

Round 17

1. MATHEMATICS

Writer: Aaron Gee

Toss Up: Multiple Choice

If an arc of 60° on circle 1 has the same length as an arc of 45° on circle 2, what is the ratio of the area of circle 1 to the area of circle 2?

W) 9:16

X) 9:15

Y) 4:3

Z) 2:5

Toss Up Answer: W

Bonus: Short Answer

What is the reciprocal of the complex number $2 + i$?

Bonus Answer: $(2/5) - (1/5)i$

2. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

What is the name given to the crosses that occur when maternal and paternal DNA intertwine?

W) polymerase

X) chiasmata

Y) zona pellucida

Z) cambium

Toss Up Answer: X

Bonus: Short Answer

What is the name given to the follicle cells surrounding an egg that has left the ovary?

Bonus Answer: corona radiata

3. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

Which scientist came up with the laws of planetary motion?

Bonus Answer: Kepler

Bonus: Short Answer

Which constellation is the star that remains stationary in northern hemisphere part of?

Bonus Answer: Ursa Minor

4. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

What is the name given to a "free-for-all" competition for resources?

W) contest competition

X) scramble competition

Y) intraspecific competition

Z) random competition

Toss Up Answer: X

Bonus: Short Answer

What form of mimicry is described as a "wolf-in-sheep's-clothing" approach?

Bonus Answer: aggressive mimicry

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5. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

A ball with mass 0.2 kg is thrown at a wall with velocity 20 m/s and rebounds with a velocity of 15 m/s. What is the impulse of the net force imposed on the ball?

Bonus Answer: 7 kgm/s

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Bonus: Short Answer

In a jousting game, a student of 60 kg with velocity 5 m/s is rolled towards a student of 30 kg at rest. When they collide, their poles conserve all of their kinetic energy as potential energy and redistribute it. What is the final velocity of the 30 kg student to the tenth place?

Bonus Answer: 6.6 m/s

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6. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

What hormone is released by the kidneys in response to oxygen deficiency?

W) erythropoietin

X) Renin

Y) calcitonin

Z) Leptin

Toss Up Answer: W

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Bonus: Short Answer

By what type of system is RBC numbers regulated?

Bonus Answer: negative-feedback system

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7. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

There are many mineral categories. Which of the following mineral groups below is classified based on varying ratios of silicon and oxygen?

W) Sulfides

X) Phosphates

Y) Carbonates

Z) Silicates

Toss Up Answer: Z

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Bonus: Short Answer

Of the following minerals listed, which belong in the mineral group of silicates: Olivine, Mica, Topaz and Talc.

Bonus Answer: Olivine, Mica, Topaz (1, 2, 3)

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8. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following forces is the only force that bonds noble gases?

- W) Dipole-Dipole
- X) Ionic
- Y) Covalent
- Z) London Dispersion Forces

Toss Up Answer: Z

Bonus: Short Answer

What term is used to describe the energy released by the bonding of gaseous ions to form one mole of a substance?

Bonus Answer: lattice energy

9. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Multiple Choice

A function with the zero $1 + 23i$ must have a multiplicity of at least?

- W) 1
- X) 23
- Y) 4
- Z) 2

Toss Up Answer: Z

Bonus: Short Answer

Find the zeros of the function: $0 = x^4 - 81$

Bonus Answer: $3i$, $-3i$, 3 , -3

10. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following elements has the highest reflectivity?

- W) Gold
- X) Silver
- Y) Mercury
- Z) Gallium

Toss Up Answer: X

Bonus: Short Answer

What is Avogadro number to the nearest ten-thousandths?

Bonus Answer: 6.0221×10^{23}

11. MATHEMATICS

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

A square is inscribed within a circle with a radius of 2.5 cm. To the nearest tenths place what is the area of the square?

Bonus Answer: 12.5 cm^2

Bonus: Multiple Choice

Given the parabola $y = 4x^2 + 2x - 10$ what is the equation of the line tangent to it at the point $(0, -10)$?

- W) $y = 2x + 10$
- X) $y = 2x - 5$
- Y) $y = 5x - 8$

Z) $y=2x-10$

Bonus Answer: Z

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12. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which element breaks the octet rule?

W) Ga

X) Xe

Y) Cu

Z) F

Toss Up Answer: X

Bonus: Short Answer

What is the empirical formula of C_6H_{11} ?

Bonus Answer: C_6H_{11}

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13. 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

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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14. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

For E2 reactions to occur, the Hydrogen has to be what to the leaving group?

Bonus Answer: antiperiplanar

Bonus: Short Answer

List the following formations in order of lowest stability to highest: Trans, Geminal, Cis

Bonus Answer: cis, geminal, trans

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15. 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

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

16. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following is the largest patch containing lymphocytes?

- W) lymph nodes
- X) spleen
- Y) thymus
- Z) tonsils

Toss Up Answer: Z

Bonus: Short Answer

What mineral deficiency is associated small sex glands and growth failure?

Bonus Answer: Zinc

17. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

A bullet with mass 0.01 kg and a velocity of 300 m/s is aimed at a wood block on a table. If the mass of the block is 1 kg and the bullet is embedded in the wood block, what is the final velocity of the system?

Bonus Answer: 3 m/s

Bonus: Short Answer

A 0.400 kg soccer ball approaches a player horizontally with a speed of 15 m/s. The player illegally strikes the ball with her hand and causes it to move in the opposite direction with a speed of 22 m/s. What impulse was delivered to the ball by the player to the nearest whole number?

Bonus Answer: -15 kgm/s

18. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

In the following redox reaction: $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ which compound is the oxidizing agent?

- W) O_2
- X) CH_4
- Y) CO_2
- Z) H_2O

Toss Up Answer: W

Bonus: Short Answer

Given the organic molecule C₆H₁₄ how many different structural isomers can be formed?

Bonus Answer: Five

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19. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

If a 5000 kg truck is traveling at 30 m/s, how high must a ramp be to bring the truck to a complete stop?

Bonus Answer: 45 m

Bonus: Short Answer

A 1 kg radio controlled car is traveling at 10 m/s. When the car is 5 m from a cliff, the operator hits the brakes. How much force is required to stop the car?

Bonus Answer: 10 N

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20. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

What enzyme in the digestive system first breaks down starches?

W) protease

X) secretin

Y) cholecystokinin

Z) amylase

Toss Up Answer: Z

Bonus: Short Answer

What cavity is used cnidarians in digestion?

Bonus Answer: gastrovascular cavity

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21. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

Just before hitting a nail, a 2 kg hammer is moving at 10 m/s. If the wood exerts a constant 180 N force on the nail, how far does the nail go?

Bonus Answer: 0.6 m

Bonus: Short Answer

What is the velocity of a particle after falling 10 m if its initial velocity is 10 m/s?

Bonus Answer: 10rad(3) m/s

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22. BIOLOGY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Photorespiration occurs the most under which conditions?

W) High Levels of Carbon Dioxide, Low levels of Oxygen

X) in CAM plants

Y) low levels of carbon dioxide, high levels of oxygen

Z) in C₄ plants

Toss Up Answer: Y

Bonus: Short Answer

How many carbons does ribulose biphosphate have?

Bonus Answer: 5

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23. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

A sports car dealer claims that his product will accelerate at a constant rate from rest to a speed of 90 km/hr in 8s.

What is the acceleration of the car in m/s^2 to the nearest whole number?

Bonus Answer: 3 m/s^2

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Bonus: Short Answer

A rock released at rest from the top of a tower hits the ground after falling for 2 s. What is the height of the tower if air resistance is negligible to the nearest whole number?

Bonus Answer: 20 m

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24. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

In the 1920's, the Russian scientist Ivan Pavlov performed a famous set of experiments on dogs. What was the experiment?

Bonus Answer: Conditioning the dogs to salivate when a bell was rung.

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Bonus: Short Answer

What hormone maintains the thick lining of the uterus?

Bonus Answer: Progesterone

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25. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

What do CFC's do to the environment?

Bonus Answer: They destroy the ozone layer.

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Bonus: Short Answer

Name three structures that are in plant cells but not animal cells.

Bonus Answer: Chloroplasts, cell wall, and central vacuole.

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