Team Round

**TOSS UP**

1. PHYSICS: *Short Answer:* What is the name of the phenomenon that occurs when an insulating material is subjected to a sufficiently large electric field, resulting in its partial ionization that permits increased conduction?  
  
ANSWER: dielectric breakdown

**BONUS**

1. PHYSICS: *Short Answer:* Calculate the potential energy stored in a capacitor that hold 5 Coulombs of charge with a potential difference of 10 volts

ANSWER: 25 J

**TOSS UP**

2. CHEMISTRY: *Multiple Choice:* Which of the following alkanes has the highest boiling point under standard conditions?  
  
W) triacontane

X) octane

Y) dodecane

Z) nonane

ANSWER: W) triacontane

**BONUS**

3. CHEMISTRY: *Short Answer:* Give the IUPAC name for the molecule which contains two carbon atoms and four hydrogen atoms, with the carbon atoms double-bonded to each other  
  
ANSWER: ethene

**TOSS UP**

3. BIOLOGY: *Short Answer:* By name or number, denote all of the following four statements which are true regarding fungi:

1. plants then they are to animals

2. although many fungi feed by absorbing nutrients from their environments, some fungi have specialized structures called hyphae that allow them to feed on living animals

3. mutualism between fungi and plant roots is referred to as mycorrhizae

4. the ascomycetes, also called sac fungi, contain the most species of the five recognized phyla of fungi

ANSWER: 2, 3, 4

**BONUS**

3. BIOLOGY: *Multiple Choice:* Which of the following phyla of fungi are most closely related to Chytrids?  
  
W) Glomeromycetes  
X) Zygomycetes  
Y) Ascomycetes  
Z) Basidiomycetes

**TOSS UP**

4. EARTH AND SPACE SCIENCE: *Multiple Choice:* Based on Hubble's tuning-fork diagram, which of the following galaxies would contain the most young, hot, bright stars?  
  
W) E0  
X) S0  
Y) Sa  
Z) SBc  
  
ANSWER: Z) SBc

**BONUS**

4. EARTH AND SPACE SCIENCE: *Multiple Choice:* Which of the following shapes of galaxies best describes the Milky Way galaxy?  
  
W) Elliptical

X) Irregular  
Y) Normal spiral  
Z) Barred spiral  
  
ANSWER: Z) barred spiral

**TOSS UP**

5. PHYSICS: *Multiple Choice:* Which of the following two components must be present in a R-L circuit?  
  
W) resistor and transistor

X) resistor and inductor

Y) capacitor and inductor  
Z) capacitor and resistor

ANSWER: X) resistor and inductor

**BONUS**

5. PHYSICS: *Short Answer:* Calculate the capacitance of a capacitor that holds 1 coulomb of charge with a potential difference of 2 volts, giving your answer in microfarads.

ANSWER: 500,000 (5x105)

**TOSS UP**

6. CHEMISTRY: *Multiple Choice:* To the nearest degree, what is the bond angle of two single-bonded carbon atoms?  
  
W) 100°  
X) 109°  
Y) 120°  
Z) 129°  
  
ANSWER: X) 109°

**BONUS**

6. CHEMISTRY: *Short Answer:* While microorganisms can oxidize ethanol to produce acetic acid, or vinegar, the human liver oxidizes it into a different compound. Name this compound, which lacks the hydroxl group of acetic acid and instead has a hydrogen atom in its place.

ANSWER: acetaldehyde

**TOSS UP**

7. BIOLOGY: *Short Answer:* What term is given to a cell that, when differentiated, can be cultured into a functional clone of the original organism?  
  
ANSWER: totipotent

**BONUS**

7. BIOLOGY: *Multiple Choice:* Which of the following statements regarding cloning is false?  
  
W) one the first animals to be cloned were frogs, which was done by Robert

Briggs and Thomas King in the 1950s

X) John Gurdon discovered that the potential of a transplanted nucleus to direct

normal development was inversely related to the age of the donor; with older donor nuclei lowering the percentage of normally developing organisms

Y) all cloned animals are physically identical to the animal they were cloned from

Z) in culture, embryonic stem cells can reproduce indefinitely, can be made to differentiate into a variety of specialized cells based on culture conditions

ANSWER: Y) all cloned animals are physically identical to the animal they were cloned from

**TOSS UP**

8. MATHEMATICS: *Short Answer:* Solve the following equation for all values of 0°≤x**<**360°:  
sin x = - sin x  
  
ANSWER: 60°, 120°

**BONUS**

8. MATHEMATICS: *Short Answer:* Solve the following equation for all values of 0°≤x**<**360°:

2sin4 x - 3sin2 x + 1 =0

ANSWER: 45°, 90°, 135°, 270°

**TOSS UP**

9. ENERGY: *Multiple Choice:* What type of geothermal power plant which is most commonly used around the world takes hot, high-pressure water from underneath the surface and injects it into lower-pressure tanks, where it is turns into steam which is used to drive a turbine?  
  
W) wet steam

X) dry steam

Y) flash steam

Z) binary cycle

ANSWER: Y) flash steam

**BONUS**

9. ENERGY: *Multiple Choice:* As of 2009, what energy source generated the greatest percentage of emissions-free electricity in the world?  
  
W) nuclear

X) hydroelectricity

Y) wind

Z) geothermal

ANSWER: X) hydroelectricity

**TOSS UP**

10. EARTH AND SPACE SCIENCE: *Short Answer:* What term is given to the magnetization of iron-rich lava in the direction of the Earth's magnetic field as it cools, which leaves a band of magnetic anomalies on the seafloor which confirms the periodic reversal of the Earth's magnetic poles?  
  
ANSWER: thermoremenant magnetization

**BONUS**

11. EARTH AND SPACE SCIENCE: *Multiple Choice:* What is the name of the present-day magnetic chron?

W) Brunches normal chron  
X) Matuyama reversed chron  
Y) Gauss normal chron  
Z) Gilbert reversed chron  
  
ANSWER: W) Brunches normal chron

**TOSS UP**

12. PHYSICS: *Multiple Choice:* Which statement of the second law of thermodynamics, also known as the "refrigerator" statement, states that it is impossible for a process to have as its sole result the transfer of heat from a cooler to hotter body?

W) Kelvin-Planck

X) Carnot

Y) Boltzmann

Z) Clausius  
  
ANSWER: Z) Clausius

**BONUS**

13. PHYSICS: *Short Answer:* Calculate the coefficient of performance of a air conditioner if it removes 2000 J of heat per second from a room while using 1000 W of electrical power.  
  
ANSWER: 2

**TOSS UP**

14. CHEMISTRY: *Short Answer:*  What is the term given to the breaking of chemical bonds such that each of the atoms retains one of the bond's two electrons, forming free radicals?

ANSWER: homolytic cleavage OR radical cleavage

**BONUS**

14. CHEMISTRY: *Short Answer:* Calculate the net change in enthalpy for the reaction  
CH3 + Cl2 -> CH3Cl + Cl given that the bond enthalpy of Cl - Cl is 243 kJ/mol and the bond enthalpy for CH3 - Cl is 352 kJ/mol and all compounds are undergo homolytic leavage.

ANSWER: -109 kJ/mol

**TOSS UP**

15. BIOLOGY: *Multiple Choice:* What type of mutation occurs when nucleotides are either inserted or deleted in a mRNA sequence, and leads to the nucleotides following the mistake being improperly grouped into codons?  
  
W) translational

X) frameshift

Y) base-pair substitution

Z) nonsense

ANSWER: X) frameshift

**BONUS**

15. BIOLOGY: *Multiple Choice:* Which of the following types of point mutations will most likely result in a nonfunctional protein?  
  
W) a base-pair substitution in the middle of a gene

X) a frameshift mutation at the very end of a gene

Y) a missense mutation towards the beginning of a gene  
Z) a nonsense mutation towards the beginning of a gene

ANSWER: Z) a nonsense mutation towards the beginning of a gene

**TOSS UP**

16. MATHEMATICS: *Short Answer:* Solve the following equation for all values of 0°≤x**<**360°:

sec2x - sec x - 2 = 0

ANSWER: 180°

**BONUS**

17. MATHEMATICS: *Short Answer:* Solve the following equation for all values of 0°≤x**<**360°:

4cos3x - 3cosx = 0

ANSWER: 30°, 90°, 270°, 330°

**TOSS UP**

18. ENERGY: *Short Answer:* What form of petroleum, which has large deposits in Colorado, Utah, and Wyoming, is produced when kerogen accumulates in rock formations without being subjected to enough heat to be completely cooked into oil? Refinement of the kerogen into usable oil is achieved by heating it until it vaporizes, then distilling it into a synthetic crude.

ANSWER: oil shale

**BONUS**

18. ENERGY: *Multiple Choice:* Drilling for oil in which of the following locations woould offer the highest EROEI, or energy returned on energy invested?  
  
W) Gulf of Mexico

X) Middle East  
Y) Eastern Siberia

Z) Brazil

ANSWER: X) Middle East

**TOSS UP**

19. EARTH AND SPACE SCIENCE: *Short Answer:* Rank the following stars from closest to farthest from the earth  
  
sun, alpha centuri, wolf 359, Barnard's star, beta centuri

ANSWER: sun, alpha centuri, beta centuri, Barnard's star, wolf 359

**BONUS**

19. EARTH AND SPACE SCIENCE: *Multiple Choice:* Which of the following stars is the brightest in terms of apparent visual magnitude?  
  
W) Rigil Kentaurus

X) Vega  
Y) Betelgeuse  
Z) Canopus

ANSWER: Z) Canopus

**TOSS UP**

20. BIOLOGY: *Multiple Choice:* Edward's syndrome results from the excess of which chromosome?  
  
W) chromosome 8

X) chromosome 13

Y) chromosome 18

Z) chromosome 21

ANSWER: Y) chromosome 18

**BONUS**

20. BIOLOGY: *Multiple Choice:* Which of the following is not true regarding Edward's syndrome?  
  
W) infants with Edward's syndrome are usually born healthy, but develop often fatal complications later in life

X) Edward's syndrome is the second most common autosomal trisomy, after Down syndrome in infants which survive birth

Y) the incidence of Edward's syndrome increases as the mother's age increases

Z) infants born with Edward's syndrome experience heart abnormalities, kidney malformations, and other internal organ disorders, which often lead to death

ANSWER: W) infants with Edward's syndrome are usually born healthy, but develop often fatal complications later in life