**TOSS UP**

BIOLOGY *Multiple Choice* Which of the following organelles does NOT have a double membrane?

W) Mitochondrion

X) Nucleus

Y) Chloroplast

Z) Ribosome

ANSWER: Z) Ribosome

**BONUS**

BIOLOGY *Short Answer* Name all of the following three statements which are true of free ribosomes:

I) Free ribosomes are suspended in the cytosol

II) Free ribosomes are structurally identical to bound ribosomes

III) Free ribosomes are made of ribosomal RNA

ANSWER: I, II, III

**TOSS UP**

PHYSICS *Short Answer* Find in Netwons the force of tension in a 5m rope at the end of which a 5kg mass is moving in constant circular motion at an angular velocity of 120 rad/min to the nearest integer.ANSWER: 100 n

**BONUS**

PHYSICS *Short Answer* A spring with a spring constant k and an equilibrium length of 0 is attached vertically to a mass at one end and the ceiling of an elevator at the other end. The elevator is initially at rest. The mass is displaced slightly and oscillates with frequency f. Please answer the following three questions about the situation in terms of f:

I. What will the frequency be if the mass is displaced when the elevator is accelerating upwards at a constant acceleration?

II. What will the frequency be if the mass is replaced by a mass of half the mass?

III. What will the frequency be if the spring is cut in half and replaced in the situation?

ANSWER: f; sqrt{2}\*F, sqrt{2}\*F

**TOSS UP**

CHEMISTRY *Multiple Choice* The reaction 3 C+4 H2 --> C3H8 is best considered an example of which of the following general types of reactions:

W. Single Replacement

X. Double Replacement

Y. Combination

Z. Decomposition

ANSWER: Y. Combination

**BONUS**

CHEMISTRY *Short Answer* Calculation the enthalpy of reaction in kJ/mol of the following reaction: CaCO3 (s)+2 HCl (aq) yields CaCl2(aq)+H2O(l)+CO2(g) given that the enthalpies of formation of solid CaCO3, aqueous HCl, aqueous CaCl2, liquid H2O and gaseous CO2 are -1206.9, -92.31, -877.1, -285.83 and -393.51 kJ/mol respectively. Give your answer to the nearest integer.ANSWER: 237 kJ/mol

**TOSS UP**

EARTH AND SPACE SCIENCE *Multiple Choice* In a ten thousand square feet detector on the earth, about how many neutrinos will be detected on average every three days?W) 10

X) 3

Y) 1

Z) 1/3

ANSWER: Y

**BONUS**

EARTH AND SPACE SCIENCE *Short Answer* Give by name or number all of the following four that is or are true about the proton-proton chain:

I) Positrons created in the proton-proton chain are annihilated shortly after they are created.

II) The proton-proton chain generates energy on the magnitude of ten to the negative fourth Joules per reaction.

III) The proton-proton chain has an efficiency of about 5 times that of the human body in energy per mass.

ANSWER: I, II only

**TOSS UP**

MATH *Short Answer* Find the product of the two complex numbers (6+8i) and (8+6i) expressed in polar form.  
  
ANSWER: 100 cis(pi/2)=100e^{pi/2}

**BONUS**

MATH *Short Answer* At t=0, a man walks north from his home 1m in 1s. He then turns 45 degrees counterclockwise and walks ½ m in ½ s. He then turns 45 degrees counterclockwise and walks ¼ m in ¼ s. At t=2, what distance will the man be from his home in meters? This sentence is to provide time for computation.

ANSWER: 4/7\*sqrt{2}+2/7

**TOSS UP**

ENERGY *Short Answer* Identify all of the following four types of energy as either kinetic or potential:

I. Gravitational Energy

II. Thermal Energy

III. Chemical Energy

IV. Radiant EnergyANSWER: Potential; Kinetic; Potential; Kinetic

**BONUS**

ENERGY *Short Answer* Order by name or number the following four choices in order of increasing amount of energy:

1. The rest energy of a glass of water
2. The kinetic energy of a 5.00 kg ball travelling at 0.8c.
3. The energy required to ionize ten thousand mols of He
4. ANSWER: Click here to enter text.

**TOSS UP**

BIOLOGY *Short Answer* Click here to enter text.  
  
ANSWER: Click here to enter text.

**BONUS**

BIOLOGY *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**TOSS UP**

1. PHYSICS *Short Answer* Name all of the following four quantities that are invariant for an object to all reference frames:I. Mass

II. Energy

III. Angular Momentum

IV. Charge

ANSWER: I and IV (DO Not Accept IV Only)

**BONUS**

1. PHYSICS *Short Answer* Given that a point mass has a velocity of 0.8c and a mass of 1 kg, find its total mechanical energy in terms of c, the speed of light.ANSWER: 5/3 kg\*c^2

**TOSS UP**

CHEMISTRY *Short Answer* Click here to enter text.  
  
ANSWER: Click here to enter text.

**BONUS**

CHEMISTRY *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**TOSS UP**

EARTH AND SPACE SCIENCE *Short Answer* Click here to enter text. *\*ANSWER: Click here to enter text.

**BONUS**

EARTH AND SPACE SCIENCE *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**TOSS UP**

MATH *Short Answer* Find the product of the solutions to 6x^5+12x^4+8x^3+9x^2+11x+14  
  
ANSWER: -7/3

**BONUS**

MATH *Short Answer* Find all roots of the cubic equation x^3+2x^2+1=0.ANSWER: x=-1, x=-1/2±sqrt{5}/2

**TOSS UP**

ENERGY *Multiple Choice* Which is closest to the efficiency of the human body?

W) 40%

X) 20%

Y) 15%

Z) 10%ANSWER: Y) 15%

**BONUS**

ENERGY *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**TOSS UP**

BIOLOGY *Short Answer* What is the term for a structure that evolves in one context but is co-opted for another function?  
  
ANSWER: Exaptation

**BONUS**

BIOLOGY *Short Answer* In an exaptation, as cynodonts gave rise to early mammals, bones that formerly comprised the jaw hinge were incorporated into what region of mammals?ANSWER: Ear region

**TOSS UP**

PHYSICS *Short Answer* Find the energy in Joules that is stored in a cylindrical capacitor with capacitance 100 microfarads if the potential difference between the two cylinders is 500 VANSWER: 25 J

**BONUS**

PHYSICS *Short Answer* Name all of the following that is or are true of general capacitors:

I) If a dielectric with dielectric constant K is inserted between the plates of a capacitor, the capacitance will increase by a factor of K.

II) When the charge on a capacitor is increased, the capacitance is increased.

III) If the area of a parallel plate capacitor is increased by a factor of 4, the capacitance increases by a factor of 2.ANSWER: I only

**TOSS UP**

CHEMISTRY *Short Answer* Click here to enter text.  
  
ANSWER: Click here to enter text.

**BONUS**

CHEMISTRY *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**TOSS UP**

EARTH AND SPACE SCIENCE *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**BONUS**

EARTH AND SPACE SCIENCE *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**TOSS UP**

MATH *Multiple Choice* Given that P(x) is a third degree polynomial with real coefficients and Q(x) is a third degree polynomial with all coefficients equal to the average of the nonzero coefficients of P(x), at which x-values must P(x)=Q(x)?   
W) x=-1

X) x=0

Y) x=1

Z) x=2

ANSWER: Y

**BONUS**

MATH *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**TOSS UP**

ENERGY *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**BONUS**

ENERGY *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**TOSS UP**

BIOLOGY *Short Answer* What is the type of selection that favors traits associated with iteroparity and occurs in a logistic growth model when a population is near its carrying capacity that favors competitive ability and efficient use of resources which is the opposite of r-selection whose name derives from the variable for carrying capacity in the logistic model?  
  
ANSWER: K-selection

**BONUS**

BIOLOGY *Short Answer* Identify each of the following situations as examples of predominantly r-selection or K-selection:I) Fast-growing weeds quickly colonize a field abandoned by a farmer.

II) Mature trees grow in an old-growth forest.

III) Elephants grow at a near exponential rate unchecked by predators in a national park.

ANSWER: I) r, ii) K, III) r

**TOSS UP**

PHYSICS *Short Answer* If a 2000 N car is travelling at a constant velocity to the right at a speed of 20m/s and the coefficient of friction between the car’s tires and the road is 0.5, find the net force on the car, approximating g, the acceleration due to gravity, to one significant figure.ANSWER: 0N

**BONUS**

PHYSICS *Short Answer* Order the following four choices in order from which will reach the bottom of a frictionless ramp from least time to most time. Note if multiple choices reach the bottom at the same time, any of the orders will be accepted.

I) Solid sphere of constant density rho

II) Hollow sphere of constant density rho

III) Solid sphere of constant density 2rho

IV) Hollow sphere of density 2rho

ANSWER: I, III, II, IV (Accept any switching of I and III Or II and IV)

**TOSS UP**

CHEMISTRY *Short Answer* Click here to enter text.  
  
ANSWER: Click here to enter text.

**BONUS**

CHEMISTRY *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**TOSS UP**

EARTH AND SPACE SCIENCE *Short Answer* What is the lower edge of the main sequence band, where a star settles when it beings its stable life fusing hydrogen? ANSWER: Zero-Age Main Sequence

**BONUS**

EARTH AND SPACE SCIENCE *Short Answer* Given that the life expectancy of a star with mass M is 8 solar lifetimes, estimate the life expectancy of a star with mass 4MANSWER: 0.25 solar lifetimes

**TOSS UP**

MATH *Short Answer* Find the integral from -2 to 2 of 16x^3+8x^3+4x^2+2sin x+1 dx  
  
ANSWER: 140/3

**BONUS**

MATH *Short Answer* Find the integral from 0 to infinity of x^4\*e^{-x} dxANSWER: 24

**TOSS UP**

ENERGY *Short Answer* Click here to enter text.ANSWER: Click here to enter text.

**BONUS**

ENERGY *Short Answer* Click here to enter text.ANSWER: Click here to enter text.