NWI2 DE4

TOSS-UP

1) BIOLOGY - *Multiple Choice* The coelom (p: see-lum) is derived from which of the following embryonic germ layers?

W) Ectoderm
X) Mesoderm
Y) Endoderm
Z) Depends on whether the organism is a vertebrate or invertebrate.

ANSWER: X) MESODERM

BONUS

1) BIOLOGY - *Short Answer* The flexibility of base pairing for the third base in a codon, such as in the case of the guanine-uracil pair is known as what?

ANSWER: WOBBLE EFFECT (ACCEPT: WOBBLE or BASE WOBBLE)

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TOSS-UP

2) CHEMISTRY - *Short Answer* What effect explains why SN2 reactions proceed faster on primary carbons than on tertiary carbons?

ANSWER: STERIC HINDRANCE

BONUS

2) CHEMISTRY - *Short Answer* What is the anhydride for phosphorous acid, which has a formula of H_3PO_3?

ANSWER: P_2O_3

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TOSS-UP

3) PHYSICS *Multiple Choice* Light Bulbs A, B, and C are connected in a circuit connected to an ideal battery. When light bulb A is disconnected from the circuit, lightbulb B increases in brightness while lightbulb C's brightness remains constant. When lightbulb B is disconnected from the circuit, A's brightness increases while C's brightness remains constant. When C is disconnected from the circuit, neither A nor B lights up. Which of the following can be concluded?

W) A and B are connected in parallel, which is connected to C in series.
X) A and C are connected in parallel, which is connected to B in series.
Y) A and B are connected in series, which is connected to C in parallel.
Z) A and C are connected in series, which is connected to B in parallel.

ANSWER: W) A and B are connected in parallel, which is connected to C in series

BONUS

3) PHYSICS - Short Answer Let there be a mass of mass m connected to a spring of spring constant k. After it is pulled back and released, it oscillates with angular frequency ω. If the mass is made 8 times larger and the spring constant is doubled, what would the new angular frequency be?
W) ω/4
X) ω/2
Y) 2ω
Z) 4ω
Answer X) ω/2

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TOSS-UP

4) MATH - *Short Answer* Let r, s, and q be the three roots of the polynomial $y = 7x^3 + 4x^2 - 12x + 23$(Read as: 7 x cubed plus 4 x squared minus 12 x plus 23), what is the value of $\frac{1}{r} + \frac{1}{s} + \frac{1}{q}$?

ANSWER: 12/23

BONUS

4) MATH - *Short Answer* What is the greatest prime factor of $9^6 + 1$(Read as: 9 to the power of 6 plus 1) that doesn't divide $9^5 - 9^3 - 9^2 + 1$(Read as 9 to the power of 5 minus 9 cubed plus 9 squared plus 1)?

ANSWER: 73

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TOSS-UP

5) EARTH AND SPACE - *Multiple Choice* Which of the following fronts is most likely to produce a prolonged period of rain?
W) occluded front
X) cold front

Y) stationary front
Z) warm front

ANSWER: Y) stationary front

BONUS

5) EARTH AND SPACE - *Multiple Choice* Proxima Centauri is, following the Sun, the star closest to Earth, at 4.2 light years. Given that Proxima Centauri is 0.125 M☉ (solar masses) and cannot be seen with the naked eye, what kind of star is Proxima Centauri?
W) white dwarf
X) red dwarf
Y) red giant
Z) blue giant

ANSWER: X) red dwarf

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TOSS UP

6) ENERGY - Short Answer Researchers at the Darrin Fresh Water Institute are studying the impacts of human activities on Lake George and how to mitigate those impacts. Lake George is an example of a dimictic lake, which means that thermal layering occurs in what two seasons?
ANSWER: SUMMER AND WINTER

BONUS

6) ENERGY - Multiple Choice Researchers at the Johnson Lab at the University of Pennsylvania are studying G-quadruplexes. G-quadruplexes are formed when 4 guanine base pairs associate through hydrogen bonding to form G-tetrads. Then, these tetrads stack to form a G-quadruplex. G-quadruplexes represent which of the following levels of nucleic acid structure?
W) Primary
X) Secondary
Y) Tertiary
Z) Quaternary
ANSWER: X) SECONDARY

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TOSS-UP

7) BIOLOGY - *Multiple Choice* Which enzyme is responsible for the final electron transfer that produces NADPH in the light reactions of photosynthesis?

W) PEP carboxylase
X) RuBisCO
Y) Ferredoxin-NADP+ reductase
Z) Phosphoglycerate kinase

ANSWER: Y) Ferredoxin-NADP+ reductase

BONUS

7) BIOLOGY - *Short Answer* Which phylum of animals, diverging nearly 700 million years ago, is characterized by lacking true tissues and having a body made up of two cell layers and a gelatinous mesohyl?

ANSWER: Porifera

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TOSS-UP

8) CHEMISTRY - *Short Answer* What is the name given to a material that has properties that depend on the direction of measurement, examples of which are liquid crystals.

ANSWER: ANISOTROPES

BONUS

8) CHEMISTRY - *Short Answer* Identify all of the following three oxides that are considered amphoteric: 1) Rb_2O, 2) CuO, 3) Al_2O_3

ANSWER: 3 ONLY

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TOSS-UP

9) PHYSICS - *Multiple Choice* A train begins at rest and starts accelerating in the forward direction. In the plane you hold a pendulum. As the plane accelerates, in which way would the end of the pendulum point?

W) hangs forward, because the net force on the pendulum must be zero

X) hangs forward, because the net force must be nonzero

Y) hangs backward, because the net force must be zero

Z) hangs backward, because the net force must be nonzero

Answer: Z) hangs backward, because the net force must be nonzero

BONUS

9) PHYSICS- - *Short Answer* The position of a mass of 5 kilograms can be defined with position equation $x(t) = 3t^4+t^3+7t^2+2t+1$. What is the net force, in newtons, acting on the object in the direction of motion at t = 1 seconds?

Answer: 280

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TOSS-UP

10) MATH - *Multiple Choice* A rectangle has its upper two vertices on the graph of $y = 12 - \frac{x^2}{3}$ and its lower two vertices on the x-axis. What is the maximum possible area of the rectangle?

W) $32\sqrt{3}$
X) 96
Y) 144
Z) $216 - 72\sqrt{5}$

ANSWER W) 32 sqrt 3

BONUS

10) MATH - *Short Answer* Evaluate $\lim_{h\to 0} \frac{e^{-1}-e^{-1-h}}{h}$ (Read as: the limit as h approaches 0 of the fraction with numerator e to the power -1 minus e to the power open parenthesis -1 minus h close parenthesis and denominator h.)

ANSWER: $\frac{1}{e}$.

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TOSS-UP

11) EARTH AND SPACE - *Short Answer* The Lyman spectral series involves the emission of radiation from electrons of what element?

ANSWER: Hydrogen

BONUS

11) EARTH AND SPACE - *Short Answer* When observed using visible light, a star is obscured by a dense nebula in front of it. Identify all of the following three regions of the electromagnetic spectrum that could likely be used to see the star: 1) Infrared; 2) Radio; 3) Ultraviolet.

ANSWER: 1 and 2

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TOSS UP

12) ENERGY – *Multiple Choice*—In nuclear medicine, what radioactive isotope is commonly used in diagnostic imaging to visualize bone structure and detect certain medical conditions?

W) Iodine-131
X) Technetium-99m
Y) Cobalt-60
Z) Strontium-90

ANSWER: X) TECHNETIUM-99M

BONUS

12) ENERGY – *Short Answer*—One of the many applications of technetium-99m is its usage in imaging conditions of the thyroid gland because uptake of technetium-99m is correlated with uptake of radioactive iodine. By name or number, identify all of the following three conditions in which uptake of radioactive iodine would increase: 1) Hashimoto's thyroiditis, 2) Grave's disease, 3) Jod-Basedow hyperthyroidism[1]

ANSWER: 2 ONLY

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TOSS-UP

13) BIOLOGY – *Short Answer*—By name or number, identify all of the following four components that were not included in the Miller-Urey experiment: 1) ammonia, 2) methane, 3) oxygen gas, 4) hydrogen gas

ANSWER: 3 ONLY

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BONUS

13) BIOLOGY – *Multiple Choice*—In operant conditioning, which of the following would be an example of negative reinforcement?
W) Wearing earplugs so as to not hear your Science Bowl team's criticisms
X) Having to do push-ups when you get a toss-up wrong
Y) Getting yelled at when you fail to attend Science Bowl practice
Z) Getting your water privileges taken away when you can't answer questions correctly

ANSWER: W) WEARING EARPLUGS SO AS TO NOT HEAR YOUR SCIENCE BOWL TEAM'S CRITICISMS

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TOSS-UP

14) CHEMISTRY - *Short Answer* Identify all of the following three diatomic species that tend to move into a magnetic field. 1) B_2, 2) N_2, 3) O_2

ANSWER: 1, 3

BONUS

14) CHEMISTRY - *Short Answer* Which of the following compounds has the highest index of hydrogen deficiency or IHD value?
W) Benzene
X) Benzonitrile
Y) Benzaldehyde
Z) Toluene

ANSWER: X) Benzonitrile

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TOSS UP

15) PHYSICS - *Short Answer* A person stands on a turntable, distance r from its center and the centripetal acceleration required for this motion is a. Assuming the angular speed of the turntable remains constant, if the person walks to a distance of 2r from the center of the turntable, which of the following is the new centripetal acceleration required?

W) a/4

X) a/2

Y) 2a

Z) 4a

ANSWER: Y) 2a

BONUS

15) PHYSICS - *Short Answer* What theorem states that the flux of the electric field out of an arbitrary closed surface is proportional to the electric charge enclosed by the surface, irrespective of how that charge is distributed?

ANSWER: Gauss's law (Accept: Gauss's flux theorem)

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TOSS-UP

16) MATH - *Short Answer* The graph of the polar equation r=8 cos(theta) is a circle. What is the radius and center of the circle?

ANSWER: Radius=4, Center:(4,0)

BONUS

16) MATH - *Short Answer* Which of the following statements does there exist an integer x such that the statement is true
1) x^2=2 (mod 7)
2) x^2=2 (mod 5)
3) x^2=2 (mod 3)

ANSWER: 1 (Accept: x^2=2 (mod 7)

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TOSS-UP

17) EARTH AND SPACE - *Short Answer* Given a fault plane less than 90 degrees, if the hanging wall is above the footwall of the fault, what fault type is present?
ANSWER: reverse fault (accept: thrust fault)

BONUS

17) EARTH AND SPACE - *Multiple Choice* Which of the following astronomical objects is the dimmest, given their absolute magnitude value?
W) -1.54
X) 26.4
Y) 0.05
Z) -4.04

ANSWER: X) 26.4

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TOSS UP

18) ENERGY – *Short Answer*—What term describes the maximum electrical current that can pass through a conductor before its material properties deteriorate, leading to excessive heat and potential failure?

ANSWER: AMPACITY

BONUS

18) ENERGY – *Multiple Choice*—Which cutting-edge energy storage technology utilizes reversible chemical reactions involving the conversion between electrical and chemical energy for grid-scale storage?
W) Lithium-ion batteries
X) Flow batteries
Y) Supercapacitors
Z) Solid-state batteries

ANSWER: X) FLOW BATTERIES

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TOSS-UP

19) BIOLOGY - *Short Answer* What is the term for the skeletal system in which invertebrates such as earthworms maintain structure using fluid pressure?

ANSWER: HYDROSTATIC SKELETON (ACCEPT: HYDROSTATIC; DO NOT ACCEPT: HYDRO SKELETON or STATIC SKELETON)

BONUS

19) BIOLOGY - *Short Answer* The CRISPR system of genome editing has been modeled after the defense mechanisms of bacteria against which of the following viruses?

W) Human Immunodeficiency Virus
X) Bacteriophages
Y) H5N1
Z) Parainfluenza

ANSWER: X) BACTERIOPHAGES

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TOSS-UP

20) CHEMISTRY - *Multiple Choice* A unit cell has one atom on each vertex as well as one atom in the center of the cube. Which of the following types of unit cells is it?

W) Simple Cubic
X) Body Centered Cubic
Y) Face Centered Cubic
Z) Hexagonal Closest Packed

ANSWER: X) BODY CENTERED CUBIC

BONUS

20) CHEMISTRY - *Multiple Choice* Which of the following conditions would result in the greatest cell potential for a galvanic cell based on the reaction $Cu^{2+}_{(aq)}+Zn_{(s)} \rightarrow Zn^{2+}_{(aq)}+Cu_{(s)}$?

W) $[Cu^{2+}] = 1M, [Zn^{2+}] = 1M$
X) $[Cu^{2+}] = 3M, [Zn^{2+}] = 1M$
Y) $[Cu^{2+}] = 1M, [Zn^{2+}] = 3M$
Z) $[Cu^{2+}] = 3M, [Zn^{2+}] = 3M$

ANSWER: X) $[Cu^{2+}] = 3M, [Zn^{2+}] = 1M$
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