

TOSS-UP

1) BIOLOGY *Short Answer* What is the name for proteins which are involved with the process of vesicle fusion with the membrane, and are especially important in acetylcholine release?

ANSWER: SNARE Proteins

BONUS

1) BIOLOGY *Short Answer* If Jean Valjean eats some magical fruit which is derived from more than one ovary, what type of fruit would it be classified as?

ANSWER: Complex Fruit

TOSS-UP

2) PHYSICS *Short Answer* A block with initial velocity 5 m/s and mass 2 kg comes into contact with a rough surface which it slides horizontally on. If it slides 5 meters before stopping, what is the coefficient of kinetic friction of the surface, given $g = 10 \text{ m/s}^2$?

ANSWER: .25

BONUS

2) PHYSICS *Short Answer* Which one of Maxwell's equations describes the electromotive force induced within a conductor which is exposed to a changing magnetic flux?

ANSWER: Faraday's Law

TOSS-UP

3) EARTH AND SPACE *Short Answer* Rank the following three types of stars by spectral line width, from least to greatest:

- I. Supergiant
- II. Main sequence
- III. Giant

ANSWER: I, III, II

BONUS

3) EARTH AND SPACE *Multiple Choice* Which of the following statements about sunspots is false?

W) Sunspots are believed to occur when the Sun's tangled magnetic field rises through the surface

X) Every 11 years, the sunspot cycle repeats with sunspots appearing in the same place on the Sun, compared to the previous cycle

Y) Early in the sunspot cycle, sunspots appear at higher latitudes then move towards lower altitudes as the cycle progresses

Z) Sunspots usually appear in groups

ANSWER: X) Every 11 years, the sunspot cycle repeats with sunspots appearing in the same place on the Sun, compared to the previous cycle

TOSS-UP

4) BIOLOGY *Short Answer* Which types of cells produce somatostatin?

ANSWER: Delta Cells

BONUS

4) BIOLOGY *Short Answer* Which hormone is an inhibitor to the action of leptin?

ANSWER: Ghrelin

TOSS-UP

5) MATH *Short Answer* What is the limit of the sum of the geometric series $5 \cdot \left(\frac{1}{3}\right)^n$ as n tends to infinity?

ANSWER: '7.5'

BONUS

5) MATH *Short Answer* By name or number, indicate which of the following three x-coordinates give a vertical asymptote for the function $(x^3 + 4x + x - 6) / (x^3 + 2x - x - 2)$.

- I. -3
- II. -2
- III. 1

ANSWER: I and II

TOSS-UP

6) PHYSICS *Short Answer* What two elements are located in an RC circuit?

ANSWER: Resistor and Capacitor

BONUS

6) PHYSICS *Short Answer* What is the amount of energy stored in an inductor of inductance 2 henrys, if there is a constant current of 3A in the circuit?

ANSWER: 9J

TOSS-UP

7) EARTH AND SPACE SCIENCE *Multiple Choice* A horst is an uplifted fault block bounded by:

W) Reverse faults

X) Thrust faults

Y) Normal faults

Z) Strike-slip faults

ANSWER: Y) Normal faults

BONUS

7) EARTH AND SPACE SCIENCE *Short Answer* List the following five periods of geological time by oldest to most recent:

- I. Permian
- II. Pennsylvanian
- III. Silurian
- IV. Devonian
- V. Mississippian

ANSWER: III, IV, V, II, I

TOSS-UP

8) MATH *Multiple Choice* What is the 4th derivative of $\sin(x)$?

W) $\sin(x)$

X) $\cos(x)$

Y) $-\sin(x)$

Z) $-\cos(x)$

ANSWER: Z) $-\cos(x)$

BONUS

8) MATH *Short Answer* A solid of revolution is created by rotating function $x^2 + y^2 = 9$, where $y \geq 0$, about the y-axis 360 degrees. What is the volume of the solid of revolution created in π ?

ANSWER: '18'

TOSS-UP

9) EARTH AND SPACE *Short Answer* What type of fog is created when warm, saturated air from the sea is blown onto a cooler land surface?

ANSWER: Radiation fog

BONUS

9) EARTH AND SPACE *Short Answer* By name or number, indicate which of the following four statements about the deflection and shift in wind direction caused by the Coriolis effect are true:

- I. Deflection is always directed at right angles to direction of airflow
- II. Deflection only affects wind direction, not wind speed
- III. The stronger the wind, the greater the deflection
- IV. Deflection is strongest at the poles and grows weaker near the equator

ANSWER: All

TOSS-UP

10) PHYSICS *Multiple Choice* A pendulum follows simple harmonic motion when angle theta is smaller than

W) $\frac{1}{6}$ radians

X) $\frac{1}{4}$ radians

Y) $\frac{1}{3}$ radians

Z) $\frac{1}{2}$ radians

ANSWER: X) $\frac{1}{4}$ radians

BONUS

10) PHYSICS *Short Answer* The total energy of a 9.8 cm long pendulum following SHM with point mass 5g attached at the end is 10 N. Given that $g = 9.8$, what is the amplitude of the pendulum in cm?

ANSWER: '2'

TOSS-UP

11) MATH *Short Answer* What is the name of the series used to approximate functions within a domain using a polynomial?

ANSWER: Taylor Series

BONUS

11) MATH *Short Answer* What is the limit of $(x^3 + x^2 - 3x + 1) / (4x^3 + 3x - 1)$ as x approaches infinity?

ANSWER: $1/4$

TOSS-UP

12) PHYSICS *Multiple Choice* A block mass M rests on an inclined plane inclined theta degrees. If M is doubled, the original normal force acting on the block is multiplied by

W) 0.5

X) 1

Y) 2

Z) 4

ANSWER: Y) 2

BONUS

12) PHYSICS *Short Answer* Block A, with mass 10 kg, sits on a plane inclined 30 degrees and is attached to block B, mass M, hanging off the side of the ramp, connected by a massless string passing over a smooth pulley. At what mass in kg must block B have in order for the frictional force acting on Block A be zero, given that $g = 9.8 \text{ m/s}^2$?

ANSWER: '5'

TOSS-UP

13) BIOLOGY *Short Answer* What are the main respiratory organs in arachnids?

ANSWER: Book Lungs

BONUS

13) BIOLOGY *Short Answer* Which veins returns lymph back into circulation after arriving from the lymph vessels?

ANSWER: The Subclavian Veins

TOSS-UP

14) PHYSICS *Short Answer* A 1500 kg car with initial velocity 15 m/s takes 30 seconds to come to a stop. What is the magnitude of force applied on the car by the breaks, in Newtons?

ANSWER: '750'

BONUS

14) PHYSICS *Short Answer* The second derivative of a particle's position function returns a negative value when a value a seconds is plugged in. By name or number, indicate which of the following five statements are true regarding the particle's motion at instant a .

- I. The particle's velocity is increasing
- II. The particle's velocity is decreasing
- III. The particle is moving forward
- IV. The particle is moving backward

V. There is not enough information to determine which direction the particle is moving

ANSWER: II and V

TOSS-UP

15) MATH *Short Answer* Amaan flips a coin 25 times to guess on Mr. Mixer's true/false quiz ~~about cross-sections~~. What is the standard deviation of the number of questions he answers correctly?

ANSWER: '1.25'

BONUS

15) MATH *Short Answer* This time, Amaan flips a coin 100 times to guess on Mr. Mixer's true/false unit test, ~~still about cross-sections~~. What is the 95% confidence interval of the percentage of questions Amaan gets right?

ANSWER: 45% - 55%

TOSS-UP

16) EARTH AND SPACE SCIENCE *Short Answer* What is the name of the salt concentration change over depth in a saltwater body of water?

ANSWER: Halocline

BONUS

16) EARTH AND SPACE SCIENCE *Short Answer* In which ocean, and at what latitude is the highest salinity ocean water found?

ANSWER: The Atlantic Ocean, 10 degrees north

TOSS-UP

17) PHYSICS *Short Answer* What are the 3 independent measurable properties that a black hole possesses?

ANSWER: Charge, Mass, Angular Momentum

BONUS

17) PHYSICS *Short Answer* If a mouse on a large spinning disk is located at the axis that is spins around and walks towards the edge, name if each of the following values will change

- I. Angular Momentum of the Mouse-Disk System
- II. Angular Momentum of the Disk
- III. Angular Velocity of the Mouse
- IV. Tangential Acceleration of the bug

ANSWER: I. will not, II. will III. will not IV. will

TOSS-UP

18) BIOLOGY *Short Answer* Cells sense population density and regulate gene activity based on population density using what sensing process

ANSWER: Quorum Sensing

BONUS

18) BIOLOGY *Short Answer* Sean has shot commissar Ludwig, triggering his fight or flight system. Cortisol, secreted from Adrenal Gland, is released into the bloodstream and picked up by a heart signalling cell. The, this cell secretes a large amount of signalling molecules, communicating with its nearby cells to help increase heart rate. What are the two types of signalling involved in this process

ANSWER: Paracrine, Endocrine Signalling

TOSS-UP

19) BIOLOGY *Short Answer* What is the name of the tissue which can be contracted to cover the gills in bony fish?

ANSWER: Operculum

BONUS

19) BIOLOGY *Short Answer* What is the name for the conduction that is found when the action potential jumps from each node of ranvier to the next?

ANSWER: Saltatory Conduction

TOSS-UP

20) PHYSICS *Multiple Choice* A pulley system with a mechanical advantage of 2 and block weight W attached to a massless moving pulley has a force $0.5W$ applied to the end of the massless rope, causing the rope to move down distance D . In terms of D , the block moves up a distance:

W) $0.25D$

X) $0.5D$

Y) D

Z) $2D$

ANSWER: X) $0.5D$

BONUS

20) PHYSICS *Multiple choice* On Earth, a ball is thrown upwards with its initial velocity equal to its terminal velocity. Which of the following statements is true about the particle's velocity, assuming airflow is laminar and that the only forces acting on the ball are air resistance and gravitational force?

W) The velocity increases throughout its flight

X) The velocity decreases throughout its flight

Y) The velocity remains constant throughout its flight

Z) The velocity decreases that increases throughout its flight

ANSWER: Y) The velocity remains constant throughout its flight

TOSS-UP

21) EARTH AND SPACE *Short Answer* What is the most common type of lava formation on/near a seamount?

ANSWER: Pillow Lavas

BONUS

21) EARTH AND SPACE *Short Answer* What is the name of an isolated underwater volcano that is flat topped?

ANSWER: Tablemount (ACCEPT: Guyot)

TOSS-UP

22) EARTH AND SPACE SCIENCE *Short Answer* What is the name of the north flowing African current that forms a part of the south Atlantic gyre?

ANSWER: The Benguela Current

BONUS

22) EARTH AND SPACE SCIENCE *Short Answer* What is the name of the two currents that combine to create the North Pacific current

ANSWER: Oyashio and Kuroshio currents

TOSS-UP

23) BIOLOGY *Multiple Choice* Name the nucleotide sequence that enzyme CPSF most commonly binds too, commonly known as the polyadenylation signal

- W. AATAAA
- X. AAUAAA
- Y. ATAAAA
- Z. AAAAAA

ANSWER: W. AATAAA

BONUS

23) BIOLOGY *Short Answer* What is the name of the nucleoside that is used to create the 5'cap for most eukaryotic mRNA transcripts

ANSWER: Guanosine

TOSS-UP

24) BIOLOGY *Short Answer* In the linear electron flow of photosynthesis, what is the final electron acceptor?

ANSWER: Ferredoxin

BONUS

24) BIOLOGY *Short Answer* _____ removes nucleotides, allowing nucleotide excision repair to be performed.

ANSWER: Nuclease

TOSS-UP

25) BIOLOGY *Multiple Choice* On another planet, organisms use DNA the same way they are used on Earth, except that they are based on the conservative model. Which of the following would be true?

W) One of the daughter molecules contains all the original parent DNA, and one of the daughter molecules contains newly synthesized DNA.

X) Each of the daughter molecules contain roughly half of the original DNA, and they are randomly dispersed

Y) Each of the daughter molecules contains a strand of the original molecule, and a newly synthesized strands

Z) One of the daughter molecules contains 75% of the original while one contains 25%

ANSWER: W) One of the daughter molecules contains all the original parent DNA, and one of the daughter molecules contains newly synthesized DNA.

BONUS

25) BIOLOGY *Short Answer* Name the disease associated with inflammation and swollen membranes of the central nervous system?

ANSWER: Meningitis