

Round 37

1. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

Two forces have magnitudes of 11 newtons and 5 newtons. What's the highest value of their magnitude?

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

2. 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) Infinity
- Y) Nonexistant
- Z) 1

Bonus Answer: W

3. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

An infinitely long wire carries a current of three amps. How does the magnetic field outside the wire look like?

Bonus Answer: Circles the wire

Bonus: Short Answer

Iron is what type of magnetic material?

Bonus Answer: ferromagnetic

4. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A charged particle is moving in a UNIFORM magnetic field. If the direction of motion of the charged particle is parallel to the magnetic field, describe the shape of the charged particle's path.

Bonus Answer: Straight line

Bonus: Multiple Choice

For a parallel-plate capacitor with plate area "A" and plate separation "d", the capacitance is proportional to which of the following?

- W) A/d squared
- X) A times d
- Y) A divided by d
- Z) d divided by A

Bonus Answer: Y

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5. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

To determine if a rigid body is in equilibrium the vector sum of the gravitational forces acting on the particles of the body can be replaced by a single force acting at which point?

- W) the center of mass
- X) the geometrical center
- Y) the center of gravity
- Z) a point on the boundary

Toss Up Answer: Y

Bonus: Short Answer

A uniform 120-N plank is supported by two forces acting at one end and at a point halfway to the plank center. What are the magnitudes of these two forces?

Bonus Answer: 80, 160

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6. MATHEMATICS

Writer: Nten Nylam

Toss Up: Short Answer

What is the greatest common factor of $12x^3 + 171x^2 + 516x$

Bonus Answer: $3x$

Bonus: Short Answer

If 50% of x is equal to 25% of y , and 40% of y is equal to 60% of z , then what percent of z is x ?

Bonus Answer: 75%

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7. MATHEMATICS

Writer: Banpreet Singh

Toss Up: Short Answer

What is the derivative of $\tan(x)$

Bonus Answer: $\sec^2(x)$

Bonus: Short Answer

What is the derivative of $\ln(x)$

Bonus Answer: $1/x$

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8. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Find the sum of the first six positive perfect squares.

Bonus Answer: 91

Bonus: Short Answer

Find the sum of the first 7 positive cubes.

Bonus Answer: 784

9. MATHEMATICS

Writer: Nten Nylam

Toss Up: Short Answer

What is the value of $(11! - 10!)/9!$?

Bonus Answer: 100

Bonus: Short Answer

Baker 1 bakes a batch of cupcakes every 20 minutes, Baker 2 bakes a batch of cupcakes every 30 minutes.

Together, how many batches of cupcakes can they bake in 5 hours?

Bonus Answer: 25 batches (NOTE: accept 25)

10. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

Into what common vein does lymph dump into to bring it back into circulation?

Bonus Answer: Subclavian vein

Bonus: Short Answer

Usually, what functional group is added to molecules as part of the detoxification process in the ER to allow it to be urinated out?

Bonus Answer: Hydroxyl Group (OH group)

11. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

What type of circulation is between the heart and the lungs?

Bonus Answer: Pulmonary circulation

Bonus: Short Answer

As what form of ion does carbon dioxide travel as in the blood?

Bonus Answer: Bicarbonate ion (HCO_3^-)

12. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

The group of cells that break down bone cells are collectively called as what?

Bonus Answer: Osteoclast

Bonus: Short Answer

What class of immunoglobulins are present in tears, saliva, etc?

Bonus Answer: IGA

13. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

In plant cells grown in the presence of a metabolic poison that specifically inhibits mitochondrial F1 ATP synthase, one would expect:

- W) the pH difference across the cristae to be greater than normal.
- X) the pH difference across the cristae to be less than normal.
- Y) the electron transport chain to become inoperative.
- Z) oxygen consumption to cease.

Toss Up Answer: W

Bonus: Short Answer

With proofreading, what is approximately the error rate of DNA polymerase?

Bonus Answer: One error in every 10^9 bases.

14. BIOLOGY

Writer: Josh Tish

Toss Up: Short Answer

During the late Carboniferous period, terrestrial arthropods such as Hexapoda, Myriapoda, and Arachnida showed great diversity in form and size. Why are modern day arthropods are much smaller than their Carboniferous ancestors?

Bonus Answer: decreased volume of oxygen in the atmosphere in modern times versus comparatively higher volume of oxygen present during Carboniferous Era

Bonus: Short Answer

Arrange the following five events in the order that explains the bulk flow of substances in the phloem.

1. Sugar moves down the stem.
2. Leaf cells produce sugar by photosynthesis.
3. Sugar is transported from cell to cell via the apoplast and/or symplast.
4. Solutes are actively transported into sieve elements.
5. Water diffuses into the sieve tube elements.

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

15. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

If active transport is inhibited, the passive sodium and potassium ion fluxes across the plasma membrane are still coupled. What makes these two passive ion fluxes dependent on each other?

- W) The membrane potential.
- X) The potassium channels.
- Y) The ratio of cholesterol to phospholipids in the membrane.
- Z) The pumping ratio of the Na^+/K^+ ATPase.

Toss Up Answer: W

Bonus: Multiple Choice

If a carboxylic acid has a pKa of 3.9, what percentage of the functional

group will carry a negative charge at pH 4.9?

- W) 10%
- X) 90.90%
- Y) 9.09%
- Z) 50%

Bonus Answer: X

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16. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

The majority of proteins exist as homo-oligomers rather than hetero-oligomers. Which of the following is not a reason that quaternary structures are homo-oligomers?

- W) Aggregation of identical subunits gives rise to symmetry and possible allosteric interactions.
- X) A slow post-translational process favors a quaternary structure with the homo-oligomers held together by covalent bonds.
- Y) Homodimers may increase binding specificity and stability.
- Z) Homo-oligomerization results in a genetic savings with lower energy demand.

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following is not an action of epinephrine or norepinephrine?

- W) Glycogen broken down to glucose.
- X) Increased gastric motility and secretion.
- Y) Increased blood pressure.
- Z) Increased salivation.

Bonus Answer: X

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17. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Select the description that most correctly describes the term recessive:

- W) A weak phenotype.
- X) An allele that confers a weak phenotype.
- Y) A phenotype conferred when only one copy of an allele is present.
- Z) A phenotype conferred when two copies of an allele are present.

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following interactions is most responsible for the structural stability of soluble globular proteins?

- W) Dipole-dipole interactions.
- X) Electrostatic interactions.
- Y) Hydrogen bonds.

Z) The Hydrophobic Effect.

Bonus Answer: Z

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18. 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)

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19. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the common oxidation state of Radium?

Bonus Answer: +2 (don't accept 2)

Bonus: Short Answer

List the following atoms in order of increasing electron affinity: oxygen, boron, and fluorine.

Bonus Answer: (1) BORON, (2) OXYGEN, (3) FLUORINE

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20. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What element is in all alloys classified as amalgam?

Bonus Answer: Mercury (accept: Hg)

Bonus: Short Answer

You have a solution of 5 molar Sodium Phosphate and need to prepare a solution of 500 millimolar Sodium Phosphate.

How much water would you add to 100 milliliter of the original 5 molar solution to produce the 500 millimolar solution?

Bonus Answer: 900 MILLILITERS (or 0.9 LITERS)

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21. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the most abundant element in the human body by mass?

Bonus Answer: Oxygen

Bonus: Short Answer

What naturally occurring radioactive element is so common in homes that testing for its presence is often advisable?

Bonus Answer: Radon (accept: Rn)

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22. CHEMISTRY

Writer: Shanjeed Ali

Toss Up: Short Answer

Mixing 250 mL of 2.0 M sulfuric acid with 2 liters of 0.5 M sodium hydroxide will produce a solution with what pH?

Bonus Answer: 7

Bonus: Short Answer

Which of the following are strong bases: lithium hydroxide, strontium hydroxide, cesium hydroxide, barium hydroxide?

Bonus Answer: All except cesium hydroxide

23. EARTH and SPACE

Writer: Larry Wong

Toss Up: Short Answer

How many Dwarf planets are in the solar system?

Bonus Answer: 3

Bonus: Short Answer

What is the approximate date for the Earth's formation?

Bonus Answer: 4.5 billion BC

24. EARTH and SPACE

Writer: Ivan Zhang

Toss Up: Multiple Choice

What is the name given to planets that lie within a habitable zone of a star?

W) Extraneous Planets

X) Habitable Planets

Y) Goldilocks Planet

Z) Temperate Planets

Toss Up Answer: Y

Bonus: Short Answer

What is the name given to a cloud of dust and gas in outer space?

Bonus Answer: nebula

25. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What volcano has erupted in the years 79 A.D., 1139, 1631, 1779, 1793, 1872, 1906, and 1944?

Bonus Answer: Vesuvius

Bonus: Short Answer

What is the name of the very old mountain belt located in southern Missouri and Northern Arkansas?

Bonus Answer: the ozarks
