

Round 9

1. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

An object oscillates with equation $x = 2\cos(5\pi t)$ (READ AS: x equals 2 times cosine of open parentheses 5 PI times t close parentheses). What is the frequency of the oscillation?

W) 0.5

X) 1

Y) 2.5

Z) 4

Toss Up Answer: Y

Bonus: Multiple Choice

An LC circuit consists of a 5 henry inductor and a 20 farad capacitor connected to a battery in a series circuit. What is the frequency of the oscillation of the current in the circuit?

W) $0.05/\pi$ ($0.05/\text{PI}$)

X) $0.1/\pi$ ($0.1/\text{PI}$)

Y) $2/\pi$ ($2/\text{PI}$)

Z) $3/\pi$ ($3/\text{PI}$)

Bonus Answer: W

2. 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.

3. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

Which one of these is NOT true?

W) All planets revolve in the same direction.

X) All planets rotate in the same direction.

Y) The orbits of the planets are all ellipses.

Z) The orbits of the planets are nearly in the same plane.

Toss Up Answer: X

Bonus: Multiple Choice

Coal is believed to have been principally formed in which of the following types of environment?

- W) river beds
- X) swamps
- Y) volcanic regions
- Z) deserts

Bonus Answer: X

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4. MATHEMATICS

Writer: William Xiang

Toss Up: Short Answer

Find the first derivative of $10x^3 + 3x^2 + 3$ in the simplest form.

Bonus Answer: $30x^2 + 6x$

Bonus: Short Answer

How many points of inflection does the graph $x^3 + 5$ have?

Bonus Answer: 1

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5. 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

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6. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

What is the closest star to the solar system, 4.25 light years away from the sun?

Bonus Answer: Proxima Centauri

Bonus: Short Answer

On approximately which two days of the Gregorian calendar do full moons most commonly appear?

Bonus Answer: 15th and 16th of each month

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7. 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

8. 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.

9. BIOLOGY

Writer: Benjamin Avrahami

Toss Up: Short Answer

Which animal phylum was the first to develop true coelems? (PRONOUNCE: cee-lums)

Bonus Answer: Annelida (ACCEPT: annelids; DO NOT ACCEPT: earthworms)

Bonus: Multiple Choice

Which one of these molecules is secreted by your parietal cells?

- W) Hydrochloric Acid
- X) Pepsinogen
- Y) Trypsin
- Z) Mucus

Bonus Answer: W

10. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Short Answer

What is the largest ion with an equal amount of protons and neutrons?

Bonus Answer: Ca²⁺

Bonus: Short Answer

Who is regarded as the father of the modern periodic table? (1st and last name)

Bonus Answer: Dmitri Mendeleev

11. BIOLOGY

Writer: George Papastefanou

Toss Up: Multiple Choice

What kind of typing is used to identify tissue-specific gene expression?

- W) Southern Blot
- X) Northern Blot
- Y) Western Blot
- Z) Radioactive Tracer

Toss Up Answer: X

Bonus: Multiple Choice

Which genetic disorder is mainly characterized by an onset in middle age?

- W) Huntington's Disease
- X) Schizophrenia
- Y) Prader-Willi syndrome
- Z) Tay-Sachs Syndrome

Bonus Answer: W

12. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Given the following ions, Na⁺, Br⁻, Ag⁺, and Cu²⁺ which ion has the greatest atomic radius?

- W) Na⁺
- X) Br⁻
- Y) Ag⁺
- Z) Cu²⁺

Toss Up Answer: Y

Bonus: Short Answer

Name the group of elements with the least electronegativity.

Bonus Answer: Noble gases (Group 18)

13. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which biome is characterized by population oscillations?

- W) Temperate Deciduous
- X) Tropical Rainforest
- Y) Tundra
- Z) Taiga

Toss Up Answer: Y

Bonus: Short Answer

Large-scale population oscillations in the tundra are caused by what abiotic factor?

Bonus Answer: Thawing and freezing of the ice (Also accept: population migrations)

14. EARTH and SPACE

Writer: Seiji Yawata

Toss Up: Multiple Choice

In oceans, waves and surf current are generated by:

- W) El Nino
- X) salinity and temperature gradients
- Y) the intertropical convergence zone
- Z) wind

Toss Up Answer: Z

Bonus: Multiple Choice

During which of the following geological subdivisions was glaciation minimal on Earth?

- W) Quaternary Period
- X) Holocene Epoch
- Y) Cretaceous Period
- Z) Pleistocene Epoch

Bonus Answer: Y

15. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A toy train moves in a circle of 8 meters radius with a speed of 4 meters per second. What is the magnitude of the acceleration of the train?

Bonus Answer: 2 meters per second²

Bonus: Short Answer

A certain machine exerts a force of 200 newtons on a box whose mass is 30 kilograms. The machine moves the box a distance of 20 meters along a horizontal floor. What amount of work does the machine do on the box?

Bonus Answer: 4000 J (joules)

16. EARTH and SPACE

Writer: Justin Lam

Toss Up: Short Answer

What is the shape of the path planets take around the sun?

Bonus Answer: Elliptical

Bonus: Short Answer

Name three of the closest stars to Earth, not including the Sun.

Bonus Answer: Three of the following: Proxima Centauri, Alpha Centauri A, Alpha Centauri B, Barnard, Wolf, Luyten, Sirius

17. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A box is initially at rest on a horizontal, frictionless table. If a force of 10 Newtons acts on the box for 3 seconds, what is the momentum of the box at the end of the 3 second interval?

Bonus Answer: 30 N (newton) seconds

Bonus: Short Answer

A 10 kilogram body initially moving with a velocity of 10 meters per second makes a head-on collision with a 15 kilogram body initially at rest. The two objects stick together. What is the velocity of the combined system just after the

collision?

Bonus Answer: 4 meters per seconds

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18. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

A precipitation reaction is an example of which of the following reactions?

W) Combustion

X) Substitution

Y) Single Displacement

Z) Double Displacement

Toss Up Answer: Z

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Bonus: Short Answer

By name or number, which of the following would be a precipitate in aqueous solution?

1. Silver sulfide

2. Potassium nitrate

3. Strontium hydroxide

4. Lead(II) fluoride

Bonus Answer: Silver sulfide, Lead(II) fluoride OR (1, 4 only)

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19. MATHEMATICS

Writer: Jessica Titensky

Toss Up: Short Answer

What is the slope of the tangent line to $e^{(2x)}$ at $x=3$

Bonus Answer: $2e^6$

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Bonus: Short Answer

What is the slope of the tangent line to $\ln(2x)$ at $x=3$

Bonus Answer: $1/3$

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20. CHEMISTRY

Writer: Siam Muquit

Toss Up: Short Answer

What is the molecular geometry of ammonia (NH_3)?

Bonus Answer: Trigonal Pyramidal

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Bonus: Multiple Choice

How many lone pairs are in Xenon tetrafluoride (XeF_4)?

W) 0

X) 1

Y) 2

Z) 3

Bonus Answer: Y

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21. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

If the distance between two objects, each of mass 'M', is tripled, the force of attraction between the two objects is

- W) 1/2 original force
- X) 1/3 original force
- Y) 1/9 original force
- Z) unchanged

Toss Up Answer: Y

Bonus: Multiple Choice

In physics, a radian per second is a unit of:

- W) angular displacement
- X) angular velocity
- Y) angular acceleration
- Z) angular momentum

Bonus Answer: X

22. CHEMISTRY

Writer: Calvin Vuong

Toss Up: Multiple Choice

The relation between pressure and temperature of two ideal gases is stated in

- W) Gay-Lussac's Law
- X) Boyle's Law
- Y) Charles's Law
- Z) Avogadro's Law

Toss Up Answer: W

Bonus: Short Answer

What are the dimensions of the gas constant R in SI base units?

Bonus Answer: $\text{kg m}^2 \text{mol}^{-1} \text{K}^{-1} \text{s}^{-2}$ (accept as a fraction)

23. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

what is a front?

Bonus Answer: boundary between two air masses

Bonus: Short Answer

How does a cold front form?

Bonus Answer: cold air moves in and pushes warm air up

24. 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

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25. EARTH and SPACE

Writer: Shanjeed Ali

Toss Up: Short Answer

The Ring of Fire surrounds which ocean?

Bonus Answer: Pacific Ocean

Bonus: Multiple Choice

What kind of volcano is Mauna Loa?

W) cone

X) shield

Y) subglacial

Z) stratovolcano

Bonus Answer: X

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