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Science Bowl Team Round (24 Questions)   
  
Toss-up   
  
1) BIOLOGY Short Answer: From the time one acetyl CoA enters the Krebs cycle to the time oxaloacetate is regenerated, molecules of NADH, FADH2, CO2, and ATP are produced. By name of number, denote all of the following four statements that correctly matches these molecules with the number produced.

1) 1 FADH2  
 2) 2 ATP  
 3) 3 NADH  
 4) 4 CO2  
  
ANSWER: 1 and 3  
  
BONUS   
  
BIOLOGY Short Answer: Assume that FADH2 is the shuttle used to transport the NADH molecules of glycolysis, and that the cell is otherwise maximizing its proton-motive force with ATP at a delta G of -7. 3 kcal/mol. How many molecules of ATP are produced? Where in the body is the FADH2 shuttle used exclusively?   
  
ANSWER: 36, brain  
  
Toss-up  
  
2) Math Short Answer: What is the limit as x approaches one of the quantity x cubed - 1 close quantity divided by x-1?   
  
ANSWER: 3

BONUS   
  
Math Short Answer: In the interval [-2, 2], how many times is the derivative of x to the fourth minus 2x squared = to zero?  
  
ANSWER: 3  
  
Toss-up  
  
3) CHEMISTRY Short Answer: By using the words atom, linear, and nonlinear, match the following heat capacities at constant volume and temperature for ideal gases.

1) 3R  
2) 3/2 R  
3) 5/2 R

ANSWER: nonlinear, atom, linear

BONUS  
  
CHEMISTRY Short Answer: Give the products of the reaction between nitric acid and barium hydroxide in a balanced equation containing both reactants and products. Disregard states of matter while giving the equation.

ANSWER: HNO2 + Ba(OH) 🡪 Ba(NO3)2 + 2H2O  
  
Toss-up   
  
4)  PHYSICS Multiple Choice: Which of the following statements is true?

W) In an isovolumetric process the change in internal energy is equal to the negative of the thermal energy transferred to the system. (u=q)  
X) In an isothermal process, work is equal to the positive of the energy transferred to the system by heat. (w= -q)  
Y) In an isobaric process heat is equal to internal energy plus work. (u - w= q)  
Z) In an adiabatic process, change in internal energy is equal to work.    
  
ANSWER: Z  
  
BONUS  
  
PHYSICS Short Answer: A system of monatomic ideal gas at 2.0 x 10 to the fifth Pascals and an initial temperature of 293 K slowly expands at constant pressure from a volume of 1.0 to 2.5 L. How much work in Joules is done on the environment? Give your answer with two significant digits.

ANSWER: 3.00 x 10 the second Joules  
  
Toss-up  
  
5) EARTH/ ASTRO Short Answer: Some minerals such as quartz beak into smooth, curved surfaces resembling broken glass. What are such breaks called?   
  
ANSWER: conchoidal fracture  
  
BONUS  
  
EARTH/ ASTRO Multiple Choice: Which of the following statements is false about minerals?  
  
W) Metallic minerals generally have dense, dark streak while nonmetallic luster minerals have light colored streaks.  
X) While most minerals have only one common habit, a few such as pyrite have two or more characteristic crystal shapes.   
Y) Micas are elastic while gypsum and talc are sectile.   
Z) Muscovite’s shape is elongated with a rectangular cross section.   
  
ANSWER: Z

Toss-up   
  
6) ENERGY Short Answer: What is the source of most biodiesel today?  
  
ANSWER: soybean oil  
  
BONUS   
  
ENERGY Multiple Choice: Which of the following statements about biodiesel is true?

W) Biodiesel can be used in diesel fuel vehicles without changes to its engine.  
X) Biodiesel in B100 reduces sulfure oxide emissions by as much as 50%.  
Y) Biodiesel increases carbon monoxide in the air but reduces the amount of carbon dioxide.  
Z) Biodiesel can reduce the friction of diesel fuel at blends of 20% or more.  
  
ANSWER: W  
  
Toss-up   
  
7) BIOLOGY Short Answer: For the synthesis of one G3P molecule in the Calvin cycle, how many ATP are required?

ANSWER: 9  
  
BONUS  
  
BIOLOGY Multiple Choice: Which of the following is a C3 plant?  
W) soybean  
X) pineapple  
Y) Sugarcane   
Z) Corn  
ANSWER: W

TOSS-UP  
  
8) MATH Short Answer: What is the derivative of the square root of the quantity x squared + 1?

ANSWER: x/ (square root of x squared + 1)

BONUS  
  
Math Short Answer: Use differentials to approximate squre root of 16.5.   
  
ANSWER: 4 + 1/16  
  
TOSS-UP  
  
9) CHEMISTRY Short Answer: By name/ number indicate which of the following 3 is/ are true.

1) Nitrogen cannot be used directly by plants because nitrogen triple bonded to nitrogen has a strength of 944 KJmole-1.  
2) Nitrogen ocurrs with fraction oxidation numbers.  
3) Oxidation numbers of nitrogen range from -3 to +5.

ANSWER: all

BONUS   
  
CHEMISTRY Short Answer: State the oxidation number of nitrogen in each of the following four examples.

1) N2O5  
2) N2O4  
3) N20  
4) NO  
  
ANSWER: 1) 5 2) 4 3) 1 4) 2  
  
TOSS-UP  
  
10) PHYSICS  Short Answer: The half-life of an isotope is 10 days. How long will it take until only 1/16 of the isotope is left?

ANSWER: 30 days  
  
BONUS  
  
PHYSICS Short Answer: A living room has floor dimensions of 3.5 meters by 4.2 meters and

a height of 2.4 meters. Given air density of 1.2 kilograms per cubic meter, g of 10 meters per

second squared, and providing your answer to the nearest ten, what does the air in the room

weigh in newtons?  
  
ANSWER: 420  
  
TOSS-UP   
  
11) EARTH/ ASTRO Short Answer: By name of number indicate which of the four following factors control infiltration capacity.   
1) Intensity of rainfall  
2) Prior wetted condition of the soil  
3) Soil texture  
4) Nature of the vegetation cover  
  
ANSWER: all  
  
BONUS   
  
EARTH/ ASTRO Short Answer: A river’s chanel width is 100 kilometers, the channel depth is 10 kilometers, and the velocity is 5 kilometers per second. What is the discharge in meters cubed per second?   
  
ANSWER: 5,000,000 (5 million)

TOSS-UP

12) ENERGY Multiple Choice: What percent of America’s biomass comes from wood and wood waste?   
W) 20%  
X) 30%  
Y) 40%  
Z) 50%  
  
ANSWER: Z  
  
BONUS   
  
ENERGY Multiple Choice: What percent of subbituminous coal may be carbon?

W) 34  
X) 45  
Y) 56  
Z) 67  
  
ANSWER: X

13) BIOLOGY Short Answer: By name of number choose all of the following three statements true about mitosis.   
1) The mitotic phase is less than 1/24 of the cell cycle.  
2) Actin is involved when human chromatids are cleaved.  
3) Each kinetochore molecule in humans is correctly paired with each chromosome before the cell will proceed to metaphase,  
  
ANSWER: 1  
  
BONUS   
  
BIOLOGY Short Answer: If a plant with heterozygous for three traits is crossed with a plant homozygous for just two traits, what is the probability that at least two traits of the offspring are heterozygous?  
  
ANSWER: 3/8  
  
14) Math Short Answer: What is the indefinite integral of 1/3csx x cotx + csc squared + sinx?  
ANSWER: -cscx -cotx - cosx + c  
  
BONUS   
  
Math Short Answer: What is the volume of the solid formed by revolving the region bound by root of sin x and the x-axis (0 to pi) about the x-axis.   
  
ANSWER: 2pi  
  
Toss-up  
  
15) CHEMISTRY Short Answer: What term describes the ease with which electron clouds can be distorted, determining the strength of London interaction?

ANSWER: polarizability

BONUS

CHEMISTRY Multiple Choice: Which of the following statements is true about potential energy involved with various intermolecular forces?

W) It is inversely proportional to the sixth power of the separation in dipole-dipole forces.  
X) it is inversely proportional to the sixth power of the separation ion-dipole forces of a solid.  
Y) It is inversely proportional to the sixth power of the separation in dipole-dipole forces of a gas.  
Z) It is inversely proportional to the sixth power of the separation in London interactions.  
  
ANSWER: Z  
  
Toss-up   
  
16)  PHYSICS SA: Using name or number rank the following 3 steps of the Carnot cycle from occurring first to occurring last after isothermal expansion has occurred.   
1) Adiabatic expansion  
2) Adiabatic compression  
3) Isothermal compression  
  
ANSWER:1, 3, 2  
  
BONUS  
  
PHYSICS Short Answer: What quarks comprise a proton and neutron resepectively?  
ANSWER: uud and udd  
  
Toss-up  
  
17) EARTH/ ASTRO Short Answer: A cool star with a temperature 3000 K will emit most intensely at wavelength of what?  
  
ANSWER: 1000 nm  
  
BONUS  
  
EARTH/ ASTRO Multiple Choice: Which spectral class contains medium balmer lines and weak lines of calcium?   
  
W) M  
X) O  
Y) F  
Z) B  
  
ANSWER: Y

Toss-up   
  
18) ENERGY Short Answer: Which state has the most coal in reserves and is the 5th most coal producing state?  
  
ANSWER: Montana   
  
BONUS   
  
ENERGY Short Answer: What is the name of the almost pure carbon residue of coal used in smelting metal fuel?  
  
ANSWER: coke  
  
Toss-up   
  
19) BIOLOGY Short Answer: What is the term that describes a gene that modifies another gene at another locus?  
ANSWER: pleitotrophy

BONUS  
  
BIOLOGY Short Answer: By name/ number indicate which of the four are inherited with recessive alleles in the autosomes.

1) Huntington  
2) Sickle-cell disease  
3) Haemophilia  
4) Cystic fibrosome  
  
ANSWER: 2 and 4

TOSS-UP  
  
20) MATH Short Answer: Find the summation of i cubed from i=1 to n=10. Give your answer as a reduced fraction.

ANSWER: 12100/4 = 3025

BONUS  
  
Math Short Answer: Find the relative extremum or extrema of ln(x squared + 2x+ 3).  
  
ANSWER: (-1, ln2)  
  
TOSS-UP  
  
21) CHEMISTRY Short Answer: By name or number rank the following four substances from highest boiling point to lowest.   
1) Helium  
2) pentane  
3) 2, 2- dimethylpropane  
4) Hexene   
  
ANSWER: 4, 3, 2, 1  
  
BONUS   
  
CHEMISTRY Mult Choice: Which of the following statements is true?   
W) Hydrogen bonding is strongest when the hydrogen atom is on a straight line between the two oxygen atoms.  
X) The hydrogen bond between oxygen and hydrogen in water is 175 pm long.  
Y) The hydrogen bond between hydrogen of one water molecule and an oxygen of another is 101 pm long.  
Z) A hydrogen bonding is not strong enough to survive in the vapor of hydrogen fluoride.   
  
ANSWER: W  
  
TOSS-UP  
  
22) PHYSICS  Short Answer: During one cycle, an engine takes 5 x 10 to the second Joules of energy from a hot reservoir and transfers 4 x 10 to the second Joules to a cold reservoir. What is the efficiency of this engine?

ANSWER: 20%  
  
BONUS  
  
PHYSICS Short Answer: By name or number indicate which of the 4 statements are true.   
1) The up quark and the neutrino both have spin of 1/2.  
2) W and Z particles both have spin of 1.   
3) The graviton has spin of 2.   
4) The Higgs boson have spin of 1.   
  
ANSWER: all  
  
TOSS-UP   
  
23) EARTH/ ASTRO Multiple Choice: Which statement is false?  
  
W) Balmer lines are strongest at about spectral class A0.  
X) The sepctra of hot stars have weak Balmer lines and helium lines.  
Y) Two ultraviolet lines of ionized calcium are weak in cooler stars.  
Z) Titanium oxide bands are strong in the spectra of the coolest stars.  
  
ANSWER: Y   
  
BONUS   
  
EARTH/ ASTRO Short Answer: by name of number indicate which of the four statements is or are true.   
1) If a star is moving towards us, we perceive the peaks of the light waves slightly closer together.  
2) Light coming towards the earth experiences red shift.  
3) Light moving away from the earth experiences blue shift.   
4) In the Doppler formula, if the change in wavelength is positive, the star is receding from us.  
  
ANSWER: 1 and 4

TOSS-UP

24) ENERGY Short Answer: What is the name of the devices used in both coal producing plants and geothermal plants to remove sulfur?   
  
ANSWER: scrubber  
  
BONUS   
  
ENERGY Short Answer: 50 grams of water rise from 289 to 374 Kelvin. How much energy in Joules was needed to make this change? Give two significant digits.  
  
ANSWER: 17