

Round 10

1. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A box is initially at rest on a horizontal, frictionless table. If a force of 10 Newtons acts on the box for 3 seconds, what is the momentum of the box at the end of the 3 second interval?

Bonus Answer: 30 N (newton) seconds

Bonus: Short Answer

A 10 kilogram body initially moving with a velocity of 10 meters per second makes a head-on collision with a 15 kilogram body initially at rest. The two objects stick together. What is the velocity of the combined system just after the collision?

Bonus Answer: 4 meters per seconds

2. CHEMISTRY

Writer: Janine Goh

Toss Up: Short Answer

Which group of elements has the lowest ionization energy?

Bonus Answer: Alkali metals

Bonus: Short Answer

What are the elements in group 15 called?

Bonus Answer: Pnictogens

3. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Given the following choices chose the one that best presents the layers of the earth's atmosphere from lowest to highest altitude.

- W) Thermosphere, Mesosphere, Stratosphere, Troposphere
- X) Mesosphere, Thermosphere, Stratosphere, Troposphere
- Y) Troposphere, Stratosphere, Mesosphere, Thermosphere
- Z) Stratosphere, Troposphere, Thermosphere, Mesosphere

Toss Up Answer: Y

Bonus: Multiple Choice

There are various different particle sizes when dealing with sediments. What is the approximate particle size range of sand?

- W) 2 - 4 mm
- X) 1/16 - 2 mm
- Y) 1/256 - 1/16 mm
- Z) 4 - 64 mm

Bonus Answer: X

4. PHYSICS

Writer: Mohammed Jamil

Toss Up: Multiple Choice

Which statement describes a situation when polarization could not occur?

- W) Light waves are reflected.
- X) Light waves are scattered.
- Y) Microwaves pass through a metal grid.
- Z) Sound waves pass through a metal grid.

Toss Up Answer: Z

Bonus: Multiple Choice

An electromagnetic wave has a wavelength that is numerically of the same order of magnitude as the diameter of a nucleus.

In which region of the electromagnetic spectrum does the wave occur?

- W) Gamma ray
- X) X-ray
- Y) Visible light
- Z) Infra-red

Bonus Answer: W

5. 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

6. 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

7. CHEMISTRY

Writer: Shihab Karim

Toss Up: Multiple Choice

Which of the one of the following salts is insoluble?

W) NH_4Cl

X) $\text{Ca}(\text{NO}_3)_2$

Y) BaCO_3

Z) Na_2S

Toss Up Answer: Y

Bonus: Short Answer

What is the empirical formula for glucose?

Bonus Answer: CH_2O

8. MATHEMATICS

Writer: William Xiang

Toss Up: Short Answer

Find the integral of $2x^3 + 2$ with respect to x in simplest terms.

Bonus Answer: $(x^4)/2 + 2x$

Bonus: Multiple Choice

Which of the following is a conic section?

W) Cylinder

X) Triangle

Y) Hyperbola

Z) Asymptote

Bonus Answer: Y

9. CHEMISTRY

Writer: Hanna Yang

Toss Up: Short Answer

Name the most reactive nonmetal.

Bonus Answer: Fluorine

Bonus: Short Answer

Name the transition metal whose carbide is known to be one of the hardest, is used in drills, saws, and lightbulbs, and has the highest melting point of all pure metals.

Bonus Answer: Tungsten

10. PHYSICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

A car accelerates from rest at 4 (m/s)^2 . What is the distance traveled by the car in 3 seconds?

Bonus Answer: 18 meters (m)

Bonus: Multiple Choice

A motor scooter travels east at a speed of 13 m/s. The driver then reverses direction and heads west at 17 m/s. What was the change in velocity of the scooter?

W) 13 m/s

X) 17 m/s

Y) 30 m/s

Z) 4 m/s

Bonus Answer: Y

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11. 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

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Bonus: Multiple Choice

Which of the following is not used in cellular respiration

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

Bonus Answer: Z

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12. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What German physicist developed the 2nd law of thermodynamics, showing that the universe's entropy always increases?

- W) Wilhelm Röntgen
- X) Rudolf Clausius
- Y) Wilhelm Weber
- Z) Hermann von Helmholtz

Toss Up Answer: X

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Bonus: Multiple Choice

What German physicist, who died in 1855, formulated separate electrostatic and electrodynamical laws?

- W) James Clerk Maxwell
- X) Johann Gauss
- Y) Frederick Beck
- Z) Max von Laue

Bonus Answer: X

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13. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the name of Uranus' smallest moon, which is best known for the idea that it was shattered in a collision billions of years ago and reformed?

Bonus Answer: Miranda

Bonus: Short Answer

Which two moons in the solar system are bigger than the smallest planet?

Bonus Answer: Ganymede and Titan

14. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of these is not a viral disease?

W) Dutch elm disease

X) Yellow fever

Y) Mumps

Z) Rubella

Toss Up Answer: W

Bonus: Short Answer

In which viral reproductive cycle is the viral DNA incorporated into the host DNA?

Bonus Answer: Lysogenic

15. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What comet was the first one recognized by astronomers to be periodic, with a period of roughly 76 years?

Bonus Answer: Halley's Comet

Bonus: Short Answer

Located between the A and B rings of Saturn, what famous region stretches 4800 km and is characterized by a lack of material?

Bonus Answer: Cassini Division

16. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following is the most electronegative element?

W) Carbon

X) Vanadium

Y) Selenium

Z) Fluorine

Toss Up Answer: Z

Bonus: Short Answer

What is the name given to the hybrid orbital created with a steric number of 3?

Bonus Answer: $2sp^2$

17. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Select all of the following ways in which the mucosal epithelia protect the body against disease.

1) act as a barrier

- 2) trap pathogens
- 3) secrete antimicrobial peptides

Bonus Answer: 1, 2, 3

Bonus: Multiple Choice

Which of the following is not involved in the innate immune defense of the intestinal tract?

- W) beta-defensins
- X) alpha-defensins
- Y) commensal bacteria
- Z) cryptidins

Bonus Answer: W

18. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

Describe the expression $2 \log_3 x + \log_3 5$ as a single logarithmic expression

Bonus Answer: $\log_3 (5x^2)$

Bonus: Short Answer

Solve the equation $2|3x - 2| - 3 = 7$

Bonus Answer: $x = (7/3), -1$

19. BIOLOGY

Writer: Elias Milborn

Toss Up: Short Answer

What is the main respiratory pigment of skeletal muscle cells?

Bonus Answer: Myoglobin

Bonus: Multiple Choice

If a parent organism experiences a mutation, then all subsequent offspring of that individual will:

- W) always carry the mutated gene, but only as a recessive.
- X) Always carry the gene, but never express it phenotypically
- Y) only carry the mutated gene if it is heritable
- Z) never carry the gene as mutations can never be heritable

Bonus Answer: Y

20. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the amplitude of $y=4\sin(5x+3)$

Bonus Answer: 4

Bonus: Short Answer

What is the period of $y=4\sin(5x+3)$ rounded to the nearest 100th

Bonus Answer: 1.26

21. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which gland releases the antidiuretic hormone into the bloodstream?

- W) pituitary
- X) hypothalamus
- Y) pancreas
- Z) testes

Toss Up Answer: W (EXPLANATION: Although ADH is synthesized from the hypothalamus, it is secreted (released) from the posterior pituitary.)

Bonus: Multiple Choice

Which part of the heart functions as a pacemaker?

- W) AV node
- X) Purkinje fibers
- Y) SA node
- Z) Bundle of His

Bonus Answer: Y

22. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

Compute: $\sqrt{(3^4 \cdot 5 - 60)^2}$

Bonus Answer: 0

Bonus: Short Answer

Compute $(\frac{34}{17} - 2 + 5) * (96 + -144) * (\frac{1}{46 - \frac{130}{5}})$

Bonus Answer: -12

23. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Asexual prokaryotic cell division occurs via which process?

Bonus Answer: binary fission

Bonus: Multiple Choice

Mitosis in protists differ from other forms of eukaryotic mitosis in which way?

- W) Microtubules attach to the chromosome kinetochores.
- X) Chromosomes are condensed in prophase.
- Y) The nuclear envelope is not disassembled and remains intact throughout the process.
- Z) Sister chromatids cross over.

Bonus Answer: Y

24. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

An electron travels 45 degrees north of east in a magnetic field which points 45 degrees west of north. In what direction does the magnetic force acting on the electron points?

Bonus Answer: Down

Bonus: Short Answer

A 2C charge travels through a magnetic field $B = 6i + 15j + 9k$ with velocity $v = 2i + 5j + 3k$. What is the magnetic force acting on the charge?

Bonus Answer: 0
