

Round 17

1. PHYSICS

Writer: Brian Lim

Toss Up: Short Answer

Given the acceleration due to gravity as 10.0 meters per square second, what is the water pressure in pascals at the bottom of a pool that has a depth of 5 meters?

Bonus Answer: 50000 Pa

Bonus: Short Answer

A pendulum with a radius of 0.1 meters is released from rest at an angle of 30 degrees below the horizontal. Given the acceleration due to gravity as 10.0 meters per square second, what is the maximum speed of the pendulum assuming no energy is lost to friction?

Bonus Answer: 1 m/s

2. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

Water is flowing through a horizontal pipe. As the pipe becomes narrower, what is true about the speed and the pressure of the water?

- W) Both the speed and the pressure increase
- X) Both the speed and the pressure decrease
- Y) The speed increases and the pressure decreases
- Z) The speed decreases and the speed increases

Toss Up Answer: Y

Bonus: Short Answer

In a heat engine, hot steam at a temperature of 227 degrees Celsius does useful work before being released at a temperature of 127 degrees Celsius. What is the efficiency of the engine?

Bonus Answer: 20% or 0.2

3. PHYSICS

Writer: Yevgeniy Gorbachev

Toss Up: Short Answer

Which type of transfer orbit from one circular orbit to another is the most energy-efficient?

Bonus Answer: Hohmann transfer orbit

Bonus: Multiple Choice

In which orbit are natural objects least common?

- W) A planet's L1 point
- X) A planet's L3 point
- Y) A planet's L5 point
- Z) A planet's L4 point

Bonus Answer: W

4. PHYSICS

Writer: Brian Lim

Toss Up: Short Answer

What are the fundamental forces of the Universe?

Bonus Answer: Gravitation, Electromagnetic, Weak, Strong

Bonus: Multiple Choice

The tau particle belongs to which class of particles?

- W) Quarks
- X) Hadrons
- Y) Bosons
- Z) Leptons

Bonus Answer: Z

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5. MATHEMATICS

Writer: Banpreet Singh

Toss Up: Multiple Choice

An angle must lie in which two quadrants of the Cartesian coordinate plane for its cosecant to be negative?

- W) one and two
- X) two and three
- Y) three and four
- Z) four and one

Toss Up Answer: Y

Bonus: Short Answer

According to the Fundamental Theorem of Algebra, how many roots in the complex number system must a 7th degree polynomial have?

Bonus Answer: At least 1 (accept 1 as an answer)

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6. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

For which of the following values of x is $(x^2+x+4)/(x)$ an integer?

- W) 1
- X) 4
- Y) 3
- Z) 5

Toss Up Answer: X

Bonus: Short Answer

Find the remainder when $343x^3+49x^2+14x+1$ is divided by $7x - 1$.

Bonus Answer: 5

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7. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

What do the numbers in the n th row of Pascal's Triangle sum to?

Give your answer in terms of n .

- W) $2n$
- X) 2^n
- Y) n^2
- Z) n^3

Toss Up Answer: X

Bonus: Multiple Choice

Find the number of ordered pairs (a,b), where a and b are nonnegative integers, such that $a+b=10$.

W) 100

X) 10

Y) 11

Z) 12

Bonus Answer: Y

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8. 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 $(x^2 + 8)[(x + 8)^2]$

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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9. BIOLOGY

Writer: Eric Shau

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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10. 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

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11. 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.

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12. 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

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13. 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

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14. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Certain amino acids are considered essential in an animal's diet because they cannot be produced within the organism. Which of the following cellular processes would be most DIRECTLY affected by a dietary deficiency in essential amino acids?

- W) Translation of mRNA
- X) Cellular respiration
- Y) Cell division
- Z) Oxygen transport

Toss Up Answer: W

Bonus: Multiple Choice

Integral transmembrane proteins are proteins embedded in the cell membrane. Which of the following amino acids would you MOST expect to find in the transmembrane region of such proteins?

- W) Tryptophan
- X) Lysine
- Y) Arginine
- Z) Serine

Bonus Answer: W

15. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

Which cell does HIV attack?

Bonus Answer: The C4 Cells.

Bonus: Short Answer

What is the optimal pH for pepsin?

Bonus Answer: Around 2-3 pH.

16. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

Which scientist studied pea plants for years to conclude a pattern was in the height?

Bonus Answer: Gregor Mendel.

Bonus: Short Answer

How is radiation harmful?

Bonus Answer: It causes cells to mutate, or spontaneously die.

17. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Acetone has a distinct smell, which many people associate with the smell of nail polish remover. What might the smell of acetone in the urine or on the breath of a patient indicate?

- W) The patient might be degrading too many amino acids from muscle proteolysis.
- X) The patient's body might be oxidizing too many fatty acids.
- Y) The patient might have enteritis and is absorbing endproducts of fermentation.
- Z) The patient might have fructose toxicity.

Toss Up Answer: X

Bonus: Multiple Choice

Which description best describes what would happen to the carbon cycle if all detritivores suddenly went on "strike" and stopped working?

W) Carbon would increase in inorganic mass, while the atmospheric reservoir of carbon would continue to increase and plants would not be jeopardized.

X) Carbon would accumulate in organic mass, the atmospheric reservoir of carbon would decline, and plants would eventually be starved for CO₂.

Y) Carbon would increase in organic mass, while the atmospheric reservoir of carbon would increase and plant-life would be starved for CO₂.

Z) Carbon would decrease in organic mass, while the atmospheric reservoir of carbon would increase with the result that plant-life would be starved for CO₂.

Bonus Answer: X

18. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Which of the following is a strong nucleophile?

W) ethanol

X) butanol

Y) Bromide

Z) t-butoxide

Toss Up Answer: Y

Bonus: Multiple Choice

What causes Coordination compounds to be different colors

W) ΔE

X) s orbital overlap

Y) VESPR

Z) p orbital overlap

Bonus Answer: W

19. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

The modified form of the Ideal Gas Law includes which of the following?

W) Higher pressure, Higher Volume

X) Higher pressure, Lower volume

Y) Lower Pressure, Higher volume

Z) Lower pressure, Lower volume

Toss Up Answer: Y

Bonus: Short Answer

Rank the following gases in order from least ideal to most ideal: He, N₂, HCl, SF₆

Bonus Answer: He, N₂, SF₆, HCl (accept 1,2,4,3)

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20. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following is the most electronegative element?

- W) Carbon
- X) Vanadium
- Y) Selenium
- Z) Fluorine

Toss Up Answer: Z

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Bonus: Short Answer

What is the name given to the hybrid orbital created with a steric number of 3?

Bonus Answer: $2sp^2$

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21. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following forces is the only force that bonds noble gases?

- W) Dipole-Dipole
- X) Ionic
- Y) Covalent
- Z) London Dispersion Forces

Toss Up Answer: Z

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Bonus: Short Answer

What term is used to describe the energy released by the bonding of gaseous ions to form one mole of a substance?

Bonus Answer: lattice energy

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22. 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

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Bonus: Short Answer

What is Avogadro number to the nearest ten-thousandths?

Bonus Answer: 6.0221×10^{23}

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23. EARTH and SPACE

Writer: Nten Nylam

Toss Up: Multiple Choice

Which of the following is the mantle thought to be made up of?

- W) coal
- X) peridotite
- Y) granite

Z) conglomerate

Toss Up Answer: X

Bonus: Short Answer

In hours and minutes, how long will it take for the tidal pattern to change from high tide to low tide and back to high tide?

Bonus Answer: 24 hours 50 minutes

24. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Given the following choices choose the one that best presents the layers of the earth's atmosphere from lowest to highest altitude.

W) Thermosphere, Mesosphere, Stratosphere, Troposphere

X) Mesosphere, Thermosphere, Stratosphere, Troposphere

Y) Troposphere, Stratosphere, Mesosphere, Thermosphere

Z) Stratosphere, Troposphere, Thermosphere, Mesosphere

Toss Up Answer: Y

Bonus: Multiple Choice

There are various different particle sizes when dealing with sediments. What is the approximate particle size range of sand?

W) 2 - 4 mm

X) 1/16 - 2 mm

Y) 1/256 - 1/16 mm

Z) 4 - 64 mm

Bonus Answer: X

25. 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.
