Standard Division Round Robin 1

TOSS-UP

1) BIOLOGY *Multiple Choice* Which type of ground tissue has a primary cell wall that is unevenly thickened and provides flexible mechanical support?

W) Parenchyma **[*pair-EN-kih-ma*]**

X) Collenchyma **[*cole-EN-kih-ma*]**

Y) Sclerenchyma **[*scler-EN-kih-ma*]**

Z) Procambium

ANSWER: X) COLLENCHYMA [GKD]

BONUS

1) BIOLOGY *Multiple Choice* What type of cell junction functions as a rivet, linking epithelial cells into sheets?

W) Gap junction

X) Tight junction

Y) Desmosome

Z) Adherens **[*add-HERE-ins*]** junction

ANSWER: Y) DESMOSOME [GKD]

TOSS-UP

2) CHEMISTRY *Short Answer* How many sigma bonds are contained in the nitrate ion?

ANSWER: 3 [GKD]

BONUS

2) CHEMISTRY *Short Answer* What intermolecular force explains why octane has a much higher boiling point than methane?

ANSWER: LONDON DISPERSION (ACCEPT: VAN DER WAALS) [GKD]

TOSS-UP

3) EARTH AND SPACE *Short Answer* What is the name of the large depression formed by a volcano's magma chamber collapsing post-eruption?

ANSWER: CALDERA [EB]

BONUS

3) EARTH AND SPACE *Short Answer* How many atmospheric cells are located in each hemisphere?

ANSWER: 3 [EB]

TOSS-UP

4) MATH *Short Answer* What is the area of the region bounded by the lines y equals 0, x equals 0, x equals 4, and y equals x plus 2?

ANSWER: 16 [SG]

BONUS

4) MATH *Multiple Choice* What is the sum of the distinct prime factors of 2022?

W) 1013

X) 4056

Y) 3036

Z) 342

ANSWER: Z) 342 [AKa]

TOSS-UP

5) PHYSICS *Multiple Choice* Which of the following is closest to the temperature of the cosmic microwave background, in Kelvin?

W) 0.03

X) 3

Y) 300

Z) 3,000,000

ANSWER: X) 3 [AC]

BONUS

5) PHYSICS *Short Answer* The period of a perfect pendulum is 2 seconds. If the mass of the pendulum is doubled, its length halved, and it is moved to a planet with gravitational acceleration twice that of Earth, what is the new period, in seconds?

ANSWER: 1 [AC]

TOSS-UP

6) ENERGY *Short Answer* Davidson HS B Team members are studying the forces acting on moving and static objects. A box is sliding down a ramp at an increasing speed. By name or number, order the following three forces on the box by increasing magnitude:

1) Gravity
2) Friction
3) Normal force

ANSWER: 2, 3, 1 (ACCEPT: FRICTION, NORMAL FORCE, GRAVITY) [AC]

BONUS

6) ENERGY *Short Answer* Davidson MS B Team members are studying non-Newtonian fluids like silly putty and flubber. A mysterious bouncy ball has the strange property of bouncing 50% higher on each successive bounce. If the ball is dropped from a height of 10 meters, how much total distance, in meters, will it have covered just before its 4th bounce?

ANSWER: 152.5 [AC]

TOSS-UP

7) BIOLOGY *Short Answer* In what type of mimicry do two unpalatable species resemble each other?

ANSWER: MÜLLERIAN **[*mew-LER-ee-in*]** [GKD]

BONUS

7) BIOLOGY *Short Answer* In a population of twenty-five phoenixes, one individual is blue. Assuming that the population is in Hardy-Weinberg equilibrium and that the allele for red feather color is dominant over the allele for blue feather color, how many individuals are heterozygous?

ANSWER: 8 [EB]

TOSS-UP

8) CHEMISTRY *Multiple Choice* A neutron-rich isotope such as tritium would most likely decay by which of the following mechanisms?

W) Beta minus decay

X) Beta plus decay

Y) Alpha decay

Z) Electron capture

ANSWER: W) BETA MINUS DECAY [EB]

BONUS

8) CHEMISTRY *Short Answer* What law states that the net enthalpy change of a reaction is independent of the number of steps the reaction occurs in?

ANSWER: HESS'S LAW [GKD]

TOSS-UP

9) EARTH AND SPACE *Short Answer* Order the following three minerals from hardest to softest on the Mohs scale:

1) Apatite
2) Gypsum
3) Orthoclase

ANSWER: 3, 1, 2 (ACCEPT: ORTHOCLASE, APATITE, GYPSUM) [EB]

BONUS

9) EARTH AND SPACE *Multiple Choice* Which of the following space telescopes observes in the visible part of the electromagnetic spectrum and was launched to help discover earth-sized exoplanets?

W) Spitzer
X) COBE **[*Coby*]**
Y) Compton
Z) Kepler

ANSWER: Z) KEPLER [EB]

TOSS-UP

10) MATH *Short Answer* Sam has 3 red balls and 5 green balls. If he chooses two balls at random without replacement, what is the probability they are the same color?

ANSWER: 13/28 [SG]

BONUS

10) MATH *Multiple Choice* Given that a perfect number is any number n whose factors sum to 2 times n, which of the following numbers is perfect?

W) 18

X) 24

Y) 28

Z) 36

ANSWER: Y) 28 [AKa]

TOSS-UP

11) PHYSICS *Short Answer* What is the probability that a particle in an infinite square well will be found outside of the well?

ANSWER: 0 [AC]

BONUS

11) PHYSICS *Multiple Choice* How will the temperature of the cosmic microwave background radiation change in the future?

W) It will be hotter

X) It will be colder

Y) It will stay constant

Z) Some parts will get hotter while others will get colder

ANSWER: X) IT WILL BE COLDER [AC]

TOSS-UP

12) ENERGY *Short Answer* Davidson HS B Team members are studying the Harvard Spectral Classification. Order the following four spectral classes from coldest to hottest:

1) A
2) K
3) B
4) F

ANSWER: 2, 4, 1, 3 (ACCEPT: K, F, A, B) [EB]

BONUS

12) ENERGY *Short Answer* Davidson MS A team members are studying weak acids. If the K_a **[*k-a*]** of acetic acid is 2 x 10^{-5}, what is its K_b **[*k-b*]** in scientific notation?

ANSWER: 5 x 10^{-10} [GKD]

TOSS-UP

13) BIOLOGY *Short Answer* Which chamber of the heart is the pulmonary vein connected to?

ANSWER: LEFT ATRIUM [GKD]

BONUS

13) BIOLOGY *Multiple Choice* Which protein blocks the myosin binding sites on actin?

W) Troponin **[*tro-PAW-nin*]**
X) Alpha-actinin
Y) Tropomyosin **[*tro-poe-MY-oh-sin*]**
Z) Desmin

ANSWER: Y) TROPOMYOSIN [GKD]

TOSS-UP

14) CHEMISTRY *Short Answer* What reaction order has a half-life independent of concentration?

ANSWER: FIRST (ACCEPT: ONE) [GKD]

BONUS

14) CHEMISTRY *Short Answer* Consider the decomposition of ozone into oxygen gas. If oxygen gas is evolved at a rate of 6.0×10^{-5} molar per second, to two significant figures and in molar per second, at what rate does ozone disappear?

ANSWER: 4.0×10^{-5} (ACCEPT: -4.0×10^{-5}) [GKD]

TOSS-UP

15) EARTH AND SPACE *Short Answer* In stars, what is the last element produced before nuclear fusion requires more energy than it produces?

ANSWER: IRON [EB]

BONUS

15) EARTH AND SPACE *Short Answer* Order the following three layers of the sun from innermost to outermost:

1) Convective zone
2) Photosphere
3) Radiative zone

ANSWER: 3, 1, 2 (ACCEPT: RADIATIVE ZONE, CONVECTIVE ZONE, PHOTOSPHERE) [EB]

TOSS-UP

16) MATH *Short Answer* On each of the three days from Monday to Wednesday, the probability of rain is 40%. Given that the occurrence of rain on any two days is independent, what is the probability that there is no rain on any of the days? Express your answer as a fraction.

ANSWER: 27/125 [AKa]

BONUS

16) MATH *Short Answer* Two circles of radius 3 are externally tangent to one another and internally tangent to another, larger, circle. Giving your answer in terms of pi, find the smallest possible area of the region inside the larger circle and outside the two smaller circles.

ANSWER: 18 PI [AKa]

TOSS-UP

17) PHYSICS *Multiple Choice* Which of the following necessarily implies that angular momentum is conserved?

W) There is no angular momentum in the system

X) Linear momentum is conserved

Y) The net torque is zero

Z) All forces acting on the system are conservative

ANSWER: Y) THE NET TORQUE IS ZERO [AC]

BONUS

17) PHYSICS *Short Answer* Schrodinger's equation describes the evolution over time of what mathematical description of a quantum state?

ANSWER: WAVEFUNCTION [AC]

TOSS-UP

18) ENERGY *Short Answer* Davidson HS A Team members are currently studying freezing fog. Freezing fog is fog formed at temperatures below freezing and can lead to icy roads as the supercooled droplets in the fog freeze on the road surface. What type of precipitation behaves most similarly to freezing fog?

ANSWER: FREEZING RAIN [EB]

BONUS

18) ENERGY *Multiple Choice* Davidson MS A team members are studying the immune system. Which of the following best describes humoral immunity?

W) Cytokines recruiting neutrophils to the site of infection

X) Antibody release by plasma cells

Y) Killing of infected cells by cytotoxic T cells

Z) Release of interferon by virus-infected cells

ANSWER: X) ANTIBODY RELEASE BY PLASMA CELLS [GKD]

TOSS-UP

19) BIOLOGY *Short Answer* What is the net $FADH_2$ yield per molecule of glucose in the Krebs cycle?

ANSWER: 2 [GKD]

BONUS

19) BIOLOGY *Short Answer* One method of karyotyping **[*CARE-yo-typing*]** involves adding colchicine **[*CULL-chih-seen*]** to cells, a drug that causes microtubules to dissociate into individual tubulin units. What phase of mitosis would this arrest cells in?

ANSWER: METAPHASE [GKD]

TOSS-UP

20) CHEMISTRY *Multiple Choice* Which of the following best describes the titration between chloric acid and ammonia?

W) The equivalence point is at a pH less than 7

X) The equivalence point is at pH 7

Y) The equivalence point is at a pH greater than 7

Z) The equivalence point depends on the indicator used

ANSWER: W) THE EQUIVALENCE POINT IS AT A PH LESS THAN 7 [GKD]

BONUS

20) CHEMISTRY *Short Answer* Identify all of the following three sets of compounds that, if mixed together in the appropriate ratios, would act as buffers:

1) Sodium acetate and acetic acid
2) Dihydrogen phosphate and hydrogen phosphate
3) Carbonate and bicarbonate

ANSWER: ALL [GKD]

TOSS-UP

21) EARTH AND SPACE *Multiple Choice* In the sea/land breeze convective cell, which of the following options best describes surface wind direction at midday and during the night?

W) To sea, to sea

X) To sea, to land

Y) To land, to land

Z) To land, to sea

ANSWER: Z) TO LAND, TO SEA [EB]

BONUS

21) EARTH AND SPACE *Multiple Choice* What is the name of the type of fan fold where the youngest layers are located inside the fold, assuming no layers are overturned?

W) Anticline

X) Syncline

Y) Monocline

Z) Pycnocline **[*PICK-nuh-cline*]**

ANSWER: X) SYNCLINE [EB]

TOSS-UP

22) MATH *Short Answer* What is sixty four raised to the power of quantity log base twenty seven of nine end quantity?

ANSWER: 16 [MD]

BONUS

22) MATH *Short Answer* Yajur is on a farm. He has horses, chickens, and cows. He sees that the number of feet on his horses and cows combined is 32, on his cows and chickens is 42, and his horses and chickens is 26. How many cows does he have?

ANSWER: 6 [MD]

TOSS-UP

23) PHYSICS *Multiple Choice* A 10 kilogram block is released from rest on a frictionless 30^{o} slope. If the acceleration due to gravity is 10 m/s^2, what is the acceleration of the block?

W) 0 m/s^2

X) 5 m/s^2

Y) $5\sqrt{3}$ m/s^2

Z) 10 m/s^2

ANSWER: X) 5 M/S^2 [AC]

BONUS

23) PHYSICS *Short Answer* If the voltage across a circuit is tripled and the resistance is halved, what is the ratio of the power of the new circuit to the original?

ANSWER: 18 (ACCEPT: 18 TO 1) [AC]
