

Round 16

1. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

Diffraction plays an important role in which of the following phenomena?

- W) The sun appearing as a disk to the naked eye
- X) Light being bent through a glass prism
- Y) Shouting through a megaphone
- Z) A thin soap film displaying colors when light is incident on it

Toss Up Answer: Y

Bonus: Multiple Choice

A beam of light passes through one polarizing filter and through another filter rotated at 45 degrees compared to the first one. If the original intensity of the light was 100 W, what is the new intensity of the polarized light?

- W) 50
- X) 75
- Y) 100
- Z) 150

Bonus Answer: W

2. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

A plane mirror is in a vertical plane and is rotating about a vertical axis at 100 rpm. A horizontal beam of light is incident on the mirror. The reflected beam will rotate at:

Bonus Answer: 200 rpm (ACCEPT 200)

Bonus: Short Answer

The curvature of a concave spherical mirror is 50 cm^{-1} . How far away from the mirror does an object need to be placed as to not create an image?

Bonus Answer: 25 cm (ACCEPT 0.25m or equivalent forms)

3. PHYSICS

Writer: Brian Lim

Toss Up: Multiple Choice

Two objects stick together after they collide with each other. What is true about the collision?

- W) The collision is elastic
- X) The collision is completely inelastic
- Y) The total momentum of the system changes
- Z) The total kinetic energy of the system stays the same

Toss Up Answer: X

Bonus: Short Answer

An object moving at 10 meters per second relative to a surrounding fluid experiences a drag force of 20 newtons. If the object's speed increases to 20 meters per second, what is the drag force experienced by the object?

Bonus Answer: 80 newtons

4. PHYSICS

Writer: Yevgeniy Gorbachev

Toss Up: Multiple Choice

If an object has a mass of 10 kg and a velocity of $1.5 \cdot 10^8$ m/s, what is its kinetic energy in terms of c ?

W) $40(c^2)/3$

X) $(c^2)/3$

Y) $10c/3$

Z) $10(c^2)/3$

Toss Up Answer: Z

Bonus: Short Answer

If an object has a kinetic energy of $6 \cdot 10^{16}$ joules and a velocity of $.5c$, what is its mass?

Bonus Answer: Answer: 2kg

5. MATHEMATICS

Writer: Elias Milborn

Toss Up: Short Answer

What is the probability of, in no particular order, flipping exactly 2 heads and 2 tails when flipping 4 coins?

Bonus Answer: 3/8 (accept .375 or 37.5%)

Bonus: Short Answer

Given a circle centered at 1,2 what is the slope of a tangent line which passes through the point (3,3)

Bonus Answer: -2

6. MATHEMATICS

Writer: Siam Muquit

Toss Up: Multiple Choice

What is the derivative of the curve $y = x^3$ at the origin?

W) 0

X) 3

Y) 2

Z) $3/2$

Toss Up Answer: W

Bonus: Short Answer

Find dy/dx of $y = \sin^2 x$

Bonus Answer: 2 (sin x) (cos x)

7. MATHEMATICS

Writer: Jason Weng

Toss Up: Multiple Choice

For the function $f(x) = (x^2)/(x)$, what is the limit as x approaches 0?

W) 0

X) 1

Y) infinity

Z) There exist no limit.

Toss Up Answer: W

Bonus: Short Answer

What is the line called that connects two points of a function, generally associated with average rate of change?

Bonus Answer: Secant line

8. MATHEMATICS

Writer: Jason Weng

Toss Up: Short Answer

What is the equation for the axis of symmetry of $(3x^2) - 6x + 4$?

Bonus Answer: $x = 1$ (Don't accept 1 by itself)

Bonus: Multiple Choice

Which of the following is equivalent to $3 \pmod{4}$?

W) $32 \pmod{4}$

X) $-16 \pmod{4}$

Y) $-13 \pmod{4}$

Z) $0 \pmod{4}$

Bonus Answer: Y

9. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

What hormone is released by the kidneys in response to oxygen deficiency?

W) erythropoietin

X) Renin

Y) calcitonin

Z) Leptin

Toss Up Answer: W

Bonus: Short Answer

By what type of system is RBC numbers regulated?

Bonus Answer: negative-feedback system

10. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following is the largest patch containing lymphocytes?

W) lymph nodes

X) spleen

Y) thymus

Z) tonsils

Toss Up Answer: Z

Bonus: Short Answer

What mineral deficiency is associated small sex glands and growth failure?

Bonus Answer: Zinc

11. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

What enzyme in the digestive system first breaks down starches?

W) protease

X) secretin

Y) cholecystokinin

Z) amylase

Toss Up Answer: Z

Bonus: Short Answer

What cavity is used cnidarians in digestion?

Bonus Answer: gastrovascular cavity

12. BIOLOGY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Photorespiration occurs the most under which conditions?

W) High Levels of Carbon Dioxide, Low levels of Oxygen

X) in CAM plants

Y) low levels of carbon dioxide, high levels of oxygen

Z) in C4 plants

Toss Up Answer: Y

Bonus: Short Answer

How many carbons does ribulose biphosphate have?

Bonus Answer: 5

13. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

In the 1920's, the Russian scientist Ivan Pavlov performed a famous set of experiments on dogs. What was the experiment?

Bonus Answer: Conditioning the dogs to salivate when a bell was rung.

Bonus: Short Answer

What hormone maintains the thick lining of the uterus?

Bonus Answer: Progesterone

14. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

What do CFC's do to the environment?

Bonus Answer: They destroy the ozone layer.

Bonus: Short Answer

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

Bonus Answer: Chloroplasts, cell wall, and central vacuole.

15. 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.

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16. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

Name three structures in cells that have double membranes.

Bonus Answer: Chloroplasts, mitochondria, and the nucleus.

Bonus: Short Answer

What do we call bacteria with double membranes?

Bonus Answer: Gram-negative bacteria.

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17. BIOLOGY

Writer: Eric Chau

Toss Up: Short Answer

What hormone is released from the thyroid?

Bonus Answer: Thyroxin.

Bonus: Short Answer

What is the compacted glucose in mammals called?

Bonus Answer: Glycogen.

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18. CHEMISTRY

Writer: Janine Goh

Toss Up: Short Answer

What activates pepsinogen to change into pepsin?

Bonus Answer: Hydrochloric acid

Bonus: Short Answer

What is the pH of gastric juice?

Bonus Answer: 1.5 to 2.5 (or any number in between)

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19. CHEMISTRY

Writer: Janine Goh

Toss Up: Short Answer

What colour does Xenon release when energised?

Bonus Answer: White light (all colours)

Bonus: Short Answer

What is the difference between electronegativity and electron affinity?

Bonus Answer: Electron affinity: the amount of energy in kJ/mol needed to add an electron to an element

Electronegativity: how much an atom wants an electron (no unit)

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20. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

Each element has its own electron configuration. What is the electron configuration of chromium (Cr).

Bonus Answer: [Ar] 3d⁵ 4s¹ (Also accept 1s² 2s² 2p⁶ 3s² 3p⁶ 3d⁵ 4s¹)

Bonus: Multiple Choice

There are various numbers of pi and sigma bonds in certain compounds. Which of the choices below best describes the number of pi and sigma bonds ethyne (acetylene) has?

- W) 2 pi bonds and 1 sigma bonds
- X) 3 pi bonds and 2 sigma bonds
- Y) 2 pi bonds and 3 sigma bonds
- Z) 4 pi bonds

Bonus Answer: Y

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21. CHEMISTRY

Writer: Janine Goh

Toss Up: Multiple Choice

Who discovered electronegativity?

- W) Linus Pauling
- X) Ernest Rutherford
- Y) Harold Urey
- Z) Carl Bosch

Toss Up Answer: W

Bonus: Short Answer

List 2 gases used in the Miller-Urey experiment

Bonus Answer: Hydrogen, Water, Ammonia, Methane

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22. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

In organisms, the bonds in polypeptide chains are formed between which two ends of the amino acid?

Bonus Answer: Carboxyl, amino OR the side with the NH₂ group, the side with the COOH group

Bonus: Short Answer

Fatty acids have three carbon chains attached to what type of molecule?

Bonus Answer: glycerol

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23. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

Which scientist came up with the laws of planetary motion?

Bonus Answer: Kepler

Bonus: Short Answer

Which constellation is the star that remains stationary in northern hemisphere part of?

Bonus Answer: Ursa Minor

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24. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

There are many mineral categories. Which of the following mineral groups below is classified based on varying ratios of silicon and oxygen?

- W) Sulfides

X) Phosphates

Y) Carbonates

Z) Silicates

Toss Up Answer: Z

Bonus: Short Answer

Of the following minerals listed, which belong in the mineral group of silicates: Olivine, Mica, Topaz and Talc.

Bonus Answer: Olivine, Mica, Topaz (1, 2, 3)

25. EARTH and SPACE

Writer: Nten Nylam

Toss Up: Multiple Choice

What explains the lack of hydrogen in the atmosphere, despite its relative abundance in the universe?

W) most of it is used up in photosynthesis

X) most of it was an unstable isotope that decayed

Y) most of it escaped into space because of its low mass

Z) most of it is in water molecules

Toss Up Answer: Y

Bonus: Short Answer

What is the name of the underground surface that serves as the upper limit of the zone of saturation (the point in which all material below is saturated)?

Bonus Answer: water table
