

Round 26

1. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the name of the principle that states that 5 avocados cannot be placed in 4 holes without 2 of them being placed in the same one?

Bonus Answer: Pigeonhole Principle

Bonus: Short Answer

In triangle ABC with integer side lengths, $AB = 7$, $BC = 14$, and $AC < 9$. Find AC.

Bonus Answer: 8 (Triangle Inequality)

2. 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%

3. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Multiple Choice

What is the square root of 2 (to the nearest tenths)?

W) 1.7

X) 1.5

Y) 1.3

Z) 1.4

Toss Up Answer: Z

Bonus: Short Answer

What is the equation of a circle with circumference 6π that is positioned 3 points above the x axis and 4 points before the y axis?

Bonus Answer: $(x-4)^2 + (y+3)^2 = 9$

4. BIOLOGY

Writer: Aaron Gee

Toss Up: Multiple Choice

Which of the following tissues is MOST directly responsible for the increased diameter of a tree trunk from year to year?

W) apical meristem

X) pericycle

Y) vascular cambium

Z) pith

Toss Up Answer: Y

Bonus: Short Answer

Name all of the following 3 metabolic processes which directly require oxygen: glycolysis; alcohol fermentation; electron transport system

Bonus Answer: Electron transport system

5. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A 10 volt battery connected to a capacitor delivers a charge of 0.5 coulombs. The capacitance of the capacitor is

Bonus Answer: 5 times 10⁻² Farads

Bonus: Short Answer

To convert a galvanometer to a voltmeter, you should add what to a series?

Bonus Answer: high resistance

6. 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

7. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

As a pendulum is raised to higher altitudes, its period?

Bonus Answer: Increases

Bonus: Short Answer

The SI unit of pressure is?

Bonus Answer: Pascal

8. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

Where is the majority of Earth's freshwater "locked up"?

Bonus Answer: Antarctica

Bonus: Short Answer

What are the four terrestrial planets?

Bonus Answer: Earth, Mars, Mercury, Venus

9. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the empirical formula of glucose?

Bonus Answer: CH₂O

Bonus: Short Answer

What is the shape of an Acetylene (C₂H₂) molecule?

Bonus Answer: Linear

10. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

Does a person weigh less at the equator or the poles?

Bonus Answer: Equator

Bonus: Short Answer

Does one move faster on the equator or on the poles?

Bonus Answer: Equator

11. 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

12. PHYSICS

Writer: Ivan Zhang

Toss Up: Short Answer

What is the speed of light in km per second?

Bonus Answer: about 1.079 10⁹ km per second

Bonus: Short Answer

What equation relates and connects the the concepts of mass and energy?

Bonus Answer: $E = mc^2$

13. 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)

14. PHYSICS

Writer: Mohammed Jamil

Toss Up: Multiple Choice

A loaded freight car A with a mass of 14,000 kg moves at a constant velocity of 15 m/s on a horizontal railroad track and collides with an empty car B with a mass of 6,000 kg moving at 5 m/s. After the collision the cars stick to each other and moves like one object. What is the velocity of two cars after the collision?

- W) 6 m/s
- X) 8 m/s
- Y) 10 m/s
- Z) 12 m/s

Toss Up Answer: Z

Bonus: Multiple Choice

When two objects collide elastically the momentum is conserved. Which of the following is true about the kinetic energy during the collision?

- W) The kinetic energy is lost
- X) The kinetic energy is gained
- Y) The kinetic energy is conserved
- Z) The kinetic energy completely transforms into thermal energy

Bonus Answer: Y

15. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Multiple Choice

What is asymptote of the function: $f(x) = 1/x$?

- W) $y = 0$
- X) $x = 0$
- Y) $x = 0, y = 1$
- Z) $x = 0, y = 0$

Toss Up Answer: Z

Bonus: Short Answer

Plugging the divergent series, $1 + 2 + 3 + 4 + \dots$, into the Riemann Zeta Function results in which number?

Bonus Answer: $-1/12$

16. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A bullet travels through the air, it slows down due to air resistance. How does the bullet's momentum change as a result?

Bonus Answer: The bullet's momentum decreases as its speed decreases.

Bonus: Short Answer

How can a small force produce a large change in momentum ?

Bonus Answer: A small force can produce a large change in momentum if the force acts on an object for a long period of time.

17. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

Who is credited with the discovery of the neutron in 1932?

Bonus Answer: James Chadwick (accept: Chadwick)

Bonus: Short Answer

Who patented the common dry cell?

Bonus Answer: GEORGES LECLANCHÉ (accept: LECLANCHÉ)

18. BIOLOGY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of these is not an accepted domain of life?

- W) Archea
- X) Bacteria
- Y) Eukarya
- Z) Protista

Toss Up Answer: Z

Bonus: Short Answer

What is the causative agent of Scrapie?

Bonus Answer: prion

19. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the common oxidation state of Radium?

Bonus Answer: +2 (don't accept 2)

Bonus: Short Answer

List the following atoms in order of increasing electron affinity: oxygen, boron, and fluorine.

Bonus Answer: (1) BORON, (2) OXYGEN, (3) FLUORINE

20. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

Which type of cell has a large number of glycoproteins on the cell surface membrane?

- W) Ciliated cell
- X) Goblet cell

- Y) Lymphocyte
- Z) Red blood cell

Toss Up Answer: Y

Bonus: Short Answer

Name the bond that forms between glucose molecules in polysaccharides, such as amylose.

Bonus Answer: Glycosidic bond

21. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A horse moves a sleigh 1.00 kilometer by applying a horizontal 2,000-newton force on its harness for 45 minutes.

What is the power of the horse?

Bonus Answer: 741 watts

Bonus: Short Answer

A force of 100 newtons is used to move an object a distance of 15 meters with a power of 25 watts. Find the work done and the time it takes to do the work.

Bonus Answer: work = 1,500 joules; time = 60 seconds

22. BIOLOGY

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

Which of the following is not an amino acid?

- W) Threonine
- X) Serine
- Y) Diamine
- Z) Lysine

Toss Up Answer: Y

Bonus: Short Answer

Giving your answer in millions of years ago, name one year that was in Romer's gap.

Bonus Answer: Between 345 and 360 (inclusive)

23. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What element is in all alloys classified as amalga?

Bonus Answer: Mercury (accept: Hg)

Bonus: Short Answer

You have a solution of 5 molar Sodium Phosphate and n to prepare a solution of 500 millimolar Sodium Phosphate. How much water would you add to 100 milliliter of the original 5 molar solution to produce the 500 millimolar solution?

Bonus Answer: 900 MILLILITERS (or 0.9 LITERS)

24. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

Birds are able to sustain long flights at high altitudes because they

- W) can extract oxygen during both inhalation and exhalation

- X) use anaerobic metabolism during flight
- Y) are able to lower their body temperature during flight
- Z) decrease their heart rate during flight

Toss Up Answer: W

Bonus: Multiple Choice

Carbon monoxide (CO) is toxic to humans because

- W) it binds to myoglobin and causes it to denature.
- X) it is rapidly converted to toxic CO₂.
- Y) it binds to the globin portion of hemoglobin and prevents the binding of O₂.
- Z) it binds to the Fe in hemoglobin and prevents the binding of O₂.

Bonus Answer: Z

25. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

The fundamental cause of sickle-cell anemia is a change in the structure of

- W) blood
- X) capillaries
- Y) red blood cells
- Z) hemoglobin

Toss Up Answer: Z

Bonus: Multiple Choice

Which regulatory chemical stimulates gastric gland activity and motility?

- W) Secretin
- X) Gastrin
- Y) Leptin
- Z) Histamine

Bonus Answer: X
