Round 29

1. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

Which of the following is a process used to produce an alternating current in an electric generator?

W) a loop of wire is spun in a magnetic field

X) a loop of wire is pushed in the direction of a magnetic field

Y) a loop of wire is pushed perpendicular to a magnetic field

Z) a magnet is pushed towards a wire

Toss Up Answer: W

Bonus: Short Answer

What is the SI unit for magnetic flux?

Bonus Answer: weber

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2. 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 energ

Bonus Answer: Y

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3. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A bullet travels through the air, it slows down due to air resistance. How does the bullet’s momentum change as a result?

Bonus Answer: The bullet’s momentum decreases as its speed decreases.

Bonus: Short Answer

How can a small force produce a large change in momentum ?

Bonus Answer: A small force can produce a large change in momentum if the force acts on an object for a long period of time.

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4. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A horse moves a sleigh 1.00 kilometer by applying a horizontal 2,000-newton force on its harness for 45 minutes. What is the power of the horse?

Bonus Answer: 741 watts

Bonus: Short Answer

A force of 100 newtons is used to move an object a distance of 15 meters with a power of 25 watts. Find the work done and the time it takes to do the work.

Bonus Answer: work = 1,500 joules; time = 60 seconds

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5. 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

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6. MATHEMATICS

Writer: Aryan Bhatt

Toss Up: Short Answer

What is the sum of the roots of the polynomial f(x)= 3x^2-5x+5?

Bonus Answer: 5/3

Bonus: Short Answer

completely factor 2x^4-16x^2+32

Bonus Answer: 2(x+2)(x+2)(x-2)(x-2)

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7. 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

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8. 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)

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9. 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

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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

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10. 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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11. 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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12. 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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13. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Using accelerator mass spectrometry, the 14C atoms in a 2 mg bone fragment were directly counted and found to be 1/8 of those that would be present in a 2 mg bone fragment in 1950. What is the approximate age of this specimen?

W) 1,540 years
X) B. 5,730 years
Y) C. 17,190 years
Z) D. 22,920 years

Toss Up Answer: Y

Bonus: Multiple Choice

Positive cooperativity is an emergent property of what type of enzymatic regulatory mechanism?

W) Allosteric interactions.
X) Cellular compartmentalization.
Y) Genetic regulatory mechanisms.
Z) Second messenger systems.

Bonus Answer: W

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14. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

The chemical EDTA is routinely used in many experiments. For example, EDTA is used in electrophoresis buffer solutions. Which of the following statements is not true?

W) EDTA has a strong binding affinity for divalent and some trivalent cations.
X) EDTA is a catalyst for polymer formation and essential for protein and nucleic acid polymerization.
Y) EDTA is a chelator.
Z) EDTA is used to help denature proteins and weaken cell membranes.

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following statements is not true?
W) Insects, birds, and many reptiles excrete nitrogenous waste in the form of urea.
X) Neurons have evolved to speed the communication between distant cells in multi-cellular organisms.
Y) Synapses are specialized connections between neurons to facilitate the formation of complex neuronal networks.
Z) The regulatory proteins tropomysin and troponin control the contraction of contractile filaments, actin and myosin.

Bonus Answer: W

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15. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

When the temperature increases, which of the following statements
is not true?
W) Dissolved oxygen decreases at higher temperatures and higher salinity.
X) Many corals die when the temperature exceeds 86°F.
Y) Metabolic reactions are less likely to achieve their activation energy.
Z) The amount of carbon dioxide that can be absorbed by the ocean decreases.

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following carbohydrates contain α-1, 4-linkages?
W) amylose
X) Cellulose
Y) Deoxyarabinose
Z) Glucose

Bonus Answer: W

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16. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

What is the name of the first livestock virus eradicated by a vaccine?
W) Smallpox
X) Polio
Y) Rinderpest
Z) Mumps

Toss Up Answer: Y

Bonus: Short Answer

By mass, what element makes up most of the human body?

Bonus Answer: Oxygen

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17. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

Some birds, such as pigeons and doves secrete "milk" that they feed to their children. From which of the following organs does it come from?
W) Crop
X) Gizzard

Y) Mammary Gland
Z) Stomach
Toss Up Answer: W

Bonus: Short Answer
What is the common name for Columba livia?
Bonus Answer: Feral/City/Street pigeon

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18. CHEMISTRY

Writer: Kerwin Chen
Toss Up: Short Answer
How many neutrons are in an alpha particle?
Bonus Answer: 2

Bonus: Short Answer
Which scientist working in Canada discovered the alpha particle?
Bonus Answer: Rutherford, Ernest Rutherford

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19. CHEMISTRY

Writer: Kerwin Chen
Toss Up: Short Answer
What is the atomic number of uranium?
Bonus Answer: 92

Bonus: Short Answer
Which scientist discovered the element uranium?
Bonus Answer: Klaproth, Martin Klaproth, Martin Heinrich Klaproth

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20. 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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21. CHEMISTRY

Writer: Larry Wong
Toss Up: Short Answer
What is the geometric configuration of HF?
Bonus Answer: Linear

Bonus: Multiple Choice

For which of the following compounds is cis-trans isomerism possible?
W) hept-1-ene
X) but-1-ene
Y) 2-methylpropene
Z) but-2-ene

Bonus Answer: Z

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22. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following has the greatest entropy?
W) Gaseous Substances
X) Gases
Y) Liquids
Z) Solids

Toss Up Answer: X

Bonus: Short Answer

What is the name of the equation used to determine if a reaction is spontaneous or not?

Bonus Answer: Gibbs-Free Energy Equation

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23. EARTH and SPACE

Writer: Shanjeed Ali

Toss Up: Multiple Choice

How much of the total mass of the solar system is found in the Sun?
W) between 60.0% and 60.1%
X) between 78.5% and 78.6%
Y) between 98.2% and 98.3%
Z) between 99.8% and 99.9%

Toss Up Answer: Z

Bonus: Multiple Choice

What is the temperature at the Sun’s core?
W) 5 million degrees Celsius
X) 10 million degrees Celsius
Y) 15 million degrees Celsius
Z) 20 million degrees Celsius

Bonus Answer: Y

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24. EARTH and SPACE

Writer: Aryan Bhatt

Toss Up: Short Answer

When the planets of our solar system are listed in order from most moons to least moons, which planet is fourth in the list?

Bonus Answer: Neptune

Bonus: Short Answer

Name the Galilean moons.

Bonus Answer: Io, Ganymede, Callisto, Europa

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25. EARTH and SPACE

Writer: Mohammed Jamil

Toss Up: Multiple Choice

The seasons we experience on the Earth are caused by

W) the change in the Earth's distance from the sun during the year

X) the precession of the Earth's pole

Y) the tilt of the Earth's axis with respect to the ecliptic pole

Z) the change in the Moon's distance from the Earth during the year

Toss Up Answer: Y

Bonus: Multiple Choice

If we compare two stars of different temperature, the hotter star

W) will appear redder

X) emits more energy from each unit area of surface

Y) will have a brighter apparent magnitude

Z) will have a brighter absolute magnitude

Bonus Answer: X

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