



## MOSFET 2025 - Round 6

### TOSS-UP

1) BIOLOGY *Multiple Choice* Which of the following organelles is found in higher abundance in brown fat than in white fat?

- W) Peroxisomes
- X) Lysosomes
- Y) Mitochondria
- Z) Smooth endoplasmic reticulum

ANSWER: Y) MITOCHONDRIA [AF]

### **BONUS**

1) BIOLOGY *Short Answer* Identify all of the following three processes that occur during prophase of mitosis:

- 1) Crossing over
- 2) Microtubules attach to kinetochores
- 3) Sister chromatids separate

ANSWER: NONE [OW]

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### **TOSS-UP**

2) MATH *Short Answer* What is the degree measure of each interior angle of a regular 90-sided polygon?

ANSWER: 176 [MW]

### **BONUS**

2) MATH *Multiple Choice* How many distinct prime factors does the number nine hundred ninety nine thousand, nine hundred ninety nine have?

- W) 3
- X) 4
- Y) 5
- Z) 6

ANSWER: Y) 5 [MW]

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### **TOSS-UP**

3) CHEMISTRY *Multiple Choice* Which of the following forces decreases in strength most rapidly as distance increases?

- W) Hydrogen bonding
- X) Ion-ion forces
- Y) London dispersion forces
- Z) Ion-dipole forces

ANSWER: Y) LONDON DISPERSION FORCES [CZ]

### **BONUS**

3) CHEMISTRY *Multiple Choice* Which of the following choices would be LEAST likely to increase the Bronsted-Lowry acidity of a chemical species?

- W) Acidic proton bonded to an electronegative element
- X) Presence of electron withdrawing groups
- Y) Resonance delocalization of the acid's positive charge
- Z) Effective solvation of the conjugate base

ANSWER: Y) RESONANCE DELOCALIZATION OF THE ACID'S POSITIVE CHARGE [HJ]

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**TOSS-UP**

4) EARTH AND SPACE *Short Answer* What atmospheric phenomenon is characterized by air temperatures increasing with altitude, often exacerbating air pollution around cities by suppressing atmospheric convection?

ANSWER: TEMPERATURE INVERSION (ACCEPT: INVERSION) [HJ]

**BONUS**

4) EARTH AND SPACE *Multiple Choice* Which of the following best describes the properties of materials such as sandstone and unconsolidated gravel which make them effective aquifers?

- W) Low porosity, low permeability
- X) Low porosity, high permeability
- Y) High porosity, low permeability
- Z) High porosity, high permeability

ANSWER: Z) HIGH POROSITY, HIGH PERMEABILITY [HJ]

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**TOSS-UP**

5) PHYSICS *Short Answer* A wave is traveling at 60 meters per second. If the wavelength is doubled, and its period is tripled, what is the final speed of the wave?

ANSWER: 40 [YL]

## BONUS

5) PHYSICS *Short Answer* In the BCS theory of superconductivity, Cooper pairs are composite quasiparticles stemming from the interaction of electrons with what other quasiparticle, the quanta of a sound wave?

ANSWER: PHONON [CZ]

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## TOSS-UP

6) ENERGY *Multiple Choice* Researchers at UW-Madison are studying the genetic factors behind type one diabetes. This form of diabetes occurs because the immune system attacks what cells within the pancreas, rendering them nonfunctional?

W) Alpha cells

X) Beta cells

Y) Gamma cells

Z) Delta cells

ANSWER: X) BETA CELLS [OW]

## BONUS

6) ENERGY *Short Answer* DoE scientists are studying the myriad applications of probability distributions in science. What is the area under the curve of any probability distribution?

ANSWER: 1 [SO]

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**TOSS-UP**

7) BIOLOGY *Multiple Choice* Which of the following digestive enzymes is found in the highest amount in saliva?

W) Trypsin

X) Amylase

Y) Pepsin

Z) Nuclease

ANSWER: X) AMYLASE [AF]

**BONUS**

7) BIOLOGY *Multiple Choice* Which of the following cells is most commonly infected by HIV?

W) Helper T cell

X) Neuron

Y) Hepatocyte

Z) Myocyte

ANSWER: W) HELPER T CELL [OW]

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**TOSS-UP**

- 8) MATH *Short Answer* How many zeros are at the end of the base-3 representation of 20 factorial?

ANSWER: 8 [MW]

**BONUS**

- 8) MATH *Short Answer* Six points are evenly spaced around a circle. Michael wants to create as many right triangles using these points as possible. In how many ways can Michael create right triangles using these 6 points?

ANSWER: 12 [MW]

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**TOSS-UP**

- 9) CHEMISTRY *Short Answer* The first widespread airbag designs accomplished very rapid inflation by igniting a small amount of sodium azide, which has formula  $\text{NaN}_3$ . What gas do these airbags primarily inflate with?

ANSWER: NITROGEN [JW]

### **BONUS**

9) CHEMISTRY *Multiple Choice* Which of the following best describes how the forward and reverse reaction rates change, respectively, when a catalyst is added to a reaction in equilibrium?

- W) Increase, increase
- X) Increase, decrease
- Y) Decrease, increase
- Z) Decrease, decrease

Answer: W) INCREASE, INCREASE [CZ]

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### **TOSS-UP**

10) EARTH AND SPACE *Short Answer* What class of galaxies, denoted as S-zero on the Hubble classification scheme, is considered intermediate between spiral and elliptical galaxies?

ANSWER: LENTICULAR [SE]

### **BONUS**

10) EARTH AND SPACE *Short Answer* Identify all of the following three statements which are true about fusion in stars:

- 1) Iron is the heaviest element produced by stellar fusion
- 2) The highest-temperature stars fuse via the proton-proton chain
- 3) Stars like the Sun rely on fusing hydrogen at all points during the stellar life cycle

ANSWER: 1 ONLY [HJ]

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### **TOSS-UP**

11) PHYSICS *Multiple Choice* Which of the following laws comes directly from the conservation of angular momentum?

- W) Newton's First Law
- X) Newton's Second Law
- Y) Kepler's First Law
- Z) Kepler's Second Law

ANSWER: Z) KEPLER'S SECOND LAW [YL]

### **BONUS**

11) PHYSICS *Short Answer* Identify all of the following three quantities that, when multiplied together, give an expression for power:

- 1) Force and velocity
- 2) Momentum and acceleration
- 3) Torque and angular velocity

ANSWER: ALL [YL]

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### **TOSS-UP**

12) ENERGY *Multiple Choice* UCLA researchers are estimating the thickness of the ice shell on the second-youngest Galilean moon to see if it might harbor life. Which moon are they investigating?

W) Europa

X) Callisto

Y) Ganymede

Z) Titan

ANSWER: W) EUROPA [KW]

### **BONUS**

12) ENERGY *Short Answer* Scientists at the National Cancer Institute are studying the maturation of cancerous cells. Identify all of the following 3 statements that are true about the cell cycle:

- 1) Cyclin-dependent kinases are in highest concentration during interphase
- 2) P53 is a proto-oncogene that accelerates the cell cycle
- 3) Cells enter  $G_0$  from  $G_1$  when they become quiescent

ANSWER: 3 ONLY [AF]

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### **TOSS-UP**

13) BIOLOGY *Short Answer* When a plant cell is exposed to a hypertonic environment, it will lose water and its cell membrane will peel away from its cell wall. What is the name for this process?

ANSWER: PLASMOLYSIS [OW]

### **BONUS**

13) BIOLOGY *Multiple Choice* Short hairpin RNAs can be used to silence target genes through RNA interference. Which of the following types of enzymes is most likely to be directly involved in the processing of short hairpin RNA?

- W) Kinase
- X) Ribonuclease
- Y) Synthase
- Z) Isomerase

ANSWER: X) RIBONUCLEASE [SK]

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**TOSS-UP**

14) MATH *Short Answer* Yunyi has a six-question true-or-false test. However, he didn't study, so he randomly guesses the answer to each question. What is the probability he gets exactly half of the questions correct?

ANSWER: 5/16 [EZ]

**BONUS**

14) MATH *Short Answer* Shripriya is playing a new version of Science Bowl. She has a 80% chance to get each tossup, which awards 6 points. If she gets the tossup, she receives a bonus that awards 18 points, which she has a 50% chance to answer correctly. If Shripriya plays one pair, what is the expected number of points she will receive?

ANSWER: 12 [EZ]

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**TOSS-UP**

15) CHEMISTRY *Short Answer* An ideal gas's absolute temperature is tripled. By what factor is its internal energy multiplied by?

ANSWER: 3 [YL]

### **BONUS**

15) CHEMISTRY *Multiple Choice* For the same chemical species, which of the following statements regarding the differences between the solid and liquid phases is NOT necessarily true?

- W) The solid phase will have a fixed shape, while the liquid phase will not
- X) The solid phase will have long range order, while the liquid phase will not
- Y) The solid phase will have lower enthalpy of formation than the liquid phase
- Z) The solid phase will have lower entropy than the liquid phase

ANSWER: X) THE SOLID PHASE WILL HAVE LONG RANGE ORDER, WHILE THE LIQUID PHASE WILL NOT [HJ]

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### **TOSS-UP**

16) EARTH AND SPACE *Multiple Choice* Which of the following properties of Venus is responsible for its lack of a magnetic field?

- W) Thick atmosphere
- X) Volcanic activity
- Y) Slow rotation
- Z) Hot surface

ANSWER: Y) SLOW ROTATION [SE]

### **BONUS**

16) EARTH AND SPACE *Multiple Choice* The occurrence of magmatic intrusions such as dikes is associated most with which of the following types of metamorphism?

- W) Regional
- X) Dynamic
- Y) Shock
- Z) Contact

ANSWER: Z) CONTACT [HJ]

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### **TOSS-UP**

17) PHYSICS *Multiple Choice* In which of the following types of processes is no work done on a gas?

- W) Isobaric
- X) Isochoric
- Y) Adiabatic
- Z) Isothermal

ANSWER: X) ISOCHORIC [OW]

### **BONUS**

17) PHYSICS *Short Answer* What constant, found by multiplying the elementary charge by Avogadro's number, gives the charge of a mole of protons?

ANSWER: FARADAY'S CONSTANT [OW]

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### **TOSS-UP**

18) ENERGY *Multiple Choice* Scientists at Argonne National Lab are studying the physical properties of polymerization in plastic materials. Which of the following describes the change in hybridization of carbon atoms in ethylene as they are polymerized into polyethylene?

- W) sp to sp<sup>2</sup>
- X) sp<sup>2</sup> to sp
- Y) sp<sup>2</sup> to sp<sup>3</sup>
- Z) sp<sup>3</sup> to sp<sup>2</sup>

ANSWER: Y) SP2 TO SP3 [SO]

### **BONUS**

18) ENERGY *Short Answer* Researchers at Pacific Northwest National Lab are simulating cloud formation. Cumulonimbus clouds form anvils because they cannot rise above what atmospheric boundary, where temperatures begin to increase with altitude?

ANSWER: TROPOPAUSE [KW]

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### **TOSS-UP**

19) BIOLOGY *Multiple Choice* After moving into your new apartment, you're disrupted daily by your rowdy neighbors. However, after about a month there, you start to subconsciously tune out the noise. What type of learning is this?

- W) Operant Conditioning
- X) Classical Conditioning
- Y) Habituation
- Z) Imprinting

ANSWER: Y) HABITUATION [AF]

### **BONUS**

19) BIOLOGY *Multiple Choice* Male and female seagulls are very difficult to distinguish externally. Which of the following terms most likely describes seagulls?

- W) Polyandrous
- X) Polygynous
- Y) Monogamous
- Z) Hermaphroditic

ANSWER: Y) MONOGAMOUS [KD]

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**TOSS-UP**

20) MATH *Multiple Choice* If  $\log_{\text{x}} \text{y}$  equals 4 and  $\log_{\text{y}} \text{z}$  equals 3, what is the value of  $\log_{\text{x}} \text{z}$ ?

W) 3

X) 4

Y) 7

Z) 12

ANSWER: Z) 12 [JW]

**BONUS**

20) MATH *Short Answer* A group of  $n$  people are forming a conga line by standing in a circle. If rotations of the circle are considered the same, what is the ratio of the number of conga lines that can be formed for  $n = 26$  to the number formed by  $n = 24$ ?

ANSWER: 600 [EZ]

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**TOSS-UP**

21) CHEMISTRY *Short Answer* In the first ionization of zinc, an electron is removed from what atomic orbital?

ANSWER: 4s [CZ]

### **BONUS**

21) CHEMISTRY *Short Answer* Suzuko is observing the 2nd order decomposition of a compound X, which starts at a concentration of 1 molar and decreases to a concentration of 0.5 molar in 5 seconds. How long, in seconds, would it take for X to decrease from a concentration of 1 Molar to 0.25 molar?

ANSWER: 15 [KD]

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### **TOSS-UP**

22) EARTH AND SPACE *Multiple Choice* Dinosaurs are believed to have gone extinct following an asteroid impact. This is because the geologic record contains a layer of what element, which is rare on Earth but common in asteroids and comets?

- W) Silicon
- X) Cobalt
- Y) Iridium
- Z) Tin

ANSWER: Y) IRIDIUM [KW]

### **BONUS**

22) EARTH AND SPACE *Multiple Choice* Which of the following methods is used to measure the distance to the furthest galaxies we can observe?

- W) Type 1a supernovae
- X) Cepheid variables
- Y) Hubble's law
- Z) Stellar parallax

ANSWER: Y) HUBBLE'S LAW [SE]

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### **TOSS-UP**

23) PHYSICS *Short Answer* When an electric field and a magnetic field are applied perpendicularly to a current in a conductor, a voltage difference results across the conductor. What is the name of this effect?

ANSWER: HALL EFFECT [YL]

### **BONUS**

23) PHYSICS *Short Answer* Evan ties a bowling ball to a 5-meter long rope, then holds the end and starts swinging it around in a circle. If the bowling ball has mass 3-kilograms, and the rope will snap once it reaches a tension of 4800 newtons, then to one significant figure and in meters per second, what is the maximum speed that the bowling ball can reach before the rope snaps?

ANSWER: 90 [YL]