



MOSFET Invitational Finals 2

TOSS-UP

1) BIOLOGY *Short Answer* What term describes the plant response to growing in dark conditions, involving the growth of long, weak stems, reduced leaves, and a yellow color?

ANSWER: ETIOLATION [W: OW, E: EB; Finals Bio-P]

BONUS

1) BIOLOGY *Short Answer* Identify all of the following three statements that are true regarding enhancers in DNA:

- 1) Enhancers can be found thousands of base pairs away from a gene,
- 2) Enhancers may be found within introns
- 3) Each gene may have multiple enhancers

ANSWER: ALL [W: OW, E: EB; Finals Bio-G]

TOSS-UP

2) CHEMISTRY *Short Answer* Identify all of the following 4 hybridization states which an atom with four total sigma and pi bonds could be in:

- 1) sp
- 2) sp²
- 3) sp³
- 4) sp³d

ANSWER: ALL [W: AS, E: HJ; Finals Chem-AM]

BONUS

2) CHEMISTRY *Short Answer* Identify all of the following three compounds which have multiple resonance structures: 1) N₂O; 2) NO₂; 3) N₂O₄

ANSWER: ALL [W: HJ, E: AS; Finals Chem-Other]

TOSS-UP

3) EARTH AND SPACE *Multiple Choice* The ratio between oxygen-16 and which of the following other oxygen isotopes is commonly used as a paleoclimate indicator?

- W) Oxygen-14
- X) Oxygen-15
- Y) Oxygen-17
- Z) Oxygen-18

ANSWER: Z) OXYGEN-18 [W: HJ, E: EB; Finals ESS-AO]

BONUS

3) EARTH AND SPACE *Short Answer* What term describes an asymmetric spiral galaxy that only has one arm?

ANSWER: MAGELLANIC SPIRAL [W: SC, E: EB; Finals ESS-SA]

TOSS-UP

4) MATH *Short Answer* How many numbers n , not including 1, exist such that 400 is congruent to 1 modulo n ?

ANSWER: 7 [W: SC, E: EB; LDE Math-NT]

BONUS

4) MATH *Short Answer* Intersecting chords AB and CD meet at point M. Given that $AM = 12$, $BM = 16$, and segment CM is three times the length of DM, what is the length of chord CD?

ANSWER: 32 [W: RF; E: HJ, Finals Math-G]

TOSS-UP

5) PHYSICS *Short Answer* What equation, derived from the conservation of energy, relates fluid flow rates, pressures, and gravitational potential energy?

ANSWER: BERNOULLI'S PRINCIPLE [W: KR, E: SC; Finals Phys-ME]

BONUS

5) PHYSICS *Multiple Choice* A ball is released over an inclined plane, and begins to bounce elastically down the slope. Which of the following is true about the ensuing process?

W) Time between bounces gets shorter

X) Time between bounces gets longer

Y) Time between bounces decreases, approaching a fixed constant

Z) Time between bounces stays constant

ANSWER: Z) TIME BETWEEN BOUNCES STAYS CONSTANT [W: RF; E: SC; Finals Phys-ME]

TOSS-UP

6) ENERGY *Short Answer* Researchers at UC Santa Barbara are studying a sedimentary structure known as the Great Unconformity. What specific type of unconformity is found where a sedimentary layer is located directly above an igneous layer?

ANSWER: NONCONFORMITY [W: EB, E: HJ; Finals]

BONUS

6) ENERGY *Short Answer* Researchers at UW Madison are studying supersymmetric string theories, specifically M theory. One drawback to this theory is that it can only explain quantum gravity in a universe with 11 spatial dimensions. Researchers have attempted to explain this apparent discrepancy with our universe by conjecturing that the extra dimensions are curled up in our universe, in what theoretical structures?

ANSWER: Branes (ACCEPT: CALABI-YAU MEMBRANES) [W: RF, E: SC; Finals]

TOSS-UP

7) BIOLOGY *Short Answer* Identify all of the following 3 statements that are true of primary succession:

- 1) The surface is almost entirely bare rock at the beginning of primary succession
- 2) Mosses and lichen are the most common pioneer species
- 3) Primary succession could occur after a glacier retreats.

ANSWER: All [W: OW, E: EB; Finals Bio-EEB]

BONUS

7) BIOLOGY *Short Answer* Identify all of the following 4 amino acids that can be phosphorylated:

- 1) Tyrosine
- 2) Leucine
- 3) Serine
- 4) Threonine

ANSWER: 1, 3, 4, [W: OW, E: EB; Finals Bio-Other]

TOSS-UP

8) CHEMISTRY *Multiple Choice* Which of the following best describes the effect that the addition of a solute has on the entropy and vapor pressure of a solution?

- W) Increased entropy, increased vapor pressure
- X) Increased entropy, decreased vapor pressure
- Y) Decreased entropy, increased vapor pressure
- Z) Decreased entropy, decreased vapor pressure

ANSWER: X) INCREASED ENTROPY, DECREASED VAPOR PRESSURE [W: HJ, E: AS; Finals Chem-T]

BONUS

8) CHEMISTRY *Multiple Choice* A reaction in which K_c is greater than K_p is most likely to be associated with which of the following conditions?

- W) Positive ΔH
- X) Negative ΔH
- Y) Positive ΔS
- Z) Negative ΔS

ANSWER: Z) NEGATIVE ΔS [W: HJ, E: AS; Finals Chem-EK]

TOSS-UP

9) EARTH AND SPACE *Multiple Choice* Which of the following describes a region in space that is likely to emit 21 centimeter radiation?

- W) Cool, neutral hydrogen
- X) Cool, ionized hydrogen
- Y) Hot, neutral hydrogen
- Z) Hot, ionized hydrogen

W) COOL, NEUTRAL HYDROGEN [W: AC, E: EB; Finals ESS-OA]

BONUS

9) EARTH AND SPACE *Multiple Choice* The light curve of an object exhibits two periodic, symmetric dips of different magnitudes. Which of the following classes of object best matches this description?

- W) Cepheid variable
- X) Star with a transiting exoplanet
- Y) Eclipsing binary
- Z) Flare star

ANSWER: X) ECLIPSING BINARY [W: SC, E: EB; Finals ESS-SA]

TOSS-UP

10) MATH *Short Answer* Log base a of b is 4, and log base b of c is 5. What is the value of log base c of ab?

ANSWER: 1/4 [W: SC, E: EB; Finals Math-A]

BONUS

10) MATH *Multiple Choice* Which of the following numbers is NOT a prime factor of $2^{16} - 1$?

- W) 3
- X) 5
- Y) 11
- Z) 17

ANSWER: Y) 11 [W: KR, E: SC; Finals Math-NT]

TOSS-UP

11) PHYSICS *Short Answer* Josh loves packing peanuts, and jumps into a pile of styrofoam. When he comes out, there are many pieces of styrofoam stuck to him by electrostatic attraction. This is an instance of what property, which describes electric charge transfer between two objects when they contact or slide against each other?

ANSWER: TRIBOELECTRICITY (ACCEPT: TRIBOELECTRIC EFFECT, DO NOT ACCEPT: ELECTRICITY OR FRICTION) [W: KR; E: SC; Finals Phys-ET]

BONUS

11) PHYSICS *Multiple Choice* Which of the following statements is true when considering rolling without slipping down an inclined plane?

W) Some mechanical energy is lost over time due to static friction

X) Some mechanical energy is lost over time due to kinetic friction

Y) No mechanical energy is lost, but static friction exerts a nonzero force

Z) No mechanical energy is lost, but kinetic friction exerts a nonzero force

ANSWER: Y) NO MECHANICAL ENERGY IS LOST, BUT STATIC FRICTION EXERTS A NONZERO FORCE [W: SC, E: EB; Finals Phys-ME]

TOSS-UP

12) ENERGY *Multiple Choice* Researchers at UNR are studying active galactic nuclei. Which of the following types of AGN is radio-loud, very bright, and has large relativistic jets pointed towards the Earth?

W) Quasar

X) Radio Galaxy

Y) Blazar

Z) Seyfert Galaxy

ANSWER: Y) BLAZAR [W: EB, E: SC; Finals]

BONUS

12) ENERGY *Multiple Choice* Researchers at the JHU Applied Physics Laboratory are studying variations in the gravity field of the Earth, caused by various geologic features. Which of the following is not a reason why gravity data is used for most oceanographic surveys?

W) It can be rapidly measured via satellites that have near-global range

X) It provides higher resolution information than other techniques

Y) It can be directly extracted from sea surface height

Z) It allows for the detection of otherwise obscured density anomalies

ANSWER: X) IT PROVIDES HIGHER RESOLUTION INFORMATION THAN OTHER TECHNIQUES
[W: SC, E: EB]

TOSS-UP

13) BIOLOGY *Multiple Choice* Which of the following types of epithelium would you expect to find in areas where gas exchange is occurring, such as the alveoli of the lungs and the lining of blood vessels?

- W) Simple Squamous
- X) Cuboidal
- Y) Simple Columnar
- Z) Stratified Squamous

ANSWER: W) SIMPLE SQUAMOUS [W: OW, E: EB; Finals Bio-AP]

BONUS

13) BIOLOGY *Multiple Choice* Which of the following statements is NOT true regarding gonadotropins and sex hormones in humans?

- W) Luteinizing hormone and follicle stimulating hormones are the main gonadotropins produced by humans
- X) Gonadotropins can cause the production of sex hormones like testosterone
- Y) A surge in luteinizing hormone causes ovulation
- Z) Follicle stimulating hormones primarily acts on Leydig cells

ANSWER: Z) FOLLICLE STIMULATING HORMONES PRIMARILY ACTS ON LEYDIG CELLS [W: OW, E: EB; Finals Bio-AP]

TOSS-UP

14) CHEMISTRY *Multiple Choice* In a low-oxygen environment, combustion of 1 mole of ethane, with chemical formula C_2H_6 , requires approximately how many moles of oxygen atoms?

- W) 2
- X) 2.5
- Y) 3
- Z) 3.5

ANSWER: X) 2.5 [W: AS, E: HJ; Finals Chem-R]

BONUS

14) CHEMISTRY *Short Answer* Place the following three gases in order of increasing boiling point:

- 1) PH_3
- 2) SO_2
- 3) Kr

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

TOSS-UP

15) EARTH AND SPACE *Short Answer* Magnetic fields around stars can split spectral lines into several weaker, thinner lines. What is the term for this effect?

ANSWER: ZEEMAN EFFECT [W: SC, E: EB; Finals ESS-OA]

BONUS

15) EARTH AND SPACE *Multiple Choice* Which of the following drainage patterns is characteristic of areas with extensive folded topography and areas of both hard and soft rock?

W) Parallel

X) Radial

Y) Rectangular

Z) Trellis

ANSWER: Z) TRELLIS [W: EB, E: HJ; Finals ESS-G]

TOSS-UP

16) MATH *Short Answer* A kite has one side of length 4, one side of length 3, and a shorter diagonal with length $24/5$. What is its area?

ANSWER: 12 [W: SC, E: EB; Finals Math-G]

BONUS

16) MATH *Multiple Choice* What is the greatest integer less than or equal to $(5^{50} + 3^{50}) / (5^{48} + 3^{48})$? [READ: the quantity 5 to the power of 50 plus 3 to the power of 50 over the quantity 5 to the power of 48 plus 3 to the power of 48]

W) 8

X) 9

Y) 24

Z) 25

ANSWER: Y) 24 [W: OW, E: SC; LDE Math-NT]

TOSS-UP

17) PHYSICS *Short Answer* A blackbody planet at a distance R from its star is in thermal equilibrium such that its entire surface is the same temperature T . The planet is then moved to a distance of $9R$ from the star and remains in thermal equilibrium. In terms of T , what is its new surface temperature?

ANSWER: $T/3$ [W: SC, E: EB; Finals Phys-ET]

BONUS

17) PHYSICS *Short Answer* What is the strength of the magnetic field found inside a solenoid with 50 coils in a length of 50 cm, carrying a current of 3 amperes, in terms of the permeability of free space, μ_0 ?

ANSWER: $300 \mu_0$ [W: RF; E: SC; Finals Phys-ET]

TOSS-UP

18) ENERGY *Short Answer* Los Alamos National lab scientists are partnering with the US Geological Survey to create computer models predicting wildfire behavior. Identify all of the following three statements that are often long-term consequences of wildfires:

- 1) Increased runoff
- 2) Decreased precipitation
- 3) Increased water turbidity

ANSWER: ALL [W: EB, E: HJ; Finals]

BONUS

18) ENERGY *Short Answer* Researchers at UW-Madison are studying semiconductors. Specifically, in semiconductors, what term describes the energy difference separating the valence and conduction bands, which electrons must overcome to begin conducting electricity?

ANSWER: BAND GAP [W: HJ, E: EB; Finals]

TOSS-UP

19) BIOLOGY *Short Answer* What process in the light reactions produces considerable amounts of ATP without the production of NADPH?

ANSWER: CYCLIC ELECTRON FLOW [W: OW, E: EB; Finals Bio-CB]

BONUS

19) BIOLOGY *Multiple Choice* Which of the following statements correctly identifies a difference between eudicots and monocots:

W) Eudicots have floral structures in groups of 4 or 5 whereas monocots have floral structures in groups of 3

X) Eudicots have a fibrous root system whereas monocots have a lateral root system

Y) Eudicots generally do not have secondary growth whereas monocots do possess secondary growth

Z) Eudicots have 5 or 6 openings in their pollen grains whereas monocots only have 2 or 3

ANSWER: W) EUDICOTS HAVE FLORAL STRUCTURES IN GROUPS OF 4 OR 5 WHEREAS MONOCOTS HAVE FLORAL STRUCTURES IN GROUPS OF 3 [W: OW, E: EB; Finals Bio-P]

TOSS-UP

20) CHEMISTRY *Multiple Choice* Which of the following choices best describe how the melting and boiling points of water, respectively, change as pressure increases?

W) Increases, increases

X) Increases, decreases

Y) Decreases, increases

Z) Decreases, decreases

ANSWER: Y) DECREASES, INCREASES [W: HJ, E: AS, LDE Chem-Other]

BONUS

20) CHEMISTRY *Multiple Choice* Which of the following is NOT a common ligand in transition metal complexes?

W) NH_3

X) CO

Y) HF

Z) H_2O

ANSWER: Y) HF [HJ, AS, LDE Chem-Other]

TOSS-UP

21) EARTH AND SPACE *Short Answer* A spiral galaxy has a distant, minor interaction with an elliptical galaxy. What central feature will it likely develop as a result?

ANSWER: BAR [W: SC, E: EB; Finals ESS-OA]

BONUS

21) EARTH AND SPACE *Short Answer* What is the condition of the atmosphere when the environmental lapse rate is 7 degrees kelvin per kilometer, and the moist adiabatic lapse rate is 6 degrees kelvin per kilometer?

ANSWER: CONDITIONALLY UNSTABLE [W: EB, E: HJ; Finals ESS-AO]

TOSS-UP

22) MATH *Multiple Choice* The polynomial $p(x)$ has a root with multiplicity 3 at root r . Which of the following is the multiplicity of the root r in its derivative, $p'(x)$?

- W) 1
- X) 2
- Y) 3
- Z) 4

ANSWER: X) 2 [W: JW, E: EB; Finals Math-A]

BONUS

22) MATH *Short Answer* Harry is given a convex hexagon and draws all of its diagonals. He notices that no three diagonals intersect at a single point. How many total regions do the diagonals divide the hexagon into?

ANSWER: 25 [W: JW, E: EB; Finals Math-G]

TOSS-UP

23) PHYSICS *Short Answer* A temperature difference between two distinct electrical conductors can produce a voltage difference between those two conductors via what effect?

ANSWER: SEEBECK EFFECT [W: RF, E: SC; Finals Phys-MO]

BONUS

23) PHYSICS *Short Answer* Identify all of the following subatomic particles which have nonzero strangeness:

- 1) Proton
- 2) Electron
- 3) Positron

ANSWER: NONE [W: RF, E: SC; Finals Phys-MO]