

Round 17

1. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

A force F of strength 20 N acts on an object of mass 3 kg as it moves a distance of 4 m. If F is perpendicular to the 4 m displacement, the work it does is equal to

W) 0 J

X) 60 J

Y) 80 J

Z) 600 J

Toss Up Answer: W

Bonus: Short Answer

Under the influence of a force, an object of mass 4 kg accelerates from 3 m/s to 6 m/s in 8 s. How much work was done on the object during this time?

Bonus Answer: 54 J

2. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Find the sum of the first 6 Fibonacci numbers

Bonus Answer: 20

Bonus: Short Answer

Find the sum of all the numbers in the first 7 rows of the Pascal Triangle

Bonus Answer: 127

3. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

If all of the forces acting on an object balance so that the net force is zero, then

W) The object must be at rest

X) The object speed will decrease

Y) The object direction can change but its speed cannot

Z) None of the above

Toss Up Answer: Z

Bonus: Short Answer

A person who weighs 800 N steps onto a scale that is on the floor of an elevator car. If the elevator accelerates upward at a rate of 5 m/s², what will the scale read ($G = 10 \text{ m/s}^2$)?

Bonus Answer: 1200 N

4. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

Factor $x^2 + y^2 + z^2 + 2xy + 2yz + 2xz$

Bonus Answer: $(x+y+z)^2$

Bonus: Short Answer

Factor $x^2(z-y) + y^2(x-z) + z^2(y-x)$

Bonus Answer: $(x-y)(y-z)(z-x)$ (or any other answer involving multiplying 2 of the binomials by -1)

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5. PHYSICS

Writer: Nicholas Adit

Toss Up: Short Answer

A baseball is thrown straight upward. What is the acceleration at the highest point?

Bonus Answer: 0

Bonus: Multiple Choice

A rock is dropped off a cliff and strikes the ground with an impact velocity of 30 m/s. How high was the cliff?

W) 15 m

X) 30 m

Y) 45 m

Z) 60 m

Bonus Answer: Y

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6. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If Bill can come up with 5 math questions in 1 hour, how many math questions can he come up with in 12 minutes?

Bonus Answer: 1

Bonus: Short Answer

Find the area of a triangle with side lengths 9, 7, and 6.

Bonus Answer: $2\sqrt{110}$

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7. PHYSICS

Writer: William Xiang

Toss Up: Short Answer

Two trailers, X with mass 500kg and Y with mass 2000kg, are being pulled at the same speed. Find the ratio of the kinetic energy of Y to that of X in simplest terms.

Bonus Answer: 4:1 (or 4 to 1)

Bonus: Multiple Choice

Given a potential energy function $U(x)$, the corresponding force F is in the positive x direction if:

W) U is positive

X) U is negative

Y) U is an increasing function of x

Z) U is a decreasing function of x

Bonus Answer: Z

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8. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

What is the area of an isosceles triangle with legs 15 and altitude 12?

Bonus Answer: 108

Bonus: Short Answer

Find the area of a triangle if 2 of its sides are 3 and 6, and its included angle is 30 degrees.

Bonus Answer: $9\sqrt{3}/2$

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9. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

Which of the following bodies has the largest kinetic energy?

W) Mass 3M and speed V

X) Mass 3M and speed 2V

Y) Mass 2M and speed 3V

Z) Mass M and speed 4V

Toss Up Answer: Y

Bonus: Multiple Choice

AN object is constrained by a cord to move in a circular path of radius 0.5m on a horizontal frictionless surface. The cord will break if its tension exceeds 16N. The maximum kinetic energy the object can have is:

W) 4J

X) 8J

Y) 17J

Z) 32J

Bonus Answer: W

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10. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

What type of cell are chromosomes located in the nucleus?

Bonus Answer: Eukaryotes.

Bonus: Short Answer

Meiosis of a diploid cell results in_

Bonus Answer: 4 haploid cells.

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11. CHEMISTRY

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

What is the name given to the non-superimposable mirror image forms of chiral compounds?

W) Diastereomers

X) Stereoisomers

Y) Enantiomers

Z) Cis-trans isomers

Toss Up Answer: Y

Bonus: Short Answer

What metal is used as a reducing agent to obtain iron from iron oxide in the Thermite process?

Bonus Answer: Aluminum

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12. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

In which two process of cellular does carbon dioxide released?

Bonus Answer: Co2 is released in the link reaction and in the Krebs cycle.

Bonus: Short Answer

What type of acid do birds excrete?

Bonus Answer: Uric acid.

13. CHEMISTRY

Writer: Ahmad Alnasser

Toss Up: Short Answer

What is the name of a cyclic molecule with 6 carbons?

Bonus Answer: cyclohexane

Bonus: Multiple Choice

Which of the following compounds contains a double bond?

W) butene

X) acetylene

Y) butane

Z) butyne

Bonus Answer: W

14. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Protein digestion in humans begins in the

W) mouth

X) stomach

Y) small intestine

Z) large intestine

Toss Up Answer: X

Bonus: Short Answer

Which protein is responsible for protein digestion in the stomach?

Bonus Answer: pepsin (DO NOT accept: pepsinogen)

15. CHEMISTRY

Writer: Calvin Aw

Toss Up: Short Answer

Find the molecular geometry for a NH₃ ion

Bonus Answer: Trigonal Pyramidal

Bonus: Short Answer

State all the group numbers which consist of the representative elements.

Bonus Answer: 1,2,13,14,15,16,17, and 18 (Accept 1-2, 13-18)

16. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

The double membranes found in mitochondria and chloroplasts suggest which of the following?

- W) mitochondria and chloroplasts are part of the endomembrane system
- X) the endosymbiont theory
- Y) chloroplasts evolved before mitochondria
- Z) chloroplasts and mitochondria are capable of synthesizing their own proteins

Toss Up Answer: X

Bonus: Short Answer

The light reactions occur in which part of the chloroplast?

Bonus Answer: the thylakoid (or thylakoid membrane)

17. CHEMISTRY

Writer: Ahmad Alnasser

Toss Up: Short Answer

What is the word that describes a substance that reacts with both strong acids and strong bases?

Bonus Answer: Amphoteric

Bonus: Multiple Choice

The triple bond between the carbon atoms causes acetylene, C₂H₂, to have which of the following shapes?

- W) Trigonal planar (pron: try-gon-al)
- X) Linear
- Y) Tetrahedral
- Z) Trigonal bipyramidal

Bonus Answer: X

18. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Glycoproteins are mainly created by ribosomes attached to which structure?

Bonus Answer: the rough endoplasmic reticulum (accept: rough ER; do NOT accept: ER or endoplasmic reticulum)

Bonus: Short Answer

Drugs like barbiturates commonly increase the size of which endomembrane organelle?

Bonus Answer: the smooth endoplasmic reticulum

19. CHEMISTRY

Writer: Mohammed Haque

Toss Up: Short Answer

How did Mendeleev arrange the elements of the periodic table?

Bonus Answer: In order of increasing atomic mass.

Bonus: Short Answer

How did Moseley change the periodic table?

Bonus Answer: He arranged the elements in increasing atomic numbers.

20. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Motor proteins transport vesicles along which cytoskeletal fiber?

Bonus Answer: microtubules

Bonus: Short Answer

Shape abnormalities of the nuclear lamina are most likely a result of a defect in which cytoskeletal structure?

Bonus Answer: intermediate filaments

21. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

Where is the majority of Earth's freshwater "locked up"?

Bonus Answer: Antarctica

Bonus: Short Answer

What are the four terrestrial planets?

Bonus Answer: Earth, Mars, Mercury, Venus

22. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Which transmembrane structures are responsible for communicating signals between the extracellular matrix and the internal microfilament cytoskeleton?

- W) integrins
- X) fibronectins
- Y) proteoglycan complexes
- Z) plasmodesmata

Toss Up Answer: W

Bonus: Multiple Choice

The plasmodesmata of plant cells are most similar to which animal cell structure?

- W) the plasma membrane
- X) desmosomes
- Y) gap junctions
- Z) desmotubules

Bonus Answer: Y

23. EARTH and SPACE

Writer: Elias Milborn

Toss Up: Multiple Choice

In which of the following locations is it possible to find an esker formed during the Pleistocene [PLY-stuh-seen] epoch?

- W) Maryland
- X) West Virginia
- Y) Tennessee
- Z) Iowa

Toss Up Answer: Z

Bonus: Short Answer

Calculate the percent relative humidity for air at 70°F containing 10 millibars of water vapor if the saturation vapor

pressure is 25 millibars at that temperature:

Bonus Answer: 40%

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24. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

What cytoskeletal component forms the cleavage furrow during cytokinesis?

Bonus Answer: Microfilaments (Accept: actin)

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Bonus: Short Answer

Microtubules are composed of what subunits?

Bonus Answer: tubulin (accept: alpha and beta tubulin dimers)

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25. EARTH and SPACE

Writer: Elias Milborn

Toss Up: Multiple Choice

Which of the following is a term specifically given to water that replenishes an aquifer?

W) Recharge

X) Discharge

Y) Hydraulic

Z) Permeable

Toss Up Answer: W

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Bonus: Multiple Choice

When a strong south wind occurs along the west coast of North America, Ekman transport causes water to move to which of the following?

W) onshore

X) offshore

Y) alongshore to the south

Z) alongshore to the north

Bonus Answer: W

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