

Round 18

1. MATHEMATICS

Writer: Elias Milborn

Toss Up: Short Answer

Giving your answer as up, down, left, or right, the graph of the equation $x = 5y - 8y^2 - 1$ opens in which direction

Bonus Answer: left

Bonus: Short Answer

If chord AB is 8 units from the center of a circle O with a radius of 17, what is the length of chord AB?

Bonus Answer: 30

2. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Which of the following compositions of particles would result in the least porosity?

W) Angular particles, loosely packed

X) Sorted particles, closely packed

Y) Rounded particles, loosely packed

Z) Unsorted particles, closely packed

Toss Up Answer: Z

Bonus: Short Answer

Given there is a full moon on Wednesday on which day of the week is it when there is an new moon on the same phase cycle?

Bonus Answer: Thursday

3. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Name all of the following genetic disorders that exhibit dominant inheritance.

1. achondroplasia

2. polydactyly

3. cri-du-chat syndrome

4. Huntington's disease

Bonus Answer: 1, 2, 4

Bonus: Short Answer

Name all of the following genetic disorders that result from chromosomal abnormalities.

1. Down syndrome

2. color blindness

3. cri-du-chat

4. Klinefelter's Syndrome

Bonus Answer: 1, 3, 4

4. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What two chemical elements are found in sphalerite?

Bonus Answer: Zinc and Sulfur (accept: Zn and S)

Bonus: Short Answer

What two chemical elements are found in periclase?

Bonus Answer: Magnesium and Oxygen (accept: Mg and O)

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5. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

In which end of DNA is the hydroxyl group found?

Bonus Answer: 3 prime

Bonus: Multiple Choice

Which of the following are types of non-essential amino acids?

W) Phenylalanine and Valine

X) Leucine and Histidine

Y) Histidine and Lysine

Z) Arginine and Tyrosine

Bonus Answer: Z

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6. EARTH and SPACE

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Which of these is till?

W) fine flacial lake clay

X) well-sorted outwash sand

Y) a polished rock outcrop

Z) unsorted sand, gravel, and clay in a moraine

Toss Up Answer: Z

Bonus: Short Answer

There are 5 officially recognized dwarf planets in our solar system. Name 3 of them.

Bonus Answer: Accept 3 of the following: Ceres, Pluto, Haumea, Makemake and Eris

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7. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

The amino acid sequences encoded by the red and green visual pigment genes in humans are 96% identical. These two loci are found close together on the X chromosome. What mechanism most likely led to the evolution of these two genes?

W) Horizontal gene transfer followed by sequence divergence

X) Gene duplication followed by sequence divergence

Y) Inversion of the human X chromosome

Z) Polyploidization

Toss Up Answer: X

Bonus: Multiple Choice

Genetic drift is best described as:

W) evolutionary change due to natural selection.

X) changes in the proportion of homozygous recessive individuals due to random mating.

Y) a random change in allele frequencies that benefits the population.

Z) evolutionary change due to random events.

Bonus Answer: Z

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8. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Short Answer

Find $x/y + y/x$ in simplest form if $x=7$ and $y=3$

Bonus Answer: 58/21

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Bonus: Short Answer

Positive integers a and b satisfy $ab \mid a^2 + 4ab + 4b^2$ [" a b divides a squared plus four a b plus four b squared"]. The smallest possible value of $a+b$ is 2, which occurs when $a=b=1$ [" a equals b equals 1"]. What is the second smallest possible value of $a+b$?

Bonus Answer: 6: $a=4$, $b=2$

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9. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

What is the typical size range for a prokaryote?

W) .1 - 1.0 micrometer

X) .5 - 5.0 micrometer

Y) 1-10 micrometer

Z) 10-100 micrometer

Toss Up Answer: X

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Bonus: Short Answer

What is the name for the factor that allows a bacteria to become a donor during conjugation?

Bonus Answer: F factor (accept fertility factor)

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10. MATHEMATICS

Writer: Justin Lam

Toss Up: Short Answer

Factor the following equation: $x^3 + 8(x^2) + 8x + 64$

Bonus Answer: $(x + 8)(x + 8)(x^2 + 8)$ or $(x^2 + 8)[(x + 8)^2]$

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Bonus: Multiple Choice

Which of the following is a primitive Pythagorean triple?

W) 9 , 12 , 15

X) 10 , 24 , 26

Y) 3 , 4 , 5

Z) 16 , 30 , 34

Bonus Answer: Y

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11. BIOLOGY

Writer: Elias Milborn

Toss Up: Short Answer

What scientist in 1936, building on the discoveries of Szent-Gyorgyi [SENT-GEE-or-gee], postulated the basic

reactions of the tricarboxylic acid cycle?

Bonus Answer: Krebs

Bonus: Short Answer

If a plant that is heterozygous for each of three independently-assorting traits is allowed to self-fertilize, what portion of the offspring would be heterozygous for all three traits?

Bonus Answer: 1/8

12. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

Given the equation $\text{HCl (aq)} + \text{NaOH (aq)} \rightarrow \text{NaCl (aq)} + \text{H}_2\text{O (l)}$ and that 10.00 mL of 1.5 M HCl was reacted with 20.00 mL of 0.80 M of NaOH, which compound is the limiting reactant?

Bonus Answer: HCl (Hydrochloric acid)

Bonus: Multiple Choice

In organic chemistry what is the name of the functional group consisting of a central carbon singly bonded to two carbon atoms and doubly bonded to an oxygen atom?

- W) amine
- X) amide
- Y) ether
- Z) ketone

Bonus Answer: Z

13. EARTH and SPACE

Writer: Elias Milborn

Toss Up: Multiple Choice

Which of the following is a term specifically given to water that replenishes an aquifer?

- W) Recharge
- X) Discharge
- Y) Hydraulic
- Z) Permeable

Toss Up Answer: W

Bonus: Multiple Choice

When a strong south wind occurs along the west coast of North America, Ekman transport causes water to move to which of the following?

- W) onshore
- X) offshore
- Y) alongshore to the south
- Z) alongshore to the north

Bonus Answer: W

14. 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}

15. EARTH and SPACE

Writer: Elias Milborn

Toss Up: Multiple Choice

In which of the following locations is it possible to find an esker formed during the Pleistocene [PLY-stuh-seen] epoch?

- W) Maryland
- X) West Virginia
- Y) Tennessee
- Z) Iowa

Toss Up Answer: Z

Bonus: Short Answer

Calculate the percent relative humidity for air at 70°F containing 10 millibars of water vapor if the saturation vapor pressure is 25 millibars at that temperature:

Bonus Answer: 40%

16. CHEMISTRY

Writer: Janine Goh

Toss Up: Multiple Choice

Which of the following elements are Lanthanides?

- W) Lawrencium
- X) Meltnerium
- Y) Seaborgium
- Z) Terbium

Toss Up Answer: Z

Bonus: Short Answer

What unit does electronegativity use?

Bonus Answer: No unit

17. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Multiple Choice

Rounded to the nearest thousand, what is the circumference of the globe?

- W) 25,000
- X) 26,000
- Y) 27,000
- Z) 28,000

Toss Up Answer: W

Bonus: Short Answer

In which country are the oldest rocks on Earth located?

Bonus Answer: Canada

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18. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of these is a weak electrolyte?

W) $C_6H_{12}O_6$

X) $MgCl_2$

Y) $NaC_2H_3O_2$

Z) NH_4OH

Toss Up Answer: Z

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Bonus: Short Answer

By name or number, which of the following can conduct electricity in solution?

1. Hydrocarbons

2. Salts

3. Weak Acids

4. Strong Acids

Bonus Answer: Salts, weak acids, strong acids (2, 3, and 4 only)

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19. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

The principal mineral in most sand beaches is

W) quartz

X) orthoclase

Y) magnetite

Z) muscovite

Toss Up Answer: W

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Bonus: Short Answer

What geological event will allow you to see a Bishop's Ring?

Bonus Answer: a volcanic eruption

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20. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

The inelastic scattering of a photon by a free electron was first explained by which of the following scientists?

W) Compton

X) Hertz

Y) Einstein

Z) Newton

Toss Up Answer: W

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Bonus: Multiple Choice

The Tesla and the Gauss are units of measure of

W) magnetic field strength

X) conductance

- Y) light
- Z) electrical current

Bonus Answer: W

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21. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

In the SI system of measure, what is the unit of capacitance?

Bonus Answer: FARAD

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Bonus: Short Answer

How much work in joules is done by friction on a sled weighing 100 newtons during a 10 meter displacement? The coefficient of sliding friction is 0.1.

Bonus Answer: 100

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22. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Not all laws that hold in an inertial frame hold in a non-inertial frame. An obvious example is the law of inertia. Does the Work-Energy Theorem hold in a non-inertial frame?

- W) It only holds in inertial frames.
- X) It will not hold in a non-inertial frame unless there aren't any conservative forces at work.
- Y) It will hold in a non-inertial frame unless there are non-conservative forces.
- Z) It holds for any non-inertial frame.

Toss Up Answer: Z

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Bonus: Short Answer

An object is launched on a horizontal surface with an initial speed of 20 m/s, so that it covers a distance of 5 meters in the time interval 4 sec to 5 sec. What is the coefficient of friction between the object and the horizontal surface?

Assume gravitational acceleration is 10 m/s²

Bonus Answer: 1/3

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23. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

In what branch of physics would you expect to find the worm-like chain model?

- W) Wormhole Physics
- X) Newtonian Physics
- Y) Plasma Physics
- Z) Polymer Physics

Toss Up Answer: Z

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Bonus: Short Answer

By name or number, name which of the following muon decay can produce.

1. Electron
2. Muon Neutrino
3. Electron Neutrino
4. Positron

Bonus Answer: 1,3,4; Electron, Electron Neutrino, Positron

24. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What kind of lens has a different optical power and focal length in two orientations perpendicular to each other?

- W) Toric
- X) Parabolic
- Y) Cylindrical
- Z) Ellipsoid

Toss Up Answer: W

Bonus: Multiple Choice

Einstein's Field Equations are a set of how many equations in his theory of general relativity?

- W) 7
- X) 9
- Y) 10
- Z) 11

Bonus Answer: Y

25. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Light from a monochromatic lamp is shone upon a sheet of metal, and yet, the photoelectric effect is not observed. What change in the setup will most likely result in an observed photoelectric effect?

- W) Increasing the brightness of the lamp
- X) Moving the lamp closer to the sheet of metal
- Y) Decreasing the wavelength of the light
- Z) Increasing the surface area of the sheet of metal

Toss Up Answer: Y

Bonus: Short Answer

An electric current of 1 Ampere is flowing along an infinite horizontal wire in the x-axis. At $x = 0$ m the wire splits into a circle of radius 0.05 m and then comes back together at $x = 4$ m. What is the magnitude in Tesla of the magnetic field in the middle of this loop of wire?

Bonus Answer: 0
