

## Round 19

### 1. EARTH and SPACE

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Which of the following is not a silicate?

- W) Quartz
- X) Halite
- Y) Feldspar
- Z) Mica

Toss Up Answer: X

---

Bonus: Multiple Choice

Which of these mineral groups has the best cleavage?

- W) Silicates
- X) Sulfides
- Y) Oxides
- Z) Carbonates

Bonus Answer: Z

---

### 2. MATHEMATICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Unknown to be algebraic or transcendental

- W) Rational
- X) Algebraic irrational
- Y) Transcendental
- Z) Impossible to tell

Toss Up Answer: Y

---

Bonus: Short Answer

Let  $f(x) = ax^7 + bx^3 + cx - 5$ , where  $a, b$ , and  $c$  are real numbers. What is the value of  $f(7)$  if  $f(-7) = 8$ ?

Bonus Answer: -18

---

### 3. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

In terms of mass, what are the four biggest planets in our solar system?

Bonus Answer: Jupiter, Saturn, Neptune, Uranus

---

Bonus: Multiple Choice

Dark energy makes up about how much of the energy in the universe?

- W) 20%
- X) 40%
- Y) 70%
- Z) 80%

Bonus Answer: Y

---

## 4. MATHEMATICS

Writer: Seiji Yawata

Toss Up: Short Answer

What is the limit as  $x$  approaches 0 of  $x^x$ ?

Bonus Answer: Does not exist. (NOT 1)

---

Bonus: Short Answer

Let  $f(x)$  be a function with no real roots. If  $f(3) = 4$ , then in what quadrants can  $f(x)$  be in?

Bonus Answer: All four quadrants (b.c. there's no specification  $f$  has to be continuous)

---

## 5. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

Which is the new satellite/telescope replacing Hubble?

Bonus Answer: James Webb Space Telescope

---

Bonus: Short Answer

Why is Mars red?

Bonus Answer: Oxidised iron on Mars' surface

---

## 6. 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

---

## 7. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

You come across a yellow pea colored garden pea plant, and you want to determine its genotype. You testcross it with a green pea colored pea plant, which yields 501 yellow plants and 495 green plants. What is the genotype of the yellow parent?

Bonus Answer: ACCEPT any of the following: heterozygous, hybrid

---

Bonus: Short Answer

You are cross breeding two garden pea plants. The first parent's genotype is heterozygous yellow for its pea color, homozygous purple for its flower color, and is heterozygous for its tall trait. The second parent's genotype is homozygous green for its pea color, heterozygous purple for its flower color, and heterozygous for its tall trait. What fraction of their offspring will be green pea colored, purple flower colored, and short?

Bonus Answer: 1/8

---

## 8. PHYSICS

Writer: Jan Wojcik

Toss Up: Multiple Choice

An electron is placed in a horizontally hollow cylindrical solenoid with the current moving clockwise around the solenoid. The electron is released from rest in the middle of the solenoid. What direction will the electron move in?

- W) To the left
- X) To the right
- Y) Stays in the same place
- Z) Oscillates between both ends

Toss Up Answer: X

---

Bonus: Multiple Choice

There are two charges, one with charge  $+2Q$  and one with charge  $-4Q$  a distance of 2 meters from each other. Assuming the universal charge constant is  $1.6 \times 10^{-19}$ , which of the following is the force of attraction felt by the two charges, rounded to one decimal place

- W)  $4.8 \times 10^{-19}$  C
- X)  $9.6 \times 10^{-19}$  C
- Y)  $2.4 \times 10^{-19}$  C
- Z)  $3.2 \times 10^{-19}$  C

Bonus Answer: Z

---

## 9. EARTH and SPACE

Writer: Shantanu Jha

Toss Up: Short Answer

What phenomena best explains why the sky is blue?

Bonus Answer: Rayleigh Scattering

---

Bonus: Short Answer

What are the high intensity spots of light at the horizontal points of the 22 degree halo that may form around the sun due to ice crystals in the air called?

Bonus Answer: Parhelia (ALSO ACCEPT: Sun Dogs, Parhelion)

---

## 10. PHYSICS

Writer: Mohammed Jamil

Toss Up: Multiple Choice

A loaded freight car A with a mass of 14,000 kg moves at a constant velocity of 15 m/s on a horizontal railroad track and collides with an empty car B with a mass of 6,000 kg moving at 5 m/s. After the collision the cars stick to each other and moves like one object. What is the velocity of two cars after the collision?

- W) 6 m/s
- X) 8 m/s
- Y) 10 m/s
- Z) 12 m/s

Toss Up Answer: Z

---

Bonus: Multiple Choice

When two objects collide elastically the momentum is conserved. Which of the following is true about the kinetic energy during the collision?

- W) The kinetic energy is lost  
X) The kinetic energy is gained  
Y) The kinetic energy is conserved  
Z) The kinetic energy completely transforms into thermal energy

**Bonus Answer: Y**

=====

## 11. BIOLOGY

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Which disease was famously eradicated in 1977?

- W) Polio  
X) Smallpox  
Y) Mumps  
Z) AIDS

**Toss Up Answer: X**

=====

**Bonus: Short Answer**

Which human body system is attacked by AIDS?

**Bonus Answer: Immune system**

=====

## 12. PHYSICS

**Writer: Shantanu Jha**

**Toss Up: Multiple Choice**

In what branch of physics would you expect to find the worm-like chain model?

- W) Wormhole Physics  
X) Newtonian Physics  
Y) Plasma Physics  
Z) Polymer Physics

**Toss Up Answer: Z**

=====

**Bonus: Short Answer**

By name or number, name which of the following muon decay can produce.

1. Electron
2. Muon Neutrino
3. Electron Neutrino
4. Positron

**Bonus Answer: 1,3,4; Electron, Electron Neutrino, Positron**

=====

## 13. CHEMISTRY

**Writer: Mohammed Jamil**

**Toss Up: Short Answer**

Calculate the approximate amount of heat necessary to raise the temperature of 72 grams of liquid water from 13.0°C to 43.0°C. (The specific heat of water liquid is 4.18 J/g°C.)

**Bonus Answer: 9028.8**

=====

**Bonus: Short Answer**

The molarity of a solution obtained when 500.0 mL of 6.0 M HCl is diluted to a final volume of 750.0 mL is

**Bonus Answer: 4.0 M**

=====

## 14. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What law most directly states that the total of the electric flux out of a closed surface is equal to the charge enclosed divided by the permittivity?

Bonus Answer: Gauss's Law

---

Bonus: Short Answer

When a magnet is moved into a coil of wire, changing the magnetic field and magnetic flux through the coil, a voltage will be generated in the coil according to which law?

Bonus Answer: Faraday's Law

---

## 15. CHEMISTRY

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Identify the INCORRECT statement below:

- W) In the most fundamental sense, the properties of the elements are periodic functions of their atomic weight.
- X) The vertical columns of the periodic chart are called groups, sharing similar properties.
- Y) Elements with atomic numbers of 9, 17, 35, and 53 are members of the halogen family, meaning "salt formers."
- Z) Elements Li, B, N and F are all in the same period.

Toss Up Answer: W

---

Bonus: Multiple Choice

All of the following statements are true EXCEPT:

- W) the enthalpy change of an endothermic reaction is positive.
- X) at constant pressure the heat flow for a reaction equals the change in enthalpy.
- Y)  $\Delta H$  for a reaction is equal in magnitude but opposite in sign to  $\Delta H$  for the reverse reaction.
- Z) enthalpy change is dependent upon the number of steps in a reaction.

Bonus Answer: Z

---

## 16. MATHEMATICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Let  $f$  be an odd function over the real numbers. What is the value of  $f$  at 0?

- W) -1
- X) 0
- Y) 1
- Z) There is not enough information to determine an answer

Toss Up Answer: Z

---

Bonus: Multiple Choice

Which of the following is true?

- W) An irrational number raised to an irrational power must have an irrational value.
- X) For all positive number  $x$  and  $y$ ,  $x^{\ln(y)}$  is equal to  $y^{\ln(x)}$
- Y) For all real numbers  $a, b, c, d$  with  $b$  and  $d$  being non-zero, if  $a/b > c/d$ , then  $a*d$  must be greater than  $b*c$
- Z) There are more complex numbers than there are real numbers.

Bonus Answer: X

=====

## 17. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the correct formula for Aluminum Oxide?

Bonus Answer:  $\text{Al}_2\text{O}_3$  (accept: Aluminum 2 Oxygen 3)

-----

Bonus: Short Answer

What is the formal charge of oxygen in  $\text{H}_3\text{O}^+$ ?

Bonus Answer: +1 (do not accept 1)

=====

## 18. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Not all laws that hold in an inertial frame hold in a non-inertial frame. An obvious example is the law of inertia. Does the Work-Energy Theorem hold in a non-inertial frame?

W) It only holds in inertial frames.

X) It will not hold in a non-inertial frame unless there aren't any conservative forces at work.

Y) It will hold in a non-inertial frame unless there are non-conservative forces.

Z) It holds for any non-inertial frame.

Toss Up Answer: Z

-----

Bonus: Short Answer

An object is launched on a horizontal surface with an initial speed of 20 m/s, so that it covers a distance of 5 meters in the time interval 4 sec to 5 sec. What is the coefficient of friction between the object and the horizontal surface?

Assume gravitational acceleration is  $10 \text{ m/s}^2$

Bonus Answer:  $1/3$

=====

## 19. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Which immune cell, derived from a common lymphoid progenitor and matured in the thymus, functions in the cell mediated adaptive immune response?

Bonus Answer: T cell

-----

Bonus: Short Answer

T cells contain either CD8 or CD4 coreceptors. CD8 preferentially binds with class I MHC molecules while CD4 preferentially binds with class II MHC molecules. Which coreceptor is present in cytotoxic T cells, and which coreceptor is present in helper T cells?

Bonus Answer: Cytotoxic T cell: CD8

Helper T cell: CD4

=====

## 20. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

Given 2,3-dichloropentane, what is the resulting molecule if potassium hydroxide is reacted with it at 200 degrees celsius?

Bonus Answer: 2 pentyne

-----

**Bonus: Short Answer**

Which single atom is the difference between an organic acid functional group and an aldehyde functional group?

**Bonus Answer: O, Oxygen**

=====

**21. BIOLOGY**

**Writer: Matthew Lee**

**Toss Up: Short Answer**

What is the main fiber that makes up the extracellular matrix?

**Bonus Answer: Collagen**

-----

**Bonus: Multiple Choice**

Which of the following allow for cell signaling?

I. Desmosomes II. Gap Junctions III. Tight Junctions IV. Plasmodesmata

W) I, II, III

X) II and IV

Y) II and III

Z) I and IV

**Bonus Answer: X**

=====

**22. CHEMISTRY**

**Writer: Jan Wojcik**

**Toss Up: Multiple Choice**

A certain chemical reaction has an equilibrium constant  $K_{eq}$  (pronounced K-sub EQ) of 2.0. Which of the following statements is true?

W) The products are favored

X) The reactants are favored

Y) The reaction is in equilibrium

Z) The reaction is reversible

**Toss Up Answer: X**

-----

**Bonus: Multiple Choice**

A certain chemical reaction involves reactants A and B and one product C. Reactant A and product C are both gases and reactant B is liquid water. The concentration of A, B, and C are 0.1 M (read as 0.1 Molar), 0.5 M and 0.01 M respectively. If the order of the equilibrium constant is 3 and the coefficient in front of C in the chemical reaction was 2, what is the value of the equilibrium constant K?

W) 0.0001

X) 0.005

Y) 0.05

Z) 0.001

**Bonus Answer: Z**

=====

**23. MATHEMATICS**

**Writer: Seiji Yawata**

**Toss Up: Multiple Choice**

What is the geometric mean of the roots of the polynomial  $2x^3 - 2x^2 - 228x - 432$

W) 4

X) 6

Y) 8

Z) 10

**Toss Up Answer: X**

---

**Bonus: Short Answer**

The first term of an arithmetic sequence is  $x$ , and the  $x$ th term is  $x^2$ , for  $x$  not equal to 1. If the common difference is equal to 7, what is the 12th term of the sequence?

**Bonus Answer: 84**

---

## **24. BIOLOGY**

**Writer: Shanjeed Ali**

**Toss Up: Multiple Choice**

The phenomenon by which diploid cells cease to divide is known as

W) parthenogenesis

X) alternation of generations

Y) cellular senescence

Z) lysis

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

What country has the highest human life expectancy?

**Bonus Answer: Japan**

---