Round 4

1. PHYSICS

Writer: Jessica Titensky

Toss Up: Multiple Choice

Which has the same units as joules?

W) Newton / meter

X) Pascal * meter^2

Y) Coulomb * volt

Z) Kilogram * meter / second^2

Toss Up Answer: Y

Bonus: Short Answer

What is the derived unit for Newton / meter^2?

Bonus Answer: Pascal

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2. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Which of the following has the largest ionic radius?

W) Li

X) Be

Y) Na

Z) Mg

Toss Up Answer: X

Bonus: Short Answer

Why does Oxygen have a smaller atomic radius than boron?

Bonus Answer: Effective nuclear charge

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3. 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

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4. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Glaciers effect the land through glacial erosion. Different geographies are formed but what is the specific name of the long narrow ridges that show where the glacier was once present?

W) Glacial retreat

X) Drumlins

Y) Glacial errotics

Z) Morianes

Toss Up Answer: Z

Bonus: Short Answer

Ice sheets and glaciers expanded to cover large areas of land during the last major glacial epoch. During which time period did this take place?

Bonus Answer: Quaternary

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5. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What is the Zeroth Law of Thermodynamics?

W) Energy cannot be created or destroyed in an isolated system.

X) Absolute Zero is the lowest temperature that is theoretically possible.

Y) If two systems are at the same time in thermal equilibrium with a third system, they are in thermal equilibrium with each other.

Z) The entropy of any isolated system always increases.

Toss Up Answer: Y

Bonus: Short Answer

If the actual vapor density is 5.8 g/m^3 and the saturation vapor density is 10 g/m^3, then what is the relative humidity?

Bonus Answer: 58%

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6. BIOLOGY

Writer: Matthew Lee

Toss Up: Multiple Choice

Chitons, a type of mollusk, have oval-shaped bodies and a shell composed of how many dorsal plates?

W) 6

X) 7

Y) 8

Z) 9

Toss Up Answer: Y

Bonus: Short Answer

Gastropods undergo a distinct developmental process, which causes their visceral mass to rotate 180 degrees, and as a consequence its anus ends up above its head. What is this process called?

Bonus Answer: torsion

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7. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Sedimentary rocks are formed from accumulation of different sediments. What is the term for a rock made by living organisms or composed of materials from life forms?

W) Conglomerate

X) Evaporites

Y) Crystalline

Z) Bioclastic

Toss Up Answer: Z

Bonus: Short Answer

Give the following classifications for these sedimentary rocks, breccia, conglomerate, and shale.

Bonus Answer: All Clastic sedimentary rocks.

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8. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

Certain proteins are released by virus-infected cells which induce neighboring cells to produce substances that will inhibit viral replication. What are these proteins called?

Bonus Answer: Interferons

Bonus: Short Answer

What is the process by which antibodies cover a pathogen such that it is marked for destruction and forms a precipitate to be flushed out?

Bonus Answer: Opsonization

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9. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

What are the numbers of sigma bonds and pi bonds, in ethyne, respectively?

Bonus Answer: 3 sigma bonds, 2 pi bonds

Bonus: Short Answer

Pi bonds are created by the overlap of what type of orbital?

Bonus Answer: p, p orbitals

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10. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the area of the circle x^2+y^2=6/pi^2 in terms of pi

Bonus Answer: 6/pi

Bonus: Short Answer

What is the area of the circle x^2-4x+y^2-6y-2=0 in terms of pi

Bonus Answer: 15pi

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11. EARTH and SPACE

Writer: Jessica Titensky

Toss Up: Multiple Choice

What is the closest star to earth

W) Sirius

X) Betelgeuse

Y) Alpha proxima

Z) The sun

Toss Up Answer: Z

Bonus: Short Answer

What is the closest star to the sun

Bonus Answer: Proxima centauri

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12. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

How many distinct roots does x^3-6x^2+32 have

Bonus Answer: 2

Bonus: Short Answer

What is the remainder when x^3-6x^2+32 is divided by x-1

Bonus Answer: 27

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13. BIOLOGY

Writer: Matthew Lee

Toss Up: Multiple Choice

Which of the following types of antibodies is typically used to fight parasitic infections?

W) E

X) M

Y) G

Z) A

Toss Up Answer: W

Bonus: Short Answer

The immune response can include complement protein cascades, which form pores in the membrane of the target cell. The cell then swells and lyses do to water and ions rushing in. The type of complex that forms the pore in the membrane is called?

Bonus Answer: membrane attack (accept: membrane attack complex)

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14. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

How many seconds are in a day

Bonus Answer: 86400

Bonus: Multiple Choice

How many days are in a second

W) 1.16*10^-3

X) 1.16*10^-4

Y) 1.16*10^-5

Z) 1.16*10^-6

Bonus Answer: Y

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15. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

The shape of a PCl3 molecule is described as

W) bent

X) trigonal pyramidal

Y) linear

Z) trigonal planar

Toss Up Answer: X

Bonus: Short Answer

Twenty-five percent of element X exists as 210(superscript) X and 75 percent of it exists as 214(superscript) X. What

is the atomic weight of element X?

Bonus Answer: 211

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16. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

HIV can be treated with a drug cocktail known as HAART. What does HAART stand for?

Bonus Answer: Highly Active Anti-Retroviral Treatment

Bonus: Short Answer

AIDS patients may become afflicted with an extremely rare cancer caused by a certain herpesvirus. What is this cancer called?

Bonus Answer: Kaposi's Sarcoma

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17. CHEMISTRY

Writer: Raafiul Hossain

Toss Up: Short Answer

Is HCL a strong acid?

Bonus Answer: Yes

Bonus: Short Answer

Is NAOH a strong base?

Bonus Answer: Yes

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18. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

In 1999, scientists discovered a fossil in China of what appeared to be an early chordate. This chordate had eyes and a brain but no skull, a derived feature of craniates. What was this fossil called?

Bonus Answer: Haikouella

Bonus: Short Answer

What is the class of the most basal group of craniates?

Bonus Answer: Myxini (accept: Hagfishes)

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19. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

A 12-N horizontal force is applied to a 40-N box resting on a rough horizontal floor. If the static coefficient of friction is 0.5 and the kinetic coefficient of friction is 0.4, the magnitude of the frictional force on the box is:

Bonus Answer: 12

Bonus: Multiple Choice

What is the coefficient of static friction between the ground and the object if it object is moving in a horizontal circle with a speed of 20 m/s around a radius of 50 m? Assume that g = 10 m/s^2 (READ AS: meters per second squared)?

W) 0.3

X) 0.5

Y) 0.8

Z) 0.9

Bonus Answer: Y

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20. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

The phenomenon where bacteria monitor the presence of secreted signaling molecules to determine the local density of cells is called?

Bonus Answer: Quorum sensing

Bonus: Short Answer

Quorum sensing allows bacteria to coordinate their behaviors in synchrony. One example of said behavior is illustrated when you find them on your teeth when you wake up. What has formed on your teeth?

Bonus Answer: biofilm

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21. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

A 2-kg object is moving to the right at 3m/s. A 4-N force is applied to the left of the object and then removed after the object has traveled an additional 5m. The work done by this force is:

W) 20 joules

X) 15 joules

Y) 13 joules

Z) -20 joules

Toss Up Answer: Z

Bonus: Short Answer

A 20kg dog initially runs at 10 m/s. What is the dog's final speed if 3000 joules of work is done on it?

Bonus Answer: 20

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22. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following species is amphoteric?

W) Na_3PO_4

X) HSO_4^-

Y) KOH

Z) HNO_3

Toss Up Answer: X

Bonus: Short Answer

A 600-milliliter container holds 2 moles of $O_2(g)$, 3 moles of $H_2(g)$, and 1 mole of He(g). Total pressure within the container is 760 torr. What is the partial pressure of O_2?

Bonus Answer: 253 torr

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23. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

Block A, with a mass of 4 kg, is moving with a speed of 3.0m/s while block B, with a mass of 8 kg, is moving in the opposite direction with a speed of 3.0m/s. The center of mass of the two block-system is moving with a velocity of:

W) 1.0 m/s in the same direction as B

X) 1.3 m/s in the same direction as A
Y) 4.0 m/s in the same direction as B
Z) 6.0 m/s in the same direction as A

Toss Up Answer: W

Bonus: Multiple Choice

A 60kg hunter gets a rope around a 300kg polar bear. They are stationary, 12m apart, on frictionless level ice. When the hunter pulls the polar bear to him, the polar bear will move:
W) 0.5 m
X) 2 m
Y) 4 m
Z) 7m

Bonus Answer: X

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24. BIOLOGY

Writer: Josh Tish

Toss Up: Short Answer

Which three amino acids can most often be phosphorylated in eukaryotes?

Bonus Answer: Serine, Threonine, Tyrosine

Bonus: Short Answer

After transforming the Ku11 gene into XL10 Gold E. coli and growing the bacteria for a day in selective media in the 25°C incubator, you notice that the colonies are much smaller than they should be. Why did this happen?

Bonus Answer: 37°C is the optimal temperature for growing E. coli. The colonies were smaller because they grew more slowly.

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25. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Natural selection is effective in the evolutionary process because it:
W) causes evolution
X) changes allele frequencies
Y) increases the mean fitness of a population
Z) leads to fixation or loss of particular alleles

Toss Up Answer: Y

Bonus: Short Answer

You tie a ribbon to a tree trunk. The height measured from the ribbon to the ground is five feet. The tree grows at a rate of three feet per year. After 10 years, how far up from the ground will the ribbon be?

Bonus Answer: Five feet. The elongation of a tree trunk occurs from the apical meristem up.

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