

Round 6

1. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

Where was GFP originally isolated?

Bonus Answer: Jellyfish

Bonus: Multiple Choice

In which of the following organisms was the gene originally expressed in?

- W) C. elegans
- X) Salmonella
- Y) E. coli
- Z) Petromyzon

Bonus Answer: W

2. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

$f(x) = x^4 + 5x^8 + 7x^6 + 5$ Which of the following is true about $f(x)$?

- W) $f(x)$ is odd, only
- X) $f(x)$ is even, only
- Y) $f(x)$ is neither odd nor even
- Z) $f(x)$ is both even and odd

Toss Up Answer: X

Bonus: Short Answer

Simplify: $\cos(\sin^{-1}(3/5))$

Bonus Answer: 4/5

Solution:

Draw a 3-4-5 right triangle and find the angle that $\sin^{-1}(3/5)$ is equal to. Then, take its cosine.

3. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Isolated RNA molecules are generally less stable than DNA at physiological pH because:

- W) RNA has ribose
- X) RNA is always linear
- Y) RNA uses uracil instead of thymine
- Z) RNA is usually single-stranded

Toss Up Answer: W

Bonus: Multiple Choice

What is the half-life of DNA?

- W) 673 years
- X) 100 years
- Y) 272 years
- Z) 521 years

Bonus Answer: Z

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4. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

To the nearest order of magnitude, how thick are Saturn's rings?

- W) 10 m
- X) 100 m
- Y) 1000 m
- Z) 10000 m

Toss Up Answer: W

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Bonus: Short Answer

Which planets have active plate tectonics?

Bonus Answer: Earth

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5. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following types of symmetry does $x^2 + (y-1)^2 = 36$ have?

- W) Y-axis symmetry, only
- X) X-axis symmetry, only
- Y) Both x and y axis symmetry
- Z) Neither x nor y axis symmetry

Toss Up Answer: Y

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Bonus: Multiple Choice

Which of the following types of symmetry does $x^2 - y^2 = 36$ have?

- W) Y-axis symmetry, only
- X) X-axis symmetry, only
- Y) Both x and y axis symmetry
- Z) Neither x nor y axis symmetry

Bonus Answer: Y

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6. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

What is the US state with the most glaciers?

Bonus Answer: Washington

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Bonus: Short Answer

How many glaciers are there in Hawaii rounded to the nearest 1000?

Bonus Answer: 0

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7. BIOLOGY

Writer: Josh Tish

Toss Up: Short Answer

A population of 2800 flowers is in Hardy-Weinberg equilibrium, and 2352 of them are red in color. The red allele R is

dominant; the white allele r is recessive. What is the frequency of heterozygotes in the population?

Bonus Answer: 48%, or any equivalent form

Bonus: Multiple Choice

Which of the following would be least damaged by a lipase?

- W) endoplasmic reticulum
- X) mitochondria
- Y) ribosome
- Z) nuclei

Bonus Answer: Y

8. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

What kind of process is the loss of electrons?

- W) electrolysis
- X) thermodynamically favored
- Y) reduction
- Z) oxidation

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following metals does not react with water to produce hydrogen?

- W) Zn
- X) Li
- Y) Ca
- Z) Na

Bonus Answer: W

9. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Multiple Choice

What happens as air rises?

- W) It gets warmer
- X) It gets colder
- Y) The temperature fluctuates
- Z) Nothing

Toss Up Answer: X

Bonus: Short Answer

How are winds named?

Bonus Answer: By the direction they are coming in

10. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

Which of the following is not commonly produced by eletrolysis?

- W) NaOCl
- X) Al
- Y) Fe
- Z) NaOH

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following pairs of constants are not mathematically related to each other?

- W) Equilibrium constant and Gibbs Free Energy
- X) Rate Constant and Activation Energy
- Y) Standard Cell Voltage and Equilibrium Constant
- Z) Standard Cell Voltage and Rate Constant

Bonus Answer: Z

11. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Simplify: $(24 \cdot 63) / (72 \cdot 21)$

- W) 1
- X) 3
- Y) 7
- Z) $1/3$

Toss Up Answer: W

Bonus: Short Answer

Simplify $(333(x^4 - x^2)) / (9(x^2 + 2x + 1)(x^2))$

Bonus Answer: $(x-1)/((37)(x+1))$

12. 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

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

13. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

What is the cause of trisomy 21?

- W) error during meiosis
- X) error during mitosis
- Y) over duplication of chromosome 21
- Z) chromosomal insertion

Toss Up Answer: W

Bonus: Multiple Choice

Why is pepsinogen secreted as a zymogen into the stomach?

- W) to change the pH of the stomach fluids to aid digestion.
- X) to prevent digestion of the gastric glands
- Y) to inactivate pepsinogen
- Z) to digest complex carbohydrates

Bonus Answer: X

14. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

Which would be the easiest way to burn an iron nail?

- W) Hold an iron nail with crucible tongs, and heat strongly in the flame of a bunsen burner.
- X) Use the above method with an oxyacetylene torch to reach highest temperatures.
- Y) Grind the nail into very small, dust-sized particles and spray them into a flame.
- Z) Dissolve the nail in acid to make the oxide.

Toss Up Answer: Y

Bonus: Multiple Choice

What is a reasonable and safe substitute for zinc in reduction reactions in aqueous solutions?

- W) S
- X) F2
- Y) K
- Z) Cd

Bonus Answer: Z

15. PHYSICS

Writer: Raafiul Hossain

Toss Up: Short Answer

What is energy measured in?

Bonus Answer: Joules

Bonus: Short Answer

What is the unit of charge?

Bonus Answer: Columbus

16. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following is a nonpolar molecule?

- W) Carbon dioxide
 - X) Water
 - Y) Ammonia
 - Z) Hydrochloric acid
- Toss Up Answer: W**

Bonus: Short Answer

Which of the following forms of radioactive decay has (or have) no electrical charges? 1) Alpha Decay 2) Beta Decay 3) Gamma Decay

Bonus Answer: 3 only

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17. PHYSICS

Writer: Jan Wojcik

Toss Up: Multiple Choice

An electron is placed in a horizontally hollow cylindrical solenoid with the current moving clockwise around the solenoid. The electron is released from rest in the middle of the solenoid. What direction will the electron move in?

- W) To the left
- X) To the right
- Y) Stays in the same place
- Z) Oscillates between both ends

Toss Up Answer: X

Bonus: Multiple Choice

There are two charges, one with charge $+2Q$ and one with charge $-4Q$ a distance of 2 meters from each other. Assuming the universal charge constant is 1.6×10^{-19} , which of the following is the force of attraction felt by the two charges, rounded to one decimal place

- W) 4.8×10^{-19} C
- X) 9.6×10^{-19} C
- Y) 2.4×10^{-19} C
- Z) 3.2×10^{-19} C

Bonus Answer: Z

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18. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

How does atropine counter the effects of nerve gas?

- W) Atropine binds to the nerve gas and inactivates it
- X) Atropine inactivates acetylcholinesterase and allows more acetylcholine to cross the synaptic cleft
- Y) atropine blocks the acetylcholine receptor which blocks the excess acetylcholine lingering in the synaptic cleft
- Z) atropine stimulates the production of an enzyme that breaks down the nerve gas

Toss Up Answer: Y

Bonus: Short Answer

In order to flower, what does a short-day plant need?

Bonus Answer: Night that is longer than a certain critical length

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19. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What type of radiation is both the most penetrating and the most effectively stopped if blocked by a hydrogen-rich material?

- W) Alpha
- X) Beta
- Y) Gamma
- Z) Neutron

Toss Up Answer: Z

Bonus: Multiple Choice

What type of radiation originates from the electron cloud?

- W) Alpha
- X) Beta
- Y) X-Ray
- Z) Gamma

Bonus Answer: Y

20. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is a retrovirus?

- W) HIV
- X) Hepatitis B virus
- Y) Poliovirus
- Z) Influenza A virus

Toss Up Answer: W

Bonus: Short Answer

Where do DNA viruses usually replicate?

Bonus Answer: In the nucleus.

21. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What law most directly states that the total of the electric flux out of a closed surface is equal to the charge enclosed divided by the permittivity?

Bonus Answer: Gauss's Law

Bonus: Short Answer

When a magnet is moved into a coil of wire, changing the magnetic field and magnetic flux through the coil, a voltage will be generated in the coil according to which law?

Bonus Answer: Faraday's Law

22. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is present in plant cells but not animal cells?

- W) Nuclei

- X) Plasmodesmata
- Y) Mitochondria
- Z) Vacuoles

Toss Up Answer: X

Bonus: Short Answer

What is the name of the theory that explains the existence of mitochondria (and why they have their own DNA)?

Bonus Answer: Endosymbiotic Theory

23. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

Who first suggested that radiant energy could exist only in discrete quanta which were proportional to the frequency in order to explain the frequency distribution of blackbody radiation?

- W) Isaac Newton
- X) Max Planck
- Y) Ernest Rutherford
- Z) Paul Dirac

Toss Up Answer: X

Bonus: Short Answer

Later solved by Planck's quantum radiation formula, what asymptotic result of the classical Rayleigh-Jeans Law was the most troubling?

Bonus Answer: Ultraviolet Catastrophe

24. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

What transmissible agent causes Mad Cow Disease (BSE)?

- W) Viron
- X) Virus
- Y) Bacteria
- Z) Prion

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following are prions made up of?

- W) Proteins, only
- X) Nucleic Acids, only
- Y) Proteins and Nucleic Acids, only
- Z) Proteins and Carbohydrates, only

Bonus Answer: W

25. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What is the relativistic mass of a particle with a rest mass of 8g traveling at a speed of .6c?

- W) 4g

- X) 8g
- Y) 10g
- Z) 12g

Toss Up Answer: Y

Bonus: Multiple Choice

What is the length of a 1 meter rod traveling on a spaceship going at .8c, as measured by an astronaut on the ship?

- W) .8m
- X) .6m
- Y) 1m
- Z) 1.25m

Bonus Answer: Y
