

Round 5

1. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Short Answer

In 12.4 hours, a 100 gram sample of an element decays so that its mass is 25 grams. What is the approximate half-life of this radioactive substance?

Bonus Answer: 6.2 hours

Bonus: Multiple Choice

Which of the following will raise the boiling point of a sample of water?

- W) Heat the water
- X) Mix gasoline into the water
- Y) Bring the water to a higher altitude
- Z) Dissolve table sugar in the water

Bonus Answer: Z

2. MATHEMATICS

Writer: George Zhou

Toss Up: Multiple Choice

Donald Trump has $10x+5$ apples where $x=3$. How many apples does he have if he eats two of them?

- W) 35
- X) 39
- Y) 30
- Z) 33

Toss Up Answer: Z

Bonus: Short Answer

Donald Trump has a tower consisting of 0.00405×10^{45} grams of gold. How many kilograms of gold is in his tower? Express in scientific notation.

Bonus Answer: 4.05×10^{39} (kilograms of gold)

3. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following statements is NOT true for the element of sodium?

- W) It has an oxidation state of +1
- X) It forms a basic solution with water
- Y) It gives off a bright red color when burned
- Z) It reacts with a halogen to form a salt

Toss Up Answer: Y

Bonus: Short Answer

Which of the following are products made from the reaction $\text{H}_2\text{SO}_4(\text{aq}) + \text{Ba}(\text{OH})_2(\text{aq}) \rightarrow ?$ I) $\text{O}_2(\text{g})$ II) $\text{H}_2\text{O}(\text{l})$ III) $\text{BaSO}_4(\text{s})$

Bonus Answer: II and III

4. EARTH and SPACE

Writer: Matthew Lee

Toss Up: Multiple Choice

Which of these factors has the least influence on the velocity of a stream?

- W) discharge
- X) channel shape
- Y) roughness of stream bottom
- Z) gradient

Toss Up Answer: Y

Bonus: Multiple Choice

Where does water flow fastest in the meanders of a stream?

- W) near the inside of the stream bend
- X) near the outside of the stream bend
- Y) near the center of the stream
- Z) the velocity is equal everywhere

Bonus Answer: X

5. 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

6. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

How is oxygen transported in blood?

- W) It is dissolved in the blood
- X) It is carried by hemoglobin on white blood cells
- Y) It is carried by hemoglobin on red blood cells
- Z) It is carried by hemoglobin on platelets

Toss Up Answer: Y

Bonus: Short Answer

By name or by number, identify which of the following ways carbon dioxide can be transported in blood?

1. It can be dissolved in the blood
2. It can be carried by hemoglobin on white blood cells
3. It can be carried by hemoglobin on red blood cells
4. It can be carried by hemoglobin on platelets

Bonus Answer: 1 & 3

7. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

Who did not have a unit of electrical measurement named after him?

- W) Voltaire
- X) Georg Ohm
- Y) Andre Ampere
- Z) Charles Coulomb

Toss Up Answer: W

Bonus: Short Answer

It converts electrical energy into electromagnetic radiation and vice versa. Name this device designed to transmit and receive radio waves.

Bonus Answer: Antenna

8. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

Which of the following processes in cellular respiration produce the most ATP

- W) Glycolysis
- X) Link Reaction
- Y) Krebs Cycle
- Z) Oxidative Phosphorylation

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following is not used in cellular respiration

- W) Glucose
- X) NADH
- Y) FADH₂
- Z) NADPH

Bonus Answer: Z

9. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

What does Pauli's Exclusion Principle state?

- W) Electrons of an atom must have the same spin
- X) No two electrons of an atom travel in the same orbital
- Y) no two electrons in an atom can be at the same time in the same state or configuration
- Z) Electrons can switch spin automatically

Toss Up Answer: Y

Bonus: Short Answer

What law states that electrons in the same orbitals reorganize themselves to maximize spin?

Bonus Answer: Hund's law

10. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is true?

W) -1 is congruent to 1 modulo 5

X) -1 is congruent to 2 modulo 5

Y) -1 is congruent to 3 modulo 5

Z) -1 is congruent to 4 modulo 5

Toss Up Answer: Z

Bonus: Short Answer

Which is larger, 8^{10} or 3^{30}

Bonus Answer: 3^{30}

11. 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

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

12. BIOLOGY

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

The chromosomes responsible for characteristics other than sex are known by what name?

Bonus Answer: Autosomes

Bonus: Short Answer

What is the term given to enzymes whose action is modulated by binding of a molecule to a site other than the active site?

Bonus Answer: allosteric enzymes

13. MATHEMATICS

Writer: Aaron Gee

Toss Up: Multiple Choice

Solve the following equation for x:

$$x^2 - 20x + 19 = 0$$

W) 9, 10

X) 10 and 9

Y) 21 and 19

Z) 19 and 1

Toss Up Answer: Z

Bonus: Short Answer

Convert log base 4 of 53 into a base 10 expression:

Bonus Answer: $\log 53 / \log 4$

14. 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}

15. CHEMISTRY

Writer: Janine Goh

Toss Up: Short Answer

Which group of the periodic table has a fully filled d orbital?

Bonus Answer: Group 12

Bonus: Short Answer

Name 2 elements that behave both as a metal and non-metal

Bonus Answer: Any 2: Boron, silicon, germanium, arsenic, antimony, tellurium, (polonium)

16. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Multiple Choice

In the Northern Hemisphere, the Coriolis force deflects in which direction?

W) Up

X) Down

Y) Right

Z) Left

Toss Up Answer: Y

Bonus: Short Answer

What is the altitude of Polaris equal to?

Bonus Answer: Your latitude

17. 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/s^2

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18. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

What is the main driving force behind all erosion?

Bonus Answer: Gravity

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Bonus: Short Answer

What type of body of water causes erosion to happen quickly?

Bonus Answer: fast flowing streams and rivers

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19. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

What is the wavelength of a 5 Hz wave that travels with a speed of 10 m/s ?

W) 0.25 m

X) 0.5 m

Y) 1 m

Z) 2 m

Toss Up Answer: Z

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Bonus: Short Answer

A string, fixed at both ends, supports a standing wave with a total of 4 nodes. If the length of the string is 6 m, what is the wavelength of the wave?

Bonus Answer: 4 m

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20. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

What determines a mineral's properties?

Bonus Answer: The internal arrangement of its atoms.

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Bonus: Short Answer

What type of currents cause plates to move in the mantle?

Bonus Answer: Convection currents

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21. PHYSICS

Writer: Shihab Karim

Toss Up: Multiple Choice

As defined in physics, speed is:

W) a vector quantity

X) always negative

Y) always zero

Z) always positive

Toss Up Answer: Z

Bonus: Multiple Choice

Electric current may be expressed in which one of the following units?

- W) joules/coulomb
- X) coulombs/second
- Y) coulombs/volt
- Z) ohms/second

Bonus Answer: X

22. EARTH and SPACE

Writer: George Papastefanou

Toss Up: Multiple Choice

How is the ISS powered?

- W) Solar Energy from photovoltaic cells
- X) Nuclear Power
- Y) A combination of solar energy and nuclear power
- Z) Rocket fuel

Toss Up Answer: W

Bonus: Short Answer

Who was the first American astronaut in space?

Bonus Answer: Alan Shepard

23. BIOLOGY

Writer: Matthew Lee

Toss Up: Multiple Choice

A person with type A blood has children with a person with type AB blood. What possible blood types can their offspring be?

- W) A only
- X) A and AB
- Y) A, B, and AB
- Z) A, AB, and O

Toss Up Answer: Y

Bonus: Multiple Choice

What sex chromosome system determines gender in birds?

- W) X-Y system
- X) X-0 system (read as X-zero)
- Y) Z-W system
- Z) haplo-diploid system

Bonus Answer: Y

24. EARTH and SPACE

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

What element accounts for the second-most percentage of volume of the Earth's crust?

- W) Oxygen
- X) Calcium
- Y) Potassium
- Z) Silicon

Toss Up Answer: Z

Bonus: Short Answer

Give four pieces of information that would be present on a typical weather map.

Bonus Answer: Any four of the following: Temperature, visibility, weather or weather conditions, dew point, wind speed, wind direction, pressure or barometric pressure, precipitation, and cloud cover

25. BIOLOGY

Writer: Olivia Gallager

Toss Up: Short Answer

What part of the brain controls the interaction between the two hemispheres?

Bonus Answer: corpus callosum

Bonus: Short Answer

Which lobe of the brain is known for spatial reasoning and navigation?

Bonus Answer: parietal lobes
