

Round 19

1. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A 10 farad capacitor is used in a circuit. The voltage difference between the plates of the capacitor is 20 volts. What is the magnitude of the charge on each of the capacitor's plates?

Bonus Answer: 200 Coloumbs

Bonus: Multiple Choice

A circuit which employs a DIRECT CURRENT source has a branch which contains a capacitor. After the circuit has reached a steady state, what is the magnitude of the current in the circuit branch which contains the capacitor?

- W) 0
- X) havled
- Y) doubled
- Z) infinity

Bonus Answer: W

2. 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: $37(x-1)/(x+1)$

3. EARTH and SPACE

Writer: Yae June Lee

Toss Up: Multiple Choice

What is the relationship between size of a particle and the capillarity of soil?

- W) As soil particle increases, capillarity increases.
- X) As soil size increases, capillarity decreases.
- Y) As soil size increases, capillarity stays the same.
- Z) As soil size increases, the capillarity curves in a parabola.

Toss Up Answer: X

Bonus: Short Answer

Why do polar jet streams vary throughout the seasons?

Bonus Answer: The rays of the sun shift north of the equator during the summer.

4. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Name all of the following that are amphipathic: I) integral proteins, II) cholesterol, III) phospholipids, IV) triacylglycerol, V) mannose

Bonus Answer: I and III only (integral proteins and phospholipids)

Bonus: Multiple Choice

Which of the following is not true about a part of the phospholipid?

W) They contain two fatty acid chains.

X) Their heads contain a net charge.

Y) They have a phosphate group in their heads.

Z) They have a choline group in their heads.

Bonus Answer: X

5. PHYSICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the third derivative of displacement with respect to time

Bonus Answer: Jerk

Bonus: Short Answer

What is the fourth derivative of displacement with respect to time

Bonus Answer: jounce or snap

6. EARTH and SPACE

Writer: Benjamin Avrahami

Toss Up: Short Answer

From least to greatest, order these minerals in order of pressure needed to create it: Schist, Phyllite, Gneiss, Slate

Bonus Answer: 4,2,1,3

Bonus: Short Answer

During what era did oxygen begin to enter the atmosphere in abundance?

Bonus Answer: Early Proterozoic or Proterozoic

7. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

Who is credited with the discovery of the neutron in 1932?

Bonus Answer: James Chadwick (accept: Chadwick)

Bonus: Short Answer

Who patented the common dry cell?

Bonus Answer: GEORGES LECLANCHÉ (accept: LECLANCHÉ)

8. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

The mass of the planet Yor'Ectum is 1/100 that of Earth and its radius is 1/4 that of Earth. If a person weighs 600N on Earth, what would he weigh on Yor'Rectum?

Bonus Answer: 96N

Bonus: Multiple Choice

The escape speed at the surface of Earth is approximately 8 km/s. What is the mass, in units of Earth's mass, of a planet with twice the radius of Earth for which the escape speed is twice that for Earth?

- W) 2
- X) 4
- Y) 8
- Z) 1/2

Bonus Answer: Y

9. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

The fundamental cause of sickle-cell anemia is a change in the structure of

- W) blood
- X) capillaries
- Y) red blood cells
- Z) hemoglobin

Toss Up Answer: Z

Bonus: Multiple Choice

Which regulatory chemical stimulates gastric gland activity and motility?

- W) Secretin
- X) Gastrin
- Y) Leptin
- Z) Histamine

Bonus Answer: X

10. EARTH and SPACE

Writer: Shanjeed Ali

Toss Up: Multiple Choice

Where is the Great Rift Valley located?

- W) Western Africa
- X) Eastern Asia
- Y) Eastern Africa
- Z) Western Asia

Toss Up Answer: Y

Bonus: Multiple Choice

Which of these countries does the Great Rift Valley not run through?

- W) Tanzania
- X) Kenya
- Y) Burundi
- Z) Angola

Bonus Answer: Z

11. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the slope of a line parallel to $45x=9y+5$?

Bonus Answer: 5

Bonus: Multiple Choice

How many vertical asymptotes does $f(x)=(x^2+2x+1)/(x^3-x)$ have?

W) 0

X) 1

Y) 2

Z) 3

Bonus Answer: Y

12. EARTH and SPACE

Writer: Jan Wojcik

Toss Up: Short Answer

Name the soil horizon that contains a mixture of organic matter and highly altered mineral matter and is dark in color.

Bonus Answer: A-horizon

Bonus: Short Answer

By name or number, which of the following phenomena cause acidification in agricultural soils:

1) Leaching of excess nitrate

2) Build-up in mostly plant-based organic matter

3) Removal of plant and animal products

4) Addition of nitrogen based fertilisers

Bonus Answer: All of them (accept 1,2,3,4)

13. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

What do the numbers in the n th row of Pascal's Triangle sum to?

Give your answer in terms of n .

W) $2n$

X) 2^n

Y) n^2

Z) n^3

Toss Up Answer: X

Bonus: Multiple Choice

Find the number of ordered pairs (a,b) , where a and b are nonnegative integers, such that $a+b=10$.

W) 100

X) 10

Y) 11

Z) 12

Bonus Answer: Y

14. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

Which famous astronomer created the "dirty snowball" hypothesis for comets, saying that comets were icy objects containing some dust and rock?

- W) Fred Whipple
- X) Fred Hoyle
- Y) Carl Sagan
- Z) Clyde Tombaugh

Toss Up Answer: W

Bonus: Short Answer

Which comet was dubbed the comet of the 20th century, reaching an absolute magnitude value of -0.8 at perihelion?

Bonus Answer: Comet Hale-Bopp

15. PHYSICS

Writer: Mohammed Jamil

Toss Up: Multiple Choice

A loaded freight car A with a mass of 14,000 kg moves at a constant velocity of 15 m/s on a horizontal railroad track and collides with an empty car B with a mass of 6,000 kg moving at 5 m/s. After the collision the cars stick to each other and moves like one object. What is the velocity of two cars after the collision?

- W) 6 m/s
- X) 8 m/s
- Y) 10 m/s
- Z) 12 m/s

Toss Up Answer: Z

Bonus: Multiple Choice

When two objects collide elastically the momentum is conserved. Which of the following is true about the kinetic energy during the collision?

- W) The kinetic energy is lost
- X) The kinetic energy is gained
- Y) The kinetic energy is conserved
- Z) The kinetic energy completely transforms into thermal energy

Bonus Answer: Y

16. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Given the pressure and temperature of gas A and the temperature of gas B, which law would be most efficient in determining the pressure of gas B?

- W) Gay-Lussac's Law
- X) Boyle's Law
- Y) Charles's Law
- Z) Combined Gas Law

Toss Up Answer: W

Bonus: Short Answer

What is the metric equivalence of 760 mm Hg?

Bonus Answer: 101325 Pascals

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17. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A helicopter is ascending vertically with a constant speed of 6 meters per second relative to the ground. At the instant the helicopter is 60 meters above the ground it releases a package.

What is the magnitude and direction of the velocity of the package, relative to the ground, the instant the package is released by the helicopter?

Bonus Answer: 6 meters/second up

Bonus: Multiple Choice

If the resultant force acting on a body of constant mass is zero, the body's momentum is

- W) increasing
- X) decreasing
- Y) always 0
- Z) Constant!

Bonus Answer: Z

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18. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What is the process of electrons being shuttled between Photosystem I and the cytochrome complex called?

Bonus Answer: cyclic electron flow

Bonus: Multiple Choice

In linear electron flow during the light reactions, electrons shuttled by Plastocyanin reduce what molecule?

- W) P700
- X) P680
- Y) Plastoquinone
- Z) Ferredoxin

Bonus Answer: W

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19. 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

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20. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

What do the Neon, Fluorine(1-) and Magnesium(2+) have in common?

- W) They are isotopes of each other
- X) They are isomers of each other
- Y) They are isoelectronic with each other
- Z) They have nothing in common

Toss Up Answer: Y

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Bonus: Multiple Choice

The half-life of francium-212 is 19 minutes. How many minutes will it take for 1 gram of this isotope to decay to 0.125 grams?

- W) 4.75 min
- X) 9.5 min
- Y) 38 min
- Z) 57 min

Bonus Answer: Z

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21. EARTH and SPACE

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Which of the following is a local base level?

- W) Lake
- X) point bar
- Y) alluvial fan
- Z) floodplain

Toss Up Answer: Z

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Bonus: Multiple Choice

The dry lake beds in many deserts are

- W) playas
- X) pediments
- Y) bajadas
- Z) mesas

Bonus Answer: W

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22. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the element formed by the beta decay of Carbon-14?

Bonus Answer: Nitrogen-14

Bonus: Short Answer

If the abundance of Lithium-6 (6.0 amu) is 7.500% and the abundance of Lithium-7 (7.0 amu) is 92.500%, what is the average atomic mass to the tenth place?

Bonus Answer: 6.9 amu

23. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What molecule is the phosphorylated intermediate of the ATP-coupled reaction derived from?

The reaction is glutamic acid + ammonia \rightarrow glutamine. The free energy change is +3.4 kcal/mol.

Bonus Answer: Glutamic Acid

Bonus: Short Answer

The evolution of enzymes was traced in an experiment with E. coli. What enzyme was mutated in the experiment?

Bonus Answer: beta-galactosidase

24. CHEMISTRY

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following statements is true?

- W) Hydrogen peroxide has a planar structure
- X) Tritium is radioactive and emits alpha particles
- Y) H₂ is insoluble in water
- Z) Hydrogen constitutes 70% of the Earth's crust by mass

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following gas mixtures is not applicable to Dalton's law of Partial Pressures?

- W) CO₂ and N₂
- X) CO₂ and CO
- Y) SO₂ and O₂
- Z) N₂ and CO

Bonus Answer: Y

25. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Mutation in which of the following types of genes is least likely to result in higher chances of developing cancer?

- W) oncogene
- X) tumor suppressor gene
- Y) proto-oncogene
- Z) tumor necrosis factor gene

Toss Up Answer: Z

Bonus: Short Answer

Rearrange the following list of the structures of a nephron in the order in which filtrate flows through them:

1. proximal convoluted tubule
2. ascending limb of Loop of Henle
3. distal convoluted tubule
4. collecting duct
5. Bowman's capsule
6. descending limb of Loop of Henle

Bonus Answer: 5, 1, 6, 2, 3, 4

***A list of the structures or the correct reordering of the numbers assigned to each structure are valid answers**
