MOSFET Invitational
Double Elimination 1

TOSS-UP

1) BIOLOGY *Multiple Choice* What protein component of the cytoskeleton is responsible for pulling apart sister chromatids during meiosis and transporting molecules around the cell?
W) Microfilaments
X) Actin filaments
Y) Microtubules
Z) Intermediate Filaments

ANSWER: Y) MICROTUBULES [W: OW, E: EB; EDE Bio-CB]

BONUS

1) BIOLOGY *Short Answer* During DNA replication, what term describes the disjointed strands of DNA, formed by DNA polymerase during synthesis of the lagging strand?

Answer: OKAZAKI FRAGMENTS [W: OW, E: EB; EDE Bio-G]

TOSS-UP

2) CHEMISTRY *Multiple Choice* Which of the following quantum numbers corresponds most closely to the energy level of an electron?

W) Principal
X) Angular Momentum
Y) Magnetic
Z) Spin

ANSWER: W) PRINCIPAL [W: EB, E: HJ; EDE Chem-AM]

BONUS

2) CHEMISTRY *Short Answer* In joules, what is the change in internal energy of a gas if 6 kJ of heat is supplied, and the gas expands 3 cubic meters against a pressure of 1500 Pascals?

ANSWER: +1500 J [W: ND E: HJ; EDE Chem-T]

TOSS-UP

3) EARTH AND SPACE *Short Answer* Order the following three cloud types from lowest to highest in altitude:

1) Cirrus
2) Stratus
3) Altocumulus

ANSWER: 2, 3, 1 [W: HJ, E: EB; EDE ESS-AO]

BONUS

3) EARTH AND SPACE *Short Answer* What is the term given to the hypothetical phenomenon causing the universe's expansion to accelerate, despite the gravitational pull of all matter in existence?

ANSWER: Dark energy [W: SC, E: EB; EDE ESS-OA]

TOSS-UP

4) MATH *Multiple Choice* A certain conic has the equation x^2 + 4x - y^2 - 5 = 0. Which of the following types of conic sections best describes it?

W) Circle

X) Ellipse

Y) Parabola

Z) Hyperbola

ANSWER: Z) HYPERBOLA [W: JW, E: SC; EDE Math-G]

BONUS

4) MATH *Short Answer* Given that the polynomial P(x) has zeros at x = 2 and x = -3, for what values of x does the function $P(\log_2(x))$ [READ: P of log base two of x] have zeros?

ANSWER: 4 and ⅛ [W: RF, E: SC; EDE Math-A]

TOSS-UP

5) PHYSICS *Short Answer* Standing at the top of Middleton High School, Owen throws a ball horizontally off the building with an initial velocity of 5 m/s. At the same instant, Ray drops an identical ball straight downward. Assuming Middleton High School is very tall, what is the distance between the two balls, in meters, after 5 seconds?

ANSWER: 25 [W: RF, E: EB; EDE Phys-ME]

BONUS

5) PHYSICS *Short Answer* In the form of a simplified fraction, what is the Lorentz factor of an object traveling at 80% the speed of light?

ANSWER: 5/3 [W: RF; E: SC; EDE Phys-MO]

TOSS-UP

6) ENERGY *Short Answer* Researchers at UW-Madison are studying the behavior of matter at very low temperatures. Specifically, they are studying helium-4 around temperatures of 2 kelvin, which takes the form of what exotic state of matter?

ANSWER: SUPERFLUID (ACCEPT: BOSE-EINSTEIN CONDENSATE) [W: OW, E: SC; EDE]

BONUS

6) ENERGY *Short Answer* Researchers at UW-Madison are studying corn kernels and the structures they derive nutrients from during growth. What triploid structure in a corn embryo contains the majority of the corn seed's food storage?

ANSWER: ENDOSPERM [W: OW, E: EB; EDE]

TOSS-UP

7) BIOLOGY *Multiple Choice* Stephen is currently very stressed about college applications, and his sympathetic nervous system is kicking into overdrive. Which of the following physical responses would you NOT expect him to have?

W) Increased blood pressure

X) Increased blood glucose

Y) Increased diameter of bronchioles

Z) Increased saliva production

ANSWER: Z) INCREASED SALIVA PRODUCTION [W: EB, E: OW; EDE Bio-AP]

BONUS

7) BIOLOGY *Multiple Choice* Which of the following best describes the difference between apical and lateral meristems?

W) Apical meristems are found at the tips of shoots and lateral meristems are found at the tips of roots.

X) Apical meristems allow plants to grow in height and lateral meristems allow plants to grow in width

Y) Apical meristems can produce new organisms if isolated and lateral meristems can only produce parts of organisms when isolated

Z) Apical meristems can divide indefinitely and lateral meristems can only divide a finite number of times

ANSWER: X) APICAL MERISTEMS ALLOW PLANTS TO GROW IN LENGTH AND LATERAL MERISTEMS ALLOW PLANTS TO GROW IN WIDTH [W: OW, E: EB; EDE Bio-P]

TOSS-UP

8) CHEMISTRY *Multiple Choice* The rate constant of a reaction is most directly dependent on which of the following quantities?

W) Activation energy

X) Initial reactant concentration

Y) Initial product concentration

Z) External pressure

ANSWER: W) ACTIVATION ENERGY [W: HJ, E: AS, EDE Chem-EK]

BONUS

8) CHEMISTRY *Multiple Choice* In which of the following compounds does sulfur have the highest oxidation number?

W) H_2S

X) H_2SO_4

Y) FeS

Z) SO_2

ANSWER: X) H_2SO_4 [W: EB, E: HJ; EDE; Chem-Other]

TOSS-UP

9) EARTH AND SPACE *Multiple Choice* Which of the following would most likely be the dominant source of energy production in a 4 solar mass post-main sequence star?
W) Proton-proton chain
X) CNO Cycle
Y) PEP Pathway
Z) Triple Alpha Process

ANSWER: Z) Triple Alpha Process [W: RF, E: EB; EDE ESS-SA]

BONUS

9) EARTH AND SPACE *Multiple Choice* Which of the following processes would NOT be classified as a type of chemical weathering?
W) Salt wedging
X) Hydrolysis
Y) Oxidation
Z) Dissolution

ANSWER: W) SALT WEDGING [W: HJ, E: EB; EDE ESS-G]

TOSS-UP

10) MATH *Multiple Choice* What is the units digit of 3 raised to the 2024th power?
W) 1
X) 3
Y) 7
Z) 9

ANSWER: W) 1 [W: EB, E: RF; RR Math-N]

BONUS

10) MATH *Short Answer* Kartik plots 15 distinct points on a plane, no three of which are collinear. How many total line segments can he draw in between these points?

ANSWER: 105 [W: KR, E: HJ, EDE Math-C]

TOSS-UP

11) PHYSICS *Multiple Choice* Josh is developing a device that can measure the exact location of a photon at any given instant. However, as he's testing this device, he notices that the closer he gets to reaching his goal, the less he's able to measure the momentum of said photon. This observation is a direct consequence of which of the following laws?

W) Schrödinger Equation

X) Pauli Exclusion Principle

Y) Heisenberg Uncertainty Principle

Z) Selection Rules

ANSWER: Y) HEISENBERG UNCERTAINTY PRINCIPLE [W: KR, E: EB; EDE Phys-MO]

BONUS

11) PHYSICS *Short Answer* An aluminum rod with coefficient of linear thermal expansion 25 * 10^-6 is heated from 0 degrees celsius to 400 degrees celsius. Expressed in scientific notation, and assuming the initial length of the rod was 1 meter, what is the change in length of the rod, in millimeters?

ANSWER: 10 [W: RF, E: SC; EDE Phys-ET]

TOSS-UP

12) ENERGY *Multiple Choice* Researchers at UW Madison are studying the strong nuclear force and how quarks are held together in an atom. Which of the following particles is the carrier of the strong force?

W) Photon

X) W boson

Y) Z boson

Z) Gluon

ANSWER: Z) GLUON [W: OW, E: EB; EDE]

BONUS

12) ENERGY *Short Answer* Researchers at UW Madison are studying the unique properties of network covalent solids and how these properties could be used to increase thermal efficiency in wiring. Identify all of the following three molecules that form network covalent solids:

1) Fe_2O_3
2) SiO_2
3) I_2

ANSWER: 2 ONLY [W: OW, E: EB; EDE]

TOSS-UP

13) BIOLOGY *Multiple Choice* What type of enzymatic inhibition occurs when an inhibitor binds to a site on the enzyme other than the active site?

W) Competitive
X) Uncompetitive
Y) Allosteric
Z) Restrictive

ANSWER: Y) ALLOSTERIC [W: OW, E: EB; EDE Bio-Other]

BONUS

13) BIOLOGY *Short Answer* What type of cells in the nervous system provide physical and chemical support for neurons, and help create the myelin surrounding the axons of neurons?

ANSWER: GLIAL CELLS (ACCEPT: OLIGODENDROCYTES) [W: OW, E: EB; EDE Bio-AP]

TOSS-UP

14) CHEMISTRY *Short Answer* Identify all of the following three properties of an ideal gas that are directly proportional to temperature

1) Pressure
2) Volume
3) Amount of substance

ANSWER: 1 AND 2 (PRESSURE, VOLUME) [W: HJ, E: EB; EDE Chem-Other]

BONUS

14) CHEMISTRY *Short Answer* Identify all of the following three bond properties which would be higher in a carbon-carbon double bond than a carbon-carbon triple bond:

1) Bond length
2) Bond strength
3) Bond polarity

ANSWER: 1 ONLY [W: HJ, E: AS, EDE Chem-AM]

TOSS-UP

15) EARTH AND SPACE *Short Answer* Ray looks through a refracting telescope and thinks he's seeing double because different wavelengths of light are focusing at different points. What is the name for this optical effect?

ANSWER: CHROMATIC ABERRATION [W: RF, E: EB; EDE ESS-OA]

BONUS

15) EARTH AND SPACE *Short Answer* Order the following three gases from most to least prevalent in the atmosphere of Venus:

1) Nitrogen
2) Carbon dioxide
3) Sulfur dioxide

ANSWER: 2, 1, 3 [W: RF, E: SC; EDE ESS-SS]

TOSS-UP

16) MATH *Short Answer* Many Science Bowl tournaments have a double-elimination bracket with 32 teams. In such a bracket, what is the maximum number of matches that must be played to determine a winner, assuming that there are no ties?

ANSWER: 63 [W: JW, E: SC; EDE Math-C]

BONUS

16) MATH *Multiple Choice* Which of the following figures cannot be constructed with a ruler and compass?

W) Equilateral triangle
X) Square
Y) Regular hexagon
Z) Regular heptagon

ANSWER: Z) REGULAR HEPTAGON [W: JW, E: EB; EDE Math-G]

TOSS-UP

17) PHYSICS *Short Answer* An 8 volt battery is connected to two resistors wired in series, each with resistance 2 ohms. In watts, what is the power dissipated across this circuit?

ANSWER: 16 [W: RF, E: SC; EDE Phys-ET]

BONUS

17) PHYSICS *Multiple Choice* An object experiences quadratic drag with magnitude Fd = 0.5 * v^2. If the object has mass 100kg, what is its terminal velocity in meters per second?

W) 0.7

X) 70

Y) 140

Z) 1400

ANSWER: Y) 140 [W: JW; E: SC; EDE Phys-ME]

TOSS-UP

18) ENERGY *Multiple Choice* Researchers at Penn State University are studying the effects of external radiation exposure on astronauts' bone health and skeletal integrity. Which of the following nuclear decay pathways produces the radiation they are most concerned about?

W) Alpha
X) Beta plus
Y) Beta minus
Z) Gamma

ANSWER: Z) GAMMA [W: EB, E: HJ; EDE]

BONUS

18) ENERGY *Short Answer* Researchers at UW-Madison are studying the ABO blood group and blood transfusions. If a female of blood type A mates with a male of blood type B, identify all of the following three blood types their child could have:

1) A
2) B
3) O

ANSWER: ALL [W: OW, E: EB; EDE]

TOSS-UP

19) BIOLOGY *Multiple Choice* What type of species, which is usually not abundant in an ecosystem, exerts strong control on an ecosystem's structure due to its pivotal ecological role?

W) Dominant Species
X) Restraining Species
Y) Keystone Species
Z) Basal Species

ANSWER: Y) KEYSTONE SPECIES [W: OW, E: EB; EDE Bio-EEB]

BONUS

19) BIOLOGY *Short Answer* Identify all of the following three proteins that are transmembrane proteins:

1) Aquaporins
2) G protein coupled receptors
3) Sodium-potassium pumps

ANSWER: ALL [W: OW, E: EB; EDE Bio-CB]

TOSS-UP

20) CHEMISTRY *Short Answer* Identify all of the following three types of chemical species which would be soluble in ethanol, but not in benzene:

1) Ions
2) Nonpolar molecules
3) Polar molecules

ANSWER: 1 AND 3 [W: HJ, E: AS, EDE Chem-R]

BONUS

20) CHEMISTRY *Short Answer* Order the following three elements in terms of increasing reduction potential:

1) Lithium
2) Fluorine
3) Sodium

ANSWER: 1, 3, 2 [W: HJ, E: AS; EDE Chem-Other]

TOSS-UP

21) EARTH AND SPACE *Multiple Choice* Which of the following geologic periods occurred directly after the largest mass extinction in Earth's history?

W) Cretaceous
X) Permian
Y) Tertiary
Z) Triassic

ANSWER: Z) TRIASSIC [W: EB; E: HJ; EDE ESS-G]

BONUS

21) EARTH AND SPACE *Multiple Choice* Which of the following mineral properties analyzes the color of a mineral after it has been crushed into a powder?

W) Diaphaneity
X) Streak
Y) Luster
Z) Tenacity

ANSWER: X) STREAK [W: HJ, E: EB; EDE ESS-RM]

TOSS-UP

22) MATH *Short Answer* How many distinct real roots does the quadratic $9x^2 - 4x + 2$ have?

ANSWER: 0 [W: EB, E: SC; EDE Math-A]

BONUS

22) MATH *Short Answer* How many ways are there to select a committee of 5 people, 2 men and 3 women, from a body of applicants of 6 men and 4 women?

ANSWER: 60 [W: KR E: EB; EDE Math-C]

TOSS-UP

23) PHYSICS *Multiple Choice* In degrees, which of the following is the critical angle from the normal at which a light ray transitioning between materials of n=2 and n=sqrt(3) will experience total internal reflection?

W) 15

X) 30

Y) 45

Z) 60

ANSWER: Z) 60 [W: JW; E: SC; EDE Phys-ME]

BONUS

23) PHYSICS *Short Answer* An infinite line of resistors is wired in parallel, such that the first resistor has resistance 1 ohm, the second resistor has resistance 3 ohms, the third resistor has resistance 9 ohms, and so on. What is the equivalent resistance of this arrangement, in ohms?

ANSWER: 2/3 OHMS [W: RF, E: EB; EDE Phys-ET]