

Round 18

1. MATHEMATICS

Writer: Benjamin Avrahami

Toss Up: Short Answer

In simplest form, express the surface area to volume ratio of a cube with side length s .

Bonus Answer: $6:s$

Bonus: Short Answer

Calculate the harmonic mean of the first two perfect numbers and 10.

Bonus Answer: $4 * \sqrt{105}$

2. EARTH and SPACE

Writer: Yae June Lee

Toss Up: Multiple Choice

How are rocks sorted in water erosion?

W) Sorted, rounded, smooth

X) Not sorted, rounded, smooth

Y) Not sorted, not rounded, smooth

Z) Not sorted, not rounded, not smooth

Toss Up Answer: W

Bonus: Short Answer

U shaped valleys are made by what type of agent of erosion?

Bonus Answer: Glaciers.

3. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

Name three structures that are in animal cells but not plant cells.

Bonus Answer: Centrioles, Flagella

Bonus: Short Answer

What do invasive species do to the ecosystem they disrupt?

Bonus Answer: They don't have natural predators, so they crowd out the native species, effectively killing them off.

4. EARTH and SPACE

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

Since Pumice and Rhyolite are both extrusive felsic rocks, they both have:

W) Vesicles and low density

X) No vesicles and silicon

Y) Magnesium and high density

Z) Low density and aluminum

Toss Up Answer: Z

Bonus: Short Answer

By name or number, order these materials from lowest specific heat to highest specific heat: Ice, (liquid) water, water vapor, iron

Bonus Answer: Iron, water vapor, ice, liquid water (4, 3, 1, 2)

5. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Certain compounds are insoluble in solution. Which of the following choices below is soluble in aqueous solution?

W) BaSO₄

X) AgCl

Y) AgNO₃

Z) NiCO₃

Toss Up Answer: Y

Bonus: Short Answer

There is a variety of lab techniques that could be used to separate precipitates from the supernatant liquid. Which of the following lab techniques: centrifuge, distillation, chromatography, and titration can be used to separate them.

Bonus Answer: Centrifuge (1)

6. EARTH and SPACE

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following is a sedimentary rock?

W) slate

X) marble

Y) basalt

Z) sandstone

Toss Up Answer: Z

Bonus: Short Answer

What is the name for the outer shadow cast during eclipses, which gives rise to a partial eclipse?

Bonus Answer: Penumbra

7. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

A rock is thrown downward from the top of a tower with an initial speed of 12 m/s. If the rock hits the ground after 2 s, what is the speed of the rock as it hits the ground if air resistance is negligible to the nearest whole number?

Bonus Answer: 32 m/s

Bonus: Short Answer

Human reaction time is usually greater 0.10 s. If someone holds a ruler between your finger and thumb and releases it without warning, how far can you expect the ruler to fall before you catch in cm to the 10th place?

Bonus Answer: 4.9 cm

8. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

In the Christmas carol "The 12 Days of Christmas", the singer says that for every day of Christmas, their significant other gives them a quantity of a new gift equal to the current day of Christmas, plus the previous gifts given. For example, on the second day onward, the singer receives 2 turtledoves on each day until the end of Christmas. What is the greatest quantity of a single gift given during the 12 days?

W) 36

X) 40

Y) 42

Z) 48

Toss Up Answer: Y

Bonus: Short Answer

How many total gifts are given in the 12 days of Christmas?

Bonus Answer: 364

9. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

Please balance the given equation $\text{CO}_3^{2-} + 2\text{H}^+ \rightarrow \text{H}_2\text{O} + \text{CO}_2$

Bonus Answer: 1,1,1

Bonus: Multiple Choice

There are various pieces of chemical equipment. What is a piece of glassware designed specifically for usage in creating solutions?

W) Erlenmeyer flask

X) Florence flask

Y) Volumetric flask

Z) Graduated cylinder

Bonus Answer: Y

10. MATHEMATICS

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

What is the smallest positive 'taxicab' number?

W) 87

X) 91

Y) 95

Z) 100

Toss Up Answer: X

Bonus: Short Answer

To what power do you have to raise any number for it to be 0, 1, or -1 in mod 7?

Bonus Answer: 3

11. PHYSICS

Writer: Elias Milborn

Toss Up: Short Answer

A train moving 35 meters per second emits a whistle with a frequency of 900 hertz. Assuming that the speed of sound in air is 350 meters per second, what is the frequency, in hertz, measured by a stationary observer in front of the train?

Bonus Answer: 1000

Bonus: Multiple Choice

Which of the following has the highest vapor pressure at STP?

W) mercury

X) ethyl alcohol

Y) methyl alcohol

Z) acetone

Bonus Answer: Z

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12. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Which of the following has a coordinate covalent bond?

W) butanol

X) CO₂

Y) Methane

Z) NH₄⁺

Toss Up Answer: Z

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Bonus: Short Answer

What is the formal charge of Nitrogen in an ammonia molecule?

Bonus Answer: 0

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13. BIOLOGY

Writer: Eric Shau

Toss Up: Short Answer

Name three structures in cells that have double membranes.

Bonus Answer: Chloroplasts, mitochondria, and the nucleus.

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Bonus: Short Answer

What do we call bacteria with double membranes?

Bonus Answer: Gram-negative bacteria.

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14. CHEMISTRY

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following compounds does not exist?

W) PF₅

X) P₄O₁₀

Y) P₄O₆

Z) PH₅

Toss Up Answer: Y

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Bonus: Short Answer

Order the following hydrogen halides from the one with the lowest boiling point to one with the highest: HI, HCl, HBr, HF

Bonus Answer: HCl, HBr, HI, HF (2, 3, 1, 4)

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15. BIOLOGY

Writer: Eric Shau

Toss Up: Short Answer

What hormone is released from the thyroid?

Bonus Answer: Thyroxin.

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Bonus: Short Answer

What is the compacted glucose in mammals called?

Bonus Answer: Glycogen.

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16. CHEMISTRY

Writer: Seiji Yawata

Toss Up: Multiple Choice

Which of the following is the most acidic?

W) o-methoxy benzoic acid

X) benzoic acid

Y) m-methoxy benzoic acid

Z) p-methoxy benzoic acid

Toss Up Answer: W

Bonus: Short Answer

What is the equivalent weight of HNO₃ in the reaction: Cu reacts with HNO₃, forming Cu(NO₃)₂, NO and water.

Bonus Answer: 84

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17. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

What causes acid rain?

Bonus Answer: Factories produce sulfur and nitrogen as wastes, and it gets into the air and mixes with rain.

Bonus: Short Answer

Which organism takes in the most CO₂ (collectively)?

Bonus Answer: Phytoplankton.

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18. PHYSICS

Writer: Elias Milborn

Toss Up: Multiple Choice

When a resistor, inductor, and capacitor are connected in series to an AC generator, the current through the capacitor must be in phase with the voltage across which of the following?

W) The capacitor

X) The inductor

Y) The entire circuit

Z) The inductor

Toss Up Answer: Z

Bonus: Short Answer

Which lower case letter is commonly used to denote planck's constant?

Bonus Answer: h

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19. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

The function of an electron in the electron transport chain is to:

W) transfer energy from complex II to complex I.

X) pump hydrogen ions using complex II.

Y) use its free energy to pump protons against the concentration gradient.

Z) combine with phosphate when ATP is synthesized.

Toss Up Answer: Y

Bonus: Multiple Choice

Fatigue in iron deficiency anemia may be explained in part by all of the following

EXCEPT:

W) a lack of functional hemoglobin in the blood.

X) the inability to synthesize ATP.

Y) a lack of functional cytochromes in the electron transport chain.

Z) a lack of functional Coenzyme Q.

Bonus Answer: Z

20. PHYSICS

Writer: Elias Milborn

Toss Up: Multiple Choice

As an object falls to the earth with air resistance present, what happens to the acceleration of the object?

W) It remains a constant 9.8 m/s^2

X) It increases from 0 to 9.8 m/s^2

Y) It remains at a constant 0 m/s^2

Z) It decreases from 9.8 to 0 m/s^2

Toss Up Answer: Z

Bonus: Multiple Choice

Mary and Joe are on a merry-go-round. Mary is seated near the center of rotation and Joe is on the outer edge. Which of the following BEST describes their motion?

W) Mary has a greater acceleration than Joe

X) Joe has a greater acceleration than Mary

Y) neither Joe nor Mary are accelerating

Z) both Mary and Joe have the same acceleration

Bonus Answer: X

21. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

What phylum are jellyfish in?

Bonus Answer: Cnidaria.

Bonus: Short Answer

What order are humans in?

Bonus Answer: Primates.

22. PHYSICS

Writer: Elias Milborn

Toss Up: Short Answer

A person standing on a scaffolding lowers an object with weight 250 newtons by means of a rope, at constant speed.

If the weight of the ropes is negligible, what is the force in newtons that the person exerts on the rope?

Bonus Answer: 250

Bonus: Short Answer

Green light has a wavelength of 500 nanometers. What is its associated frequency in hertz?

Bonus Answer: 6×10^{14}

23. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Concerning the generation of ATP by oxidative phosphorylation, all of the following are true EXCEPT:

- W) NADH produced in the cytosol of the cell will generate approximately 2.5 ATPs.
- X) NADH produced in the mitochondria will generate approximately 2.5 ATPs.
- Y) NADH produced by the succinate thiokinase reaction will generate approximately 1.5 GTPs.
- Z) FADH₂ produced in the mitochondria will generate approximately 1.5 ATPs.

Toss Up Answer: Y

Bonus: Multiple Choice

What enzyme does a retrovirus primarily rely on to create a copy of its genome that is ready for integration into the host genome?

- W) DNA gyrase
- X) RNA polymerase
- Y) Reverse transcriptase
- Z) DNA polymerase

Bonus Answer: Y

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. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

What type of pathogen causes malaria?

Bonus Answer: Parasites (or protists).

Bonus: Short Answer

When specialization is starting in the fetus, what three layers are formed (inner to outer)?

Bonus Answer: Endoderm, Mesoderm, Ectoderm
