2025 Bay Area Science-Estimathon Duel

Round Robin

Question Set 1

Questions will begin on the next page.

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*E&S = Earth and Space, Est = Estimation.

TOSS-UP

1) **Biology – *Short Answer*** Which organelle, responsible for producing energy in eukaryotes, is commonly referred to as "The Powerhouse Of The Cell?"

ANSWER: MITOCHONDRIA [QG]

BONUS

1) **Biology – *Short Answer*** By name or number, identify all of the following four organelles that contain DNA:

1. Chloroplast
2. Nucleus
3. Mitochondria
4. Lysosome

ANSWER: 1, 2, AND 3 [QG]

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TOSS-UP

2) **Physics – *Multiple Choice*** Max is driving his car. His initial speed is 20 meters per second, and he accelerates by 2 meters per second squared for 5 seconds. Over those 5 seconds, how far does he travel in meters?

W) 75
X) 100
Y) 125
Z) 150

ANSWER: Y) 125 [QG]

BONUS

2) **Physics – *Multiple Choice*** Which of the following statements about the coefficients of static friction and kinetic friction between two surfaces is false?

W) The coefficients are always unitless
X) The coefficient of kinetic friction must be less than or equal to the coefficient of static friction
Y) The coefficients do not depend on any external forces
Z) The product of normal force and the coefficient of static friction always equals the static frictional force

ANSWER: Z) THE PRODUCT OF NORMAL FORCE AND COEFFICIENT OF STATIC FRICTION ALWAYS EQUALS THE STATIC FRICTIONAL FORCE [QG]

TOSS-UP

3) **Y-Risk – *Multiple Choice*** Hydrogen-4 decays to tritium through what process?

W) Beta plus decay
X) Beta minus decay
Y) Alpha decay
Z) Neutron emission

ANSWER: Z) NEUTRON EMISSION [AG]

BONUS

3) **Y-Risk – *Short Answer*** By name or number, order the following three isotopes of hydrogen by increasing natural abundance:

1. Protium
2. Deuterium
3. Tritium

ANSWER: 3, 2, 1 [AG]

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TOSS-UP

4) **Math – *Short Answer*** In the arithmetic sequence with first term 6 and fifth term 18, what is the seventh term?

ANSWER: 24 [QG]

BONUS

4) **Math – *Short Answer*** In the geometric sequence with second term 1/60 and fourth term 4/15, what is the eighth term?

ANSWER: 1024/15 [QG]

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TOSS-UP

5) **Chemistry – *Short Answer*** What is the chemical formula of butane?

ANSWER: C4H10 [AG]

BONUS

5) **Chemistry – *Multiple Choice*** Which of the following elements has the lowest first ionization energy?

W) Nitrogen
X) Phosphorus
Y) Arsenic
Z) Antimony

ANSWER: Z) ANTIMONY [AG]

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TOSS-UP

6) **Earth and Space – *Multiple Choice*** At which of the following temperatures is water densest?

W) 40 degrees Celsius
X) 4 degrees Celsius
Y) 0.4 degrees Celsius
Z) 0.04 degrees Celsius

ANSWER: X) 4 DEGREES CELSIUS [AG]

BONUS

6) **Earth and Space – *Short Answer*** By name or number, order the following three regions by increasing albedo.

1. Rock outcrops
2. Glaciers
3. Forests

ANSWER: 1, 3, 2 [AG]

TOSS-UP

7) **Math – *Short Answer*** If a right triangle has legs of length 1 and 2, what is the length of its hypotenuse?

ANSWER: $\sqrt{5}$ [QG]

BONUS

7) **Math – *Multiple Choice*** If a triangle has sides of lengths 4 and 6, which of the following could NOT be the length of the third side?

W) 2
X) 3
Y) 4
Z) 5

ANSWER: W) 2 [QG]

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TOSS-UP

8) **Y-Risk – *Multiple Choice*** Warren is a director of green energy at Saratoga High School. He is looking to make the school greener by eliminating the use of non-renewable energy resources. Which of the following energy sources is non-renewable?

W) Wind
X) Solar
Y) Geothermal
Z) Nuclear

ANSWER: Z) NUCLEAR [AG]

BONUS

8) **Y-Risk – *Short Answer*** Biofuels are another type of renewable resource. By name or number, identify all of the following three plants which would likely be useful for biofuel production:

1. Sugar beet
2. Pine
3. Corn

ANSWER: 1 AND 3 [AG]

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TOSS-UP

9) **Biology – *Short Answer*** After a severe rainstorm, Alex observes two species of trout inhabiting the same section of river. A few years later, he comes back to see that only one species is still living in the same river. What principle, which states that two species cannot coexist in the same niche, is demonstrated by these trout?

ANSWER: COMPETITIVE EXCLUSION PRINCIPLE (accept GAUSS'S PRINCIPLE) [AG]

BONUS

9) **Biology – *Short Answer*** The competitive exclusion principle states that two species occupying the same niche cannot coexist for long periods of time. However, species with different niches may sometimes adapt to fit each others' needs. What is the name of this phenomenon, driven by natural selection for complementary traits?

ANSWER: COEVOLUTION [EP]

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TOSS-UP

10) **Chemistry – *Multiple Choice*** If the volume of a sample of gas was halved while keeping temperature constant, which of the following properties would be doubled?

W) Internal energy
X) Pressure
Y) Moles of gas
Z) Entropy

ANSWER: X) PRESSURE [AG]

BONUS

10) **Chemistry – *Multiple Choice*** Alex is conducting an experiment where he places a cotton ball dipped in ammonia at one end of a glass tube and a cotton ball dipped in hydrochloric acid at the other. When vapors from the cotton balls meet, they react to form a white precipitate. Where in the tube relative to the cotton balls will the precipitate form?

W) Closer to the ammonia
X) Closer to the hydrochloric acid
Y) Equidistant to both
Z) Cannot be calculated

ANSWER: X) CLOSER TO THE HYDROCHLORIC ACID [AG]

TOSS-UP

11) **Earth and Space – *Short Answer*** What counterpart to spring tides occurs when the sun and moon form a right angle with the Earth, resulting in generally weaker, more moderate tidal waves?

ANSWER: NEAP TIDES [AG]

BONUS

11) **Earth and Space – *Multiple Choice*** Approximately how much of the Earth's freshwater is stored as groundwater?

W) 10%
X) 20%
Y) 30%
Z) 40%

ANSWER: Y) 30% [AG]

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TOSS-UP

12) **Physics – *Multiple Choice*** While making s'mores on a campfire, Max feels warmth from the fire, yet cannot directly see the infrared photons being emitted. What property of an infrared photon is too large for the human eye to observe?

W) Frequency
X) Wavelength
Y) Energy
Z) Velocity

ANSWER: X) WAVELENGTH [MR]

BONUS

12) **Physics – *Multiple Choice*** A positive electric charge is moved at a constant speed between two locations in an electric field, with no work done by or against the field at any time during the entire process. Under which of the following conditions can this occur?

W) The charge is moved in the direction of the electric field
X) The charge is moved opposite to direction of the electric field
Y) The charge is moved along an equipotential line
Z) The charge is moved perpendicularly to equipotential lines

ANSWER: Y) THE CHARGE IS MOVED ALONG AN EQUIPOTENTIAL LINE [MR]

TOSS-UP

13) **Earth and Space – *Short Answer*** What is the measure of length defined as the average distance from the Earth to the Sun?

ANSWER: ASTRONOMICAL UNIT (accept AU) [MR]

BONUS

13) **Earth and Space – *Short Answer*** By name or number, indicate all of the following four gases which are present in significant amounts in Mercury's atmosphere:

1. Carbon dioxide
2. Nitrogen
3. Ammonia
4. Methane

ANSWER: NONE [MR]

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TOSS-UP

14) **Math – *Short Answer*** The interior angles of a regular polygon each measure 175 degrees. How many sides does this polygon have?

ANSWER: 72 [QG]

BONUS

14) **Math – *Short Answer*** What is the sum of the first five prime numbers?

ANSWER: 28 [EC]

TOSS-UP

15) **Biology – *Multiple Choice*** Which of the following macromolecules does not contain the element nitrogen?

W) Proteins
X) DNA
Y) RNA
Z) Carbohydrates

ANSWER: Z) CARBOHYDRATES [AG]

BONUS

15) **Biology – *Multiple Choice*** Corals and sea anemones belong to which of the following phyla?

W) Mollusca
X) Echinodermata
Y) Crustacea
Z) Cnidaria

ANSWER: Z) CNIDARIA [AG]

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TOSS-UP

16) **Chemistry – *Short Answer*** By name or number, identify all of the following three conditions which describe an acidic solution:

1. pH greater than 7
2. Concentration of H+ greater than that of OH-
3. Ability to turn litmus paper blue

ANSWER: 2 ONLY [QG]

BONUS

16) **Chemistry – *Multiple Choice*** Which of the following compounds is NOT a strong acid?

W) HNO_3
X) $HClO_4$
Y) HBr
Z) H_2SO_3

ANSWER: Z) H_2SO_3 [QG]

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TOSS-UP

17) **Y-Risk – *Multiple Choice*** Students at Saratoga High School are exploring data storage options in Google Drive. One plan that they are considering gives them four gigabytes of storage space for $10. How many bytes are in four gigabytes?

W) Four thousand
X) Four million
Y) Four billion
Z) Four trillion

ANSWER: Y) FOUR BILLION [WC]

BONUS

17) **Y-Risk – *Short Answer*** Ethan is visiting a haunted house and comes across distorted reflections of himself in a hall of mirrors. By name or number, identify all of the following four possible images that can be produced by a concave mirror:

1. Real and upright
2. Virtual and upright
3. Real and inverted
4. Virtual and inverted

ANSWER: 2 AND 3 [WC]

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TOSS-UP

18) **Physics – *Multiple Choice*** Max is experimenting with the principles of fluid dynamics. To understand Bernoulli's principle, he approximates Warren as a fluid and pushes him through a series of pipes. What will happen to Warren's approximate pressure when he flows from a wider pipe to a narrower pipe?

W) Increases
X) Decreases
Y) Stays constant
Z) Increases, then decreases

ANSWER: X) DECREASES [EP]

BONUS

18) **Physics – *Short Answer*** If Warren flows from a cylindrical pipe with radius 1 meter and a velocity of 5 meters per second to a circular pipe of radius 2 meters, what is his resulting speed in meters per second?

ANSWER: 1.25 [WC]

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TOSS-UP

19) **Biology – *Multiple Choice*** In a food chain, approximately how much energy transfers from one trophic level to the next?

W) 10%
X) 20%
Y) 30%
Z) 40%

ANSWER: W) 10% [QG]

BONUS

19) **Biology – *Multiple Choice*** In a certain ecosystem, owls feed on sparrows, which feed on insects, which feed on tree leaves. If a new species A, which feeds on owls, is introduced to the ecosystem, what type of consumer would species A be classified as?

W) Primary consumer
X) Secondary consumer
Y) Tertiary consumer
Z) Quaternary consumer

ANSWER: Z) QUATERNARY CONSUMER [QG]

TOSS-UP

20) **Chemistry – *Short Answer*** By name or number, order the following three intermolecular forces by increasing strength:

1. Dipole dipole forces
2. London dispersion forces
3. Hydrogen bonding

ANSWER: 2, 1, 3 [AG]

BONUS

20) **Chemistry – *Short Answer*** A scientist initially has a 100-gram sample of substance A, which has a half-life of 25 minutes. To the nearest gram, how much of substance A remains after an hour and forty minutes have passed?

ANSWER: 6 [QG]

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TOSS-UP

21) **Earth and Space – *Multiple Choice*** Which of the following gases is NOT a greenhouse gas?

W) Carbon dioxide
X) Carbon monoxide
Y) Ozone
Z) Water vapor

ANSWER: X) CARBON MONOXIDE [AG]

BONUS

21) **Earth and Space – *Multiple Choice*** Which of the following best compares the relative amount of cratering on the two sides of the moon?

W) More heavily cratered on the far side
X) More heavily cratered on the near side
Y) No cratering on either side
Z) Equally heavily cratered, but not zero, on both sides

ANSWER: W) MORE HEAVILY CRATERED ON THE FAR SIDE [MR]

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TOSS-UP

22) **Math – *Short Answer*** On pi day, Edward makes a pie with area pi square meters. If he eats one pi-th of the pie, then, in square meters, how much area of pie has he eaten?

ANSWER: 1 [EC]

BONUS

22) **Math – *Short Answer*** What is the greatest common divisor of 252 and 105?

ANSWER: 21 [AG]

TOSS-UP

23) **Physics – *Multiple Choice*** What physical quantity is classically calculated by multiplying mass and velocity?

W) Force
X) Momentum
Y) Kinetic energy
Z) Acceleration

ANSWER: X) MOMENTUM [WC]

BONUS

23) **Physics – *Short Answer*** As a final project for AP Physics C, Max and Warren are tasked with building a toothpick bridge. By name or number, indicate which of the following four forces are important to consider when building an actual bridge:

1. Tension
2. Torsion
3. Compression
4. Shear

ANSWER: ALL [MR]

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TOSS-UP (30 seconds)

24) **Estimation – *Short Answer*** Stressing over their disastrous AP Lang test, Saratoga Science Bowl members focus on taking deep breaths to calm themselves down. To the nearest order of magnitude, estimate how many oxygen molecules each person inhales with every single breath.

ANSWER: 21 [MR]

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End of Questions.