Round 15

1. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

In terms of mass, what are the four biggest planets in our solar system?

Bonus Answer: Jupiter, Saturn, Neptune, Uranus

Bonus: Multiple Choice

Dark energy makes up about how much of the energy in the universe?

W) 20%

X) 40%

Y) 70%

Z) 80%

Bonus Answer: Y

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2. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

A ball with mass 0.2 kg is thrown at a wall with velocity 20 m/s and rebounds with a velocity of 15 m/s. What is the impulse of the net force imposed on the ball?

Bonus Answer: 7 kgm/s

Bonus: Short Answer

In a jousting game, a student of 60 kg with velocity 5 m/s is rolled towards a student of 30 kg at rest. When they collide, their poles conserve all of their kinetic energy as potential energy and redistribute it. What is the final velocity of the 30 kg student to the tenth place?

Bonus Answer: 6.6 m/s

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3. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What type of number is defined as a number that is not a root of a polynomial with rational coefficients?

Bonus Answer: Transcendental numbers

Bonus: Short Answer

Of the following, which of these numbers is transcendental? pi, e, i, phi, e times i, 2 ^ root(2)

Bonus Answer: pi, e, e times i, 2 ^ root(2)

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4. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

A pendulum which is suspended from the ceiling of a railroad car is observed to hang at an angle of 10 degrees to the right of vertical. Which of the following answers could explain this phenomena?

W) The railroad car is at rest

X) The railroad car is accelerating to the left.

Y) The railroad car is accelerating to the right.

Z) Huh?

Toss Up Answer: X

Bonus: Multiple Choice

Two forces have magnitudes of 11 newtons and 5 newtons. The magnitude of their sum could NOT be equal to which of the following values?

W) 16
X) 5
Y) 9
Z) 7

Bonus Answer: X

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5. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

What cytoskeletal component forms the cleavage furrow during cytokinesis?

Bonus Answer: Microfilaments (Accept: actin)

Bonus: Short Answer

Microtubules are composed of what subunits?

Bonus Answer: tubulin (accept: alpha and beta tubulin dimers)

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6. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Which type of weather front is represented by alternating purple spikes and semicircles?
W) Cold front
X) Warm front
Y) Occluded front
Z) Stationary front

Toss Up Answer: Y

Bonus: Short Answer

What weather front is formed as a cold air mass pushes under a warm air mass?

Bonus Answer: Cold front

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7. 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

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8. EARTH and SPACE

Writer: Jan Wojcik

Toss Up: Short Answer

By name or number, which of the following is not a mineral: diamond, gold, coal, silt

Bonus Answer: Coal and silt (accept 3 and 4)

Bonus: Short Answer

The Mohs scale is used to measure mineral hardness. By name or number order the following minerals in increasing order: Fluorite, Gypsum, Quartz, Talc

Bonus Answer: Talc, Gypsum, Fluorite, Quartz (accept 1 2 3 4, in that order)

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9. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

A charge of mass m and charge q is moving in a circle of radius r and speed v due to a uniform magnetic field B. If the speed is doubled to 2v, what happens to the period, T ?

W) T increases by a factor of 2

X) T increases by a factor of 4

Y) T stays the same

Z) T decreases by a factor of 2

Toss Up Answer: Y

Bonus: Short Answer

A particle of charge –0.04 C is projected with speed 2 × 10^4 m/s into a uniform magnetic field, B, of strength 0.5 T. If the particle's velocity as it enters the field is perpendicular to B, what is the magnitude of the magnetic force on this particle?

Bonus Answer: 400 N

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10. 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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11. MATHEMATICS

Writer: Siam Muquit

Toss Up: Multiple Choice

What is the derivative of the curve y = x^3 at the origin?

W) 0

X) 3

Y) 2

Z) 3/2

Toss Up Answer: W

Bonus: Short Answer

Find dy/dx of y = sin^2 x

Bonus Answer: 2 (sin x) (cos x)

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12. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

There are many mineral categories. Which of the following mineral groups below is classified based on varying ratios of silicon and oxygen?

W) Sulfides

X) Phosphates

Y) Carbonates

Z) Silicates

Toss Up Answer: Z

Bonus: Short Answer

Of the following minerals listed, which belong in the mineral group of silicates: Olivine, Mica, Topaz and Talc.

Bonus Answer: Olivine, Mica, Topaz (1, 2, 3)

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13. CHEMISTRY

Writer: Ahmad Alnasser

Toss Up: Short Answer

What is the name of a cyclic molecule with 6 carbons?

Bonus Answer: cyclohexane

Bonus: Multiple Choice

Which of the following compounds contains a double bond?

W) butene

X) acetylene

Y) butane

Z) butyne

Bonus Answer: W

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14. PHYSICS

Writer: William Xiang

Toss Up: Short Answer

A ball is thrown with an initial velocity of 10 meters per second off the top of a 30 foot building, at an angle 30 degrees above the horizontal. Assuming there is no air friction and the scenario occurs on Jupiter where objects have a

gravitational acceleration of 25 meters per second squared, find the time it takes, in seconds, for the ball to reach ground level. Round to the nearest tenth.

Bonus Answer: 0.4

Bonus: Multiple Choice

A boy in freefall swings a ball tied to a string around in horizontal circles. Assuming no air friction, which of the following forces are NOT acting ball?

W) Centripetal Force
X) Centrifugal Force
Y) Gravitational Force
Z) Normal Force

Bonus Answer: Z

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15. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

The San Andreas fault is what specific type of fault line?

W) Transform plate boundary
X) Normal faullt
Y) Reverse fault
Z) Strike slip fault

Toss Up Answer: Z

Bonus: Short Answer

There are different types of seismic waves, body waves and surface waves. Name the two different types of body waves.

Bonus Answer: P waves and S waves

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16. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Neurotransmitters induce a cellular response primarily via

W) G protein coupled receptors
X) receptor tyrosine kinases
Y) ion gated channels
Z) intracellular receptors

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following is the immediate effect of a signal molecule binding to a receptor tyrosine kinase molecule?

W) It forms a dimer with another receptor tyrosine kinase.
X) It initiates a phosphorylation cascade.
Y) It becomes activated with phosphate groups.
Z) It attaches to a scaffolding protein.

Bonus Answer: W

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17. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

There are two small, thermally isolated rooms A and b. The heat capacitance of room A is 40 units of energy and room A contains 32 units of energy. The heat capacitance of room B is 100 units of energy and room B contains 50 units of energy. When the two rooms are thermally connected, in which direction will energy flow, on average?

W) Energy will not flow

X) Can't tell

Y) Room A to Room B

Z) Room B to Room A

Toss Up Answer: Y

Bonus: Short Answer

A piece of aluminium with mass 800 g is heated up to 1000 degrees C. Given the specific heat capacity of aluminium is 900 J/(kg K), calculate the amount of heat (in Joules) given out if the piece is cooled down to 200 degrees C.

Bonus Answer: 576,000 J

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18. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

Mass spectrometers shoot which subatomic particle at a sample to ionize it?

Bonus Answer: electrons

Bonus: Multiple Choice

Radium-226 is most likely to undergo which type of nuclear decay?

W) electron capture

X) alpha

Y) beta

Z) positron

Bonus Answer: X

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19. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which pair of organisms is correctly matched with the interspecific interaction?

W) Commensalism: Clownfish and sea anemone

X) Parasitism: Whales and barnacles

Y) Mutualism: Oxpecker and rhino

Z) Predation: Apes and bees

Toss Up Answer: Y

Bonus: Short Answer

List the 5 types of interspecific interaction.

Bonus Answer: Predation, Commensalism, Parasitism, Mutualism, Neutral

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20. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Multiple Choice

What is asymptote of the function: f(x) = 1/x?

W) y = 0

X) x = 0
Y) x = 0, y = 1
Z) x= 0, y = 0
Toss Up Answer: Z

Bonus: Short Answer
Plugging the divergent series, 1 + 2 + 3 + 4 + ..., into the Riemann Zeta Function results in which number?
Bonus Answer: -1/12

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21. BIOLOGY

Writer: Calvin Vuong
Toss Up: Multiple Choice
Fluctuations in the concentration of which of the following molecules is most responsible for transitioning between the phases of the cell cycle?
W) Cyclin-dependent kinases
X) potassium ions
Y) sucrose
Z) cyclins

Toss Up Answer: Z

Bonus: Multiple Choice
What occurs after the M phase checkpoint in the cell cycle?
W) Cohesins alter separase to allow chromatids to separate.
X) Separase enzyme cleaves cohesins and allows chromatids to separate.
Y) Kinetochores are able to bind to spindle microtubules.
Z) Daughter cells are allowed to pass into G1.

Bonus Answer: X

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22. CHEMISTRY

Writer: Mohammed Jamil
Toss Up: Multiple Choice
What suggests that metal, M, is not in Group I of the Periodic Table?
W) M has a bright, silvery appearance and is a good conductor of electricity.
X) M is hard and difficult to cut
Y) M produces an alkaline solution when it reacts with water.
Z) M produces hydrogen gas when it reacts with water.

Toss Up Answer: X

Bonus: Multiple Choice
Lactic acid, CH3CH(OH)CO2H, causes pain when it builds up in muscles.
Which reagent reacts with both of the –OH groups in lactic acid?
W) acidified potassium dichromate(VI)
X) ethanol
Y) sodium
Z) sodium hydroxide

Bonus Answer: Y

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23. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Which of the following types of cells do not exhibit density-dependent inhibition concerning reproduction?

W) neurons

X) cells in your liver

Y) cells in a malignant tumor

Z) cells surrounding your stomach

Toss Up Answer: Y

Bonus: Short Answer

Which cell part is most directly responsible for detecting the cell density of its surrounding area in order for the cell to exhibit density-dependent inhibition?

Bonus Answer: extracellular matrix

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24. 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

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25. CHEMISTRY

Writer: George Papastefanou

Toss Up: Short Answer

What is the common name of the chemical with formula $C_9H_8O_4$

Bonus Answer: Aspirin

Bonus: Short Answer

What is the molar mass, to the nearest whole number, of three moles of aspirin?

Bonus Answer: 540 g

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