

Round 23

1. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

Which of the following is NOT true?

- W) the magnetic field associated with the current on a straight long wire is inversely proportional to the distance from the wire
- X) Kirchhoff's first rule has to do with the accounting of total charges entering and leaving a junction per unit time
- Y) superconducting quantum interference devices, or SQUID's, are based on the Josephson Effect
- Z) resistance and voltage are the two most common parameters used to characterize a resistor

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following is the strongest spectral line in the visible region of the hydrogen spectrum

- W) red Balmer line
- X) orange Lyman line
- Y) green Paschen line
- Z) blue Brackett line

Bonus Answer: W

2. 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: Y

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

3. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

If 1000 pounds is applied to a spring with spring constant of 100 pounds per inch on top of a hydraulic piston, how many pounds of force is transferred to the piston?

Bonus Answer: 1000

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 500 kilogram table of granite moving across a horizontal surface at constant speed if there is a kinetic frictional coefficient of 0.10 between the surface and the table?

Bonus Answer: 490 N

4. EARTH and SPACE

Writer: Olivia Gallager

Toss Up: Short Answer

How many planets in our solar system have moons?

Bonus Answer: 6

Bonus: Short Answer

What layer of the atmosphere lies between the troposphere and mesosphere?

Bonus Answer: Stratosphere

5. CHEMISTRY

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following reactions is expected to produce a precipitate?

W) $\text{CdSO}_4 + \text{K}_2\text{S} \rightarrow \text{CdS} + \text{K}_2\text{SO}_4$

X) $\text{CoCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{CoSO}_4 + \text{NaCl}$

Y) $\text{HI} + \text{Zn}(\text{NO}_3)_2 \rightarrow \text{ZnI}_2 + \text{H}(\text{NO}_3)_2$

Z) $\text{Pb}(\text{NO}_3)_2 + \text{K}_2\text{SO}_4 \rightarrow 2\text{KNO}_3 + \text{PbSO}_4$

Toss Up Answer: W

Bonus: Short Answer

Name the precipitate for the following reaction: $3\text{CaCl}_2 + 2\text{Na}_3\text{PO}_4 \rightarrow ? + ?$

Bonus Answer: $\text{Ca}_3(\text{PO}_4)_2$ (Calcium Phosphate)

6. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Multiple Choice

Find the points of intersection of the following curves:

$y = \sqrt{x^2 - x + 29}$

$y = x + 2$

W) (5,7)

X) $(\sqrt{2} - 1, \sqrt{2} + 1)$

Y) $(\sqrt{29} - 1, \sqrt{29} + 1)$

Z) (2,4)

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following expressions is not divisible by 9

W) $5^3 + 7^3$

X) $4^5 + 2^5$

Y) $10^3 - 7^3$

Z) $9^7 - 6^7$

Bonus Answer: W

7. CHEMISTRY

Writer: Hanna Yang

Toss Up: Short Answer

What element is mixed with gold to make rose gold / pink gold?

Bonus Answer: Copper

Bonus: Short Answer

What two elements are mixed with gold to make white gold?

Bonus Answer: Silver and Copper

8. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

If the atomic mass of carbon-12 is exactly 12 atomic mass units, why is the atomic mass of carbon not exactly 12 when listed on the Periodic Table?

- W) mass deficit
- X) neutrons are not the same mass as protons
- Y) it adds mass of electrons
- Z) the presence in nature of about 1.1% carbon-13

Toss Up Answer: Z

Bonus: Short Answer

If 2500 pounds is applied to a spring with spring constant of 100 pounds per inch on top of a hydraulic piston, how many pounds of force is transferred to the piston:

Bonus Answer: 2500

9. MATHEMATICS

Writer: Hussain Waris

Toss Up: Multiple Choice

What conic section is described by the following: the intersection of a cone and some plane parallel to that cone's side such that that intersection is non-empty?

- W) Circle
- X) Parabola
- Y) A point
- Z) Ellipse

Toss Up Answer: X

Bonus: Short Answer

Respectively, give the vertex and the focus of the following parabola: $(y - 3)^2 = 8(x - 5)$?

Bonus Answer: vertex: (5,3); focus: (7,3)

10. CHEMISTRY

Writer: Josh Tish

Toss Up: Multiple Choice

A 20.0 g sample of mercury(II) oxide is heated strongly, causing it to decompose to metallic Hg and O₂ gas. What volume of O₂ gas is produced (measured at STP)?

- W) 1.03 L
- X) 2.07 L
- Y) 4.14 L
- Z) 14.0 L

Toss Up Answer: W

Bonus: Multiple Choice

When 30.0 mL of 0.10 M AgNO₃ is added to 30.0 mL of 0.10 M NaCl, aqueous NaNO₃ and solid AgCl are formed. How much solid AgCl is produced?

- W) 0.0030 mol
- X) 0.0060 mol
- Y) 0.030 mol
- Z) 0.060 mol

Bonus Answer: W

11. MATHEMATICS

Writer: Hussain Waris

Toss Up: Multiple Choice

Which of the following best characterizes every transcendental number?

- W) Irrational
- X) A linear combination of e or pi in which the coefficients are non-zero
- Y) A real number that is not a root of any non-zero polynomial with rational coefficients
- Z) e or pi

Toss Up Answer: W

Bonus: Short Answer

Which of the following numbers are transcendental numbers: 1) e; 2) sqrt(2); 3) iⁱ; 4) pi?

Bonus Answer: e, iⁱ, pi [Accept any permutation of 1, 3, and 4]

12. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Glycoproteins are mainly created by ribosomes attached to which structure?

Bonus Answer: the rough endoplasmic reticulum (accept: rough ER; do NOT accept: ER or endoplasmic reticulum)

Bonus: Short Answer

Drugs like barbiturates commonly increase the size of which endomembrane organelle?

Bonus Answer: the smooth endoplasmic reticulum

13. CHEMISTRY

Writer: Josh Tish

Toss Up: Multiple Choice

How much Sr(OH)₂ • 8 H₂O (M = 265.76) is needed to prepare 250.0 mL of solution in which [OH⁻] = 0.100 M?

- W) 3.32 g
- X) 6.64 g
- Y) 9.97 g
- Z) 13.3 g

Toss Up Answer: W

Bonus: Multiple Choice

A 10.00 g sample of a compound containing only carbon, hydrogen, and oxygen forms 23.98 g CO₂ and 4.91 g H₂O

upon complete combustion. What is the empirical formula of the compound?

- W) C₂H₂O
- X) C₃H₃O
- Y) C₆H₃O₂
- Z) C₆H₆O

Bonus Answer: X

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14. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

The double membranes found in mitochondria and chloroplasts suggest which of the following?

- W) mitochondria and chloroplasts are part of the endomembrane system
- X) the endosymbiont theory
- Y) chloroplasts evolved before mitochondria
- Z) chloroplasts and mitochondria are capable of synthesizing their own proteins

Toss Up Answer: X

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Bonus: Short Answer

The light reactions occur in which part of the chloroplast?

Bonus Answer: the thylakoid (or thylakoid membrane)

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15. 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

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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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16. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Protein digestion in humans begins in the

- W) mouth
- X) stomach
- Y) small intestine
- Z) large intestine

Toss Up Answer: X

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Bonus: Short Answer

Which protein is responsible for protein digestion in the stomach?

Bonus Answer: pepsin (DO NOT accept: pepsinogen)

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17. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

e Often some of the strongest spectral lines in cold interstellar gas are produced by

W) neutral lithium

X) ionized iron

Y) carbon and iron

Z) calcium and sodium

Toss Up Answer: Z

Bonus: Short Answer

The cosmic background radiation discovered by Penzias and Wilson closely matches the radiation from a black body with what temperature Kelvin, to the nearest whole number?

Bonus Answer: 3

18. EARTH and SPACE

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

At above what size does a rock need to be in order to be a boulder?

W) 15.3

X) 25.6

Y) 40.2

Z) 22.9

Toss Up Answer: X

Bonus: Short Answer

At which two zones of Earth's atmosphere does the temperature rise as the altitude increases?

Bonus Answer: Stratosphere and Thermosphere

19. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

The process in which an atom reradiates a photon after interacting with an incident photon of the same energy is called:

W) Cooleo Theorem

X) the Cherenkov effect

Y) Bragg's Law

Z) Thomson scattering

Toss Up Answer: Z

Bonus: Multiple Choice

A protanomalous person has decreased sensitivity of the red cones

in his or her eyes. Which of the following color pairs will this person have difficulty distinguishing between:

W) black and yellow

X) blue green

Y) purple blue

Z) red and yellow

Bonus Answer: Y

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20. CHEMISTRY

Writer: Josh Tish

Toss Up: Multiple Choice

Which of the following is a nonelectrolyte in aqueous solution?

W) H₂SO₄

X) NaC₂H₃O₂

Y) K₂CO₃

Z) CH₂O

Toss Up Answer: Z

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Bonus: Multiple Choice

An aqueous solution of potassium sulfate has a freezing point of -2.24 °C. What is its molality?

(K_f = 1.86 °C·m⁻¹)

W) 0.401 m

X) 0.602 m

Y) 1.20 m

Z) 4.17 m

Bonus Answer: W

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21. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

In which two process of cellular does carbon dioxide released?

Bonus Answer: Co₂ is released in the link reaction and in the Krebs cycle.

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Bonus: Short Answer

What type of acid do birds excrete?

Bonus Answer: Uric acid.

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22. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

What type of endocytosis is used when it uses pseudopods to move cells between membranes?

Bonus Answer: Receptor mediated endocytosis.

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Bonus: Multiple Choice

How can small intestine increase its surface area?

W) Rugae

X) Villi

Y) Cecae

Z) Sphincters

Bonus Answer: X

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23. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

Which plant tissue conducts water from the roots to the leaves?

Bonus Answer: Xylem

Bonus: Multiple Choice

Which system rids of nitrogenous waste?

W) Digestive system

X) Integumentary system

Y) Respiratory system

Z) Urinary system

Bonus Answer: Z

24. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

Why do we need oxygen for cellular respiration?

Bonus Answer: Oxygen is the final electron acceptor for cellular respiration.

Bonus: Short Answer

How are saturated fat and unsaturated fat different?(refer to bonds)

Bonus Answer: Saturated fats are single bonded, and straight. Unsaturated fats are double bonds and curved.

25. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

What type of cell are chromosomes located in the nucleus?

Bonus Answer: Eukaryotes.

Bonus: Short Answer

Meiosis of a diploid cell results in_

Bonus Answer: 4 haploid cells.
