

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

Bonus: Multiple Choice

Which of the following is true for B₃N₃H₆

- 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

2. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Certain amino acids are considered essential in an animal's diet because they cannot be produced within the organism. Which of the following cellular processes would be most DIRECTLY affected by a dietary deficiency in essential amino acids?

- W) Translation of mRNA
- X) Cellular respiration
- Y) Cell division
- Z) Oxygen transport

Toss Up Answer: W

Bonus: Multiple Choice

Integral transmembrane proteins are proteins embedded in the cell membrane. Which of the following amino acids would you MOST expect to find in the transmembrane region of such proteins?

- W) Tryptophan
- X) Lysine
- Y) Arginine
- Z) Serine

Bonus Answer: W

3. 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

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)

4. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

In what branch of physics would you expect to find the worm-like chain model?

W) Wormhole Physics

X) Newtonian Physics

Y) Plasma Physics

Z) Polymer Physics

Toss Up Answer: Z

Bonus: Short Answer

By name or number, name which of the following muon decay can produce.

1. Electron

2. Muon Neutrino

3. Electron Neutrino

4. Positron

Bonus Answer: 1,3,4; Electron, Electron Neutrino, Positron

5. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

Which cell does HIV attack?

Bonus Answer: The C4 Cells.

Bonus: Short Answer

What is the optimal pH for pepsin?

Bonus Answer: Around 2-3 pH.

6. MATHEMATICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

Which of the following sets has the greatest cardinality?

W) The set of all real numbers

X) The set of all integers

Y) The set of all rational numbers

Z) They all have the same cardinality

Toss Up Answer: Z

Bonus: Short Answer

If set A has a cardinality of 5, set B has a cardinality of 6, and set A and B are disjoint sets, what is the cardinality of the union of set A and B?

Bonus Answer: 11

7. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

Which scientist studied pea plants for years to conclude a pattern was in the height?

Bonus Answer: Gregor Mendel.

Bonus: Short Answer

How is radiation harmful?

Bonus Answer: It causes cells to mutate, or spontaneously die.

8. CHEMISTRY

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following statements is true?

- W) Hydrogen peroxide has a planar structure
- X) Tritium is radioactive and emits alpha particles
- Y) H₂ is insoluble in water
- Z) Hydrogen constitutes 70% of the Earth's crust by mass

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following gas mixtures is not applicable to Dalton's law of Partial Pressures?

- W) CO₂ and N₂
- X) CO₂ and CO
- Y) SO₂ and O₂
- Z) N₂ and CO

Bonus Answer: Y

9. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Acetone has a distinct smell, which many people associate with the smell of nail polish remover. What might the smell of acetone in the urine or on the breath of a patient indicate?

- W) The patient might be degrading too many amino acids from muscle proteolysis.
- X) The patient's body might be oxidizing too many fatty acids.
- Y) The patient might have enteritis and is absorbing endproducts of fermentation.
- Z) The patient might have fructose toxicity.

Toss Up Answer: X

Bonus: Multiple Choice

Which description best describes what would happen to the carbon cycle if all detritivores suddenly went on "strike" and stopped working?

- W) Carbon would increase in inorganic mass, while the atmospheric reservoir of carbon would continue to increase and plants would not be jeopardized.
- X) Carbon would accumulate in organic mass, the atmospheric reservoir of carbon would decline, and plants would eventually be starved for CO₂.

Y) Carbon would increase in organic mass, while the atmospheric reservoir of carbon would increase and plant-life would be starved for CO₂.

Z) Carbon would decrease in organic mass, while the atmospheric reservoir of carbon would increase with the result that plant-life would be starved for CO₂.

Bonus Answer: X

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10. 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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11. MATHEMATICS

Writer: Elias Milborn

Toss Up: Multiple Choice

What are the solutions for x in the following equation: $x^2 - 2x = 8$?

W) 0

X) 0 and -2

Y) 4 and -2

Z) -4 and 2

Toss Up Answer: Y

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Bonus: Multiple Choice

The sum of the squares of reciprocals of all positive integers equals which of the following?

W) $\pi^{1/2}$ (read as square root of pi)

X) $\pi/3$

Y) $\pi^2/6$

Z) $\pi^3/12$

Bonus Answer: Y

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12. 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

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

13. EARTH and SPACE

Writer: Seiji Yawata

Toss Up: Multiple Choice

In oceans, waves and surf current are generated by:

- W) El Nino
- X) salinity and temperature gradients
- Y) the intertropical convergence zone
- Z) wind

Toss Up Answer: Z

Bonus: Multiple Choice

During which of the following geological subdivisions was glaciation minimal on Earth?

- W) Quaternary Period
- X) Holocene Epoch
- Y) Cretaceous Period
- Z) Pleistocene Epoch

Bonus Answer: Y

14. 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)

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

15. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

What is the defining characteristic of the classification of types of supernovas?

- W) total energy released
- X) elemental spectral lines
- Y) duration of the supernova
- Z) size of the initial star

Toss Up Answer: X

Bonus: Short Answer

What element is released in a Type IA supernova that is not released in other Type I supernovae?

Bonus Answer: silicon

16. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

Given the equation $\text{HCl (aq)} + \text{NaOH (aq)} \rightarrow \text{NaCl (aq)} + \text{H}_2\text{O (l)}$ and that 10.00 mL of 1.5 M HCl was reacted with 20.00 mL of 0.80 M of NaOH, which compound is the limiting reactant?

Bonus Answer: HCl (Hydrochloric acid)

Bonus: Multiple Choice

In organic chemistry what is the name of the functional group consisting of a central carbon singly bonded to two carbon atoms and doubly bonded to an oxygen atom?

- W) amine
- X) amide
- Y) ether
- Z) ketone

Bonus Answer: Z

17. 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

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

18. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

How many sigma and pi bonds does 1,3 butdiene have, respectively?

Bonus Answer: 3 sigma, 2 pi

Bonus: Short Answer

S orbital overlap has what shape?

Bonus Answer: spherical, sphere

19. EARTH and SPACE

Writer: Seiji Yawata

Toss Up: Multiple Choice

Although scientists are unable to obtain samples by drilling, they believe the predominant mineral in the mantle is:

W) quartz

X) olivine

Y) potassium feldspar

Z) iron pyrite

Toss Up Answer: X

Bonus: Multiple Choice

If the intent is to neutralize soil acidity, the mixing of which of the following materials in the soil would be the LEAST effective?

W) gypsum

X) pure CaCO_3

Y) ground limestone

Z) ground oyster shells

Bonus Answer: W

20. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

How many turns in the Calvin Cycle can it produce one PGAL molecule?

Bonus Answer: 2

Bonus: Short Answer

What diffuses through the ATP synthases in the process of photosynthesis?

Bonus Answer: Hydrogen ions/protons. The protons in the thylakoids membrane is diffused out by the process of chemiosmosis.

21. CHEMISTRY

Writer: Ahmad Alnasser

Toss Up: Short Answer

Which element is the more electronegative?

Bonus Answer: Flourine

Bonus: Short Answer

Name all the atoms that are diatomic.

Bonus Answer: Hydrogen (H₂)

Nitrogen (N₂)

Oxygen (O₂)

Fluorine (F₂)

Chlorine (Cl₂)

Iodine (I₂)

Bromine (Br₂)

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22. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of these does not result in recombinant bacteria?

W) Transformation

X) Insertion

Y) Transduction

Z) Conjugation

Toss Up Answer: X

Bonus: Short Answer

What serves as an intermediate in transduction?

Bonus Answer: Virus (accept viruses)

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23. 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/s², the force of the spring has a magnitude of:

W) 0N

X) 2.8N

Y) 5.6N

Z) 11.2N

Toss Up Answer: Y

Bonus: Multiple Choice

A 42-kg man stands in an elevator that has a downward acceleration of 3.4m/s². 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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24. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

What is the typical size range for a prokaryote?

W) .1 - 1.0 micrometer

X) .5 - 5.0 micrometer

- Y) 1-10 micrometer
- Z) 10-100 micrometer

Toss Up Answer: X

Bonus: Short Answer

What is the name for the factor that allows a bacteria to become a donor during conjugation?

Bonus Answer: F factor (accept fertility factor)

25. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

What is another name for pinocytosis

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Bonus Answer: Cell drinking.

Bonus: Multiple Choice

Sugar molecules can enter cells through

- W) Exocytosis
- X) Facilitated diffusion.
- Y) Osmosis.
- Z) ATP Synthase.

Bonus Answer: X
