  $-x^2/y^2$**  (negative x squared over y squared)

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## 15. PHYSICS

**Writer: Shantanu Jha**

**Toss Up: Multiple Choice**

What German physicist developed the 2nd law of thermodynamics, showing that the universe's entropy always increases?

W) Wilhelm Röntgen

X) Rudolf Clausius

Y) Wilhelm Weber

Z) Hermann von Helmholtz

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

What German physicist, who died in 1855, formulated separate electrostatic and electrodynamical laws?

W) James Clerk Maxwell

X) Johann Gauss

Y) Frederick Beck

Z) Max von Laue

**Bonus Answer: X**

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## 16. MATHEMATICS

**Writer: Yevgeniy Gorbachev**

**Toss Up: Short Answer**

What is the integral from 1 to 4 of  $4x^3$ ?

**Bonus Answer: 255**

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**Bonus: Multiple Choice**

What is  $d/dx \tan x / \sec x$ , in simplest form?

W)  $\sec^2 x - \tan x$

X)  $\sec^2 x - \tan^2 x$

Y)  $\sec^3 x - \tan^2 x \sec x$

Z)  $(\sec x - \tan x)^2$

**Bonus Answer: X**

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## 17. BIOLOGY

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Bottom-heavy age structure diagrams are characteristic of populations in:

W) Developed countries

X) Developing countries

- Y) Stable populations  
Z) Populations with high numbers of elderly

**Toss Up Answer: X**

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**Bonus: Short Answer**

What is the expression for doubling time of a population given that it grows at constant annual rate of  $r\%$ ?

**Bonus Answer:  $70/r$**

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**18. CHEMISTRY**

**Writer: Seiji Yawata**

**Toss Up: Multiple Choice**

Which of the following compounds does not exist?

- W)  $\text{PF}_5$   
X)  $\text{P}_4\text{O}_{10}$   
Y)  $\text{P}_4\text{O}_6$   
Z)  $\text{PH}_5$

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Order the following hydrogen halides from the one with the lowest boiling point to one with the highest: HI, HCl, HBr, HF

**Bonus Answer: HCl, HBr, HI, HF (2, 3, 1, 4)**

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**19. BIOLOGY**

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Nitrifying bacteria convert

- W) Atmospheric Nitrogen to Ammonia  
X) Ammonia to Nitrite  
Y) Nitrite to Nitrate  
Z) Nitrate to Nitrite

**Toss Up Answer: X**

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**Bonus: Short Answer**

What is the shape of the curve of a population growing in ideal conditions?

**Bonus Answer: J-curve**

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**20. CHEMISTRY**

**Writer: Olivia Gallager**

**Toss Up: Multiple Choice**

Which of the following has a coordinate covalent bond?

- W) butanol  
X)  $\text{CO}_2$   
Y) Methane  
Z)  $\text{NH}_4^+$

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the formal charge of Nitrogen in an ammonia molecule?

**Bonus Answer: 0**

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## 21. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of these is not characteristic of an r-selecting species?

- W) Small physical size
- X) Short life span
- Y) Parental care
- Z) Variable and unpredictable mortality

Toss Up Answer: Y

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Bonus: Short Answer

For each of the following, state whether it is an r-strategist or k-strategist: Oyster, Garden weeds, Desert flowers, Humans

Bonus Answer: Oyster: r-strategist; Garden weeds: r-strategist; Desert flowers: r-strategist; Humans: k-strategist

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## 22. CHEMISTRY

Writer: Banpreet Singh

Toss Up: Short Answer

At what temperature Kelvin does water freeze?

Bonus Answer: 273 K

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Bonus: Short Answer

Who came up with the caloric theory?

Bonus Answer: Antoine Lavoisier

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## 23. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

HIV is an example of which type of shape of virus?

- W) Spiral
- X) Polyhedral
- Y) Spherical
- Z) Complex

Toss Up Answer: Z

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Bonus: Short Answer

Which of the following types of virus is HIV associated with? Type IV, Type V, Type VI

Bonus Answer: Type VI only (3 only)

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## 24. BIOLOGY

Writer: Ahmad Alnasser

Toss Up: Short Answer

In marine sponges, intracellular digestion of peptides is usually immediately preceded by

Bonus Answer: Endocytosis

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Bonus: Short Answer

The large surface area in the gut directly facilitates

Bonus Answer: Absorption

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## 25. BIOLOGY

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

Which of the following choices would most likely promote random distribution?

- W) flocking and schooling behaviors
- X) homogeneous chemical and physical factors in the environment
- Y) spacing during the breeding season
- Z) territorial species

Toss Up Answer: X

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Bonus: Multiple Choice

The Allee effect is used to describe a population that

- W) has become so large that it will have difficulty surviving and reproducing.
- X) has exceeded its carrying capacity.
- Y) has become so small that it will have difficulty surviving and reproducing.
- Z) Is in crash decline

Bonus Answer: Y

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