

## Round 19

### 1. 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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### 2. 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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### 3. 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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### 4. 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  $\text{HNO}_3$  in the reaction: Cu reacts with  $\text{HNO}_3$ , forming  $\text{Cu}(\text{NO}_3)_2$ , NO and water.

**Bonus Answer: 84**

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## 5. 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  $5.6\text{m/s}^2$ , 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  $3.4\text{m/s}^2$ . 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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## 6. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

In interval notation, find the domain of  $1/\sqrt{x^2+5x+4} \geq 0$  (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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## 7. 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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## 8. 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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## 9. 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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## 10. 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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## 11. CHEMISTRY

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following compounds does not exist?

W) PF<sub>5</sub>

X) P<sub>4</sub>O<sub>10</sub>

Y) P<sub>4</sub>O<sub>6</sub>

Z) PH<sub>5</sub>

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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## 12. 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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## 13. 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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## 14. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Which of the following has a coordinate covalent bond?

W) butanol

X) CO<sub>2</sub>

Y) Methane

Z) NH<sub>4</sub><sup>+</sup>

**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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## 15. 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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## 16. 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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## 17. 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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## **18. 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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## **19. 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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## **20. 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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## **21. 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) Amonia
- Y) Hydrogen
- Z) Carbon

**Bonus Answer: Y**

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**22. 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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**23. 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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**24. 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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## **25. 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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