Round 20

1. EARTH and SPACE

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Where is the Sea of Tranquility?

W) Near the Bermuda Triangle

X) In the Atlantic Ocean

Y) In the Pacific Ocean

Z) On the Moon

Toss Up Answer: Z

Bonus: Multiple Choice

The outermost layer of the sun is called the:

W) Ionosphere

X) Chromosphere

Y) Corona

Z) Photosphere

Bonus Answer: Y

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2. 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) H_2 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) CO_2 and N_2

X) CO_2 and CO

Y) SO_2 and O_2

Z) N_2 and CO

Bonus Answer: Y

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3. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

Which two monosaccharides make up lactose?

Bonus Answer: Glucose and galactose

Bonus: Short Answer

Which two monosaccharides make up sucrose?

Bonus Answer: Glucose and fructose

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4. CHEMISTRY

Writer: Mohammed Jamil

Toss Up: Short Answer

For the reaction, A + B-> C, Enthalpy = +30 kJ; Entropy = -50 J/K.

When is this reaction spontaneous

Bonus Answer: Always

Bonus: Multiple Choice

Which process leads to an increase in entropy

W) Freezing

X) Deposition

Y) Sublimation

Z) Condensation

Bonus Answer: Y

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5. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

HIV is an example of which type of shape of virus?

W) Spiral

X) Polyhedral

Y) Spherical

Z) Complex

Toss Up Answer: Z

Bonus: Short Answer

Which of the following types of virus is HIV associated with? Type IV, Type V, Type VI

Bonus Answer: Type VI only (3 only)

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6. 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

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7. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Which of the following would be least damaged by lipase?

W) endoplasmic reticulum

X) mitochondria

Y) ribosome

Z) nuclei

Toss Up Answer: Y

Bonus: Short Answer

A population of 2800 flowers is in Hardy-Weinberg equilibrium, and 2352 of them are red in color. The red allele R is dominant; the white allele r is recessive. What is the frequency of heterozygotes in the population?

Bonus Answer: 48% (ACCEPT any equivalent answer)

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8. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

In which hemisphere are constellations named after scientific instruments?

Bonus Answer: Southern

Bonus: Short Answer

What is the latin name for the constellation that the big dipper is a part of?

Bonus Answer: Ursa Major

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9. MATHEMATICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

A point with coordinates (3,5) is rotated 90 degrees clockwise about the point (2,1) and is then reflected across the y-axis. What are the coordinates of the resulting image?

W) (-5,-3)

X) (-4,0)

Y) (-6,0)

Z) (-5,-1)

Toss Up Answer: Y

Bonus: Multiple Choice

AC=BD=(AB)(sqrt(2)) [AC equals BD equals AB times the square root of 2]

W) The circumcircle of ABC is centered at the midpoint of AC

X) The midlines of ABCD are perpendicular

Y) The perpendicular bisectors of AB and CD are the same line

Z) None of the above.

Bonus Answer: Z

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10. CHEMISTRY

Writer: Mohammed Jamil

Toss Up: Short Answer

Use the values for standard enthalpy of formation to calculate the standard enthalpy change for the reaction

$\Delta Hf(NH_3(g))$ = -46.1 kJ mol-1

$\Delta Hf(HCl(g))$ = -82.3 kJ mol-1

$\Delta Hf(NH_4Cl(s))$ = -414.4 kJ mol-1

Bonus Answer: -286

Bonus: Multiple Choice

Spontaneous reactions are driven by

W) Low enthalpy values and high entropy values

X) High temperatures and low pressures

Y) High enthalpy values and low entropy values
Z) High enthalpy values and high entropy values

Bonus Answer: W

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11. MATHEMATICS

Writer: Seiji Yawata

Toss Up: Short Answer

What is the 5th non-triangular number?

Bonus Answer: 8

Bonus: Short Answer

Name all the following that are true:
1. An icosahedron has 18 faces.
2. A regular hexahedron has 16 edges.
3. There are only nine regular polyhedra.
4. A regular octahedron has 4 times the volume of a regular tetrahedron with the same side length.

Bonus Answer: 2,4 (an icosahedron has 20 faces; a cube has 12 edges)

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12. CHEMISTRY

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Radiation from a mercury lamp source is of energy 2.845 eV. Calculate the wavelength of the radiation.
W) 579 nm
X) 355 nm
Y) 405 nm
Z) 436 nm

Toss Up Answer: Z

Bonus: Multiple Choice

The force constant of the bond in a hydrogen chloride, HCl, molecule is 516 N m-1. Calculate the vibrational potential energy of an HCl molecule with a bond that is extended from its equilibrium length by 0.11 Å.
W) 3.1 × 10^-20 J
X) 6.2 × 10^-20 J
Y) 1.5 × 10^-20 J
Z) 2.6 × 10^-20 J

Bonus Answer: W

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13. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the sum of the infinite geometric series whose first term is 1 and fourth term is 1/64?

Bonus Answer: 4/3

Bonus: Multiple Choice

What is the value of e to the (pi times i/2)?
W) e^-1
X) 1

Y) -1
Z) i

Bonus Answer: Z

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14. EARTH and SPACE

Writer: Jan Wojcik

Toss Up: Multiple Choice

What is the chemical formula for quartz?
W) Si
X) SiO
Y) SiO2
Z) SiO4

Toss Up Answer: Y

Bonus: Multiple Choice

What is the crystal form of sodium chloride?
W) halite
X) calcite
Y) chlorite
Z) natrite

Bonus Answer: W

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15. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the integral of sec x dx?

Bonus Answer: Ln (abs(sec x + tan x)) + C

Bonus: Multiple Choice

Which of these functions cannot be integrated and represented with elementary functions?
W) (sin^5)x times (cos^6)x dx
X) e^x times x^3 dx
Y) e^(x^2) dx
Z) tan x sin x dx

Bonus Answer: Y

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16. 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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17. PHYSICS

Writer: George Zhou

Toss Up: Multiple Choice

A metallic cylindrical conductor is used to produce some heat by applying a constant voltage between it's two ends. You want to double the heat released. Which of the following is the most appropriate thing to be done?

W) The length should be doubled

X) The radius should be doubled

Y) Both the length as well as the radius should be halved

Z) Both the length as well as the radius should be doubled

Toss Up Answer: Z

Bonus: Short Answer

A parallel plate capacitor of capacitance 10 micro F is charged to 50 micro C using a battery, and is then disconnected from the circuit. How much energy in micro joules is required to pull apart the plates such that the distance between them is doubled?

Bonus Answer: 125

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18. 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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19. BIOLOGY

Writer: Benjamin Avrahami

Toss Up: Short Answer

Which animal phylum was the first to develop true coelems? (PRONOUNCE: cee-lums)

Bonus Answer: Annelida (ACCEPT: annelids; DO NOT ACCEPT: earthworms)

Bonus: Multiple Choice

Which one of these molecules is secreted by your parietal cells?

W) Hydrochloric Acid

X) Pepsinogen

Y) Trypsin

Z) Mucus

Bonus Answer: W

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20. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Light from a monochromatic lamp is shone upon a sheet of metal, and yet, the photoelectric effect is not observed. What change in the setup will most likely result in an observed photoelectric effect?

W) Increasing the brightness of the lamp

X) Moving the lamp closer to the sheet of metal

Y) Decreasing the wavelength of the light

Z) Increasing the surface area of the sheet of metal

Toss Up Answer: Y

Bonus: Short Answer

An electric current of 1 Ampere is flowing along an infinite horizontal wire in the x-axis. At x = 0 m the wire splits into a circle of radius 0.05 m and then comes back together at x = 4 m. What is the magnitude in Tesla of the magnetic field in the middle of this loop of wire?

Bonus Answer: 0

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21. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Choose all of the following that differentiate glucose and cellulose:

I) their alpha/beta glucose configuration

II) branching

III) ability to be metabolized by the human digestive system

Bonus Answer: I, II, and III (all of them)

Bonus: Short Answer

N-Acetylglucosamine is the monomer of which common polysaccharide?

Bonus Answer: chitin

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22. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

The focal length of a concave mirror is 2 meters. An object is positioned 6 meters in front of the mirror. Where is the image of this object formed?

Bonus Answer: 3 meters in front of the mirror

Bonus: Multiple Choice

A standing wave is formed on a tightly stretched string. The distance between a node and an antinode is how many wavelengths?

W) 1/2

X) 1/4

Y) 1/8

Z) 1

Bonus Answer: X

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23. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which biome is characterized by population oscillations?

W) Temperate Deciduous

X) Tropical Rainforest

Y) Tundra

Z) Taiga

Toss Up Answer: Y

Bonus: Short Answer

Large-scale population oscillations in the tundra are caused by what abiotic factor?

Bonus Answer: Thawing and freezing of the ice (Also accept: population migrations)

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24. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

Who first suggested that radiant energy could exist only in discrete quanta which were proportional to the frequency in order to explain the frequency distribution of blackbody radiation?

W) Isaac Newton

X) Max Planck

Y) Ernest Rutherford

Z) Paul Dirac

Toss Up Answer: X

Bonus: Short Answer

Later solved by Planck's quantum radiation formula, what asymptotic result of the classical Rayleigh-Jeans Law was the most troubling?

Bonus Answer: Ultraviolet Catastrophe

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