

Round 24

1. PHYSICS

Writer: Aryan Bhatt

Toss Up: Short Answer

If the distance between two objects is halved and the mass of one of them is doubled, what happens to the gravitational force between them?

Bonus Answer: It is halved (prompt on decreases)

Bonus: Multiple Choice

Which of the following is NOT a factor that affects the force of gravity between them?

- W) The distance between them
- X) The mass of the more massive object
- Y) The density of the less massive object
- Z) The mass of the less massive object

Bonus Answer: Y

2. PHYSICS

Writer: Brian Lim

Toss Up: Short Answer

When measured in meters, visible light has a wavelength with what order of magnitude?

Bonus Answer: 10^{-7}

Bonus: Multiple Choice

The indices of refraction for various materials are typically measured with what type of light?

- W) Red light
- X) Yellow light
- Y) Green Light
- Z) Blue Light

Bonus Answer: X

3. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

What best describes the relationship between a planet's escape velocity and its radius and mass?

- W) Escape velocity increases as radius increases or mass increases
- X) Escape velocity increases as radius increases or mass decreases
- Y) Escape velocity increases as radius decreases or mass increases
- Z) Escape velocity increases as radius decreases or mass decreases

Toss Up Answer: Y

Bonus: Multiple Choice

In terms of the permittivity of free space, denoted as ϵ_0 [epsilon naught], and the permeability of free space, denoted as μ_0 [mu naught], which expression is equivalent to the speed of light?

- W) $\epsilon_0 \mu_0$
- X) $1/(\epsilon_0 \mu_0)$
- Y) ϵ_0 / μ_0
- Z) $1/\sqrt{\epsilon_0 \mu_0}$

Bonus Answer: Z

=====

4. PHYSICS

Writer: Brian Lim

Toss Up: Short Answer

What law of physics states that a planet orbiting a single star moves in an elliptical orbit?

Bonus Answer: Kepler's First Law [of Planetary Motion]

=====

Bonus: Short Answer

If a charged particle enters a uniform magnetic field at an angle of 45 degrees to the field direction, what is the geometry of the path of the particle?

Bonus Answer: Helix [or helical]

=====

5. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Factor $x^2 + y^2 + z^2 + 2xy + 2yz + 2xz$

Bonus Answer: $(x+y+z)^2$

=====

Bonus: Short Answer

Factor $x^2(z-y) + y^2(x-z) + z^2(y-x)$

Bonus Answer: $(x-y)(y-z)(z-x)$ (or any other answer involving multiplying 2 of the binomials by -1)

=====

6. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Find the sum of the first 6 Fibonacci numbers

Bonus Answer: 20

=====

Bonus: Short Answer

Find the sum of all the numbers in the first 7 rows of the Pascal Triangle

Bonus Answer: 127

=====

7. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

What was the first name of the person who discovered the Fibonacci Sequence?

Bonus Answer: Leonardo

=====

Bonus: Short Answer

What is the full name of the man who invented the Power of a Point?

Bonus Answer: Jacob Steiner

=====

8. MATHEMATICS

Writer: Elias Milborn

Toss Up: Multiple Choice

What are the solutions for x in the following equation: $x^2 - 2x = 8$?

W) 0

X) 0 and -2

Y) 4 and -2

Z) -4 and 2

Toss Up Answer: Y

Bonus: Multiple Choice

The sum of the squares of reciprocals of all positive integers equals which of the following?

W) $\pi^{1/2}$ (read as square root of π)

X) $\pi/3$

Y) $\pi^2/6$

Z) $\pi^3/12$

Bonus Answer: Y

9. BIOLOGY

Writer: Aryan Bhatt

Toss Up: Short Answer

This genetic condition results in developmental delays and a flattened facial profile. It is caused by trisomy of the 21st chromosome in humans.

Bonus Answer: Down Syndrome

Bonus: Short Answer

What is the name of the genetic condition in which a person has two X chromosomes and one Y chromosome?

Bonus Answer: Klinefelter syndrome

10. BIOLOGY

Writer: Aryan Bhatt

Toss Up: Short Answer

Blood headed toward the lungs exits which chamber of the heart, and through into what blood vessel?

Bonus Answer: Exits the Right ventricle into the pulmonary artery

Bonus: Short Answer

how many chambers do the hearts of bony fish and frogs have, respectively?

Bonus Answer: 2 and 3

11. BIOLOGY

Writer: Aryan Bhatt

Toss Up: Short Answer

Which group of cells at the top of the heart, also known as the "pacemaker of the heart", sends an electrical signal that causes the atria to contract?

Bonus Answer: The Sinoatrial node (accept SA node)

Bonus: Short Answer

What is the name of the valve that prevents blood from flowing from the left ventricle to the left atrium?

Bonus Answer: Mitral valve

12. BIOLOGY

Writer: Aryan Bhatt

Toss Up: Short Answer

What is the name of the regions of repetitive DNA sequences at the ends of chromosomes?

Bonus Answer: Telomeres?

Bonus: Short Answer

What proteins are DNA strands wrapped around in chromosomes?

Bonus Answer: Histones

13. BIOLOGY

Writer: Aryan Bhatt

Toss Up: Short Answer

The name for the process where an amino acid loses its amino group is called what?

Bonus Answer: Deamination

Bonus: Short Answer

Which essential amino acid, encoded by the DNA codons GTA, GTG, GTC, and GTT, replaces glutamic acid in the β -globin of people with sickle-cell anemia?

Bonus Answer: Valine

14. BIOLOGY

Writer: Aryan Bhatt

Toss Up: Short Answer

What alternative to the Calvin cycle is used by sugarcane and corn?

Bonus Answer: the C₄ cycle (prompt on carbon fixation)

Bonus: Short Answer

Plants that use the CAM cycle as their method of carbon fixation have this adaptation because of what type of climate?

Bonus Answer: Arid or Dry

15. BIOLOGY

Writer: Aryan Bhatt

Toss Up: Short Answer

Where does the digestion of carbohydrates begin when eating, and which type of enzyme is used?

Bonus Answer: The mouth, amylase (prompt on saliva)

Bonus: Short Answer

What is the enzyme that digests proteins in the human stomach?

Bonus Answer: Pepsin

16. BIOLOGY

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

Photosynthesis and cellular respiration are said to be complimentary reactions. Which molecule is involved in both the Calvin cycle in photosynthesis and glycolysis in cellular respiration?

W) OAA

X) PGA

Y) PGAL

Z) 1,3-BPG

Toss Up Answer: Y

Bonus: Short Answer

In chemiosmosis, how many hydrogen ions need to diffuse out of the membrane through ATP synthase before a molecule of ATP can be formed?

Bonus Answer: 3

=====

17. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which type of microscopy takes advantage of differences in the refractive index of biological materials and the surrounding medium to create an image without a stain?

- W) scanning electron
- X) transmission electron
- Y) fluorescence
- Z) phase-contrast

Toss Up Answer: Z

=====

Bonus: Short Answer

What does MRSA stand for?

Bonus Answer: Methicillin-resistant Staphylococcus Aureus

=====

18. CHEMISTRY

Writer: Brian Lim

Toss Up: Multiple Choice

Which best describes a sample that is boiling?

- W) Potential energy increases and kinetic energy stays the same
- X) Both potential and kinetic energy increase
- Y) Potential energy stays the same and kinetic energy increases
- Z) Potential energy decreases and kinetic energy increases

Toss Up Answer: W

=====

Bonus: Short Answer

What is the IUPAC name for FeCr_2O_7 ?

Bonus Answer: Iron(II) Dichromate

=====

19. CHEMISTRY

Writer: Andrew Chen

Toss Up: Multiple Choice

Heating ferrite above 1000 kelvin yields what phase of steel?

- W) cementite
- X) austenite
- Y) martensite
- Z) ceramic steel

Toss Up Answer: X

=====

Bonus: Short Answer

Cooling white tin below 13 degrees Celsius turns it into what?

Bonus Answer: gray tin

=====

20. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

What is the term for a substance that yields a mechanical response upon application of electricity?

Bonus Answer: piezoelectric

Bonus: Multiple Choice

At the yield point of a material, what happens?

W) the material breaks into two pieces

X) the material cracks

Y) the material begins to deform plastically

Z) the material begins to neck, or narrow

Bonus Answer: Y

21. CHEMISTRY

Writer: Andrew Chen

Toss Up: Short Answer

What is the flame test result of boric acid?

Bonus Answer: green

Bonus: Multiple Choice

Which of the following metal ions appears green in solution?

W) nickel two

X) iron three

Y) copper two

Z) silver

Bonus Answer: W

22. CHEMISTRY

Writer: Andrew Chen

Toss Up: Multiple Choice

Which element reacts vigorously with water, producing a purple color?

W) sodium

X) chromium

Y) potassium

Z) barium

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following doesn't dissolve in aqua regia?

W) lead

X) gold

Y) titanium

Z) zinc

Bonus Answer: Y

23. EARTH and SPACE

Writer: Yevgeniy Gorbachev

Toss Up: Short Answer

What is the fourth most common element in the universe?

Bonus Answer: Oxygen.

Bonus: Multiple Choice

The maximum mass for a white dwarf is:

W) 3 solar masses

X) 5 solar masses

Y) 1.4 solar masses

Z) .5 solar masses

Bonus Answer: Y

24. EARTH and SPACE

Writer: Mohammed Haque

Toss Up: Multiple Choice

How many days (24 hours) does it take for Mars to make one full rotation around the Sun?

W) 687 days

X) 997

Y) 453

Z) 503

Toss Up Answer: W

Bonus: Multiple Choice

Why does Mars appear to have a red tint when looking through a telescope?

W) It's atmosphere is composed of Argon

X) The iron within the dust reacts with the Oxygen in the air.

Y) The neon in it's atmosphere.

Z) Non of the above.

Bonus Answer: X

25. EARTH and SPACE

Writer: Yevgeniy Gorbachev

Toss Up: Short Answer

Which planet has a group of asteroids at its L5 point?

Bonus Answer: Jupiter

Bonus: Multiple Choice

Which one of Jupiter's moons is predominantly covered in ice and has a subsurface ocean?

W) Io

X) Callisto

Y) Europa

Z) Lysithea

Bonus Answer: Y
