

Round 32

1. 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: $-8Gm^2/d^2$

2. 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)

3. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

Assume that Earth is in circular orbit around the Sun with kinetic energy K and potential energy U , taken to be zero for infinite separation. What is the relationship between K and U ?

Bonus Answer: $K = -U/2$ (accept equivalent forms)

Bonus: Multiple Choice

A planet is in circular orbit around the Sun. Its distance from the Sun is four times the average distance of Earth from the Sun. The period of this planet, in Earth years, is:

W) 4

X) 8

Y) 16

Z) 64

Bonus Answer: X

4. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

If a wheel is turning at $3.0/\pi$ rad/s, what is its period?

- W) 3.14
- X) 6.58
- Y) 8.73
- Z) 9.67

Toss Up Answer: X

Bonus: Multiple Choice

What is the total energy of a block attached to a spring with spring constant of 50 N/m if the block's velocity corresponds to the equation, $v(t) = 10\sin(2t)$ (READ AS: v of t equals 10 times sin of quantity 2*t)?

- W) 100 J
- X) 125 J
- Y) 250 J
- Z) 500 J

Bonus Answer: X

5. MATHEMATICS

Writer: Benjamin Avrahami

Toss Up: Short Answer

What is the volume of a hole 2 meters by 2 meters by 2 meters after 1 cubic meter of dirt has been added to it?

Bonus Answer: 1 cubic meter

Bonus: Multiple Choice

Avogadro's number is approximately 6.022 times 10 to what power

- W) -23
- X) -11
- Y) 11
- Z) 23

Bonus Answer: Z

6. MATHEMATICS

Writer: Benjamin Avrahami

Toss Up: Short Answer

If the capstone is taken off the Great Pyramid of Giza, then it is no longer a pyramid but a what?

Bonus Answer: A frustum

Bonus: Multiple Choice

Which one of these is Euclid's parallel postulate?

- W) If a line intersects one of two parallel lines, both of which are coplanar with the original line, then it will also intersect with the other line.
- X) If a line segment intersects two straight lines forming two interior angles on the same side that sum to less than two right angles, then the two lines, if extended indefinitely, meet on the side on which the angles sum to less than two right angles.
- Y) In a plane, given a line and a point not on it, exactly one line parallel to the given line can be drawn through the point.
- Z) For any acute angle A and any point D in the interior of angle A, there exists a line through D and not through A which intersects both sides of angle A.

Bonus Answer: X

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7. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is a triangular number?

W) 2

X) 6

Y) 9

Z) 11

Toss Up Answer: X

Bonus: Short Answer

What is the greatest common factor of 456 and 460?

Bonus Answer: 4

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8. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

What is the smallest even triangular number?

Bonus Answer: 6

Bonus: Multiple Choice

If p and q are inversely proportional, and $p = 7$ when $q = 24$, then find p when $q = 12$.

W) 3.5

X) 7

Y) 12

Z) 14

Bonus Answer: Z

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9. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

Where does the electrical signal in the heart start

W) sinoatrial node

X) atrioventricular node

Y) atrioventricular bundle

Z) purkinje fibers

Toss Up Answer: W

Bonus: Multiple Choice

Which valve separates the right atrium from the right ventricle

W) Mitral Valve

X) Tricuspid valve

Y) Bicuspid Valve

Z) Semi-lunar valves

Bonus Answer: X

10. 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

11. 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

12. 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

13. 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

14. BIOLOGY

Writer: Jason Weng

Toss Up: Short Answer

What is the process called by which tumor spreads to other parts of the body?

Bonus Answer: Metastasis

Bonus: Short Answer

How many subunits does tubulin have?

Bonus Answer: 2

15. 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

16. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Which of the following is required for motor proteins to function in the movement of chromosomes toward the poles of the mitotic spindle?

- W) intact centromeres
- X) a kinetochore attached to the metaphase plate
- Y) ATP as an energy source
- Z) synthesis of cohesin

Toss Up Answer: Y

Bonus: Short Answer

At which phase are centrioles beginning to move apart in animal cell mitosis?

Bonus Answer: prophase (DO NOT ACCEPT: prometaphase)

17. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Which of the following proteins are involved in binary fission as well as eukaryotic mitotic division?

- W) cyclins
- X) Cdks (read as an acronym)
- Y) condensins
- Z) actin and tubulin

Toss Up Answer: Z

Bonus: Short Answer

The materials used to synthesize a new cell wall in plant cell cytokinesis comes primarily from which plant cell organelle?

Bonus Answer: Golgi apparatus (ACCEPT: Golgi complex, Golgi body, Golgi)

18. CHEMISTRY

Writer: Shanjeed Ali

Toss Up: Short Answer

Mixing 250 mL of 2.0 M sulfuric acid with 2 liters of 0.5 M sodium hydroxide will produce a solution with what pH?

Bonus Answer: 7

Bonus: Short Answer

Which of the following are strong bases: lithium hydroxide, strontium hydroxide, cesium hydroxide, barium hydroxide?

Bonus Answer: All except cesium hydroxide

19. CHEMISTRY

Writer: Shanjeed Ali

Toss Up: Multiple Choice

Which of the following is least reactive with water at room temperature?

W) Sodium

X) Potassium

Y) Rubidium

Z) Cesium

Toss Up Answer: W

Bonus: Short Answer

What is the most abundant alkali metal on earth?

Bonus Answer: Sodium

20. CHEMISTRY

Writer: Shanjeed Ali

Toss Up: Short Answer

What will happen solubility of oxygen gas as temperature increases?

Bonus Answer: Decrease

Bonus: Short Answer

Which elements are found in the form of diatomic gases at room temperature?

Bonus Answer: Hydrogen, oxygen, fluorine, chlorine, nitrogen

21. CHEMISTRY

Writer: Shanjeed Ali

Toss Up: Multiple Choice

Which element has the highest ionization energy?

W) Chlorine

X) Bromine

Y) Selenium

Z) Technetium

Toss Up Answer: W

Bonus: Short Answer

What are the periodic table trends for ionization energy?

Bonus Answer: Increases left to right and decreases from the top to the bottom

22. CHEMISTRY

Writer: Shanjeed Ali

Toss Up: Short Answer

What is the energy level and orbital of the outermost electrons in a ground state sulfur atom?

Bonus Answer: 3p

Bonus: Short Answer

What is the maximum number of covalent bonds sulfur can form?

Bonus Answer: 6

23. EARTH and SPACE

Writer: Mohammed Haque

Toss Up: Multiple Choice

Which of the following moon's do not belong to Jupiter?

- W) Europa
- X) Thebe
- Y) Titan
- Z) Io

Toss Up Answer: Y

Bonus: Multiple Choice

What element is Jupiter mainly composed of?

- W) Hydrogen
- X) Fluorine
- Y) Xenon
- Z) Arsenic

Bonus Answer: W

24. EARTH and SPACE

Writer: Mohammed Haque

Toss Up: Multiple Choice

Which of the following is the best description of Jupiter's red spot ?

- W) A Giant Tornado
- X) A Hurricane
- Y) A Weather Phenomenon.
- Z) Non of the above

Toss Up Answer: X

Bonus: Multiple Choice

What are the light and dark strips that band around Jupiter?

- W) Bands and belts
- X) Belts and zones
- Y) Bands and Zones
- Z) Non of the above

Bonus Answer: X

25. EARTH and SPACE

Writer: Mohammed Haque

Toss Up: Multiple Choice

Which of the following moons do not belong to Saturn?

- W) Titan
- X) Dione
- Y) Europa
- Z) Mimas

Toss Up Answer: Y

Bonus: Multiple Choice

What is Saturn's orbital period (Earth years)?

- W) 15 years
- X) 24 years
- Y) 29 years
- Z) 17 years

Bonus Answer: Y
