

Round 10

1. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

You come across a yellow pea colored garden pea plant, and you want to determine its genotype. You testcross it with a green pea colored pea plant, which yields 501 yellow plants and 495 green plants. What is the genotype of the yellow parent?

Bonus Answer: ACCEPT any of the following: heterozygous, hybrid

Bonus: Short Answer

You are cross breeding two garden pea plants. The first parent's genotype is heterozygous yellow for its pea color, homozygous purple for its flower color, and is heterozygous for its tall trait. The second parent's genotype is homozygous green for its pea color, heterozygous purple for its flower color, and heterozygous for its tall trait. What fraction of their offspring will be green pea colored, purple flower colored, and short?

Bonus Answer: 1/8

2. CHEMISTRY

Writer: Shihab Karim

Toss Up: Multiple Choice

Which of the one of the following salts is insoluble?

W) NH_4Cl

X) $\text{Ca}(\text{NO}_3)_2$

Y) BaCO_3

Z) Na_2S

Toss Up Answer: Y

Bonus: Short Answer

What is the empirical formula for glucose?

Bonus Answer: CH_2O

3. EARTH and SPACE

Writer: Prangon Ghose

Toss Up: Multiple Choice

Which planet's tilt of the axis is closest to that of Mars?

W) Mercury

X) Venus

Y) Earth

Z) Jupiter

Toss Up Answer: Y

Bonus: Multiple Choice

Which planet rotates the fastest in our solar system?

W) Earth

X) Jupiter

Y) Pluto

Z) Uranus

Bonus Answer: X

4. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Which of the following has the largest ionic radius?

W) Li

X) Be

Y) Na

Z) Mg

Toss Up Answer: Y

Bonus: Short Answer

Why does Oxygen have a smaller atomic radius than boron?

Bonus Answer: Effective nuclear charge

5. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the name of Uranus' smallest moon, which is best known for the idea that it was shattered in a collision billions of years ago and reformed?

Bonus Answer: Miranda

Bonus: Short Answer

Which two moons in the solar system are bigger than the smallest planet?

Bonus Answer: Ganymede and Titan

6. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

The evaporation of any liquid is expected to have

W) a positive ΔH and a negative ΔS

X) a negative ΔH and a negative ΔS

Y) a positive ΔH and a positive ΔS

Z) a positive ΔH and a negative ΔS

Toss Up Answer: Y

Bonus: Multiple Choice

The rate of reaction will be large if

W) ΔG is a large negative number

X) ΔS is a large negative number

Y) ΔH is a large negative number

Z) None of the above

Bonus Answer: Z

7. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What is stated by Kirchhoff's First Law?

W) The description of the force interacting between static electrically charged particles.

- X) The algebraic sum of currents in a network of conductors meeting at a point is zero.
- Y) The algebraic sum of the products of the resistances of the conductors and the currents in them in a closed loop is equal to the total emf available in that loop.
- Z) The net electric flux through any closed surface is equal to $\frac{1}{\epsilon_0}$ times the net electric charge within that closed surface.

Toss Up Answer: X

Bonus: Multiple Choice

If two 4-Farad capacitors and one 6-Farad are connected in parallel, what is the equivalent capacitance three capacitors?

- W) 14 Farads
- X) 4.66 Farads
- Y) 1.5 Farads
- Z) 1 Farad

Bonus Answer: W

8. 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)

9. PHYSICS

Writer: Mohammed Jamil

Toss Up: Multiple Choice

Which statement describes a situation when polarization could not occur?

- W) Light waves are reflected.
- X) Light waves are scattered.
- Y) Microwaves pass through a metal grid.
- Z) Sound waves pass through a metal grid.

Toss Up Answer: Z

Bonus: Multiple Choice

An electromagnetic wave has a wavelength that is numerically of the same order of magnitude as the diameter of a nucleus.

In which region of the electromagnetic spectrum does the wave occur?

- W) Gamma ray
- X) X-ray
- Y) Visible light
- Z) Infra-red

Bonus Answer: W

10. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Using accelerator mass spectrometry, the ^{14}C atoms in a 2 mg bone fragment were directly counted and found to be $\frac{1}{8}$ of those that would be present in a 2 mg bone fragment in 1950. What is the approximate age of this specimen?

- W) 1,540 years
- X) B. 5,730 years
- Y) C. 17,190 years
- Z) D. 22,920 years

Toss Up Answer: Y

Bonus: Multiple Choice

Positive cooperativity is an emergent property of what type of enzymatic regulatory mechanism?

- W) Allosteric interactions.
- X) Cellular compartmentalization.
- Y) Genetic regulatory mechanisms.
- Z) Second messenger systems.

Bonus Answer: W

11. MATHEMATICS

Writer: Benjamin Avrahami

Toss Up: Short Answer

If the capstone is taken off the Great Pyramid of Giza, then it is no longer a pyramid but a what?

Bonus Answer: A frustum

Bonus: Multiple Choice

Which one of these is Euclid's parallel postulate?

- W) If a line intersects one of two parallel lines, both of which are coplanar with the original line, then it will also intersect with the other line.
- X) If a line segment intersects two straight lines forming two interior angles on the same side that sum to less than two right angles, then the two lines, if extended indefinitely, meet on the side on which the angles sum to less than two right angles.
- Y) In a plane, given a line and a point not on it, exactly one line parallel to the given line can be drawn through the point.
- Z) For any acute angle A and any point D in the interior of angle A, there exists a line through D and not through A which intersects both sides of angle A.

Bonus Answer: X

12. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

What happens in a hydrogen atom when an electron jumps from an excited energy state to a more stable energy state?

- W) electromagnetic radiation is emitted by the atom

X) electromagnetic radiation is absorbed by the atom

Y) the atom becomes a positively charged ion

Z) the atom becomes a negatively charged ion

Toss Up Answer: W

Bonus: Short Answer

A closed 5-liter vessel contains a sample of neon gas. The temperature inside the container is 25°C, and the pressure is 1.5 atmospheres. (The gas constant, R, is equal to 0.08 L·atm/mol·K.) If the neon gas in the vessel is replaced with an equal molar quantity of helium gas, which of the following properties of the gas in the container will be changed?

I. Pressure

II. Temperature

III. Density

Bonus Answer: III only

13. MATHEMATICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

Which of the following sets has the greatest cardinality?

W) The set of all real numbers

X) The set of all integers

Y) The set of all rational numbers

Z) They all have the same cardinality

Toss Up Answer: W

Bonus: Short Answer

If set A has a cardinality of 5, set B has a cardinality of 6, and set A and B are disjoint sets, what is the cardinality of the union of set A and B?

Bonus Answer: 11

14. CHEMISTRY

Writer: Jan Wojcik

Toss Up: Multiple Choice

According to VSEPR theory, which of the following molecules DOES NOT have a trigonal pyramidal geometry?

W) NH₃ (read as: Ammonia)

X) BF₃ (read as: Barium trifluoride)

Y) XeF₃ (read as: Xenon trifluoride)

Z) PCl₃ (read as: Phosphorus trichloride)

Toss Up Answer: X

Bonus: Short Answer

By name of number, which of the following molecules have a bent molecular structure?

1. SO₂

2. CO₂

3. OF₂

Bonus Answer: SO₂ and OF₂ (accept 1 and 3)

15. MATHEMATICS

Writer: Shihab Karim

Toss Up: Multiple Choice

If the diameter of a circle is 6 inches, what is the area of the circle?

W) 36π

X) 9π

Y) 12π

Z) 6π

Toss Up Answer: X

Bonus: Short Answer

Find the equation of the line that passes through the point (3,4) and is perpendicular to the line $y = 3x - 2$?

Bonus Answer: $y = -(1/3)x + 5$

16. PHYSICS

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

Given a 5 meter length of gold wire with a radius of 0.05 meters with a resistivity of 2.2×10^{-8} , find the resistance in the wire.

Bonus Answer: 4.4×10^{-5} ohms

Bonus: Multiple Choice

Given the following quantities chose the answer that contains only vector quantities.

W) Length, force, momentum

X) Momentum, temperature, work

Y) displacement, acceleration, velocity

Z) entropy, pressure, mass

Bonus Answer: Y

17. EARTH and SPACE

Writer: Matthew Lee

Toss Up: Short Answer

In which direction are winds and ocean currents deflected in the Southern Hemisphere?

Bonus Answer: left

Bonus: Multiple Choice

Which of the following does not support the heliocentric model?

W) Coriolis effect

X) rotation of the Foucault pendulum

Y) epicycles

Z) direct motion

Bonus Answer: Y

18. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A conveyor-belt, horizontally, moves a 600Kg bag a distance of 100 meters through the airport. How much work was done?

Bonus Answer: No work was done.

Bonus: Short Answer

A dryer has a power rating of 2500 watts. To dry a few towels this dryer uses 6,750,000 joules of energy. How long

will it take to dry these towels, in minutes

Bonus Answer: 45 minutes

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19. EARTH and SPACE

Writer: Matthew Lee

Toss Up: Short Answer

A time difference of 5 hours separates London and New York City. What is the longitude of New York City?

Bonus Answer: 75 degrees west (accept 74 if they actually know that by heart)

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Bonus: Short Answer

Any location north of the equator has latitude equal to the angle what star makes above the horizon at said location?

Bonus Answer: Polaris (accept: The North Star)

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20. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

A beam of white light hits the sharp end of a glass prism and is broken up into monochromatic components. Which of the following phenomenon is this a direct example of?

W) Refraction

X) Dispersion

Y) Rarefaction

Z) Diffraction

Toss Up Answer: X

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Bonus: Short Answer

A projectile whose mass is 9.4 kg is fired vertically upward. On its upward flight, an energy of 68 kJ is dissipated because of air resistance. How much higher would it have gone if the air resistance had been made negligible? Round to the nearest ten meters.

Bonus Answer: 740 m

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21. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

To the nearest day, how long is the sidereal period of the moon?

Bonus Answer: 27 days

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Bonus: Short Answer

The only supernova explosion in modern times visible in the sky to the naked eye became visible in which year?

Bonus Answer: 1987

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22. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

In a compound gearing arrangement where a 40-tooth gear drives an 80-tooth gear which is directly connected to a 50-tooth gear that drives a 100-tooth gear, the total reduction is a factor of:

W) 2

X) 6

Y) 4

Toss Up Answer: Y

Bonus: Multiple Choice

Elastic deformation is BEST described as ...

W) the linear portion of a stress/strain curve

X) 99% elongation

Y) strength of a material

Z) deformation

Bonus Answer: W

23. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Polio is caused by which type of microbe?

W) Bacteria

X) Fungus

Y) Prion

Z) Virus

Toss Up Answer: Z

Bonus: Short Answer

Which human body system does polio most directly affect?

Bonus Answer: Nervous system (accept Central nervous system)

24. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Short Answer

In DNA, to which carbon of the sugar is the nitrogenous base bonded?

Bonus Answer: Accept one OR one prime

Bonus: Short Answer

On which carbon of the sugar is the hydroxyl group located?

Bonus Answer: Accept three OR three prime

25. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

HIV can be treated with a drug cocktail known as HAART. What does HAART stand for?

Bonus Answer: Highly Active Anti-Retroviral Treatment

Bonus: Short Answer

AIDS patients may become afflicted with an extremely rare cancer caused by a certain herpesvirus. What is this cancer called?

Bonus Answer: Kaposi's Sarcoma
