

Round 15

1. 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

2. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

What's the stopping potential, in eV/C (READ AS: electron volts per coulomb) of a photoelectron ejected from a metal with work function of 1eV when the incident photon's energy is 3.5 eV?

Bonus Answer: 2.5 eV/C

Bonus: Multiple Choice

Two students conduct separate Compton scattering experiments with visible light and x-rays. The scattered radiation is observed at the same scattering angle. Which of the following statements about the observed results is true?

- W) the x rays have the greater shift in wavelength and the greater change in photon energy
- X) the two radiations have the same shift in wavelength and the visible light has the greater change in photon energy
- Y) the two radiations have the same shift in wavelength and the same change in photon energy
- Z) the two radiations have the same shift in wavelength and the x rays have the greater change in photon energy

Bonus Answer: Z

3. PHYSICS

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

How many elements are in between the first two radioactive elements on the Periodic Table?

- W) 15
- X) 16
- Y) 17
- Z) 18

Toss Up Answer: Y

Bonus: Short Answer

What is the name for the line dividing the metals and the nonmetals on the periodic table?

Bonus Answer: Amphoteric line or semimetal line or metalloid line

4. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

What does Thomas Young's Double Slit Experiment demonstrate about light?

W) Light behaves like a particle

X) Light behaves like a wave

Y) The speed of light in a vacuum is 3.00×10^8 meters per second

Z) Light is related to electromagnetism

Toss Up Answer: X

Bonus: Short Answer

In a particular medium, light travels at a speed of 2.0×10^8 meters per second. What is the index of refraction of the medium?

Bonus Answer: 1.5

5. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

Given a rectangular box with side lengths of 5, 5, and 5, what is the surface area of the box?

Bonus Answer: 150 units squared (ACCEPT: 150)

Bonus: Multiple Choice

The length, in inches, of a box is 3 inches less than twice its width, in inches. Which of the following gives the length, L inches, in terms of the width, W inches, of the box?

W) $L = .5W + 3$

X) $L = W - 3$

Y) $L = 2W + 3$

Z) $L = 2W - 3$

Bonus Answer: Z

6. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

What is the value of x when $2x + 3 = 3x - 4$?

Bonus Answer: 7

Bonus: Multiple Choice

What is the greatest common factor of 42, 126, and 210?

W) 2

X) 6

Y) 21

Z) 42

Bonus Answer: Z

7. MATHEMATICS

Writer: Henry Zheng

Toss Up: Multiple Choice

How many irrational numbers are there between 1 and 6?

W) 3

- X) 7
Y) 10
Z) infinitely many

Toss Up Answer: Z

Bonus: Short Answer

In the standard (x,y) coordinate plane, 3 vertices of a rectangle are (2,1), (-1,-1), and (6,5). What is the last vertex of the rectangle?

Bonus Answer: (3, -7)

8. MATHEMATICS

Writer: George Papastefanou

Toss Up: Short Answer

What is the tangent of $(27(\pi)/4)$

Bonus Answer: -1

Bonus: Short Answer

With a 5 percent compound interest rate, how long, to the nearest year, will it take a sum of money to double?

Bonus Answer: 14 years

9. BIOLOGY

Writer: Janine Goh

Toss Up: Short Answer

What are the two types of amino acids?

Bonus Answer: Polar and non polar R groups

Bonus: Short Answer

What determines the properties of an amino acid?

Bonus Answer: Its variable R group

10. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

Complete the analogy: RBC is to hematopoietin as platelet is to

Bonus Answer: thrombopoietin

Bonus: Short Answer

Hemocytoblasts can branch into two common progenitor cells. What lineage are erythrocytes part of?

Bonus Answer: Myeloid lineage

11. BIOLOGY

Writer: Olivia Gallager

Toss Up: Short Answer

In the light dependent reactions of photosynthesis, what molecule supplies the initial electrons?

Bonus Answer: H2O OR water

Bonus: Short Answer

In cellular respiration, the Carbon in carbon dioxide that is released comes from what original molecule?

Bonus Answer: glucose

12. BIOLOGY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Which immune cell does HIV directly target?

- W) B Cells
- X) Immunoglobulins
- Y) CD4 Cells
- Z) Killer T Cells

Toss Up Answer: Y

Bonus: Short Answer

Individuals heterozygous for the gene for which genetic disease have increased immunity to malaria?

Bonus Answer: Sick Cell Anemia

13. BIOLOGY

Writer: Nten Nylam

Toss Up: Short Answer

Of the following, name the conifers: pine, hemlock, palm, maple, cedar

Bonus Answer: pine, hemlock, and cedar or 1, 2, and 5 (in any order)

Bonus: Multiple Choice

What pigment is responsible for the red coloring of cranberries and the purple coloring of eggplant?

- W) lycopene
- X) anthocyanin
- Y) carotene
- Z) zeaxanthin

Bonus Answer: X

14. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

You have a multicellular organism that reproduces asexually by fission. When you excise a ~10,000 cell portion of its body, both the original organism and the excised portion grow into fully formed, healthy organisms. You take one of the offspring and repeat the procedure for one hundred and twenty-three generations. Each time, the resulting organisms are healthy. What must be true of the nuclei of this species?

- W) The cells contain plasmids
- X) The cells have multiple forms of DNA polymerase.
- Y) The cells have the majority of their genome stored in circular DNA
- Z) The cells contain active telomerase.

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following oligonucleotides would have the highest melting point when paired with the proper complementary strand?

- W) 5'-AAAAAAA-3'
- X) 5'-ATGCATGC-3'
- Y) 5'-CGCGCGCG-3'
- Z) 5'-TTTTGGGG-3'

Bonus Answer: Y

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15. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Which of the following is a way in which the cell increases gene expression in the nucleus?

- W) Acetylation of histone tails
- X) DNA methylation
- Y) Locating a gene within heterochromatin
- Z) Dephosphorylating DNA

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following chemicals or groups of chemicals is not a major determinant of flower color?

- W) Flavonols
- X) Carotenoids
- Y) Cyanidin
- Z) Phytoalexins

Bonus Answer: Z

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16. 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

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17. 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

18. CHEMISTRY

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is a polar molecule?

W) SO₂

X) CH₄

Y) SF₆

Z) BF₄

Toss Up Answer: W

Bonus: Short Answer

Fill in the blanks in the following statement to make it true. Ionic compounds are ____ conductors in their solid state, but ____ conductors when dissolved in water.

Bonus Answer: poor; good

19. CHEMISTRY

Writer: Nten Nylam

Toss Up: Multiple Choice

Which scientist performed an experiment in which he fired alpha particles at a thin sheet of gold foil?

W) Niels Bohr

X) Ernest Rutherford

Y) J.J. Thomson

Z) Max Planck

Toss Up Answer: X

Bonus: Multiple Choice

What is the name of the compound FeO?

W) iron monoxide

X) iron oxide

Y) iron (I) oxide

Z) iron (II) oxide

Bonus Answer: Z

20. CHEMISTRY

Writer: Nten Nylam

Toss Up: Multiple Choice

Which of the following is amphoteric?

W) hydrogen fluoride

X) ammonia

Y) water

Z) magnesium oxide

Toss Up Answer: Y

Bonus: Short Answer

What is the molecular geometry of nitrogen trichloride?

Bonus Answer: trigonal pyramidal (also accept trigonal pyramid)

21. CHEMISTRY

Writer: Kerwin Chen

Toss Up: Short Answer

Which group of elements produce colored ions?

Bonus Answer: Transition metals

Bonus: Short Answer

Which scientist won a Nobel prize in Physics in 1918, whose constant is used to determine the amount of energy, given the wavelength of a wave?

Bonus Answer: Max Planck, Planck

22. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Certain atoms exhibit paramagnetic or diamagnetic bonding. Of the following below which choice is classified as paramagnetic?

W) Zinc (Zn)

X) Krypton (Kr)

Y) Helium (He)

Z) Oxygen (O)

Toss Up Answer: Z

Bonus: Short Answer

Melting point is effected by bond strength. Order the following compounds in increasing order of melting point: graphite, methane, lithium, sodium chloride.

Bonus Answer: Methane, lithium, sodium chloride, graphite (2, 3, 4, 1)

23. EARTH and SPACE

Writer: Nten Nylam

Toss Up: Multiple Choice

The greatest distance from a planet to the sun is called?

W) aphelion

X) perihelion

Y) perigee

Z) eccentricity

Toss Up Answer: W

Bonus: Short Answer

What device was used to prove that the Earth rotates on its axis?

Bonus Answer: Foucault Pendulum

24. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

Name 3 dwarf planets

Bonus Answer: Pluto, Ceres, Makemake, Eris, Haumea (any 3)

Bonus: Short Answer

Which coloured stars are the hottest?

Bonus Answer: Blue

25. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

Which is the new satellite/telescope replacing Hubble?

Bonus Answer: James Webb Space Telescope

Bonus: Short Answer

Why is Mars red?

Bonus Answer: Oxidised iron on Mars' surface
