

Round 19

1. PHYSICS

Writer: Elias Milborn

Toss Up: Short Answer

A person standing on a scaffolding lowers an object with weight 250 newtons by means of a rope, at constant speed. If the weight of the ropes is negligible, what is the force in newtons that the person exerts on the rope?

Bonus Answer: 250

Bonus: Short Answer

Green light has a wavelength of 500 nanometers. What is its associated frequency in hertz?

Bonus Answer: 6×10^{14}

2. 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 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

Bonus: Multiple Choice

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

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

Bonus Answer: X

3. PHYSICS

Writer: William Xiang

Toss Up: Short Answer

A woman pushes a 25-kg shopping cart 10 meters along a frictionless horizontal surface. What is the total work exerted by the woman on the cart?

Bonus Answer: 0 Joules

Bonus: Multiple Choice

A 0.50kg block attached to an ideal spring with a spring constant of 80 N/m oscillates on a horizontal frictionless surface. The total mechanical energy is 0.12J. The greatest extensions from this equilibrium length is:

- W) $1.5 \times 10^{-3} \text{ m}$
- X) $3.0 \times 10^{-3} \text{ m}$
- Y) 0.039 m
- Z) 0.054 m

Bonus Answer: Z

4. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

Two particles interact by conservative forces. In addition, an external force acts on each particle. They complete round trips, ending at the points where they started. Which of the following must have the same values at the beginning and end of this trip?

- W) the total kinetic energy of the two-particle system
- X) the potential energy of the two-particle system
- Y) the total linear momentum of the two-particle system
- Z) the mechanical energy of the two-particle system

Toss Up Answer: X

Bonus: Multiple Choice

A force of 10 N holds an ideal spring with a 20 N/m spring constant in compression. The potential energy stored in the spring is:

- W) 0.5J
- X) 2.5J
- Y) 5J
- Z) 10J

Bonus Answer: X

5. MATHEMATICS

Writer: Nten Nylam

Toss Up: Multiple Choice

What is the range of $f(x) = x^2$

- W) All real numbers greater than 0
- X) All real numbers
- Y) All real numbers greater than or equal to 0
- Z) All real numbers except -1

Toss Up Answer: Y

Bonus: Short Answer

$\frac{1}{3}$ of a number plus twice half of a number equals 36. What is the number?

Bonus Answer: 27

6. MATHEMATICS

Writer: Nten Nylam

Toss Up: Multiple Choice

What is the sum of $5 - 3i$ and the conjugate of $3 + 2i$?

- W) $2-i$
- X) $2-5i$
- Y) $8-i$
- Z) $8-5i$

Toss Up Answer: Z

Bonus: Short Answer

Multiply the following complex numbers, giving the product in $a+bi$ form: $(2 + 3i)$ and $(4 + 5i)$

Bonus Answer: $-7 + 22i$

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7. MATHEMATICS

Writer: Janine Goh

Toss Up: Short Answer

What is the quadratic formula?

Bonus Answer: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Bonus: Short Answer

Solve for y if $x = \frac{5}{6}y + \frac{116}{3}y + \frac{4}{2}$ in terms of x

Bonus Answer: $y = \frac{(x-2)}{78}$

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8. MATHEMATICS

Writer: Nten Nylam

Toss Up: Short Answer

A 1081 degree angle will lie in which quadrant in the Cartesian coordinate system?

Bonus Answer: Quadrant 1 (also accept 1 or first)

Bonus: Short Answer

Multiply $3x^2 - 4xy + y^2$ by $-3xy^2$

Bonus Answer: $-9x^3y^2 + 12x^2y^3 - 3xy^4$

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9. 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

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10. 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

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11. 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)

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12. 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

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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

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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: $70/r$

15. 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

16. 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

17. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of the following is thought to have underwent secondary endosymbiosis?

W) Ciliate

X) Dinoflagellates

Y) Diatoms

Z) Algae

Toss Up Answer: Z

Bonus: Short Answer

From what specific class of bacteria are mitochondria thought to originate from?

Bonus Answer: Alpha proteobacteria

18. CHEMISTRY

Writer: Banpreet Singh

Toss Up: Multiple Choice

Under what conditions would 1.0 mol of CO₂(g) behave most like an ideal gas?

W) 100 K and 100 atm

X) 800 K and 0.1 atm

Y) 800 K and 1 atm

Z) 800 K and 100 atm

Toss Up Answer: X

Bonus: Short Answer

A sample of 9.00 grams Al(s) is added to excess HCl(aq). What is the volume of the hydrogen gas produced at STP?

Bonus Answer: 11.2 L

19. CHEMISTRY

Writer: Banpreet Singh

Toss Up: Multiple Choice

As the temperature is raised from 20 degrees Celsius to 40 degrees Celsius, the average energy of a sample of neon atoms changes by a factor of

W) 1/2

X) $\sqrt{313/293}$

Y) 313/293

Z) 2

Toss Up Answer: Y

Bonus: Short Answer

A sample of oxygen gas occupies 8.00 L at 127 degrees Celsius and 775 mmHg. It is heated at constant pressure and expands to 20.00 L. In Celsius what is the new temperature?

Bonus Answer: 727 degrees celsius

20. CHEMISTRY

Writer: Banpreet Singh

Toss Up: Multiple Choice

Which gas effuses at approximately one half as fast as ammonia?

W) He

X) CO₂

Y) Cl₂

Z) CH₄

Toss Up Answer: Y

Bonus: Multiple Choice

For which of two gases are the rates of effusion 2:1?

W) Ne and Kr

X) He and O₂

Y) H₂ and He

Z) N₂ and Ar

Bonus Answer: W

21. 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

22. 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

23. 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

24. 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 CaCO₃
- Y) ground limestone
- Z) ground oyster shells

Bonus Answer: W

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25. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

Where in the H-R Diagram would Betelgeuse be found?

- W) Upper Left Corner
- X) Lower Left Corner
- Y) Upper Right Corner
- Z) Lower Right Corner

Toss Up Answer: Y

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Bonus: Multiple Choice

At what distance is absolute magnitude the same as apparent magnitude?

- W) 1 AU
- X) 100 AU
- Y) 1 parsec
- Z) 10 parsecs

Bonus Answer: Z

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