

Round 9

1. PHYSICS

Toss Up: Multiple Choice

Which has the same units as joules?

- W) Newton / meter
- X) Pascal * meter²
- Y) Coulomb * volt
- Z) Kilogram * meter / second²

Toss Up Answer: Y

Bonus: Short Answer

What is the derived unit for Newton / meter²?

Bonus Answer: Pascal

2. PHYSICS

Toss Up: Multiple Choice

If an object is located at the focal point of a concave mirror, what type of image will form?

- W) real, inverted
- X) virtual, inverted
- Y) real, upright
- Z) Image will not exist

Toss Up Answer: Z

Bonus: Short Answer

Cone cells in the retina allow a human being to perceive color. What are the photoreceptor proteins found in cone cells called?

Bonus Answer: Photopsin

3. PHYSICS

Toss Up: Multiple Choice

If on a certain planet, acceleration due to gravity is -5 m/s^2 , how long will a ball be in the air if thrown directly upward from the ground with a velocity of 10 m/s ?

- W) 2 seconds
- X) 4 seconds
- Y) 8 seconds
- Z) 16 seconds

Toss Up Answer: X

Bonus: Multiple Choice

If Jim walks 10 meters north, then 5 meters southeast, then 5 meters northwest, then 5 meters south, what is his displacement?

- W) 25 meters north
- X) 15 meters north
- Y) 5 meters north
- Z) 5 meters south

Bonus Answer: Y

4. PHYSICS

Toss Up: Multiple Choice

Two trucks are 50 kilometers apart and traveling toward each other. One automobile is moving at 60km/h and the other is moving at 40km/h mph. How long will it take for them meet?

W) 15 minutes

X) 20 minutes

Y) 24 minutes

Z) 30 minutes

Toss Up Answer: Z

Bonus: Short Answer

The position of a particle in meters is given by $x(t) = 25t - 3t^3$ (READ AS: 16 times t minus 3 times t cubed) , where the time t is in seconds. The particle is momentarily at rest at what time t rounded to the nearest hundredth?

Bonus Answer: 1.67 seconds, accept 1.67

5. PHYSICS

Toss Up: Short Answer

What is the German term for the energy released when high voltage electrons decelerate at impact with a metal and is also known as "breaking radiation"?

Bonus Answer: Bremsstrahlung

Bonus: Short Answer

Given that Planck's constant is 4×10^{-15} eV*s (READ AS: 4 times 10 to the power of negative 15 electron volt second), what is the maximum kinetic energy, in electron volts, of an electron released from a metal with work function of 1 eV when a photon of frequency of 300 terahertz strikes the metal's surface?

Bonus Answer: 0.2 electron volts

6. MATHEMATICS

Toss Up: Short Answer

What is the slope of the tangent line to $e^{(2x)}$ at $x=3$

Bonus Answer: $2e^6$

Bonus: Short Answer

What is the slope of the tangent line to $\ln(2x)$ at $x=3$

Bonus Answer: $1/3$

7. MATHEMATICS

Toss Up: Short Answer

Convert CD from hexadecimal to decimal

Bonus Answer: 205

Bonus: Short Answer

Convert CD from hexadecimal to binary

Bonus Answer: 11001101

8. MATHEMATICS

Toss Up: Short Answer

What is the sum of the interior angles of a nonagon?

Bonus Answer: 1260 degrees

Bonus: Short Answer

How many edges does an octahedral prism have?

Bonus Answer: 24 edges

=====

9. MATHEMATICS

Toss Up: Multiple Choice

Simplify the following expression: $(x^3+27)/(x+3)$ if $x=12$

W) 125

X) 117

Y) 136

Z) 109

Toss Up Answer: X

=====

Bonus: Short Answer

Find all the real solutions of $x^4-18=-2$

Bonus Answer: $x=2$, $x=-2$

=====

10. BIOLOGY

Toss Up: Short Answer

Haemoglobin alpha and beta globin chains are found in what 2 chromosomes?

Bonus Answer: Alpha: Chromosome 16

Beta: Chromosome 11

=====

Bonus: Short Answer

Name all types of RNA

Bonus Answer: mRNA, tRNA, rRNA

=====

11. BIOLOGY

Toss Up: Short Answer

Which process is complementary to hydrolysis?

Bonus Answer: Dehydration synthesis

=====

Bonus: Multiple Choice

Which of the following inhibits carbonic anhydrase?

W) Erythromycin

X) Imipramine

Y) Acetazolamide

Z) Ambylmycin

Bonus Answer: Y

=====

12. BIOLOGY

Toss Up: Multiple Choice

Mutation in which of the following types of genes is least likely to result in higher chances of developing cancer?

W) oncogene

X) tumor suppressor gene

Y) proto-oncogene

Z) tumor necrosis factor gene

Toss Up Answer: Z

=====

Bonus: Short Answer

Rearrange the following list of the structures of a nephron in the order in which filtrate flows through them:

1. proximal convoluted tubule
2. ascending limb of Loop of Henle
3. distal convoluted tubule
4. collecting duct
5. Bowman's capsule
6. descending limb of Loop of Henle

Bonus Answer: 5, 1, 6, 2, 3, 4

***A list of the structures or the correct reordering of the numbers assigned to each structure are valid answers**

=====

13. BIOLOGY

Toss Up: Multiple Choice

The initial frequency of allele A is 0.6, and the initial frequency of allele a is 0.4. In the next generation, the frequencies for alleles change to 0.61 and 0.39, respectively for each allele. The change in allele frequency is:

- W) the result of random mating
- X) evolution
- Y) the result of natural selection
- Z) impossible in a small population

Toss Up Answer: X

=====

Bonus: Multiple Choice

What is the main structure that connects the left and right hemispheres of the brain?

- W) corpus callosum
- X) thalamus
- Y) superior colliculus
- Z) amygdala

Bonus Answer: W

=====

14. BIOLOGY

Toss Up: Short Answer

You perform a transformation and calculate a viable count of 9000 cells/mL. If your transformation efficiency was 10%, how many colonies would you expect to see if you plate 100uL of cells onto selective media?

Bonus Answer: 90

=====

Bonus: Short Answer

If the mother of a child suffers from diabetes mellitus and deafness (DAD) and the father does not, what is the likelihood that the child will develop degenerative optomosis?

**Note: Diabetes mellitus and deafness (DAD) is a genetic disorder, not separate ailments.*

Bonus Answer: 100%. DAD is caused by mutations in mtDNA, which are passed on only by the mother.

=====

15. BIOLOGY

Toss Up: Multiple Choice

If a gene is fixed in a population:

- W) the gene cannot undergo mutation
- X) one allele exhibits complete dominance over the other allele of that gene
- Y) only one allele appears for that gene in the population
- Z) the gene is incapable of recombination

Toss Up Answer: Y

Bonus: Multiple Choice

The Species-Area Relationship suggests that 10% of a given area supports:

- W) 90% of species
- X) 70% of species
- Y) 50% of species
- Z) 30% of species

Bonus Answer: Y

16. BIOLOGY

Toss Up: Multiple Choice

Natural selection is effective in the evolutionary process because it:

- W) causes evolution
- X) changes allele frequencies
- Y) increases the mean fitness of a population
- Z) leads to fixation or loss of particular alleles

Toss Up Answer: Y

Bonus: Short Answer

You tie a ribbon to a tree trunk. The height measured from the ribbon to the ground is five feet. The tree grows at a rate of three feet per year. After 10 years, how far up from the ground will the ribbon be?

Bonus Answer: Five feet. The elongation of a tree trunk occurs from the apical meristem up.

17. CHEMISTRY

Toss Up: Short Answer

Where does oxidation occur in an electrochemical cell?

Bonus Answer: Anode

Bonus: Short Answer

In the redox reaction $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ how many electrons are transferred?

Bonus Answer: 4

18. CHEMISTRY

Toss Up: Multiple Choice

How many orbitals does the p sublevel have?

- W) 1
- X) 2
- Y) 3
- Z) 4

Toss Up Answer: Y

Bonus: Short Answer

which element has the electron configuration $1s^2 2s^2 2p^6 3s^1$ in its ground state?

Bonus Answer: Sodium, Na

19. CHEMISTRY

Toss Up: Multiple Choice

Which element is most electronegative?

- W) Chlorine
- X) Fluorine
- Y) Astatine
- Z) Cesium

Toss Up Answer: X

Bonus: Multiple Choice

What is the range of electronegativity values?

- W) 0.0 to 1.0
- X) 0.0 to 2.0
- Y) 0.0 to 3.0
- Z) 0.0 to 4.0

Bonus Answer: Z

20. CHEMISTRY

Toss Up: Short Answer

Roger Y. Tsien, Osamu Shimomura, and Martin Chalfie were awarded the 2008 Nobel Prize in Chemistry for the discovery and development of which protein?

Bonus Answer: Green Fluorescent Protein, GFP

Bonus: Multiple Choice

Which organism was the Green Fluorescent Protein first isolated from?

- W) Anglerfish
- X) Jellyfish
- Y) Squids
- Z) Gulper Eels

Bonus Answer: X

21. CHEMISTRY

Toss Up: Short Answer

If you have a 1 L of a 10 M solution of HCl and you want 2 L of a 5 M solution of HCl, how much water must you add?

Bonus Answer: 1 L

Bonus: Short Answer

If the pOH of a solution is 6, what is the concentration of H⁺ ions?

Bonus Answer: 1.0×10^{-8} (also 0.00000001)

22. CHEMISTRY

Toss Up: Short Answer

Order the following in terms of the rate of diffusion along them, from fastest to slowest. 1: Open Surface. 2: Through an amorphous material. 3: Through a crystal.

Bonus Answer: 1, 3, 2

Bonus: Multiple Choice

Which of the following is a thermal conductor, but not an electrical one?

- W) Graphite

- X) Graphene
- Y) Diamond
- Z) Polystyrene

Bonus Answer: Y

=====

23. EARTH and SPACE

Toss Up: Multiple Choice

Sedimentary rocks are formed from accumulation of different sediments. What is the term for a rock made by living organisms or composed of materials from life forms?

- W) Conglomerate
- X) Evaporites
- Y) Crystalline
- Z) Bioclastic

Toss Up Answer: Z

Bonus: Short Answer

Give the following classifications for these sedimentary rocks, breccia, conglomerate, and shale.

Bonus Answer: All Clastic sedimentary rocks.

=====

24. EARTH and SPACE

Toss Up: Multiple Choice

Glaciers effect the land through glacial erosion. Different geographies are formed but what is the specific name of the long narrow ridges that show where the glacier was once present?

- W) Glacial retreat
- X) Drumlins
- Y) Glacial erotics
- Z) Morianes

Toss Up Answer: Z

Bonus: Short Answer

Ice sheets and glaciers expanded to cover large areas of land during the last major glacial epoch. During which time period did this take place?

Bonus Answer: Quaternary

=====

25. EARTH and SPACE

Toss Up: Multiple Choice

What is the name of the igneous rock that is a porous volcanic glass formed by rapidly cooling lava?

- W) Obsidian
- X) Gabbro
- Y) Basalt
- Z) Pumice

Toss Up Answer: Z

Bonus: Short Answer

What are the three general types of magma?

Bonus Answer: Basaltic magma, Andesitic magma, and Rhyolitic magma

=====