# Round 6

## 1. MATHEMATICS

**Writer: Siam Muquit**

**Toss Up: Short Answer**

Given  y = | x - 6 | , what is the derivative at x = 6?

**Bonus Answer: The derivative does not exist**

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**Bonus: Short Answer**

Find the derivative of x^3 / x^2

**Bonus Answer: 1**

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## 2. BIOLOGY

**Writer: Yae June Lee**

**Toss Up: Short Answer**

Why is oxygen required for cellular respiration?

**Bonus Answer: Oxygen is the final electron acceptor for cellular respiration.**

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**Bonus: Short Answer**

The chemical structures of saturated and unsaturated fats differ in what respect?

**Bonus Answer: Number of bonds (single, double, etc) between carbons.**

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## 3. EARTH and SPACE

**Writer: Matthew Lee**

**Toss Up: Multiple Choice**

A hill of unsorted sediments of mixed grain sizes was probably deposited by

W) ice

X) wind

Y) water

Z) frost action

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Which of the following minerals has a pretty strong set of silicon-oxygen bonds but cleaves easily into thin sheets?

W) olivine

X) hornblende

Y) mica

Z) quartz

**Bonus Answer: Y**

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## 4. MATHEMATICS

**Writer: Raafiul Hossain**

**Toss Up: Short Answer**

The surface area of a sphere is how many times the area of a circle?

**Bonus Answer: 4**

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**Bonus: Short Answer**

What is the total surface area of a cone, given l as the slant height?

**Bonus Answer: (pi)r^2 + pi*r*l**

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## 5. 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 15 called?

**Bonus Answer: Pnictogens**

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## 6. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Multiple Choice**

Whose principle or law states that each point on a wavefront may be considered a new wave source?

W) Snell's Law
X) Huygen's principle
Y) Young's Law
Z) Hertz's Law

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

The wave nature of light is demonstrated by which of the following?
W) Diffraction
X) Color
Y) Length
Z) Speed of light

**Bonus Answer: W**

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## 7. MATHEMATICS

**Writer: Ahmad Alnasser**

**Toss Up: Short Answer**

Write an equation for a sine function with an amplitude of 5/3 , a period of pi/2, and a vertical shift of 4 units up.

**Bonus Answer: y = (5/3)sin(4 x) + 4**

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**Bonus: Short Answer**

Two large and 1 small pumps can fill a swimming pool in 4 hours. One large and 3 small pumps can also fill the same swimming pool in 4 hours. How many hours will it take 4 large and 4 small pumps to fill the swimming pool?

**Bonus Answer: 1 hour and 40 minutes**

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## 8. PHYSICS

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

Negative charges are accelerated by electric fields toward points
W) at lower electric potentials
X) at higher electric potentials
Y) where the electric field is weaker

Z) where the electric field is stronger

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

The potential at point A in an electric field is 10V higher than at point B. If a negative charge, q = –2 C, is moved from point A to point B, then the potential energy of this charge will

W) decrease by 20 J

X) decrease by 5 J

Y) increase by 5 J

Z) increase by 20 J

**Bonus Answer: Z**

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## 9. CHEMISTRY

**Writer: Prangon Ghose**

**Toss Up: Multiple Choice**

If the rate of a reaction decreases fourfold when the concentration of a reactant is halved, what is the order of the reaction with respect to that reactant?

W) zero order

X) first order

Y) second order

Z) third order

**Toss Up Answer: Y**

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**Bonus: Short Answer**

In a rate law, what are the units of k when the order is 3?

**Bonus Answer: L^2 mol^-2 s^-1**

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## 10. EARTH and SPACE

**Writer: Andrew Chen (Senior)**

**Toss Up: Multiple Choice**

Given the following choices chose the one that best presents the layers of the earth's atmosphere from lowest to highest altitude.

W) Thermosphere, Mesosphere, Stratosphere, Troposphere

X) Mesosphere, Thermosphere, Stratosphere, Troposphere

Y) Troposphere, Stratosphere, Mesosphere, Thermosphere

Z) Stratosphere, Troposphere, Thermosphere, Mesosphere

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

There are various different particle sizes when dealing with sediments. What is the approximate particle size range of sand?

W) 2 - 4 mm

X) 1/16 - 2 mm

Y) 1/256 - 1/16 mm

Z) 4 - 64 mm

**Bonus Answer: X**

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## 11. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

In organisms, the bonds in polypeptide chains are formed between which two ends of the amino acid?

**Bonus Answer: Carboxyl, amino  OR the side with the NH2 group, the side with the COOH group**

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**Bonus: Short Answer**

Fatty acids have three carbon chains attached to what type of molecule?

**Bonus Answer: glycerol**

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## 12. BIOLOGY

**Writer: Jason Mohabir**

**Toss Up: Short Answer**

Nitrogen fixation refers to the direct conversion of atmospheric nitrogen gas into:

**Bonus Answer: ammonia (ACCEPT: NH3, ammonium, NH4+)**

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**Bonus: Short Answer**

The transformation of nitrates to gaseous nitrogen is accomplished by microorganisms in a series of biochemical reactions. The process is known as:

**Bonus Answer: denitrification**

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## 13. PHYSICS

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

How many orbitals are there in the third electron shell?

**Bonus Answer: 9**

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**Bonus: Short Answer**

Who discovered the neutron?

**Bonus Answer: James Chadwick**

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## 14. BIOLOGY

**Writer: Siam Muquit**

**Toss Up: Short Answer**

The enzyme catalase is associated with which cell organelle?

**Bonus Answer: Peroxisome**

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**Bonus: Short Answer**

What dangerous product of fatty acid oxidation does catalase act on?

**Bonus Answer: Hydrogen peroxide**

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## 15. EARTH and SPACE

**Writer: Shamaul Dilmohamed**

**Toss Up: Multiple Choice**

Which of the following has the lowest specific heat?

W) Copper

X) Granite

Y) Marble

Z) Dry air

**Toss Up Answer: W**

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**Bonus: Short Answer**

Order the following rock particles from the biggest to the smallest: 1. Sand 2. Silt 3. Pebbles 4. Clay

**Bonus Answer: 3, 1, 2, 4**

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## 16. BIOLOGY

**Writer: Calvin Vuong**

**Toss Up: Short Answer**

Select all of the following ways in which the mucosal epithelia protect the body against disease.

1) act as a barrier

2) trap pathogens

3) secrete antimicrobial peptides

**Bonus Answer: 1, 2, 3**

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**Bonus: Multiple Choice**

Which of the following is not involved in the innate immune defense of the intestinal tract?

W) beta-defensins

X) alpha-defensins

Y) commensal bacteria

Z) cryptidins

**Bonus Answer: W**

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## 17. PHYSICS

**Writer: Raafiul Hossain**

**Toss Up: Short Answer**

The speedometer in your car tells you what

**Bonus Answer: instantaneous speed**

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**Bonus: Short Answer**

Projectile 'A' is fired at an angle of 50° above the horizontal; projectile 'B' is fired with the same speed at an angle of 40° above the horizontal. Assuming level ground and negligible air resistance, what is true about range and height of both objects?

**Bonus Answer: A' will reach a smaller height and have a greater range than 'B'.**

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## 18. BIOLOGY

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

A female lizard washes ashore on an island after riding a floating log for hundreds of miles across the sea. She is the only member of her species to have ever made it to the island. After arriving, she lays 20 fertile eggs that hatch and form the basis of a lizard population on the island. Which of the following is NOT a likely result?

W) The new island population will have less genetic diversity than the ancestral population.

X) Mutation will add new alleles to the new population and thus increase its genetic diversity over time.

Y) There will be little or no gene exchange between the new population and the ancestral population.

Z) The new island population will have greater genetic diversity than the ancestral population.

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Loss of heterozygosity can be caused by all of the following EXCEPT:
W) genetic drift.
X) positive frequency-dependent selection.
Y) heterozygote advantage.
Z) inbreeding.

**Bonus Answer: Y**

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## 19. PHYSICS

**Writer: Nicholas Adit**

**Toss Up: Short Answer**

A baseball is thrown straight upward. What is the velocity at the highest point?

**Bonus Answer: 0**

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**Bonus: Multiple Choice**

A rock is dropped off a cliff and strikes the ground with an impact velocity of 30 m/s. How high was the cliff?
W) 15 m
X) 30 m
Y) 45 m
Z) 60 m

**Bonus Answer: Y**

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## 20. CHEMISTRY

**Writer: Hanna Yang**

**Toss Up: Short Answer**

Name the most reactive nonmetal.

**Bonus Answer: Fluorine**

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**Bonus: Short Answer**

Name the transition metal whose carbide is known to be one of the hardest, is used in drills, saws, and lightbulbs, and has the highest melting point of all pure metals.

**Bonus Answer: Tungsten**

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## 21. EARTH and SPACE

**Writer: Shamaul Dilmohamed**

**Toss Up: Short Answer**

What is the most common galaxy type in our universe?

**Bonus Answer: Spiral**

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**Bonus: Multiple Choice**

Astronomers use cepheids principally as measures of what?
W) size
X) speed
Y) chemical composition
Z) distance

**Bonus Answer: Z**

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## 22. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

What is the name for a molecule with tetrahedral electron geometry but only three substituent groups?

**Bonus Answer: trigonal pyramidal**

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**Bonus: Multiple Choice**

Which of the following is not an ionic compound?

W) NaCl

X) HF

Y) FeCl3

Z) H2SO4

**Bonus Answer: X**

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## 23. EARTH and SPACE

**Writer: Shamaul Dilmohamed**

**Toss Up: Short Answer**

In which atmospheric level does the "good" ozone preside?

**Bonus Answer: Stratosphere**

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**Bonus: Short Answer**

In which atmospheric level does the "bad" ozone preside?

**Bonus Answer: Troposphere**

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## 24. PHYSICS

**Writer: William Xiang**

**Toss Up: Multiple Choice**

Which of the following bodies has the largest kinetic energy?

W) Mass 3M and speed V

X) Mass 3M and speed 2V

Y) Mass 2M and speed 3V

Z) Mass M and speed 4V

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

AN object is constrained by a cord to move in a circular path of radius 0.5m on a horizontal frictionless surface. The cord will break if its tension exceeds 16N. The maximum kinetic energy the object can have is:

W) 4J

X) 8J

Y) 17J

Z) 32J

**Bonus Answer: W**

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## 25. EARTH and SPACE

**Writer: Shamaul Dilmohamed**

**Toss Up: Short Answer**

What comet was the first one recognized by astronomers to be periodic, with a period of roughly 76 years?

**Bonus Answer: Halley's Comet**

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**Bonus: Short Answer**

Located between the A and B rings of Saturn, what famous region stretches 4800 km and is characterized by a lack of material?

**Bonus Answer: Cassini Division**

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