

## Round 7

### 1. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is  $\tan(\arcsin(9/41))$ ?

Bonus Answer: 9/40

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Bonus: Short Answer

What is  $\sin(\operatorname{arccot}(\tan(\operatorname{arccos}(3/5))))$ ?

Bonus Answer: 3/5

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### 2. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

In a food fight, a 0.1 kg apple is given a velocity of 10 m/s. Before reaching its target, the apple is traveling at 5 m/s. What is the impulse exerted on the apple by air resistance?

Bonus Answer: 0.5 kgm/s

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Bonus: Short Answer

A 0.1 kg pinball is fired horizontally by a spring with a force constant of 40 N/m. If the spring is depressed 10 cm and the ball collides with a 0.3 kg ball elastically, what is the post collision velocity of the 0.3 kg ball?

Bonus Answer: 1 m/s

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### 3. EARTH and SPACE

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

Since Pumice and Rhyolite are both extrusive felsic rocks, they both have:

- W) Vesicles and low density
- X) No vesicles and silicon
- Y) Magnesium and high density
- Z) Low density and aluminum

Toss Up Answer: Z

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Bonus: Short Answer

By name or number, order these materials from lowest specific heat to highest specific heat: Ice, (liquid) water, water vapor, iron

Bonus Answer: Iron, water vapor, ice, liquid water (4, 3, 1, 2)

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### 4. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which is the strongest type of intermolecular force?

- W) Hydrogen bonding
- X) Dipole-dipole
- Y) Van der Waals
- Z) Metallic bonding

Toss Up Answer: W

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Bonus: Short Answer

By name or number, which of the following elements can form hydrogen bonds?

Oxygen, Chlorine, Fluorine, Nitrogen, Sulfur

**Bonus Answer: Oxygen, Fluorine, Nitrogen or (1, 3, and 4)**

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## 5. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Multiple Choice**

A Newton is equal to which of the following?

W) w) kilogram-meter per second

X) x) meter per second squared

Y) y) kilogram-meter per second squared

Z) z) kilogram per meter-second

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Work is what type of quantity?

**Bonus Answer: Scalar quantity.**

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## 6. EARTH and SPACE

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

In the stratosphere, what happens to the temperature as altitude increases?

**Bonus Answer: increases**

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**Bonus: Short Answer**

What does radar stand for?

**Bonus Answer: RAdio Detection And Ranging**

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## 7. CHEMISTRY

**Writer: Prangon Ghose**

**Toss Up: Multiple Choice**

The term(s) most useful in determining the solubility of a substance is (are)

W) Ka and Q

X) Ksp

Y) Q and Le Chatelier's Principle

Z) Kc

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

The effect of temperature on a chemical system is best described using

W) Ka and Q

X) Ksp

Y) Le Chatelier's Principle

Z) Kc

**Bonus Answer: Y**

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## 8. MATHEMATICS

**Writer: Shihab Karim**

**Toss Up: Short Answer**

What is the imaginary unit "i" when raised to the power 30?

**Bonus Answer: -1**

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**Bonus: Short Answer**

What is the sum of the first 50 positive integers?

**Bonus Answer: 1275**

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## 9. PHYSICS

**Writer: Shantanu Jha**

**Toss Up: Short Answer**

What fuel is mostly used in a nuclear power-generation station?

**Bonus Answer: Uranium-235 (Do not accept: Uranium or Uranium-238)**

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**Bonus: Multiple Choice**

Dark energy and dark matter comprise approximately how much of the known universe?

W) 50%

X) 75%

Y) 95%

Z) 99%

**Bonus Answer: Y**

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## 10. MATHEMATICS

**Writer: Hanna Yang**

**Toss Up: Short Answer**

What is the smallest even triangular number?

**Bonus Answer: 6**

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**Bonus: Multiple Choice**

If p and q are inversely proportional, and  $p = 7$  when  $q = 24$ , then find p when  $q = 12$ .

W) 3.5

X) 7

Y) 12

Z) 14

**Bonus Answer: Z**

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## 11. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Multiple Choice**

The constant potential difference across a 2 ohm resistor is 20 volts. How many watts of power are dissipated by this resistor?

W) 150 watts

X) 200 watts

Y) 250 watts

Z) 2000 watts

**Toss Up Answer: X**

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**Bonus: Short Answer**

The potential difference across a 4 ohm resistor is 20 volts. Assuming that all of the energy dissipated by this resistor is in the form of heat, how many joules of heat are radiated in 10 seconds?

**Bonus Answer: 1000 J (joules)**

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## 12. EARTH and SPACE

**Writer: Matthew Lee**

**Toss Up: Multiple Choice**

Which type of air mass is dominant in Central Canada?

- W) continental arctic
- X) continental polar
- Y) maritime polar
- Z) maritime tropical

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

A stationary front is symbolized by which of the following:

- W) triangles only
- X) semicircles only
- Y) triangles and semicircles on opposite sides of a line
- Z) triangles and semicircles on same side of a line

**Bonus Answer: Y**

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## 13. BIOLOGY

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Which of these does not result in recombinant bacteria?

- W) Transformation
- X) Insertion
- Y) Transduction
- Z) Conjugation

**Toss Up Answer: X**

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**Bonus: Short Answer**

What serves as the vector for bacterial transduction?

**Bonus Answer: Virus (accept viruses, phages, bacteriophages)**

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## 14. EARTH and SPACE

**Writer: Shamaul Dilmohamed**

**Toss Up: Short Answer**

Which planet has the slowest rotation?

**Bonus Answer: Venus**

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**Bonus: Multiple Choice**

Which planet has the fastest rotation?

- W) Jupiter
- X) Saturn
- Y) Uranus

Z) Neptune

**Bonus Answer: W**

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## 15. CHEMISTRY

**Writer: Jason Mohabir**

**Toss Up: Short Answer**

During glycolysis, electrons removed from glucose are passed to

**Bonus Answer: NAD+**

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**Bonus: Multiple Choice**

A biological redox reaction always involves

- W) an ester
- X) an alcohol
- Y) a reducing agent
- Z) a soap

**Bonus Answer: Y**

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## 16. BIOLOGY

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

Select the description that most correctly describes the term recessive:

- W) A weak phenotype.
- X) An allele that confers a weak phenotype.
- Y) A phenotype conferred when only one copy of an allele is present.
- Z) A phenotype conferred when two copies of an allele are present.

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which of the following interactions is most responsible for the structural stability of soluble globular proteins?

- W) Dipole-dipole interactions.
- X) Electrostatic interactions.
- Y) Hydrogen bonds.
- Z) The Hydrophobic Effect.

**Bonus Answer: Z**

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## 17. EARTH and SPACE

**Writer: Janine Goh**

**Toss Up: Short Answer**

What is the angle of insolation?

**Bonus Answer: The angle at which light hits the earth.**

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**Bonus: Multiple Choice**

Which of the following locations can have an angle of insolation of 90 degrees?

- W) 20 degrees N
- X) 40 degrees N
- Y) 60 degrees N
- Z) 30 degrees S

**Bonus Answer: W**

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## 18. PHYSICS

**Writer: Elias Milborn**

**Toss Up: Short Answer**

A train moving 35 meters per second emits a whistle with a frequency of 900 hertz. Assuming that the speed of sound in air is 350 meters per second, what is the frequency, in hertz, measured by a stationary observer in front of the train?

**Bonus Answer: 1000**

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**Bonus: Multiple Choice**

Which of the following has the highest vapor pressure at STP?

- W) mercury
- X) ethyl alcohol
- Y) methyl alcohol
- Z) acetone

**Bonus Answer: Z**

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## 19. BIOLOGY

**Writer: Ahmad Alnasser**

**Toss Up: Multiple Choice**

What structure in plant cells is similar to gap junctions in animal cells?

- W) Cell wall
- X) Central Vacuole
- Y) Plasmodesmata
- Z) Thylakoid

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

If, on average, 46% of the loci in a species' gene pool are heterozygous, then the average homozygosity of the species should be

- W) 23%
- X) 46%
- Y) 54%
- Z) There is not enough information to say.

**Bonus Answer: Y**

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## 20. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Multiple Choice**

e Often some of the strongest spectral lines in cold interstellar gas are produced by

- W) neutral lithium
- X) ionized iron
- Y) carbon and iron
- Z) calcium and sodium

**Toss Up Answer: Z**

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**Bonus: Short Answer**

The cosmic background radiation discovered by Penzias and Wilson closely matches the radiation from a black body with what temperature Kelvin, to the nearest whole number?

**Bonus Answer: 3**

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## 21. EARTH and SPACE

**Writer: Nicholas Parker Ng**

**Toss Up: Multiple Choice**

Which of the following are sheet silicates?

- W) Micas and clay minerals
- X) pyroxenees and amphiboles
- Y) olivine and feldspar
- Z) staurolite and quartz

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

The most common intermediate volcanic rock is

- W) Andesite
- X) Basalt
- Y) Rhyolite
- Z) Diorite

**Bonus Answer: W**

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## 22. CHEMISTRY

**Writer: Ivan Zhang**

**Toss Up: Multiple Choice**

Which of the following is the most electronegative element?

- W) Carbon
- X) Vanadium
- Y) Selenium
- Z) Fluorine

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the name given to the hybrid orbital created with a steric number of 3?

**Bonus Answer: 2sp<sup>2</sup>**

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## 23. BIOLOGY

**Writer: Jason Mohabir**

**Toss Up: Multiple Choice**

Pine, fir, spruce, cedar, larch and cypress are the famous timber-yielding plants. All these belong to:

- W) angiosperms

- X) gymnosperms
- Y) monocotyledons
- Z) dicotyledons

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

The population of algae in soil is [blank] that of either bacteria or fungi.

- W) generally smaller than
- X) generally greater than
- Y) equal to
- Z) there are no algae in soil

**Bonus Answer: W**

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**24. CHEMISTRY**

**Writer: Prangon Ghose**

**Toss Up: Short Answer**

In a rate law, what are the units of k when the order is 1?

**Bonus Answer:  $s^{-1}$**

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**Bonus: Short Answer**

In a rate law, what are the units of k when the order is 5?

**Bonus Answer:  $L^4 \text{ mol}^{-4} s^{-1}$**

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**25. BIOLOGY**

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Which of these is not a viral disease?

- W) Dutch elm disease
- X) Yellow fever
- Y) Mumps
- Z) Rubella

**Toss Up Answer: W**

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**Bonus: Short Answer**

In which viral reproductive cycle is the viral DNA incorporated into the host DNA?

**Bonus Answer: Lysogenic**

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