NWI2 DE2

TOSS-UP

1) EARTH AND SPACE - *Short Answer* A dune which was formed by wind from varying directions would fall into which category?
ANSWER: Star

BONUS

1) EARTH AND SPACE - *Multiple Choice* Which of the following land use/land coverage classifications would be the most likely source of an algal bloom in a nearby lake?
W) industrial area
X) active agriculture
Y) made land
Z) residential area
ANSWER: X) active agriculture

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TOSS-UP

2) ENERGY - *Short Answer* Scientists at Brookhaven National Labs have been studying black holes. Identify all of the following four kinds of black holes that are uncharged: 1) Schwarzschild, 2) Kerr, 3) Reissner-Nordstrom, 4) Kerr-Newman

ANSWER: 1 AND 2 (Accept: Schwarzchild and Kerr)

BONUS

2) ENERGY - What is the maximum theoretical efficiency of a heat engine operating between a high temperature of 500 K and a low temperature of 300 K?

ANSWER: 40% (Accept: 0.4)

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TOSS-UP

3) BIOLOGY - *Short Answer* Order the following 4 stages of a drug's journey throughout the body from first to last

1) Metabolism
2) Absorption
3) Elimination
4) Distribution

ANSWER: 2,4,1,3 (ACCEPT: ABSORPTION, DISTRIBUTION, METABOLISM, ELIMINATION)

BONUS

3) BIOLOGY - *Short Answer* Which of the following disorders is a result of a chromosomal deletion?

W) Huntington's Disease
X) Cri Du Chat
Y) Down Syndrome
Z) Klinefelter's Syndrome

ANSWER: X) CRI DU CHAT

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TOSS-UP

4) Chemistry - *Short Answer* What is the name given to a ligand that donates two pairs of electrons to a coordination complex?

ANSWER: BIDENTATE

BONUS

4) CHEMISTRY - *Multiple Choice* If reactions A and B have similar ΔH^{o}(Read as: Delta H naught) values but reaction A has a much smaller ΔS^{o} value, which of the following statements must be true?

W) Reaction A has a greater K_{eq}
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X) Reaction B has a greater K_{eq}
Y) Reactions A has a greater Arrhenius pre-factor
Z) Reaction B has a greater Arrhenius pre-factor
Answer: X) REACTION B HAS A GREATER K_{eq}

TOSS-UP

5) PHYSICS - *Short Answer* Planet A and planet B exist in deep space. If the distance between them is increased by a factor of 8, while the mass of each object is increased by a factor of 4, by what factor is the force of gravity between the two objects changed.

Answer: ¼

BONUS

5) PHYSICS - *Short Answer* A current loop with an area of 4.0 square meters moves in a non-uniform magnetic field. Over a duration of 8.0 seconds, it transitions from a region with a magnetic field strength of 0.70 teslas to a region with a higher magnetic field strength. The average induced EMF in the loop during this period is 0.50 volts. In Teslas and to 2 significant digits, what is the value of the final magnetic field strength?

Answer: 1.7

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TOSS-UP

6) MATH - *Short Answer* Which of the following matrices can be multiplied by a 4 by 5 matrix?

W) A 5 by 7 matrix
X) A 5 by 5 matrix
Y) A 3 by 8 matrix
Z) A 2 by 4 matrix

ANSWER: Z) A 2 by 4 matrix

BONUS

6) MATH - *Short Answer* What is the area of a triangle with side lengths 19, 20 and 15?
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ANSWER: $36\sqrt{14}$ (Read as: 36 times the square root of 14)

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TOSS-UP

7) EARTH AND SPACE - *Short Answer* The Coriolis effect, on Earth, causes drift towards which direction in the northern hemisphere?

ANSWER: right

BONUS

7) EARTH AND SPACE - *Multiple Choice* Hornfels are metamorphic facies (p: fay-sheez) of which of the following formation environments?

W) low temperature, low pressure

X) low temperature, high pressure

Y) high temperature, low pressure

Z) high temperature, high pressure

ANSWER: Y) high temperature, low pressure

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TOSS-UP

8) ENERGY - *Short Answer* Researchers at the Caswell Diabetes Institute at the University of Michigan are studying complications of diabetes, including diabetic retinopathy. Diabetic retinopathy is caused by swelling of what part of the eye that is responsible for producing central vision?

ANSWER: Macula

BONUS

8) ENERGY Short Answer Researchers at the Bharadwaj Lab at the University of Rochester are studying the role of genes associated with Parkinson's disease. What is the scientific name of the model organism they are using to study these genes due to its small genome size, short generation time and similar metabolic processes to humans?

ANSWER: D. MELANOGASTER (Accept: DROSOPHILA MELANOGASTER)

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TOSS-UP

9) BIOLOGY - *Short Answer* Oscar wants to determine whether a particular single-celled organism is an archaea, a bacteria or a eukaryote. By name or number, identify all of the following three pieces of
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evidence that would lend evidence against the organism being an archaea: 1) presence of a single membrane, 2) presence of peptidoglycan in the cell wall, 3) presence of branched C20 [C twenty] phytanyl chains

ANSWER: 2 ONLY

BONUS

9) BIOLOGY - *Short Answer* Methanopyrus kandleri is a species of archaea that lives on hydrothermal vents. It takes energy from the hydrogen gas released from the hydrothermal vents and releases methane. What is the name of this process?

ANSWER: METHANOGENESIS

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TOSS-UP

10) CHEMISTRY- *Short Answer* If one bonded atom of an octahedral molecule was replaced by a lone pair of electrons, what would be its new VSEPR molecular geometry?

ANSWER: SQUARE PYRAMIDAL

BONUS

10) CHEMISTRY- *Short Answer* Identify all of the following three reactions that would have a higher value for K_{eq} at 600K than 300K. 1) $N_2 + 3H_2 \rightarrow 2NH_3$, 2) $NH_3 + HCl \rightarrow NH_4Cl$, 3) $N_2O_4 \rightarrow 2NO_2$

ANSWER: 1 AND 2

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TOSS-UP

11) PHYSICS- *Short Answer* What law states that the induced current from a magnetic field in a conductor opposes that magnetic field?

Answer: Lenz's Law

BONUS

11) PHYSICS - *Short Answer* At a KSI concert, Oscar is in the front row of the concert, 1 meter away from the stage, listening at a volume level of 95 decibels. When the thick of it comes on, Aidan stands up and begins to walk away. When he is 100 meters away from the front row, what is the new volume level, in decibels, that he is hearing?

Answer: 55

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TOSS-UP

12) MATH - *Short Answer* What is the units digit of the sum $16^3 + 14^7 + 18^9$(Read as: 16 cubed plus 14 to the power of 7 plus 18 to the power of 9)

ANSWER: 2

BONUS

12) MATH - *Short Answer* Given the equation of the parabola $y = 3x^2 - 12x + 15$(Read as 3 x squared minus 12 x plus 15), what is the equation of the directrix?

ANSWER: y=35/12

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TOSS-UP

13) EARTH AND SPACE - *Multiple Choice* An alpine glacier found in a bowl-shaped valley between mountains would be classified as which of the following?
W) jokulhlaup (Read as: yo-kul-hep)
X) piedmont
Y) cirque (Read as: surk)
Z) arête (Read as: uh-rayt)

ANSWER: Y) cirque

BONUS

13) EARTH AND SPACE *Short Answer* The Ferrel cells circulate air through the mid-latitudes, with the cooler air sinking in lower latitudes and warming towards higher latitudes, then rising, cooling, moving back to lower latitudes, and sinking again. Given that the warm air is at relatively low altitude at the higher latitudes, what pressure systems are more likely to form at these latitudes?

ANSWER: low pressure

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14) BIOLOGY – *Short Answer*—One of the primary functions of the kidneys is to stimulate red blood cell production through a hormone produced by renal peritubular cells. What is the name of this hormone?

ANSWER: ERYTHROPOIETIN

BONUS

14) BIOLOGY – *Multiple Choice*—Which of the following direct physiological effects of kidney failure would likely not be seen in someone suffering from end-stage renal disease?
W) Brittle bones due to calcium loss
X) Anemia due to low RBC production
Y) Hypotension due to failure to retain water
Z) Edema

ANSWER: Y) HYPOTENSION DUE TO FAILURE TO RETAIN WATER

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TOSS-UP

15) EARTH AND SPACE - *Multiple Choice* Which of the following drainage patterns has no clear pattern, and occurs in areas with significant geological disruption?

W) braided

X) anastomosing

Y) dendritic

Z) deranged

ANSWER: Z) deranged

BONUS

15) EARTH AND SPACE - *Short Answer* Name all of the following astronomical bodies which are likely to contain population II (two) stars:

1) active galactic nucleus

2) open cluster

3) galactic halo

ANSWER: 3 only

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TOSS-UP
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16) CHEMISTRY - *Short Answer* What effect, which occurs when electrons in a sigma bond interact with an adjacent p-orbital, explains why tertiary carbocations are more stable than primary carbocations?

ANSWER: Hyperconjugation

BONUS

16) CHEMISTRY - *Short Answer* How many chiral centers does the compound 1-methylcyclopentane have?

ANSWER: 0

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TOSS-UP

17) BIOLOGY- *Short Answer* In operant conditioning, what is the term for a stimulus or event that decreases the likelihood of a behavior being repeated by introducing an unpleasant outcome following the behavior?

ANSWER: POSITIVE PUNISHMENT

BONUS

17) BIOLOGY- *Short Answer* In muscle contraction, which protein binds to calcium ions to expose the binding sites on actin for myosin to attach during the cross-bridge cycle?

ANSWER: TROPONIN

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TOSS-UP

18) MATH - *Short Answer* Convert the following coordinates into polar coordinates in radians: $(6, -6\sqrt{3})$

ANSWER: (12, 11π/6)

BONUS

18) MATH - *Short Answer* A goat is attached by a 10 meter long rope to one side of a rectangular house of length 20 m. If the goat is attached to the house at a point 6 m from the closest vertice, and the house is infinitely long, how much area does the goat have to walk.

Answer: 54pi

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TOSS-UP

19) PHYSICS - *Short Answer* Oscar is using a cylindrical resistor in a circuit with resistance R. If another resistor is made of the same material but has twice the radius and four times the original length, what is the new resistance in terms of R?

ANSWER: R

BONUS

19) PHYSICS - *Short Answer* A particle is constrained to move in one dimension according to the relation x = t^3 + 2t^2 - 1. What is the acceleration in meters per second squared of the particle at t = 2 seconds?

ANSWER: 16

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TOSS-UP

20) EARTH AND SPACE - *Short Answer* Bedrock in the Adirondacks lacks carbonate rocks, leading to increased damage to its bodies of water due to acid rain. The acid rain is predominantly caused by the manufacturing sector in the midwest, from which nitric and sulfuric acid are brought by clouds to the northeast by what wind current?
ANSWER: prevailing westerlies

BONUS

20) EARTH AND SPACE - *Multiple Choice* Which of the following occurs when a wave travels over a gently sloping ocean bottom leading up to shore, and is identifiable as a relatively small, foam-topped wave?
W) seiche wave
X) spilling breaker
Y) plunging breaker
Z) surging breaker
ANSWER: X) spilling breaker