

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. 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

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

Bonus: Short Answer

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

Bonus Answer: 49

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5. 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

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6. 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)

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7. 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

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8. 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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9. 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

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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10. 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

11. 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

12. 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

13. 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

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14. 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: $70/r$

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15. CHEMISTRY

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following compounds does not exist?

- W) PF_5
- X) P_4O_{10}
- Y) P_4O_6
- Z) PH_5

Toss Up Answer: Y

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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16. 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

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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17. 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

Bonus: Short Answer

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

Bonus Answer: 0

18. 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

19. 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

20. 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)

21. 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)

22. 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

23. 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.

Bonus: Short Answer

What is Io's surface primarily composed of?

Bonus Answer: Silicates and sulfur compounds.

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. 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

Bonus: Multiple Choice

What is Saturn's atmosphere mostly composed of?

W) Helium

X) Amonia

Y) Hydrogen

Z) Carbon

Bonus Answer: Y
