

Round 8

1. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

An electric vehicle has two stages. If the first stage, the battery, has an efficiency of 90% and the second stage, the inverter, has an efficiency of 80%, calculate the approximate overall efficiency of the vehicle.

Bonus Answer: 72%

Bonus: Multiple Choice

Which of the following is congruent to $(n + 1)$ modulus n ?

- W) 0
- X) 1
- Y) $n-1$
- Z) $n-2$

Bonus Answer: X

2. EARTH and SPACE

Writer: Yae June Lee

Toss Up: Multiple Choice

What happened to the melted rock after it goes through solidification to form basalt?

- W) It occurred rapidly, with fine grained minerals
- X) Slowly, coarse grained minerals
- Y) Rapidly, coarse trained minerals
- Z) Slowly, fine grained minerals

Toss Up Answer: W

Bonus: Short Answer

What are two surface traits that affect the rate of surface runoff?

Bonus Answer: Slope of land surface, soil type or composition, vegetation, porosity of soil, soil saturation.(any two of these answers are acceptable.)

3. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

Find the derivative of: $4x^3 + 18x + 2$

Bonus Answer: $8x^2 + 18$

Bonus: Short Answer

At what point is the slope of the tangent line to the parabola $y = 3x^2 + 5x + 23$ equal to 0?

Bonus Answer: $(-5/6, 251/12)$

4. EARTH and SPACE

Writer: Matthew Lee

Toss Up: Short Answer

As it pertains to, say, a recent rain storm, what zone would lie right above the impermeable bedrock?

Bonus Answer: zone of saturation

Bonus: Short Answer

In the zone of aeration, groundwater is present between spaces and cracks in soil and rock grains. What is this groundwater known as?

Bonus Answer: capillary water

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5. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

As a pendulum is raised to higher altitudes, its period?

Bonus Answer: Increases

Bonus: Short Answer

The SI unit of pressure is?

Bonus Answer: Pascal

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6. 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

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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7. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A charged particle is moving in a UNIFORM magnetic field. If the direction of motion of the charged particle is parallel to the magnetic field, describe the shape of the charged particle's path.

Bonus Answer: Straight line

Bonus: Multiple Choice

For a parallel-plate capacitor with plate area "A" and plate separation "d", the capacitance is proportional to which of the following?

W) A/d^2

X) $A \times d$

Y) A/d

Z) d/A

Bonus Answer: Y

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8. BIOLOGY

Writer: Zoe Orlin

Toss Up: Short Answer

What is climax vegetation?

Bonus Answer: The dominant type of vegetation in a biome

Bonus: Short Answer

What is the climax vegetation of the tundra?

Bonus Answer: Mosses and/or lichens

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9. PHYSICS

Writer: Prangon Ghose

Toss Up: Multiple Choice

In a hockey game, a 0.1 kg puck is slide on the ice at 40 m/s horizontally towards a goalie. If the goalie slides the puck back in the direction in which it came with a speed of 30 m/s, what is the impulse experienced by the puck?

W) 1 kgm/s

X) 7 kgm/s

Y) 3 kgm/s

Z) 120 kgm/s

Toss Up Answer: X

Bonus: Multiple Choice

A block sliding on a frictionless surface at 10 m/s hits a spring which returns the block at the same speed. If the block's mass is 5 kg, what is the impulse the block experiences?

W) 0.5 kgm/s

X) 50 kgm/s

Y) 2 kgm/s

Z) 100 kgm/s

Bonus Answer: Z

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10. 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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11. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the name of the principle that states that 5 avocados cannot be placed in 4 holes without 2 of them being placed in the same one?

Bonus Answer: Pigeonhole Principle

Bonus: Short Answer

In triangle ABC with integer side lengths, $AB = 7$, $BC = 14$, and $AC < 9$. Find AC.

Bonus Answer: 8 (Triangle Inequality)

12. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

What specific type of semiconductor is produced by adding phosphorus to silicon?

Bonus Answer: N-Type

Bonus: Short Answer

How many turns are in the secondary coil of a transformer that has a primary coil with 20,000 turns and is designed to step down 12,000 volts AC to 120 volts AC?

Bonus Answer: 200

13. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is a triangular number?

- W) 2
- X) 6
- Y) 9
- Z) 11

Toss Up Answer: X

Bonus: Short Answer

What is the greatest common factor of 456 and 460?

Bonus Answer: 4

14. BIOLOGY

Writer: William Xiang

Toss Up: Multiple Choice

Which of the following enzymes are not utilized by the human body to break down carbohydrates?

- W) Amylase
- X) Maltase
- Y) Lactase
- Z) Lipase

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following is a valid difference between animal and plant cells?

- W) Animal cells have a cell membrane whereas plant cells do not.
- X) Animal cells contain mitochondria whereas plant cells cannot.

Y) Animal cells can contain multiple vacuoles whereas plant cells cannot.

Z) Animal cells are larger than plant cells.

Bonus Answer: Y

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15. EARTH and SPACE

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

The ozone is in what layer

W) Stratosphere

X) Troposphere

Y) Hydrosphere

Z) Mesosphere

Toss Up Answer: W

Bonus: Multiple Choice

Atmospheric convection is driven by

W) Ocean currents

X) Evaporation of oceans

Y) Unequal heating by the sun

Z) Fluctuations of the Earth's magnetic field

Bonus Answer: Y

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16. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

How many nodes are there in the first overtone in a standing wave of a vibrating guitar string?

Bonus Answer: 3

Bonus: Short Answer

If $g = 9.8$ meters per second squared, to the first decimal place and in newtons, how many newtons of force are required to keep a 450 kilogram slab of granite moving across a horizontal surface at constant speed if there is a kinetic frictional coefficient of 0.20 between the surface and the slab?

Bonus Answer: 882 N

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17. BIOLOGY

Writer: George Papastefanou

Toss Up: Multiple Choice

Rett syndrome displays which of the following inheritance patterns?

W) Autosomal Dominant

X) Autosomal Recessive

Y) X-Linked Dominant

Z) X-Linked Recessive

Toss Up Answer: Y

Bonus: Short Answer

In the genetic disorder known as cri-du-chat, what chromosome is affected?

Bonus Answer: Chromosome 5

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18. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Short Answer

An ideal gas in a closed inflexible container has a pressure of 6 atmospheres and a temperature of 27°C. What will be the new pressure of the gas if the temperature is decreased to -73°C?

Bonus Answer: 4 atmospheres

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Bonus: Multiple Choice

When CO₂ is bubbled through distilled water at 25°C, which of the following is most likely to occur?

- W) Solid carbon will form
- X) The pH of the solution will be reduced
- Y) The water will boil
- Z) Methane gas will be formed

Bonus Answer: X

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19. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

Which of the following minerals has the highest number on the Mohs hardness scale?

- W) Apatite
- X) Fluorite
- Y) Quartz
- Z) Orthoclase

Toss Up Answer: Y

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Bonus: Short Answer

What are the three most abundant elements in Earth's crust?

Bonus Answer: Oxygen, Silicon, Aluminum

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20. CHEMISTRY

Writer: Janine Goh

Toss Up: Short Answer

What activates pepsinogen to change into pepsin?

Bonus Answer: Hydrochloric acid

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Bonus: Short Answer

What is the pH of gastric juice to the nearest tenth?

Bonus Answer: 1.5 to 2.5 (or any number in between)

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21. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What volcano has erupted in the years 79 A.D., 1139, 1631, 1779, 1793, 1872, 1906, and 1944?

Bonus Answer: Vesuvius

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Bonus: Short Answer

What is the name of the very old mountain belt located in southern Missouri and Northern Arkansas?

Bonus Answer: the ozarks

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22. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

What structure in the small intestine increases epithelial surface area?

Bonus Answer: Villi or microvilli

Bonus: Short Answer

What structure in the stomach increases epithelial surface area?

Bonus Answer: Rugae

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23. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

A solution of H_2SO_3 is found to have a hydrogen ion concentration of 1×10^{-3} molar at 25°C . What is the hydroxide ion concentration in the solution?

W) 1×10^{-1}

X) 1×10^{-3}

Y) 1×10^{-11}

Z) 1×10^{-13}

Toss Up Answer: Y

Bonus: Short Answer

If the pH of a solution is changed from 1 to 3 with the addition of an antacid, what percentage of $[\text{H}^+]$ was neutralized?

Bonus Answer: 99%

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24. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

What is the oxidation state of Manganese in the permanganate ion?

W) +5

X) +7

Y) +2

Z) -2

Toss Up Answer: X

Bonus: Short Answer

What is the oxidation state of molecular oxygen?

Bonus Answer: 0

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25. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

What is the correct term(s) used to determine if a system has come to equilibrium?

W) K_a and Q

X) K_{sp}

Y) Q

Z) K_c

Toss Up Answer: Y

Bonus: Multiple Choice

Chemical equilibrium may be used to describe

W) gas phase chemical reactions

X) acid and based ionization

Y) Solubility

Z) All of the Above

Bonus Answer: Z
