

Round 6

1. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the slope of the tangent line to $e^{(2x)}$ at $x=3$

Bonus Answer: $2e^6$

Bonus: Short Answer

What is the slope of the tangent line to $\ln(2x)$ at $x=3$

Bonus Answer: $1/3$

2. EARTH and SPACE

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following is a sedimentary rock?

W) slate

X) marble

Y) basalt

Z) sandstone

Toss Up Answer: Z

Bonus: Short Answer

What is the name for the outer shadow cast during eclipses, which gives rise to a partial eclipse?

Bonus Answer: Penumbra

3. 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: $70/r$

4. 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

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5. EARTH and SPACE

Writer: Sean Vaysburd

Toss Up: Multiple Choice

Which is not a type of rock?

- W) sedimentary
- X) metamorphic
- Y) igneous
- Z) elementary

Toss Up Answer: Z

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Bonus: Short Answer

Which type of rock is formed from magma?

Bonus Answer: igneous rock

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6. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the smallest even triangular number?

Bonus Answer: 6

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Bonus: Multiple Choice

If p and q are inversely proportional, and p = 7 when q = 24, then find p when q =12.

- W) 3.5
- X) 7
- Y) 12
- Z) 14

Bonus Answer: Z

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7. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

What is the US state with the most glaciers?

Bonus Answer: Alaska

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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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8. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Multiple Choice

What is asymptote of the function: $f(x) = 1/x$?

W) $y = 0$

X) $x = 0$

Y) $x = 0, y = 1$

Z) $x = 0, y = 0$

Toss Up Answer: Z

Bonus: Short Answer

Plugging the divergent series, $1 + 2 + 3 + 4 + \dots$, into the Riemann Zeta Function results in which number?

Bonus Answer: -1/12

9. EARTH and SPACE

Writer: Seiji Yawata

Toss Up: Multiple Choice

In oceans, waves and surf current are generated by:

W) El Nino

X) salinity and temperature gradients

Y) the intertropical convergence zone

Z) wind

Toss Up Answer: Z

Bonus: Multiple Choice

During which of the following geological subdivisions was glaciation minimal on Earth?

W) Quaternary Period

X) Holocene Epoch

Y) Cretaceous Period

Z) Pleistocene Epoch

Bonus Answer: Y

10. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

The speed at which a wave propagates down a string is 300 meters per second. If the frequency of this wave is 150 Hertz, what is the wavelength of this wave?

Bonus Answer: 2 meters

Bonus: Multiple Choice

When a physical property such as charge exists in discrete "packets" rather than in continuous amounts, the property is said to be:

W) quantized

X) random

Y) discontinuous

Z) nonexistent

Bonus Answer: W

11. CHEMISTRY

Writer: Jason Mohabir

Toss Up: Short Answer

During glycolysis, electrons removed from glucose are passed to

Bonus Answer: NAD⁺

Bonus: Multiple Choice

A biological redox reaction always involves

W) an ester

X) an alcohol

Y) a reducing agent

Z) a soap

Bonus Answer: Y

12. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

Two forces that have magnitudes of 11 newtons and 5 newtons are applied to an object. What's the maximum net force that can act upon the object?

Bonus Answer: 16 N

Bonus: Short Answer

A toy train moves in a circle of 8 meters radius with a speed of 4 meters per second. What is the magnitude of the acceleration of the train?

Bonus Answer: 2 m/s²

13. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

Ruminants have the ability to digest what commonly ingested substance that humans cannot digest due to microorganisms in the stomach?

Bonus Answer: Cellulose

Bonus: Short Answer

What is the main site of methane production in ruminants?

Bonus Answer: Rumen, accept first chamber/stomach

14. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which is the strongest type of intermolecular force?

W) Hydrogen bonding

X) Dipole-dipole

Y) Van der Waals

Z) Metallic bonding

Toss Up Answer: W

Bonus: Short Answer

By name or number, which of the following elements can form hydrogen bonds?

Oxygen, Chlorine, Fluorine, Nitrogen, Sulfur

Bonus Answer: Oxygen, Fluorine, Nitrogen or (1, 3, and 4)

15. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What Irish physicist, living from 1805-1865, made important contributions to his namesake branch of 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

16. CHEMISTRY

Writer: Calvin Vuong

Toss Up: Multiple Choice

The relation between pressure and temperature of two ideal gases is stated in

W) Gay-Lussac's Law

X) Boyle's Law

Y) Charles's Law

Z) Avogadro's Law

Toss Up Answer: W

Bonus: Short Answer

What are the dimensions of the gas constant R in SI base units?

Bonus Answer: $\text{kg m}^2 \text{mol}^{-1} \text{K}^{-1} \text{s}^{-2}$ (accept as a fraction)

17. BIOLOGY

Writer: Jason Mohabir

Toss Up: Short Answer

What is considered the most unifying concept in biology?

Bonus Answer: Evolution

Bonus: Multiple Choice

You capture a Pikachu and make it hold a Light Ball. You breed this Pikachu and the resulting Pokemon inherits the move Volt Tackle. This phenomenon of inheriting traits due to the actions of individuals or acquired traits reflects what

theory?

W) Darwinian Natural Selection

X) Lamarckian Inheritance

Y) Oak-azaki Fragments

Z) Parental Mimicry

Bonus Answer: X

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18. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

The shape of a PCl_3 molecule is described as

W) bent

X) trigonal pyramidal

Y) linear

Z) trigonal planar

Toss Up Answer: X

Bonus: Short Answer

Twenty-five percent of element X exists as ^{210}X and 75 percent of it exists as ^{214}X . What is the atomic weight of element X?

Bonus Answer: 211

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19. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

Which of the following quantities are vector?

W) Work

X) Speed

Y) Torque

Z) Power

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following terms is NOT commonly used to represent a higher-order derivative of displacement?

W) Acceleration

X) Jounce

Y) Lock

Z) Spin

Bonus Answer: Z

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20. MATHEMATICS

Writer: Shihab Karim

Toss Up: Short Answer

What is the imaginary unit "i" when raised to the power 30?

Bonus Answer: -1

Bonus: Short Answer

What is the sum of the first 50 positive integers?

Bonus Answer: 1275

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21. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

An object of mass 2 kg has a linear momentum of magnitude 6 kg • m/s. What is this object's kinetic energy?

W) 3 J

X) 6 J

Y) 9 J

Z) 12 J

Toss Up Answer: Y

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Bonus: Short Answer

Two objects, one of mass 3 kg and moving with a speed of 2 m/s and the other of mass 5 kg and speed 2 m/s, move toward each other and collide head-on. If the collision is perfectly inelastic, find the speed of the objects after the collision.

Bonus Answer: 0.5 m/s

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22. BIOLOGY

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

Which one of these is an enzyme?

W) Inositol

X) Lyase

Y) Alanine

Z) Butyric Acid

Toss Up Answer: X

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Bonus: Multiple Choice

Which molecule is not involved in the C3 Calvin cycle?

W) OAA

X) RuBP

Y) G3P

Z) PGA

Bonus Answer: W

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23. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

In a food fight, a 0.1 kg apple is given a velocity of 10 m/s. Before reaching its target, the apple is traveling at 5 m/s.

What is the impulse exerted on the apple by air resistance?

Bonus Answer: 0.5 kgm/s

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Bonus: Short Answer

A 0.1 kg pinball is fired horizontally by a spring with a force constant of 40 N/m. If the spring is depressed 10 cm and the ball collides with a 0.3 kg ball elastically, what is the post collision velocity of the 0.3 kg ball?

Bonus Answer: 1 m/s

24. BIOLOGY

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

What structure in plant cells is similar to gap junctions in animal cells?

- W) Cell wall
- X) Central Vacuole
- Y) Plasmodesmata
- Z) Thylakoid

Toss Up Answer: Y

Bonus: Multiple Choice

If, on average, 46% of the loci in a species' gene pool are heterozygous, then the average homozygosity of the species should be

- W) 23%
- X) 46%
- Y) 54%
- Z) There is not enough information to say.

Bonus Answer: Y

25. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

What transmissible agent causes Bovine Spongiform Encephalopathy?

- 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
