

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. 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

3. 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

=====

4. 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

=====

5. 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

=====

6. 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

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. 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 $y' = \frac{dy}{dx}$ for $x^3 + y^3 = 4$. (x cubed + y cubed)

Bonus Answer: $-\frac{x^2}{y^2}$ (negative x squared over y squared)

9. 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 $\frac{d}{dx} \tan x / \sec x$, 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

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. 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

12. 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: $70/r$

13. 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

14. 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

15. 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)

16. 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

17. 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

18. 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

19. 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 HNO₃ in the reaction: Cu reacts with HNO₃, forming Cu(NO₃)₂, NO and water.

Bonus Answer: 84

20. 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

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)

21. 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

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. 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)

24. 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.

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
