

Round 30

1. BIOLOGY

Writer: Matthew Lee

Toss Up: Multiple Choice

A person with type A blood has children with a person with type AB blood. What possible blood types can their offspring be?

W) A only

X) A and AB

Y) A, B, and AB

Z) A, AB, and O

Toss Up Answer: Y

Bonus: Multiple Choice

What sex chromosome system determines gender in birds?

W) X-Y system

X) X-0 system (read as X-zero)

Y) Z-W system

Z) haplo-diploid system

Bonus Answer: Y

2. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

In which state is the oldest North American lake located?

W) California

X) Minnesota

Y) Ohio

Z) Utah

Toss Up Answer: W

Bonus: Short Answer

What is the densest naturally occurring element?

Bonus Answer: Osmium

3. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A charged particle is moving in a UNIFORM magnetic field. If the direction of motion of the charged particle is parallel to the magnetic field, describe the shape of the charged particle's path.

Bonus Answer: Straight line

Bonus: Multiple Choice

For a parallel-plate capacitor with plate area "A" and plate separation "d", the capacitance is proportional to which of the following?

W) A/d squared

X) A times d

Y) A divided by d

Z) d divided by A

Bonus Answer: Y

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4. EARTH and SPACE

Writer: Ivan Zhang

Toss Up: Multiple Choice

What is the name given to planets that lie within a habitable zone of a star?

W) Extraneous Planets

X) Habitable Planets

Y) Goldilocks Planet

Z) Temperate Planets

Toss Up Answer: Y

Bonus: Short Answer

What is the name given to a cloud of dust and gas in outer space?

Bonus Answer: nebula

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5. ENERGY

Writer: George Papastefanou

Toss Up: Multiple Choice

Which material takes the least energy and CO₂ to produce?

W) Wood

X) Aluminum

Y) Glass

Z) HDPE (High Density Polyethylene Plastic)

Toss Up Answer: W

Bonus: Short Answer

What electrophysical process is behind wireless charging?

Bonus Answer: Induction

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6. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What volcano has erupted in the years 79 A.D., 1139, 1631, 1779, 1793, 1872, 1906, and 1944?

Bonus Answer: Vesuvius

Bonus: Short Answer

What is the name of the very old mountain belt located in southern Missouri and Northern Arkansas?

Bonus Answer: the ozarks

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7. BIOLOGY

Writer: Matthew Lee

Toss Up: Multiple Choice

Which one of the following is hexaploid?

W) apple

X) wheat

Y) strawberry

Z) banana

Toss Up Answer: X

Bonus: Short Answer

What is the only animal known to reproduce asexually?

Bonus Answer: Bdelloid rotifer

8. CHEMISTRY

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

The hydrolysis of t-bromobutane, C₄H₉Br, by hydroxide, OH⁻, ions in aqueous solution follows an S_N1 reaction mechanism in which the rate-determining step is the loss of a bromide, Br⁻, ion, followed by rapid reaction with hydroxide ions. Which of the following rate laws is consistent with this mechanism?

W) Rate = k[C₄H₉Br]

X) Rate = k[C₄H₉Br][OH⁻]

Y) Rate = k[C₄H₉Br]²

Z) Rate = k [OH⁻]

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following would be correct units for the rate constant of a reaction that is second order overall?

W) s⁻¹

X) mol⁻¹ dm³ s⁻¹

Y) mol cm⁻³ s⁻¹

Z) mol⁻² dm⁶ s⁻¹

Bonus Answer: X

9. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

Chronic myelogenous leukemia can occur when a portion of chromosome 9 translocated with chromosome 22. What is this abnormal version of chromosome 22 commonly called?

Bonus Answer: Philadelphia chromosome

Bonus: Multiple Choice

If nondisjunction occurs in a cell during meiosis I, how many of the 4 daughter cells will have an abnormal chromosome number?

W) 1

X) 2

Y) 3

Z) 4

Bonus Answer: Z

10. CHEMISTRY

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Radiation from a mercury lamp source is of energy 2.845 eV. Calculate the wavelength of the radiation.

- W) 579 nm
- X) 355 nm
- Y) 405 nm
- Z) 436 nm

Toss Up Answer: Z

Bonus: Multiple Choice

The force constant of the bond in a hydrogen chloride, HCl, molecule is 516 N m⁻¹. Calculate the vibrational potential energy of an HCl molecule with a bond that is extended from its equilibrium length by 0.11 Å.

- W) 3.1×10^{-20} J
- X) 6.2×10^{-20} J
- Y) 1.5×10^{-20} J
- Z) 2.6×10^{-20} J

Bonus Answer: W

11. ENERGY

Writer: Aaron Gee

Toss Up: Short Answer

Cadmium and boron are used in a nuclear reactor to absorb which subatomic particle?

Bonus Answer: Neutron

Bonus: Short Answer

The electrical resistance of a semiconducting wire is least likely to be reduced by a decrease in which two of the following four wire characteristics?

Radius, Melting Point, Length, or Temperature?

Bonus Answer: Melting Point and Radius

12. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

To determine if a rigid body is in equilibrium the vector sum of the gravitational forces acting on the particles of the body can be replaced by a single force acting at which point?

- W) the center of mass
- X) the geometrical center
- Y) the center of gravity
- Z) a point on the boundary

Toss Up Answer: Y

Bonus: Short Answer

A uniform 120-N plank is supported by two forces acting at one end and at a point halfway to the plank center. What are the magnitudes of these two forces?

Bonus Answer: 80, 160

13. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What model of DNA replication did Watson and Crick propose?

Bonus Answer: Semiconservative model

Bonus: Multiple Choice

What enzyme replaces RNA primers with DNA during DNA replication?

- W) DNA polymerase I
- X) DNA polymerase III
- Y) Primase
- Z) DNA ligase

Bonus Answer: W

14. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

A cube with 2-m sides and a bulk modulus of $4 \times 10^5 \text{ N/m}^2$ (READ 4 times 10 to the sixth newton meters squared). When it's subjected to a pressure of $2 \times 10^5 \text{ Pa}$, what is the resulting volume of the cube?

- W) 0.5 m^3
- X) 2 m^3
- Y) 3 m^3
- Z) 4 m^3

Toss Up Answer: Z

Bonus: Multiple Choice

A 4.0-m long steel beam with a cross-sectional area of $1.0 \times 10^{-2} \text{ m}^2$ and a Young's modulus of $2.0 \times 10^{11} \text{ N/m}^2$ is wedged horizontally between two vertical walls. In order to wedge the beam, it is compressed by 0.020mm. If the coefficient of static friction between the beam and the walls is 0.70, what is the maximum mass (including its own) it can bear without slipping?

- W) 700kg
- X) 710kg
- Y) 900kg
- Z) 910kg

Bonus Answer: X

15. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What is the repeated 6-base DNA sequence of a human telomere?

Bonus Answer: TTAGGG

Bonus: Multiple Choice

Which histone is involved in the formation of the 30-nm chromatin fiber during chromatin packing?

- W) H3
- X) H2B
- Y) H4
- Z) H1

Bonus Answer: Z

16. ENERGY

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

In a typical power plant used to generate electricity in the U.S., the percentage of energy in the fuel that is converted to electricity is about:

- W) 60%
- X) 90%
- Y) 20%
- Z) 35%

Toss Up Answer: Z

Bonus: Short Answer

The Nuclear Waste Policy Act of 1982 and amendments require what

Federal agency to site, construct and operate a geologic repository for disposal of high-level nuclear waste?

Bonus Answer: U.S. Department of Energy

17. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What fatal, degenerative disease caused by a prion is most commonly found in sheep and goats?

Bonus Answer: scrapie

Bonus: Short Answer

What fatal, degenerative disease caused by a prion is most commonly found in people?

Bonus Answer: Creutzfeldt-Jakob disease

18. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

The mass of the planet Yor'Ectum is 1/100 that of Earth and its radius is 1/4 that of Earth. If a person weighs 600N on Earth, what would he weigh on Yor'Rectum?

Bonus Answer: 96N

Bonus: Multiple Choice

The escape speed at the surface of Earth is approximately 8 km/s. What is the mass, in units of Earth's mass, of a planet with twice the radius of Earth for which the escape speed is twice that for Earth?

- W) 2
- X) 4
- Y) 8
- Z) 1/2

Bonus Answer: Y

19. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Which of the following would lead to a DECREASE in activity of the Anterior Pituitary gland?

- W) A lack of receptors for Cortisol on the Hypothalamus.

- X) A lack of receptors for Cortisol on the Anterior Pituitary.
- Y) Intravenous injection of a large amount of ACTH.
- Z) A tumor of the Hypothalamus causing it to secrete excess Corticotropin- Releasing Hormone

Toss Up Answer: Y

Bonus: Multiple Choice

What would happen if the Adrenal Cortex was artificially stimulated to produce large amounts of Cortisol?

- W) Less Corticotropin-Releasing Hormone would be released.
- X) More ACTH would be released.
- Y) The activity of the Hypothalamus would increase.
- Z) The activity of the Anterior Pituitary would increase.

Bonus Answer: W

20. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

An object is dropped from an altitude of one Earth radius above Earth's surface. In terms of M, the mass of Earth, and R, Earth's radius, what is the speed of the object just before it hits Earth?

Bonus Answer: $\sqrt{GM/R}$ (READ AS: square root of GM over R)

Bonus: Short Answer

Two particles, each of mass m, are a distance d apart. If an external force brings a third particle, with mass 2m, from far away to a resting point midway between the two particles, what is the work done by this force?

Bonus Answer: $-8Gm^2/d^2$

21. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Polarity in the developing Drosophila embryo is determined by:

- W) a protein gradient of the segmentation protein engrailed
- X) a protein gradient of the bicoid protein expressed from maternal mRNA
- Y) a protein gradient of the gap protein hunchback
- Z) expression of the segmentation protein engrailed throughout the embryo

Toss Up Answer: X

Bonus: Multiple Choice

When a four-cell Xenopus embryo is divided into ventral and dorsal halves, the half containing the Nieuwkoop center will develop:

- W) ventralized features
- X) dorsalized features
- Y) as a normal embryo
- Z) only to the 8-cell stage

Bonus Answer: X

22. PHYSICS

Writer: Andrew Zheng

Toss Up: Multiple Choice

An artificial satellite orbiting Earth above North America releases a bomb. Neglecting air resistance, the bomb will do which one of the following?

- W) strike North America at the instant of release
- X) strike China at the instant of impact
- Y) never strike Earth
- Z) strike China at the instant of release

Toss Up Answer: Y

Bonus: Short Answer

In planetary motion the line from the star to the planet sweeps out equal areas in equal times. This is a direct consequence of which law?

Bonus Answer: law of conservation of angular momentum (DO NOT ACCEPT Kepler's Second Law)

23. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Insulin release results in all of the following physiological effects EXCEPT:

- W) Decreased glycogen stores in liver cells.
- X) Activation of glycogen synthase.
- Y) Inhibition of glycogen phosphorylase.
- Z) Increased fat production from glycerol and fatty acids in adipose tissue.

Toss Up Answer: W

Bonus: Multiple Choice

All of the following are stimulated by the sympathetic nervous system EXCEPT:

- W) increased heart rate.
- X) increase secretion of the sweat glands.
- Y) constriction of blood vessels
- Z) increased peristalsis in the gastrointestinal tract.

Bonus Answer: Z

24. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Where do the microtubules of the spindle originate during mitosis in both plant and animal cells?

- W) centromere
- X) centrosome
- Y) centriole
- Z) kinetochore

Toss Up Answer: Y

Bonus: Multiple Choice

If cells in the process of dividing are subjected to colchicine, at which stage will mitosis be arrested?

- W) anaphase

- X) prophase
- Y) metaphase
- Z) interphase

Bonus Answer: Y

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25. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

In the genetic pathway containing genes A, B, and C, gene A negatively regulates gene B, which in turn negatively regulates gene C. If a loss-of-function mutation were introduced into gene B, what would be the resulting effect on the expression of gene C?

- W) Decreased expression of gene C.
- X) No effect on expression of gene C.
- Y) Changes in expression levels of gene C would be the same as those for gene A.
- Z) Increased expression of gene C.

Toss Up Answer: Z

Bonus: Multiple Choice

Concentration of urine is essential to the survival of many vertebrates.

Which class of vertebrates would you expect does not use this mechanism for homeostasis?

- W) Aves
- X) Lepidosauria
- Y) Mammalia
- Z) Osteichthyes

Bonus Answer: Z

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