Round 3

1. 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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2. PHYSICS

Writer: Jason Weng

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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3. PHYSICS

Writer: Charles Zhang

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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4. PHYSICS

Writer: Charles Zhang

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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5. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

There are 27 people in a party. If 16 people wanted ice cream and 17 people wanted chocolate, at most how many people wanted only ice cream?

Bonus Answer: 10

Bonus: Short Answer

How many non congruent rectangles are there with an area of 324 and positive integer side lengths?

Bonus Answer: 8

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6. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If x^5 - 4x^4 + 3x^2 - 2x + 1 = 0, find the sum of all five of the roots.

Bonus Answer: 4

Bonus: Short Answer

If polynomial P(x) leaves a remainder of 5 when divided by x-1 and a remainder of 7 when divided by x+1, find the remainder when P(x) is divided by x^2-1.

Bonus Answer: -x+6

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7. MATHEMATICS

Writer: Calvin Aw

Toss Up: Multiple Choice

Which of the following shapes is always cyclic?

W) A parallelogram

X) A rhombus

Y) An obtuse triangle
Z) A pentagon
Toss Up Answer: Y

Bonus: Short Answer
In a triangle with side lengths 10, 10 sqrt3, and 20, find the length of the angle bisector which intersects the side of length 10 sqrt3.
Bonus Answer: 20 sqrt3/3

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8. MATHEMATICS

Writer: Janine Goh
Toss Up: Short Answer
In what type of triangle is the angle bisector, the altitude and the median the same line?
Bonus Answer: Isosceles or equilateral triangle

Bonus: Short Answer
Find the other roots of x^3 + 6x^2 -13x - 42 if one of them is -2
Bonus Answer: -7, 3

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9. BIOLOGY

Writer: Kerwin Chen
Toss Up: Short Answer
What is the smallest and simplest amino acid called?
Bonus Answer: Glycine, GLY

Bonus: Short Answer
What is the R group of the amino acid glycine?
Bonus Answer: a single hydrogen

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10. BIOLOGY

Writer: Kerwin Chen
Toss Up: Multiple Choice
Tetrachromacy is the condition of possessing how many types of cone cells?
W) 1
X) 2
Y) 3
Z) 4
Toss Up Answer: Z

Bonus: Short Answer
The lens of the human eye blocks out ultraviolet light, which in turn prevents us from seeing UV light directly. What is the absence of the lens of the eye called?
Bonus Answer: Aphakia

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11. BIOLOGY

Writer: Kerwin Chen
Toss Up: Multiple Choice
How many sections does the small intestine consist of?
W) 2
X) 3

Y) 4
Z) 5
Toss Up Answer: X

Bonus: Short Answer
What are the names of the three sections of the small intestine?
Bonus Answer: Duodenum, Jejunum, Ileum

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12. BIOLOGY

Writer: Kerwin Chen
Toss Up: Short Answer
Where is the smallest bone in your body located?
Bonus Answer: Ear

Bonus: Short Answer
What is the name of the smallest bone in the human body
Bonus Answer: Stapes, Stirrup

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13. BIOLOGY

Writer: Kerwin Chen
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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14. BIOLOGY

Writer: Josh Tish
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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15. BIOLOGY

Writer: Josh Tish

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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16. BIOLOGY

Writer: Josh Tish

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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17. BIOLOGY

Writer: Josh Tish

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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18. CHEMISTRY

Writer: Janine Goh

Toss Up: Multiple Choice

Which of the following elements are Lanthanides?

W) Lawrencium

X) Meltnerium

Y) Seaborgium

Z) Terbium

Toss Up Answer: Z

Bonus: Short Answer

What unit does electronegativity use?

Bonus Answer: No unit

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19. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

Order the following in terms of the rate of diffusion along them, from fastest to slowest. 1: Open Surface. 2: Through an amorphous material. 3: Through a crystal.

Bonus Answer: 1, 3, 2

Bonus: Multiple Choice

Which of the following is a thermal conductor, but not an electrical one?

W) Graphite

X) Graphene

Y) Diamond

Z) Polystyrene

Bonus Answer: Y

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20. CHEMISTRY

Writer: Kerwin Chen

Toss Up: Short Answer

Roger Y. Tsien, Osamu Shimomura, and Martin Chalfie were awarded the 2008 Nobel Prize in Chemistry for the discovery and development of which protein?

Bonus Answer: Green Fluorescent Protein, GFP

Bonus: Multiple Choice

Which organism was the Green Fluorescent Protein first isolated from?

W) Anglerfish

X) Jellyfish

Y) Squids

Z) Gulper Eels

Bonus Answer: X

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21. CHEMISTRY

Writer: Kerwin Chen

Toss Up: Multiple Choice

Which element is most electronegative?

W) Chlorine

X) Fluorine
Y) Astatine
Z) Cesium

Toss Up Answer: X

Bonus: Multiple Choice
What is the range of electronegativity values?
W) 0.0 to 1.0
X) 0.0 to 2.0
Y) 0.0 to 3.0
Z) 0.0 to 4.0

Bonus Answer: Z

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22. CHEMISTRY

Writer: Kerwin Chen

Toss Up: Multiple Choice
How many orbitals does the p sublevel have?
W) 1
X) 2
Y) 3
Z) 4

Toss Up Answer: Y

Bonus: Short Answer
which element has the electron configuration 1s^22s^22p^63s^1 in its ground state?

Bonus Answer: Sodium, Na

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23. 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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24. 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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25. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

What is the name of the igneous rock that is a porous volcanic glass formed by rapidly cooling lava?

W) Obsidian

X) Gabbro

Y) Basalt

Z) Pumice

Toss Up Answer: Z

Bonus: Short Answer

What are the three general types of magma?

Bonus Answer: Basaltic magma, Andesitic magma, and Rhyolitic magma

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