

## Round 12

### 1. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

If  $f(x) = x^4 + 5x^8 + 7x^6 + 5$ , which of the following is true about  $f(x)$ ?

W)  $f(x)$  is odd, only

X)  $f(x)$  is even, only

Y)  $f(x)$  is neither odd nor even

Z)  $f(x)$  is both even and odd

Toss Up Answer: X

---

Bonus: Short Answer

Simplify:  $\cos(\sin^{-1}(3/5))$

Bonus Answer: 4/5

Solution:

Draw a 3-4-5 right triangle and find the angle that  $\sin^{-1}(3/5)$  is equal to. Then, take its cosine.

---

### 2. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

A charge of mass  $m$  and charge  $q$  is moving in a circle of radius  $r$  and speed  $v$  due to a uniform magnetic field  $B$ . If the speed is doubled to  $2v$ , what happens to the period,  $T$ ?

W)  $T$  increases by a factor of 2

X)  $T$  increases by a factor of 4

Y)  $T$  stays the same

Z)  $T$  decreases by a factor of 2

Toss Up Answer: Y

---

Bonus: Short Answer

A particle of charge  $-0.04$  C is projected with speed  $2 \times 10^4$  m/s into a uniform magnetic field,  $B$ , of strength  $0.5$  T. If the particle's velocity as it enters the field is perpendicular to  $B$ , what is the magnitude of the magnetic force on this particle?

Bonus Answer: 400 N

---

### 3. CHEMISTRY

Writer: Ahmad Alnasser

Toss Up: Short Answer

Write the formula name for the strongest acid?

Bonus Answer: H<sub>2</sub>SO<sub>4</sub>

---

Bonus: Short Answer

List in order of strength the following strong acid: (1) H<sub>3</sub>PO<sub>4</sub> (2) HBr (3) HCl (4) H<sub>2</sub>SO<sub>4</sub>

Bonus Answer: 1 3 2 4

---

### 4. PHYSICS

Writer: Sean Vaysburd

Toss Up: Short Answer

If the acceleration is always perpendicular to an object's velocity, what can be deduced about the object's motion?

Bonus Answer: It is circular motion.

---

**Bonus: Short Answer**

If the acceleration of an object is opposite its velocity, what can be said about the object's velocity over time? Assume that the direction of the velocity is positive.

**Bonus Answer: It is decreasing.**

=====

**5. MATHEMATICS**

**Writer: Elias Milborn**

**Toss Up: Short Answer**

Giving your answer as up, down, left, or right, the graph of the equation  $x = 5y - 8y^2 - 1$  opens in which direction

**Bonus Answer: left**

-----

**Bonus: Short Answer**

If chord AB is 8 units from the center of a circle O with a radius of 17, what is the length of chord AB?

**Bonus Answer: 30**

=====

**6. BIOLOGY**

**Writer: Benjamin Avrahami**

**Toss Up: Short Answer**

What type of immune disease is SCID?

**Bonus Answer: Immune deficiency disease**

-----

**Bonus: Multiple Choice**

Which one of the following classes of organisms has a pseudocoelom (pronounce soo-do-cee-lum)?

- W) Calcarea
- X) Ceriantharia
- Y) Chromadorea
- Z) Clitellata

**Bonus Answer: Y**

=====

**7. CHEMISTRY**

**Writer: Seiji Yawata**

**Toss Up: Multiple Choice**

The last electron of lanthanum enters in the:

- W) d orbital
- X) s orbital
- Y) p orbital
- Z) f orbital

**Toss Up Answer: W**

-----

**Bonus: Multiple Choice**

Which of the following is true for  $B_3N_3H_6$

- W) Its name is Nitroborane
- X) All the atoms are sp-hybridised
- Y) It has 3 lone pairs of electrons
- Z) It is isostructural with benzene

**Bonus Answer: Z**

=====

## 8. EARTH and SPACE

Writer: Yae June Lee

Toss Up: Multiple Choice

What happened to the melted rock after it goes through solidification to form basalt?

W) It occurred rapidly, with fine grained minerals

X) Slowly, coarse grained minerals

Y) Rapidly, coarse trained minerals

Z) Slowly, fine grained minerals

Toss Up Answer: W

---

Bonus: Short Answer

What are two surface traits that affect the rate of surface runoff?

Bonus Answer: Slope of land surface, soil type or composition, vegetation, porosity of soil, soil saturation.(any two of these answers are acceptable.)

---

## 9. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Simplify:  $(24 \cdot 63) / (72 \cdot 21)$

W) 1

X) 3

Y) 7

Z)  $1/3$

Toss Up Answer: W

---

Bonus: Short Answer

Simplify  $(333(x^4 - x^2)) / (9(x^2 + 2x + 1)(x^2))$

Bonus Answer:  $37(x-1)/(x+1)$

---

## 10. BIOLOGY

Writer: Aaron Gee

Toss Up: Multiple Choice

Which of the following tissues is MOST directly responsible for the increased diameter of a tree trunk from year to year?

W) apical meristem

X) pericycle

Y) vascular cambium

Z) pith

Toss Up Answer: Y

---

Bonus: Short Answer

Name all of the following 3 metabolic processes which directly require oxygen: glycolysis; alcohol fermentation; electron transport system

Bonus Answer: Electron transport system

---

## 11. MATHEMATICS

Writer: Justin Lam

Toss Up: Short Answer

On which point does  $y = 10x + 8$  and  $y = x + 5$  intersect?

Bonus Answer: ( - 1 / 3 , 14 / 3 )

---

**Bonus: Short Answer**

How many distinct roots does the cubic equation  $y = x^3 - 4x^2 + 4x$  have?

**Bonus Answer: It has 2 roots.**

(Explanation: It intersects the x-axis twice, once at  $x = 0$  and once at  $x = 2$ .)

---

## 12. PHYSICS

**Writer: Seiji Yawata**

**Toss Up: Multiple Choice**

What kind of friction will act on a rolling, round object at an instant if the surface is horizontal and rough and no other force acts in the horizontal direction?

- W) Static Friction
- X) Kinetic Friction
- Y) Rolling Friction
- Z) No Friction

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

If the acceleration due to gravity is  $10 \text{ m/s}^2$ , find the force required to move an object of mass 200 kilograms up an incline of 1 in 50 with an acceleration of  $2 \text{ m/s}^2$  and a frictional force of 20 N.

**Bonus Answer: 420 N**

---

## 13. 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) Arginine and Tyrosine

**Bonus Answer: Z**

---

## 14. CHEMISTRY

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

How much  $\text{Sr}(\text{OH})_2 \cdot 8 \text{H}_2\text{O}$  ( $M = 265.76$ ) is needed to prepare 250.0 mL of solution in which  $[\text{OH}^-] = 0.100 \text{ M}$ ?

- W) 3.32 g
- X) 6.64 g
- Y) 9.97 g
- Z) 13.3 g

**Toss Up Answer: W**

---

**Bonus: Multiple Choice**

A 10.00 g sample of a compound containing only carbon, hydrogen, and oxygen forms 23.98 g CO<sub>2</sub> and 4.91 g H<sub>2</sub>O upon complete combustion. What is the empirical formula of the compound?

- W) C<sub>2</sub>H<sub>2</sub>O
- X) C<sub>3</sub>H<sub>3</sub>O
- Y) C<sub>6</sub>H<sub>3</sub>O<sub>2</sub>
- Z) C<sub>6</sub>H<sub>6</sub>O

**Bonus Answer: X**

=====

**15. 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**

-----

**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)**

=====

**16. BIOLOGY**

**Writer: Matthew Lee**

**Toss Up: Multiple Choice**

Which of the following pairs of scientists elucidated the current model of the cell membrane?

- W) Frye and Edidin
- X) Davson and Danielli
- Y) Singer and Nicholson
- Z) Gorter and Grendel

**Toss Up Answer: Y**

-----

**Bonus: Short Answer**

Which of the following allow the protist *Paramecium caudatum* to survive in their hypotonic environments? I. Plasma membrane II. Cell Wall  
III. Pseudopodia IV. Contractile Vacuole

**Bonus Answer: I and IV**

=====

**17. PHYSICS**

**Writer: Aaron Gee**

**Toss Up: Short Answer**

As a pendulum is raised to higher altitudes, its period?

**Bonus Answer: Increases**

-----

**Bonus: Short Answer**

The SI unit of pressure is?

**Bonus Answer: Pascal**

=====

**18. CHEMISTRY**

**Writer: Hanna Yang**

**Toss Up: Multiple Choice**

Which of the following reactions is expected to produce a precipitate?

W)  $\text{CdSO}_4 + \text{K}_2\text{S} \rightarrow \text{CdS} + \text{K}_2\text{SO}_4$

X)  $\text{CoCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{CoSO}_4 + \text{NaCl}$

Y)  $\text{HI} + \text{Zn}(\text{NO}_3)_2 \rightarrow \text{ZnI} + \text{H}(\text{NO}_3)_2$

Z)  $\text{Pb}(\text{NO}_3)_2 + \text{K}_2\text{SO}_4 \rightarrow 2\text{KNO}_3 + \text{PbSO}_4$

**Toss Up Answer: W**

=====

**Bonus: Short Answer**

Name the precipitate for the following reaction:  $3\text{CaCl}_2 + 2\text{Na}_3\text{PO}_4 \rightarrow ? + ?$

**Bonus Answer:  $\text{Ca}_3(\text{PO}_4)_2$  (Calcium Phosphate)**

=====

**19. PHYSICS**

**Writer: Prangon Ghose**

**Toss Up: Multiple Choice**

In a hockey game, a 0.1 kg puck is slide on the ice at 40 m/s horizontally towards a goalie. If the goalie slides the puck back in the direction in which it came with a speed of 30 m/s, what is the impulse experienced by the puck?

W) 1 kgm/s

X) 7 kgm/s

Y) 3 kgm/s

Z) 120 kgm/s

**Toss Up Answer: X**

=====

**Bonus: Multiple Choice**

A block sliding on a frictionless surface at 10 m/s hits a spring which returns the block at the same speed. If the block's mass is 5 kg, what is the impulse the block experiences?

W) 0.5 kgm/s

X) 50 kgm/s

Y) 2 kgm/s

Z) 100 kgm/s

**Bonus Answer: Z**

=====

**20. 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**

=====

## 21. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Short Answer**

The frequency of a wave is 50 Hertz and its wavelength is 25 meters. What is the velocity of this wave?

**Bonus Answer: 1250 meters/second**

-----

**Bonus: Short Answer**

The focal length of a concave spherical mirror is equal to 1 meter. What is the radius of curvature of this mirror?

**Bonus Answer: 2 meters**

=====

## 22. EARTH and SPACE

**Writer: George Papastefanou**

**Toss Up: Multiple Choice**

How is the ISS powered?

W) Solar Energy from photovoltaic cells

X) Nuclear Power

Y) A combination of solar energy and nuclear power

Z) Rocket fuel

**Toss Up Answer: W**

-----

**Bonus: Short Answer**

Who was the first American astronaut in space?

**Bonus Answer: Alan Shepard**

=====

## 23. CHEMISTRY

**Writer: Ahmad Alnasser**

**Toss Up: Short Answer**

What is the name of a cyclic molecule with 6 carbons?

**Bonus Answer: cyclohexane**

-----

**Bonus: Multiple Choice**

Which of the following compounds contains a double bond?

W) butene

X) acetylene

Y) butane

Z) butyne

**Bonus Answer: W**

=====

## 24. EARTH and SPACE

**Writer: Matthew Lee**

**Toss Up: Short Answer**

Name the layers of the atmosphere, from lowest to highest altitude.

**Bonus Answer: Troposphere, Stratosphere, Mesosphere, Thermosphere**

---

**Bonus: Short Answer**

Through what city does the prime meridian run through?

**Bonus Answer: Greenwich, England (accept: Greenwich)**

---

## **25. BIOLOGY**

**Writer: Calvin Vuong**

**Toss Up: Multiple Choice**

Which of the following is a storage protein?

W) aquaporin

X) actin

Y) ovalbumin

Z) AP2

**Toss Up Answer: Y**

---

**Bonus: Short Answer**

What amino acid common in living organisms has a sulfhydryl group in its side chain?

**Bonus Answer: cysteine**

---