**TOSS UP**

1. BIOLOGY *Multiple Choice* Cells than can divide and give rise to all parts of the differentiated cells in an organism, including extraembryonic tissues are  
   W) pluripotent

X) unipotent

Y) totipotent

Z) multipotent  
ANSWER: Y) totipotent

**BONUS**

1. BIOLOGY *Short Answer* By name or number, identify all of the following 4 choices that are examples of totipotent cells under normal conditions1. human embryonic stem cell

2. differentiated carrot cell from which a whole carrot can be grown

3. animal zygote

4. human red blood cellANSWER: 2, 3

**TOSS UP**

1. PHYSICS *Multiple Choice* Which of the following physical quantities for a rotating system is analogous to mass?W) angular momentum

X) angular velocity

Y) torque

Z) moment of inertiaANSWER: Z) moment of inertia

**BONUS**

1. PHYSICS *Short Answer* Two iceboats, A and B, of masses M and 2M respectively are started from rest on a frozen, frictionless lake. Both are pushed by a wind that exerts a constant force F and race towards a finish line. By name or number, identify all of the following three statements that are true regarding the two iceboats1. Iceboat A crosses the finish line first

2. Iceboat A crosses the finish line with more kinetic energy than iceboat A

3. Iceboat B has a greater momentum when it crosses the finish line than iceboat AANSWER: 1, 3

**TOSS UP**

1. CHEMISTRY *Short Answer* For each of the following 3 reactions, predict whether delta S reaction is positive or negative  
   1. Cl2 gas plus H2O liquid yields HCl aqueous plus HClO aqueous

2. NaCl solid yields Na+ aqueous plus Cl- aqueous

3. CH4 gas plus two O2 gas yields CO2 gas plus two H2O gas plus heat

ANSWER: 1. negative 2. positive 3. positive

**BONUS**

1. CHEMISTRY *Short Answer* List the following four substances in order of INCREASING molar entropy at 298 K: solid NaCl, NaCl saline solution, Neon, Carbon DioxideANSWER: Solid nacl, nacl solution, neon, carbon dioxide

**TOSS UP**

1. EARTH AND SPACE SCIENCE *Short Answer* The cretaceous paleogene boundary, is a geological signature dated to 66 million years ago, marking the mass extinction of the dinosaurs, among other things. The extinction is hypothesized by many scientists be the caused by a massive asteroid striking earth. The presence of what element, found in concentrations of up to 160 greater than background levels in the K Pg boundary supports this hypothesis? ANSWER: iridium

**BONUS**

1. EARTH AND SPACE SCIENCE *Multiple Choice* Which of the following hypotheses explaining the extinction of the dinosaurs has been discredited due to the lack of Pu 244 found in the K-Pg boundary if this event were to happen?W) Alvarez impact

X) Deccan Traps flood basalts

Y) Maastrichtian marine regression

Z) supernova hypothesisANSWER: Z) supernova hypothesis

**TOSS UP**

1. MATH *Short Answer* Vector A has magnitude 6 units and lies in the direction of the positive x axis. Vector B has magnitude 4 units and lies in the xy plane, making an angle of 30 degrees with the positive x-axis. What is the magnitude and sign of A cross B?  
     
   ANSWER: +12

**BONUS**

1. MATH *Short Answer* By name or number, identify all of the following 4 vector combinations that have a dot product of zero1. [2, 0, 0] and [0, 3, 1]

2. [-2, 6, 3] and [6, 1, 2]

3. [1, 0, 0] and [-1, 0, 0]

4. [1, 1, 1] and [-1, 1, 0]ANSWER: all but 3

**TOSS UP**

1. ENERGY *Short Answer* By name or number, identify all of the following four properties of diesel fuel that are considered to be important markers of fuel quality 1. cetane number

2. density

3. lubricity

4. sulfur contentANSWER: all of them

**BONUS**

1. ENERGY *Multiple Choice* Which of the following statements best explains why there has been a shift away from diesel fuels with high sulfur content in favor of ultra low sulfur diesel?W) to decrease emissions of sulfur containing compounds and particulate matter

X) to increase the lubricity of the fuel

Y) to increase the cetane number of the fuel

Z) to decrease the flammability of the fuelANSWER: W) to decrease emissions of sulfur containing compounds and particulate matter

**TOSS UP**

1. BIOLOGY *Multiple Choice* A scientist studying the oxygen concentration in seal chambers containing plant cells finds that when the chambers are illuminated, the concentration of oxygen increases. However, when the chambers are kept dark, the concentration of oxygen decreases. Why does the oxygen decrease when the chamber is darkened?  
   W) plant cell mitochondria consume oxygen by aerobic respiration

X) plant cell chloroplasts run the photosynthetic pathway backward to consume oxygen

Y) plant cell chloroplasts switch their structure and function and become mitochondria

Z) there is a leak in the chamber that allows oxygen to escape  
ANSWER: W) plant cell mitochondria consume oxygen by aerobic respiration

**BONUS**

1. BIOLOGY *Multiple Choice* Which of the following immune system cells is most severely depleted by HIV/AIDS? W) plasma B cells

X) helper T cells

Y) cytotoxic T cells

Z) memory T cellsANSWER: X) helper T cells

**TOSS UP**

1. PHYSICS *Short Answer* Ramon and James stand 30 m apart on a frozen, slippery pond. Ramon has mass 70 kg, and James a mass of 90 kg. Halfway in between them is a dollar. If both men pull on a rope stretched between them to move towards the dollar, who reaches the dollar first?  
   ANSWER: Ramon

**BONUS**

1. PHYSICS *Multiple Choice* A uniform disk rotates at a constant angular velocity on an axis passing through its center, perpendicular to the disk, and has kinetic energy E. The disk is then made to rotate about another axis on the edge of the disk, also normal to the plane of the disk at the same velocity. The disk's kinetic energy is now given by W) 1/2 E

X) E

Y) 3/2 E

Z) 2EANSWER: X) E

**TOSS UP**

1. CHEMISTRY *Multiple Choice* Gibbs free energy represents  
   W) the total energy contained inside a system

X) the total energy required to initiate a reaction

Y) the maximum expansion work obtainable from a closed system

Z) the maximum nonexpansion work obtainable from a closed system  
ANSWER: Z) the maximum nonexpansion work obtainable from a closed system

**BONUS**

1. CHEMISTRY *Short Answer* What is the proper classification name of a colloidal mixture of a liquid dispersed in another liquid, suhc as in milk and mayonnaise?ANSWER: emulsion

**TOSS UP**

1. EARTH AND SPACE SCIENCE *Short Answer* The gravitational perturbations caused by what body in the solar system is mainly responsible for the disturbance of asteroids in the asteroid belt, causing them to change orbit into the inner solar system? ANSWER: JUPITER

**BONUS**

1. EARTH AND SPACE SCIENCE *Short Answer* Order the following three chondrites in order from formation closest to the sun to farthest away from the sun: ordinary chondrites, carbonaceous chondrites, enstatite chondritesANSWER: enstatite, ordinary, carbonaceous

**TOSS UP**

1. MATH *Short Answer* Differentiate the following function: e to the quantity log base six of x closed quantity, giving your answer in simplest fraction form  
     
   ANSWER: e to the log base six of x all over x times natural log of 6

**BONUS**

1. MATH *Short Answer* Let f be a function whose domain is an interval l. If f has an inverse function, g, by name or number, identify all of the following four statements that are true:1. if f is continuous on its domain, then g is also continuous on its domain

2. if f prime of c is zero, then the g prime of c is undefined

3. if f is increasing on its domain, then g must also be increasing on its domain

4. if f is continuous and differentiable on its domain, g is not necessarily continuous and differentiable on its domainANSWER: 1, 2, 3

**TOSS UP**

1. ENERGY *Multiple Choice* Which of the following statements best explains why tetraethyl lead, the "lead" component of leaded gasoline phased out in the 70s, was originally added to gasoline?W) to improve the fuel's lubricity

X) to increase the fuel's energy density

Y) to improve the fuel's octane rating

Z) to improve the efficiency of catalytic converters

ANSWER: Y) to improve the fuel's octane rating

**BONUS**

1. ENERGY *Short Answer* By name or number, identify all of the following 5 properties that are true regarding crude oil fractions with higher boiling points:1. more carbon atoms

2. easier to ignite and burn

3. more branched chain alkanes

4. less viscous

5. lighter in colorANSWER: 1, 3