2026 Collierville Ultimate Tournament - Double Elimination 2

TOSSUP

1) Biology – *Multiple Choice* In a positive feedback loop during the birthing process, which of the following hormones continuously increases the stimulus to promote uterine contractions?

W) Serotonin
X) Dopamine
Y) Prolactin
Z) Oxytocin

ANSWER: Z) Oxytocin [RK]

BONUS

1) Biology – *Short Answer* Order the following 3 steps of PCR in terms of increasing temperature:

1) Annealing
2) Denaturation
3) Extension

ANSWER: 132 [RK]

TOSSUP

2) Chemistry – *Short Answer* What effect is given to the scattering of light as it passes through a colloidal dispersion?

ANSWER: tyndall effect [SY]

BONUS

2) Chemistry – *Short Answer* Identify all of the following 3 parameters that are accounted for by the Van der Waals equation:

1) intermolecular forces
2) gas volume
3) molecular geometry

ANSWER: 1 and 2 [SY]

TOSSUP

3) Physics – *Short Answer* A rigid object with mass of 3 kilograms has a moment of inertia of 2 kilogram-meter squared about an axis through its center of mass. In kilogram-meter squared, what is the moment of inertia of the object about a parallel axis that is 2 meters away from the center of mass-axis?

ANSWER: 14 [SA]

BONUS

3) Physics – *Multiple Choice* Which of the following describes the hamiltonian operator in quantum mechanics?

W) kinetic energy of a system
X) potential energy of a system
Y) sum of kinetic and potential energies of a system
Z) difference between kinetic and potential energies of a system

ANSWER: Y) sum of kinetic and potential energies of a system [SA]

TOSSUP

4) Earth and Space – *Multiple Choice* Which of the following scenarios would produce an annular solar eclipse with the largest apparent ring, assuming the Moon is in its New Moon phase?

W) Sun at perihelion, Moon at perigee
X) Sun at perihelion, Moon at apogee
Y) Sun at aphelion, Moon at perigee
Z) Sun at aphelion, Moon at apogee

ANSWER: X) Sun at perihelion, Moon at apogee [SY]

BONUS

4) Earth and Space – *Short Answer* Identify all of the following 3 supernovae that could contain Lyman spectral lines:

1) type 1a
2) type 1b
3) type 2

ANSWER: 3 only [SY]

TOSSUP

5) Math – *Short Answer* Two chords intersect inside a circle. Chord AB is split into segments of length 4 and 6. Chord CD is split into segments of lengths 3 and x. What is the length of x?

ANSWER: 8 [SA]

BONUS

5) Math – *Short Answer* A function f is continuous on the closed interval [1,5] and differentiable on open interval (1,5). If f(1) = 2, and f(5) = 14, what value must f’(c) [*f prime of c*] equal for some c on the open interval (1,5)?

ANSWER: 3 [SA]

TOSSUP

6) Energy – *Short Answer* At the Smithsonian Tropical Research Institute, ecologists are studying how species interactions shape rainforest diversity. When two species compete for the same resource, what ecological principle states that they cannot coexist indefinitely?

ANSWER: competitive exclusion principle (accept: Gause's law) [RK]

BONUS

6) Energy – *Multiple Choice* Researchers at the University of Sydney are studying thermodynamic cycles. For a process at constant volume, heat flow equals the change in which of the following thermodynamic quantities?

W) Enthalpy
X) Gibbs free energy
Y) Entropy
Z) Internal energy

ANSWER: Z) Internal energy [RK]

TOSSUP

7) Biology – *Short Answer* Viruses such as HIV are able to synthesize and incorporate viral DNA into the host cell's genome due to the existence of what enzyme that synthesizes DNA from an RNA template?

ANSWER: Reverse transcriptase [RK]

BONUS

7) Biology – *Multiple Choice* An evil company dumped multiple pollutants into a chaparral environment. Which of the following species would most likely be at risk of extinction due to biomagnification of PCBs?

W) Roadrunner
X) Gopher snake
Y) Bobcat
Z) Coyote

ANSWER: Z) Coyote [RK]

TOSSUP

8) Chemistry – *Short Answer* Identify all of the following 3 elements that commonly violate the octet rule:

1) boron
2) fluorine
3) sulfur

ANSWER: 1 and 3 [SY]

BONUS

8) Chemistry – *Short Answer* According to Huckel's rule, identify all of the following 3 numbers of pi electrons in a conjugated planar cyclic system that would make it aromatic:

1) 10
2) 11
3) 12

ANSWER: 1 only [SY]

TOSSUP

9) Physics – *Short Answer* A plane wave is seen as the sum of infinite spherical wavelets. This is an application of what principle, which states that every point on a wavefront acts as a source of secondary wavelets?

ANSWER: Huygen's principle [SA]

BONUS

9) Physics – *Short Answer* A resistor has a resistance of 5 ohms and carries an alternating current with an amplitude of 4 amperes. In volts, what is the instantaneous voltage across the resistor at a time when cos(omega t) equals 1/2?

ANSWER: 10 [SA]

TOSSUP

10) Earth and Space – *Multiple Choice* Which of the following minerals is least likely to show a significant change in concentration below the lysocline?

W) calcite
X) dolomite
Y) gypsum
Z) aragonite

ANSWER: Y) gypsum [SY]

BONUS

10) Earth and Space – *Short Answer* Order the following 4 minerals in increasing resistance to weathering:

1) olivine
2) biotite
3) quartz
4) muscovite

ANSWER: 1243 [SY]

TOSSUP

11) Math – *Short Answer* The average value of a function f on the closed interval [0,4] is 5. What is the area under the curve of the function f from 0 to 4?

ANSWER: 20 [SA]

BONUS

11) Math – Short Answer A fair coin is flipped 6 times. What is the probability of getting exactly 4 heads?

ANSWER: 15/64 [SA]

TOSSUP

12) Energy – *Short Answer* Scientists at Oak Ridge National Lab are performing calculations to calculate groundwater discharge. What law in hydrology states that groundwater discharge depends on the hydraulic gradient, hydraulic conductivity, and cross-sectional area of an aquifer?

ANSWER: Darcy's law [SY]

BONUS

12) Energy – *Short Answer* Oak Ridge National Lab scientists have developed a line of best fit and found that the R-squared value was 0.67. Identify all of the following 3 statements that MUST be true:

1) the correlation coefficient is positive
2) the r-squared value is higher than the correlation coefficient
3) 67% of the variance is explained by the variables in the line of best fit

ANSWER: 3 only [SY]

TOSSUP

13) Biology – *Short Answer* When an elk moves up into the mountains from sea level, the lower oxygen concentration in the high mountain air stimulates the elk to breathe more rapidly and deeply. This is an example of what general process that describes an animal's physiological adjustment to changes in the external environment?

ANSWER: Acclimatization [RK]

BONUS

13) Biology – *Short Answer* Produced by trees that inhabit tidal swamps, what specialized type of roots project above the water surface to obtain oxygen for the root system?

ANSWER: Pneumatophores [RK]

TOSSUP

14) Chemistry – *Multiple Choice* If an exothermic reaction has positive change in entropy, which of the following statements must be true about the spontaneity of the reaction?

W) the reaction is spontaneous only at high temperatures
X) the reaction is spontaneous only at low temperatures
Y) the reaction is spontaneous at all temperatures
Z) the reaction is nonspontaneous at all temperatures

ANSWER: Y) the reaction is spontaneous at all temperatures [SY]

BONUS

14) Chemistry – *Short Answer* Identify all of the following 3 statements that MUST be true about a compound with a negative slope of the solid-liquid phase transition line:

1) more pressure is needed for the substance to be in this equilibrium state at higher temperatures
2) the liquid phase is denser than the solid phase
3) the compound has a high specific heat

ANSWER: 2 only [SY]

TOSSUP

15) Physics – *Multiple Choice* Kirchhoff's loop rule is based on the conservation of which of the following quantities?

W) energy
X) charge
Y) momentum
Z) mass

ANSWER: W) energy [SA]

BONUS

15) Physics – *Short Answer* A block of mass m is launched horizontally at a velocity of 5 meters per second from the top of a tower that is 30 meters tall. Rounded to the nearest tenth, what is the time, in seconds, that it will take for the block to reach the ground?

ANSWER: 2.5 [SB]

TOSSUP

16) Earth and Space – *Multiple Choice* Melted snow would most likely cause which of the following volcanic hazards?

W) pyroclastic flow
X) pyroclastic surge
Y) flood basalts
Z) lahar

ANSWER: Z) lahar [SY]

BONUS

16) Earth and Space – *Short Answer* Identify all of the following 3 solar system bodies that have coronae as its feature:

1) Sun
2) Mercury
3) Venus

ANSWER: 1 and 3 [SY]

TOSSUP

17) Math – *Multiple Choice* Which of the following functions does NOT have an inverse function that is defined for all real numbers?

W) $f(x) = x^3$
X) $f(x) = 2x + 1$
Y) $f(x) = x^2$
Z) $f(x) = x - 5$

ANSWER: Y) $f(x) = x^2$ [SA]

BONUS

17) Math – *Short Answer* A random variable Z follows a standardized normal distribution. Identify all of the following 3 statements that are always true.

1) The mean of Z equals 0
2) The standard deviation of Z is 1
3) The distribution is symmetric about 0

ANSWER: All [SA]

TOSSUP

18) Energy – *Short Answer* Researchers at Oak Ridge National Lab are studying the Big Bang nucleosynthesis. Within a few minutes after the Big Bang, what state of matter condensed into protons and neutrons?

ANSWER: quark-gluon plasma (DO NOT ACCEPT: plasma) [SY]

BONUS

18) Energy – *Multiple Choice* Scientists at Oak Ridge National Lab are studying cysteine. Cysteine has a unique ability to form disulfide bonds due to the presence of which of the following functional groups?

W) aldehyde
X) ketone
Y) thiol
Z) thioether

ANSWER: Y) thiol [SY]

TOSSUP

19) Biology – *Short Answer* Identify all of the following 3 vitamins that are fat soluble:

1) B
2) E
3) K

ANSWER: 2 AND 3 [RK]

BONUS

19) Biology – *Short Answer* What method of reproduction, common in rotifers and water fleas, involves an egg developing without fertilization?

ANSWER: parthenogenesis [RK]

TOSSUP

20) Chemistry – *Short Answer* Identify all of the following 3 changes that would change the equilibrium constant K:

1) changing temperature
2) adding reactants
3) adding catalyst

ANSWER: 1 only [SY]

BONUS

20) Chemistry – *Short Answer* Order the following 3 species from most negative to most positive standard reduction potential:

1) Cl_2
2) Li^+
3) Zn^{2+}

ANSWER: 231 [SY]

TOSSUP

21) Physics – *Short Answer* A high-energy photon passes near a nucleus and disappears, producing an electron and a positron. What is the name of this process where energy is converted into a particle-antiparticle pair?

ANSWER: pair production [SB]

BONUS

21) Physics – *Multiple Choice* A system's center of mass accelerates as if all its mass were concentrated at a single point. Which of the following statements must be true?

W) the object is rotating
X) all parts of the object have the same acceleration
Y) the net external force is zero
Z) the net external force is nonzero

ANSWER: Z) the net external force is nonzero [SA]

TOSSUP

22) Earth and Space – *Multiple Choice* Which of the following pairs of adjectives describes the universe?

W) isotropic and heterogeneous
X) anisotropic and heterogeneous
Y) isotropic and homogeneous
Z) isotropic and heterogeneous

ANSWER: Y) isotropic and homogeneous [SY]

BONUS

22) Earth and Space – *Short Answer* Identify all of the following 3 features that are erosional:

1) baymouth bar
2) tombolo
3) spit

ANSWER: none [SY]

TOSSUP

23) Math – *Short Answer* Sumin wants to buy candied apples. The candied apples come in packs of 11 and 6. What is the maximum number of candied apples that Sumin cannot buy?

ANSWER: 49 [SA]

BONUS

23) Math – *Short Answer* How many distinct arrangements of the letters in the word LEVEL, L-E-V-E-L, are there?

ANSWER: 30 [SA]

TOSSUP

24) Energy – *Short Answer* Scientists at Oak Ridge National Lab are studying dark energy. What term added to Einstein's field equations is used to explain dark energy and the accelerating expansion of the universe?

ANSWER: cosmological constant [SY]

BONUS

24) Energy – *Short Answer* Scientists at Los Alamos National Lab are studying lanthanide contraction, a phenomenon occurring in lanthanide elements due to the poor shielding of the increasing nuclear charge by the added 4f electrons. Identify all of the following 3 elements that display lanthanide contraction:

1) cerium
2) promethium
3) europium

ANSWER: all [SY]