

Round 19

1. 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^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

Bonus: Multiple Choice

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

- W) 12N
- X) 270N
- Y) 340N
- Z) 412N

Bonus Answer: X

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

Bonus: Short Answer

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

Bonus Answer: Lysogenic

3. 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

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4. 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

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5. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

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

Bonus Answer: 435

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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6. BIOLOGY

Writer: Siam Muquit

Toss Up: Short Answer

What does the Shannon Index quantify?

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

Bonus: Short Answer

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

Bonus Answer: 0

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7. 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: $(-\infty, -4) \cup (-1, \infty)$

Bonus: Short Answer

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

Bonus Answer: 49

8. 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

9. 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

Bonus: Short Answer

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

Bonus Answer: Vernal Equinox (Accept: Spring Equinox)

10. 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

11. 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

Bonus: Short Answer

What is the equivalent weight of HNO_3 in the reaction: Cu reacts with HNO_3 , forming $\text{Cu}(\text{NO}_3)_2$, NO and water.

Bonus Answer: 84

12. 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)

13. 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

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: $70/r$

14. MATHEMATICS

Writer: Yevgeniy Gorbachev

Toss Up: Short Answer

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

Bonus Answer: 255

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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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. 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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17. 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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18. CHEMISTRY

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following compounds does not exist?

W) PF₅

X) P₄O₁₀

Y) P₄O₆

Z) PH₅

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. 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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20. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Which of the following has a coordinate covalent bond?

W) butanol

X) CO₂

Y) Methane

Z) NH₄⁺

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

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

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

22. CHEMISTRY

Writer: Banpreet Singh

Toss Up: Short Answer

At what temperature Kelvin does water freeze?

Bonus Answer: 273 K

Bonus: Short Answer

Who came up with the caloric theory?

Bonus Answer: Antoine Lavoisier

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

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)

24. BIOLOGY

Writer: Ahmad Alnasser

Toss Up: Short Answer

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

Bonus Answer: Endocytosis

Bonus: Short Answer

The large surface area in the gut directly facilitates

Bonus Answer: Absorption

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

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
