Round 40

1. 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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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

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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4. 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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5. 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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6. 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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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: 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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9. 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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10. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

Where was GFP originally isolated?

Bonus Answer: Jellyfish

Bonus: Multiple Choice

In which of the following organisms was the gene originally expressed in?

W) C. elegans

X) Salmonella

Y) E. coli

Z) Petromyzon

Bonus Answer: W

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11. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

In DNA replication, the lagging strand is replicated in what fragments?

Bonus Answer: Okazaki

Bonus: Short Answer

Sickle-cell anemia is caused by what type of mutation?

Bonus Answer: Point mutation/deletion

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12. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

In which end of DNA is the hydroxyl group found?

Bonus Answer: 3 prime

Bonus: Multiple Choice

Which of the following are types of non-essential amino acids?

W) Phenylalanine and Valine

X) Leucine and Histidine

Y) Histidine and Lysine

Z) Argenine and Tyrosine

Bonus Answer: Z

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13. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

Haemoglobin alpha and beta globin chains are found in what 2 chromosomes?

Bonus Answer: Alpha: Chromosome 16

Beta: Chromosome 11

Bonus: Short Answer

Name all types of RNA

Bonus Answer: mRNA, tRNA, rRNA

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14. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

Which process is complementary to hydrolysis?

Bonus Answer: Dehydration synthesis

Bonus: Multiple Choice

Which of the following inhibits carbonic anhydrase?

W) Erythromycin

X) Imipramine

Y) Acetazolamide

Z) Ambylmycin

Bonus Answer: Y

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15. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Mutation in which of the following types of genes is least likely to result in higher chances of developing cancer?

W) oncogene

X) tumor suppressor gene

Y) proto-oncogene

Z) tumor necrosis factor gene

Toss Up Answer: Z

Bonus: Short Answer

Rearrange the following list of the structures of a nephron in the order in which filtrate flows through them:

1. proximal convoluted tubule
2. ascending limb of Loop of Henle
3. distal convoluted tubule
4. collecting duct
5. Bowman's capsule
6. descending limb of Loop of Henle

Bonus Answer: 5, 1, 6, 2, 3, 4

***A list of the structures or the correct reordering of the numbers assigned to each structure are valid answers**

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16. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

The initial frequency of allele A is 0.6, and the initial frequency of allele a is 0.4. In the next generation, the frequencies for alleles change to 0.61 and 0.39, respectively for each allele. The change in allele frequency is:

W) the result of random mating

X) evolution

Y) the result of natural selection

Z) impossible in a small population

Toss Up Answer: X

Bonus: Multiple Choice

What is the main structure that connects the left and right hemispheres of the brain?

W) corpus callosum

X) thalamus

Y) superior colliculus

Z) amygdala

Bonus Answer: W

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17. BIOLOGY

Writer: Josh Tish

Toss Up: Short Answer

You perform a transformation and calculate a viable count of 9000 cells/mL. If your transformation efficiency was 10%, how many colonies would you expect to see if you plate 100uL of cells onto selective media?

Bonus Answer: 90

Bonus: Short Answer

If the mother of a child suffers from diabetes mellitus and deafness (DAD) and the father does not, what is the likelihood that the child will develop degenerative optomosis?

*Note: Diabetes mellitus and deafness (DAD) is a genetic disorder, not separate ailments.

Bonus Answer: 100%. DAD is caused by mutations in mtDNA, which are passed on only by the mother.

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18. 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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19. 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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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: Ashneel Das

Toss Up: Short Answer

If you have a 1 L of a 10 M solution of HCl and you want 2 L of a 5 M solution of HCl, how much water must you add?

Bonus Answer: 1 L

Bonus: Short Answer

If the pOH of a solution is 6, what is the concentration of H+ ions?

Bonus Answer: 1.0 * 10^-8 (also 0.00000001)

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22. 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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23. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

What is the driving force behind all erosion?

Bonus Answer: Gravity

Bonus: Short Answer

What type of body of water does the most erosion?

Bonus Answer: Streams

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24. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Multiple Choice

What happens as air rises?
W) It gets warmer
X) It gets colder
Y) The temperature fluctuates

Z) Nothing

Toss Up Answer: X

Bonus: Short Answer

How are winds named?

Bonus Answer: By the direction they are coming in

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25. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

What is the US state with the most glaciers?

Bonus Answer: Washington

Bonus: Short Answer

How many glaciers are there in Hawaii rounded to the nearest 1000?

Bonus Answer: 0

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