

## Round 40

### 1. 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

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Bonus: Short Answer

which element has the electron configuration  $1s^2 2s^2 2p^6 3s^1$  in its ground state?

Bonus Answer: Sodium, Na

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### 2. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

What is the driving force behind all erosion?

Bonus Answer: Gravity

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Bonus: Short Answer

What type of body of water does the most erosion?

Bonus Answer: Streams

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### 3. 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

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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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### 4. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

Where was GFP originally isolated?

Bonus Answer: Jellyfish

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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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## 5. 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

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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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## 6. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

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

Bonus Answer: Okazaki

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Bonus: Short Answer

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

Bonus Answer: Point mutation/deletion

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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

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Bonus: Short Answer

In a triangle with side lengths 10,  $10\sqrt{3}$ , and 20, find the length of the angle bisector which intersects the side of length  $10\sqrt{3}$ .

Bonus Answer:  $20\sqrt{3}/3$

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## 8. 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**

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**Bonus: Short Answer**

How are winds named?

**Bonus Answer: By the direction they are coming in**

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## 9. 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**

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**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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## 10. 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**

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**Bonus: Short Answer**

To measure moderately low pressures, oil with a density of  $8.5 \times 10^2 \text{ kg/m}^3$  (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  $g = 10 \text{ m/s}^2$ .

**Bonus Answer: 8.5 Pa**

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## 11. EARTH and SPACE

**Writer: Zoe Orlin**

**Toss Up: Short Answer**

What is the US state with the most glaciers?

**Bonus Answer: Washington**

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**Bonus: Short Answer**

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

Bonus Answer: 0

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## 12. PHYSICS

Writer: Jason Weng

Toss Up: Multiple Choice

What is the normal force on an object that is accelerating at  $2 \text{ m/s}^2$  upwards if the object is  $10 \text{ kg}$ ? (Use  $10 \text{ m/s}^2$  for gravity and neglect other forces)

- W) 80
- X) 100
- Y) 120
- Z) 20

Toss Up Answer: Y

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Bonus: Short Answer

If a projectile is launched  $30$  degrees above the horizontal at a velocity of  $40 \text{ m/s}$ , how long does it take for it to reach the ground? (Use  $10 \text{ m/s}^2$  for gravity and neglect other forces)

Bonus Answer: 4 seconds

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## 13. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

In which end of DNA is the hydroxyl group found?

Bonus Answer: 3 prime

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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) Arginine and Tyrosine

Bonus Answer: Z

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## 14. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

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

- W)  $1.0 \text{ m/s}$  in the same direction as B
- X)  $1.3 \text{ m/s}$  in the same direction as A
- Y)  $4.0 \text{ m/s}$  in the same direction as B
- Z)  $6.0 \text{ m/s}$  in the same direction as A

Toss Up Answer: W

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Bonus: Multiple Choice

A  $60 \text{ kg}$  hunter gets a rope around a  $300 \text{ kg}$  polar bear. They are stationary,  $12 \text{ m}$  apart, on frictionless level ice. When the hunter pulls the polar bear to him, the polar bear will move:

- W)  $0.5 \text{ m}$
- X)  $2 \text{ m}$

Y) 4 m

Z) 7m

**Bonus Answer: X**

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## 15. 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**

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**Bonus: Short Answer**

If the pOH of a solution is 6, what is the concentration of H<sup>+</sup> ions?

**Bonus Answer:  $1.0 \times 10^{-8}$  (also 0.00000001)**

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## 16. 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**

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**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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## 17. 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**

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**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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## 18. 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**

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**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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## 19. 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**

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**Bonus: Short Answer**

Name all types of RNA

**Bonus Answer: mRNA, tRNA, rRNA**

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## 20. 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**

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**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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## 21. 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**

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**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  $g = 10 \text{ m/s}^2$  (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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## 22. BIOLOGY

**Writer: Janine Goh**

**Toss Up: Short Answer**

Which process is complementary to hydrolysis?

**Bonus Answer: Dehydration synthesis**

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**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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**23. 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**

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**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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**24. 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**

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**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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**25. 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**

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**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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