Round 7

1. PHYSICS

Toss Up: Multiple Choice

The sound intensity 3.0m from a point source is 22 W/m^2 (READ AS: 25 watts per meter squared). The power output of the source is:

W) 53

X) 396π

Y) 168

Z) 300π

Toss Up Answer: X

Bonus: Short Answer

A string has length L and mass M. If its fundamental frequency is f, find its tension in terms of L, M and f.

Bonus Answer: 4LMf^2 (READ AS: 4 times L times M times f squared)

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2. PHYSICS

Toss Up: Multiple Choice

A wave's equation is given as y = 0.1 sin(3x+10t) (READ AS: y equals 0.1 times sine of open parentheses 3x plus 10t close parentheses). What is the angular wave number?

W) 0.3

X) 1

Y) 10

Z) 3

Toss Up Answer: Z

Bonus: Short Answer

An EM wave has a magnetic field with an amplitude of 200 Teslas. What is the amplitude of the wave's electric field in N/c (READ AS: newtons per coulomb)?

Bonus Answer: 6 * 10^10 N/c

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3. PHYSICS

Toss Up: Short Answer

If an object attached to one end of a spring makes 20 complete oscillations in 2*PI s, what is its angular frequency?

Bonus Answer: 20 rad/s

Bonus: Multiple Choice

A 1-kg object attached to a spring whose spring constant is 400N/m executes simple harmonic motion. If its maximum speed is 5.0m/s, find the amplitude of its oscillation.

W) 0.1

X) 0.25 m

Y) 0.45

Z) 0.75

Bonus Answer: X

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4. PHYSICS

Toss Up: Multiple Choice

A hose has a diameter of 2 inches and its nozzle is 0.2 inches in radius. If water flows at 4 m/s in the hose, then how fast will it leave the nozzle?

W) 4 m/s

X) 1 m/s
Y) 100 m/s
Z) 200 m/s
Toss Up Answer: Y

Bonus: Short Answer
To measure moderately low pressures, oil with a density of 8.5 × 10^2 kg/m^3 (READ AS: 8.5 times 10 to the -2 kilogram per cubic meter) is used in place of mercury in a barometer. If the height of the oil column changes by 1.0mm, find the change in the pressure, assuming g = 10 m/s.
Bonus Answer: 8.5 Pa

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5. PHYSICS

Toss Up: Multiple Choice
What is the normal force on an object that is accelerating at 2 m/s^2 upwards if the object is 10 kg? (Use 10 m/s^2 for gravity and neglect other forces)
W) 80
X) 100
Y) 120
Z) 20
Toss Up Answer: Y

Bonus: Short Answer
If a projectile is launched 30 degrees above the horizontal at a velocity of 40 m/s, how long does it take for it to reach the ground? (Use 10 m/s^2 for gravity and neglect other forces)
Bonus Answer: 4 seconds

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6. MATHEMATICS

Toss Up: Multiple Choice
How many zeroes does the equation x^3 + 6x^2 + 11x + 6 = 0 have?
W) 1
X) 2
Y) 3
Z) 4
Toss Up Answer: Y

Bonus: Short Answer
Find the solution(s) of the following system of linear equations: 2x + 4y = 6, x + 2y = 5
Bonus Answer: No solutions

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7. MATHEMATICS

Toss Up: Short Answer
How many ways are there to distribute 4 identical blue balls and 3 identical red balls among 3 people?
Bonus Answer: 315 (accept 21*15)

Bonus: Short Answer
What are all possible shapes that are yielded by inverting a circle across another circle?
Bonus Answer: circle, line

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8. MATHEMATICS

Toss Up: Short Answer

Prime factorize 273.

Bonus Answer: 3*7*13

Bonus: Multiple Choice

Which of the following numbers is a root of unity?

W) 1 + i

X) 1/2 + (1/2)(root3)(i)

Y) 3 + 4i

Z) (1/2)(root2) + (3/2)(root2)(i)

Bonus Answer: X

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9. MATHEMATICS

Toss Up: Short Answer

What is the amplitude of y=4sin(5x+3)

Bonus Answer: 4

Bonus: Short Answer

What is the period of y=4sin(5x+3) rounded to the nearest 100th

Bonus Answer: 1.26

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10. BIOLOGY

Toss Up: Short Answer

What substance protects the stomach from consuming itself?

Bonus Answer: Mucus

Bonus: Multiple Choice

In which organs is thrombopoietin produced?

W) Heart and Liver

X) Liver and Kidney

Y) Kidney and Pancreas

Z) Pancreas and Liver

Bonus Answer: X

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11. BIOLOGY

Toss Up: Short Answer

What is it called when a species of animal becomes two separate species while inhabiting the same area?

Bonus Answer: Sympatric speciation

Bonus: Multiple Choice

Cladograms are used to determine?

W) Taxonomy

X) Geographic Distribution

Y) Genotype

Z) Evolutionary relatedness

Bonus Answer: Z

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12. BIOLOGY

Toss Up: Multiple Choice

How does atropine counter the effects of nerve gas?

W) Atropine binds to the nerve gas and inactivates it

X) Atropine inactivates acetylcholinesterase and allows more acetylcholine to cross the synaptic cleft

Y) atropine blocks the acetylcholine receptor which blocks the excess acetylcholine lingering in the synaptic cleft

Z) atropine stimulates the production of an enzyme that breaks down the nerve gas

Toss Up Answer: Y

Bonus: Short Answer

In order to flower, what does a short-day plant need?

Bonus Answer: Night that is longer than a certain critical length

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13. BIOLOGY

Toss Up: Multiple Choice

What is the cause of trisomy 21?

W) error during meiosis

X) error during mitosis

Y) over duplication of chromosome 21

Z) chromosomal insertion

Toss Up Answer: W

Bonus: Multiple Choice

Why is pepsinogen secreted as a zymogen into the stomach?

W) to change the pH of the stomach fluids to aid digestion.

X) to prevent digestion of the gastric glands

Y) to inactivate pepsinogen

Z) to digest complex carbohydrates

Bonus Answer: X

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14. BIOLOGY

Toss Up: 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%, or any equivalent form

Bonus: Multiple Choice

Which of the following would be least damaged by a lipase?

W) endoplasmic reticulum

X) mitochondria

Y) ribosome

Z) nuclei

Bonus Answer: Y

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15. BIOLOGY

Toss Up: Multiple Choice

Isolated RNA molecules are generally less stable than DNA at physiological pH because:

W) RNA has ribose

X) RNA is always linear
Y) RNA uses uracil instead of thymine
Z) RNA is usually single-stranded

Toss Up Answer: W

Bonus: Multiple Choice
What is the half-life of DNA?
W) 673 years
X) 100 years
Y) 272 years
Z) 521 years

Bonus Answer: Z

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16. BIOLOGY

Toss Up: Short Answer
Which two scientists are credited with the discovery of the double helix of DNA?
Bonus Answer: James Watson and Francis Crick, Watson and Crick

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Bonus: Short Answer
Which scientist incorrectly proposed the triple DNA helix model, with the nitrogenous bases pointing outwards and the phosphate forming the core?
Bonus Answer: Linus Pauling, Paulingb

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17. CHEMISTRY

Toss Up: Multiple Choice
What is the most reasonable pH of the solution when the salt formed by reacting hydrochloric acid and aluminum hydroxide is dissolved in water?
W) 7
X) 4
Y) 10
Z) 0
Toss Up Answer: X

Bonus: Short Answer
125 mL from a 4M perchloric acid stock solution is reacted with excess sodium hydroxide. How many moles of the salt are formed if the system is 50% efficient?
Bonus Answer: 0.25 mol; 1/4 mol

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18. CHEMISTRY

Toss Up: Short Answer
What is the oxidation number of chromium in the dichromate ion?
Bonus Answer: +6

Bonus: Short Answer
Name the following: CuCr2O7.
Bonus Answer: Copper (II) dichromate; or Cupric dichromate

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19. CHEMISTRY

Toss Up: Multiple Choice

Which of the following substances cannot be decomposed further chemically?

W) Carbon Dioxide

X) Water

Y) Silicon

Z) Ammonia

Toss Up Answer: Y

Bonus: Short Answer

If 0.5 moles of NaCl are dissolved in 2 kg of water, what is the molality of the resulting solution?

Bonus Answer: 0.25 or 1/4

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20. CHEMISTRY

Toss Up: Multiple Choice

The conjugate base of HCl is which of the following?

W) A weak acid

X) A strong acid

Y) A weak base

Z) A strong base

Toss Up Answer: Y

Bonus: Short Answer

How many sigma and pi bonds does carbon dioxide have?

Bonus Answer: 2 sigma, 2 pi

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21. CHEMISTRY

Toss Up: Multiple Choice

In the reaction A + B -> C + D, which of the following occurs when reactant B is added?

W) The concentration of A decreases

X) The concentration of C decreases

Y) The concentration of D decreases

Z) The reaction shifts to the left

Toss Up Answer: W

Bonus: Short Answer

Given the specific heat capacity of water is 4.18 Joule/gram*C, if you have 20 grams of water and want to heat it from 10 degrees C to 15 degrees C, how many joules must be added?

Bonus Answer: 418 Joules

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22. CHEMISTRY

Toss Up: Multiple Choice

Which of the following describes the carbon dioxide molecule?

W) Polar and Linear

X) Polar and Bent

Y) Nonpolar and Linear

Z) Nonpolar and Bent

Toss Up Answer: Y

Bonus: Short Answer

What hybridization is typically found in linear molecules?

Bonus Answer: sp

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23. EARTH and SPACE

Toss Up: Multiple Choice

What is the penultimate spectral type of a star?

W) F

X) G

Y) K

Z) M

Toss Up Answer: Y

Bonus: Short Answer

What spectral type is the Sun?

Bonus Answer: G

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24. EARTH and SPACE

Toss Up: Short Answer

Which planet has the slowest rotation?

Bonus Answer: Venus

Bonus: Multiple Choice

Which planet has the fastest rotation?

W) Jupiter

X) Saturn

Y) Uranus

Z) Neptune

Bonus Answer: W

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25. EARTH and SPACE

Toss Up: Multiple Choice

Which of the following is NOT true regarding cirrus clouds?

W) They are typically found between 10,000 feet and 15,000 feet above sea level

X) They can be formed from any cloud that goes under glaciation

Y) They cover 25% of the Earth and have a heating effect

Z) They have been seen forming on other planets such as Mars and Jupiter

Toss Up Answer: W

Bonus: Multiple Choice

The most common cloud source for a majority of tornadoes is:

W) Cumulus

X) Nimbostratus

Y) Atlostratus

Z) Cumulonimbus

Bonus Answer: Z

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