ROUND 3

TOSS-UP

1) Earth and Space – *Multiple Choice* What is the name of the mass wasting event where a mass of rock or material moves along a curved surface?

W) Lahar
X) Earthflow
Y) Creep
Z) Slump

ANSWER: Z) SLUMP [SP]

BONUS

1) Earth and Space – *Short Answer* What drainage pattern would form on a volcano?

ANSWER: RADIAL [SP]

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TOSS-UP

2) Physics – *Short Answer* Identify all of the following particles emitted from the nucleus during beta minus decay: 1) Electron 2) Neutron 3) Neutrino 4) Antineutrino

ANSWER: Electron and Antineutrino, 1 and 4

BONUS

2) Physics – *Short Answer* A bodybuilder is performing 20 repetitions of raising a 5 kilogram dumbbell up and down a height of 1 meter. After the 20 repetitions, what is the total work done on the dumbbell?

ANSWER: X) 0, 0 Joules

TOSS-UP

3) Chemistry – *Multiple Choice* Molality is expressed as the moles of solute divided by what quantity

W) kilograms of solution
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X) liters of solution
Y) kilograms of solvent
Z) liters of solvent

Answer: Y) kilograms of solvent

BONUS

3) Chemistry -- *Multiple Choice* Why is molality an important measure of concentration in chemistry?

W) It is solute independent
X) It is solvent independent
Y) It is pressure independent
Z) It is temperature independent

Answer: Z) It is temperature independent

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TOSS-UP

4) Math – *Multiple Choice* A particle's position can be defined by the equation x of t equals 4 times t cubed minus 3 times t squared plus 2 times t minus 1 meter, where t is in seconds. At t equals 4 seconds, what is the acceleration of the particle in meters per second squared?
W) 80
X) 90
Y) 100
Z) 120

ANSWER: X) 90

BONUS

4) Math – *Short Answer* How many distinct ordered pairs of integers *x* and *y* satisfy 1 over x plus 1 over y equals 1 over 2?

ANSWER: 5

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TOSS-UP

5) Biology – *Multiple Choice* Which of the following biological structures are mismatched to their function?

W) Flagella - whiplike motion for motility
X) Cilia - rowing motion for motility
Y) Fimbriae - pulls egg into oviduct
Z) Pili - transduction of ovum

ANSWER: Z) Pili - transduction of ovum

BONUS

5) Biology – *Multiple Choice* Which of the following utilize oxygen as part of their metabolism when it is available but are also capable of living anaerobically?

W) Microaerophiles
X) Facultative aerobes
Y) Aerotolerant anaerobes
Z) Facultative anaerobes

ANSWER: Z) FACULTATIVE ANAEROBES

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TOSS-UP

6) Physics – *Short Answer* What is the total work done by a jack that raises one side of a 400-kilogram box by 25 centimeters, rounded to the nearest ten Joules?

ANSWER: 980, 980 J

BONUS

6) Physics – *Short Answer* A large, heavy, rigid sail is still in space. An asteroid with a mass of 20 kg and speed 15 m/s collides into it and bounces back off with the same speed. What is the momentum of the sail after the collision, in Newton seconds?

ANSWER: 600, 600 Newton seconds

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TOSS-UP

7) Biology – *Multiple Choice* Which of the following structures are NOT homologous to the other mentioned structures?

W) Fins of a cetacean
X) Arms of a hominid
Y) Wings of a gliding squirrel
Z) Tentacles of an cnidarian

ANSWER: Z) TENTACLES OF AN cnidarian

BONUS

7) Biology – *Multiple Choice* Which of the following excretory structures is mismatched to the organism within which they are present?

W) Flame cells - freshwater flatworm
X) Malpighian Tubules - black widow
Y) Nephridia - earthworms
Z) Antennal gland - grass shrimp

X) MALPIGHIAN TUBULES - BLACK WIDOW

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TOSS-UP

8) Math – *Multiple Choice* A continuous function *f* passes through points 2 comma 8 and 6 comma 10. Which of the following points can *f* pass through, by the Intermediate Value Theorem:
W) 3 comma 6
X) 6 comma 7
Y) 7 comma 9
Z) 3 comma 9

ANSWER: Z) 3 comma 9

BONUS

8) Math – *Multiple Choice* What shape is described by the equation x squared plus y squared plus 2 times x times y equals 4?
W) Parabola
X) Ellipse
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Y) Hyperbola
Z) Parallel lines

ANSWER: Z) Parallel lines

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TOSS-UP

9) Earth and Space – *Multiple Choice* Which of the following is a term for a gaping crack in a glacier formed when it moves over irregular terrain

W) Zone of Fracture
X) Crevass
Y) Fjord
Z) Glacial Trough

ANSWER: X) CREVASSE [SP]

BONUS

9) Earth and Space – *Short Answer* The Hawaiian Islands are well known for being formed by volcanoes. What type of volcanoes are the Hawaiian Islands composed of?

ANSWER: SHIELD [SP]

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TOSS-UP

10) Chemistry – *Short Answer* What are the units of a rate constant of a second-order reaction?

ANSWER: 1/(M*s) (read as: 1 over molar seconds, or inverse molar times inverse seconds, etc) (Accept: Hz/M or any other equivalent unit)

BONUS

10) Chemistry -- *Short Answer* What is the term for the stage of a reaction with the highest free energy?

Answer: Rate-determining Step

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TOSS-UP
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11) Biology – *Short Answer* Which of the following would be higher in eukaryotic organisms than bacterial organisms in respect to their genomes?

1) Genome size in mega-base pairs
2) Gene density
3) Number of genes
4) Noncoding DNA

ANSWER: 1, 3, AND 4

BONUS

11) Biology – *Short Answer* Under which phylum are platypuses classified, ~~and which phylum is most closely related to this phylum~~?

ANSWER: CHORDATA, ~~HEMICHORDATA~~

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TOSS-UP

12) Chemistry – *Short Answer* How many rotational degrees of freedom does a molecule of carbon dioxide have?

Answer: 2

12) Chemistry -- *Short Answer* What is the maximum number of vibrational degrees of freedom a nonlinear molecule with 3 atoms have?

Answer: 3

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TOSS-UP

13) Math – *Short Answer* Among the 30 students in the AP Physics 2 class at Dulles, 6 students are also taking AP Physics C and 18 are also taking AP Chemistry. Among these 30 students, what is the maximum number of students potentially taking only one of the three courses mentioned?

ANSWER: 12

BONUS

13) Math – *Short Answer* Two spheres of radii [ray – dee – ai] 6 and 12 are externally tangent. The two common externally tangent planes to these spheres intersect at a line. What is the closest distance from a point on this line to a point on the sphere of radius 6?

ANSWER: 12

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TOSS-UP

14) Physics – *Multiple Choice* Polarizing filters are used by photographers to eliminate glare. What fraction of the intensity of unpolarized light remains after passing through a linear polarizer?

W) One quarter
X) One half
Y) Three quarters
Z) One

ANSWER: X) One half

BONUS

14) Physics – *Short Answer* Identify all of the following that a photon lacks: 1) Energy, 2) Momentum, 3) Mass

ANSWER: 3 Only

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TOSS-UP

15) Earth and Space – *Short Answer* What is the name of the formation where multiple supernova remnants merge. This formation eventually leads to the formation of a galactic fountain.

ANSWER: SUPERBUBBLE [SP]

BONUS

15) Earth and Space – *Multiple Choice* The Crab Nebula has a characteristic hazy glow in its center caused by high-speed electrons spiraling through an electric field and is known as which of the following?

W) Synchrotron Radiation
X) Cyclotron Radiation
Y) Cherenkov Radiation
Z) Gamma Radiation

ANSWER: W) SYNCHROTRON RADIATION [SP]

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TOSS-UP

16) Chemistry – *Short Answer* What is the hybridization of xenon tetrafluoride?

Answer: sp3d2 (accept: d2 sp3)

BONUS

16) Chemistry -- *Short Answer* Because of xenon tetrafluoride's low volatility compared to xenon difluoride and xenon hexafluoride, it can be purified using what technique?

Answer: Fractional sublimation

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TOSS-UP

17) Math – *Short Answer* Alice and Bob play a game in which they each roll a standard six-sided die and compute the absolute value of their difference. If the obtained value is positive, then they get a point and otherwise they lose a point. After 6 rolls each, what is the expected number of points that they would have?

ANSWER: 4

BONUS

17) Math – *Short Answer* What is the sum of the squares of the roots of the polynomial <u>x squared minus 2022 times x plus 242</u>?

ANSWER: 4,088,000

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TOSS-UP
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18) Physics – *Multiple Choice* Room A is filled with helium gas, He. Room B is identical to Room A; however, it is filled with methane gas, CH4. Under the same conditions, what is the approximate ratio of the speed of sound in Room A to that in Room B?

W) 0.5
X) 1.7
Y) 2.2
Z) 7.9

ANSWER: Y) 2.2

BONUS

18) Physics – *Multiple Choice* The intensity from a point source of light is proportional to the distance raised to what power?

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

ANSWER: Z) -2

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TOSS-UP

19) Earth and Space – *Short Answer* Which of the Galilean moons has the youngest surface characterized by a lack of impact craters?

ANSWER: IO [SP]

BONUS

19) Earth and Space – *Multiple Choice* About what percentage of galaxies contain active galactic nuclei?

W) 0.1%
X) 1%
Y) 10%
Z) 50%
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ANSWER: X) 1% [SP]

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TOSS-UP

20) Biology – *Short Answer* In a human sarcomere, which filaments would you find in the H band?

ANSWER: THICK FILAMENTS (ACCEPT: MYOSIN)

BONUS

20) Biology – *Short Answer* Which of the following orders of *Insecta* undergo incomplete metamorphosis?

1) Coleoptera
2) Lepidoptera
3) Orthoptera
4) Hymenoptera

ANSWER: 3 ONLY (ORTHOPTERA)

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