

## Round 2

### 1. PHYSICS

Writer: Jessica Titensky

Toss Up: Multiple Choice

Which has the same units as joules?

- W) Newton / meter
- X) Pascal \* meter<sup>2</sup>
- Y) Coulomb \* volt
- Z) Kilogram \* meter / second<sup>2</sup>

Toss Up Answer: Y

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Bonus: Short Answer

What is the derived unit for Newton / meter<sup>2</sup>?

Bonus Answer: Pascal

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### 2. PHYSICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the third derivative of displacement with respect to time

Bonus Answer: Jerk

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Bonus: Short Answer

What is the fourth derivative of displacement with respect to time

Bonus Answer: jounce

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### 3. 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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### 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**

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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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## 5. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

Find the product of all primes less than 11.

**Bonus Answer: 210**

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**Bonus: Multiple Choice**

Find the number of triangular numbers less than 2016.

W) 58

X) 60

Y) 62

Z) 64

**Bonus Answer: Y**

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## 6. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Multiple Choice**

Which three numbers satisfy the Pythagorean Theorem?

W) 1, 1, and  $\sqrt{3}$

X) 3, 4, and 5.01

Y)  $\pi/3$ ,  $\pi/4$ ,  $\pi/5$

Z)  $1/3$ ,  $1/4$ ,  $5/12$

**Toss Up Answer: Z**

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**Bonus: Short Answer**

Triangle ABC has side lengths of 10, 10, and  $10\sqrt{2}$ . State all distinct median lengths of the triangle in increasing value.

**Bonus Answer:  $5\sqrt{2}$ ,  $5\sqrt{5}$  (only accept the numbers said in that order).**

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## 7. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

What is the full name of the French mathematician who invented the Cartesian coordinate plane?

**Bonus Answer: Rene Descartes (You may also accept Descartes Rene, but do not accept Descartes or Rene)**

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**Bonus: Short Answer**

What is the name of the value of x in the ordered pair (x,y)

**Bonus Answer: Abscissa**

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## 8. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

Find the limit of  $(x^2 - x - 2)/(x + 1)$  as  $x$  approaches  $-1$ .

**Bonus Answer: -3**

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**Bonus: Short Answer**

Find the limit of  $(x^2 + 6x + 5)/x^3$  as  $x$  approaches infinite

**Bonus Answer: 0**

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## 9. BIOLOGY

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

If a gene is fixed in a population:

- W) the gene cannot undergo mutation
- X) one allele exhibits complete dominance over the other allele of that gene
- Y) only one allele appears for that gene in the population
- Z) the gene is incapable of recombination

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

The Species-Area Relationship suggests that 10% of a given area supports:

- W) 90% of species
- X) 70% of species
- Y) 50% of species
- Z) 30% of species

**Bonus Answer: Y**

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## 10. 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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## 11. 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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**12. 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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**13. 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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**14. 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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**15. 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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**16. 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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**17. 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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**18. CHEMISTRY**

**Writer: Calvin Aw**

**Toss Up: Multiple Choice**

Which of the following isoelectronic ions has the largest ionic radius?

W) Sulfur: 2-

X) Chlorine: 1-

Y) Potassium: 1+

Z) Calcium: 2+

**Toss Up Answer: W**

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**Bonus: Short Answer**

Complete the sentence with one word: As the nuclear charge of an ion increases, the ionic radius \_\_\_\_\_.

**Bonus Answer: decreases (Do not accept decrease)**

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## 19. CHEMISTRY

**Writer: Calvin Aw**

**Toss Up: Multiple Choice**

Which of the following is false about metals?

W) Metals are malleable and ductile

X) Metals tend to lose electrons to become cations

Y) Metallic reactivity increases as you go down a group.

Z) All metals are solid at room temperature

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which of the following metals isn't solid at room temperature?

W) Mercury

X) Tantalum

Y) Barium

Z) Chromium

**Bonus Answer: W**

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## 20. CHEMISTRY

**Writer: Calvin Aw**

**Toss Up: Short Answer**

How many orientation of f orbitals are there?

**Bonus Answer: 7**

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**Bonus: Short Answer**

The Pauli Exclusion Principle states that at most how many electrons can occupy a single atomic orbital?

**Bonus Answer: 2**

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## 21. CHEMISTRY

**Writer: Janine Goh**

**Toss Up: Short Answer**

Which group of the periodic table has a fully filled d orbital?

**Bonus Answer: Group 12**

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**Bonus: Short Answer**

Name 2 elements that behave both as a metal and non-metal

**Bonus Answer:** Any 2: Boron, silicon, germanium, arsenic, antimony, tellurium, (polonium)

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## 22. CHEMISTRY

**Writer:** Janine Goh

**Toss Up:** Short Answer

Which group of elements has the lowest ionization energy?

**Bonus Answer:** Alkali metals

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**Bonus:** Short Answer

What are the elements in group 5 called?

**Bonus Answer:** Pnictogens

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## 23. EARTH and SPACE

**Writer:** Janine Goh

**Toss Up:** Short Answer

In which hemisphere are constellations named after scientific instruments?

**Bonus Answer:** Southern

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**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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## 24. EARTH and SPACE

**Writer:** Janine Goh

**Toss Up:** Short Answer

What is the general name for blood disorders?

**Bonus Answer:** Thalassemia

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**Bonus:** Multiple Choice

Which of the following is a housekeeping gene?

W) Ubiquitin

X) Haemoglobin

Y) Ovalbumin

Z) Pyronisin

**Bonus Answer:** W

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## 25. EARTH and SPACE

**Writer:** Andrew Chen

**Toss Up:** Short Answer

What is the name of the tectonic plate that is currently undergoing subduction under the South American plate, responsible for the Andes mountains?

**Bonus Answer:** Nazca

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**Bonus:** Multiple Choice

Which of the following has the highest number of cleavage planes?

W) Muscovite

X) Halite

Y) Fluorite

Z) Mica

**Bonus Answer: Y**

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