Standard Division Round Robin 2

TOSS-UP

1) BIOLOGY *Short Answer* Identify all of the following three enzymes that are used in both DNA replication and transcription:

1) Helicase
2) Ligase
3) Topoisomerase

ANSWER: 1 AND 3 (ACCEPT: HELICASE AND TOPOISOMERASE) [GKD]

BONUS

1) BIOLOGY *Short Answer* Which component of the eukaryotic cytoskeleton is associated with the motor protein dynein [***DIE-nee-in***]?

ANSWER: MICROTUBULES [GKD]

TOSS-UP

2) CHEMISTRY *Short Answer* A solution at 25°C has a hydrogen ion concentration 100 times greater than its hydroxide ion concentration. What is the pH of this solution?

ANSWER: 6 [GKD]

BONUS

2) CHEMISTRY *Multiple Choice* Which of the following sets of quantum numbers is not allowed in the ground state of antimony, located in period five of the periodic table?

W) N equals 4, L equals 2, M sub L equals 1

X) N equals 5, L equals 1, M sub L equals -1

Y) N equals 2, L equals 0, M sub L equals 0

Z) N equals 3, L equals 3, M sub L equals -2

ANSWER: Z) N EQUALS 3, L EQUALS 3, M SUB L EQUALS -2 [EB]

TOSS-UP

3) EARTH AND SPACE *Short Answer* What is the name for the fusion cycle common in stars greater than 1.3 solar masses where protons fuse with isotopes of three heavier elements before the production of helium and regeneration of the first intermediate?

ANSWER: CNO CYCLE (ACCEPT: BETHE-WEIZSACKER CYCLE) [EB]

BONUS

3) EARTH AND SPACE *Short Answer* What is the name of the point where the solar wind is no longer strong enough to travel through the interstellar medium?

ANSWER: HELIOPAUSE [EB]

TOSS-UP

4) MATH *Short Answer* For a "research project", Sophie goes to 500 different ice cream shops. At each one, she orders vanilla ice cream, and then rolls a die for each of the 20 toppings, getting it if she rolls a 6. What is the expected mode number of toppings?

ANSWER: 3 [MD]

BONUS

4) MATH *Short Answer* Julian and Melody, along with 8 other of their classmates, get in a line randomly. What is the probability the two are next to each other?

ANSWER: 1/5 [MD]

TOSS-UP

5) PHYSICS *Multiple Choice* Which of the following best describes the electric field distribution in a charged conductor?

W) Decreases linearly from center

X) Decreases quadratically from center

Y) Stays zero throughout the interior

Z) Stays a constant, nonzero value throughout the interior

ANSWER: Y) STAYS ZERO THROUGHOUT THE INTERIOR [AC]

BONUS

5) PHYSICS *Short Answer* A satellite orbiting a planet in a circular orbit constantly undergoes gravitation acceleration. Identify all of the following four factors that affect the magnitude of the acceleration:

1) Velocity of satellite
2) Mass of planet
3) Radius of orbit
4) Mass of satellite

ANSWER: 2 AND 3 (ACCEPT: MASS OF PLANET, RADIUS OF ORBIT) [AC]

TOSS-UP

6) ENERGY *Short Answer* Davidson MS B Team members are studying solar system objects and their histories. As the planet Mercury formed, it underwent one, possibly two, periods of heavy bombardment by comets and asteroids, leading to the presence of multiple large impact basins. What is the name of the largest of Mercury's impact basins?

ANSWER: CALORIS BASIN [EB]

BONUS

6) ENERGY *Short Answer* Davidson HS A Team members are studying languages that don't have a base 10 number system. In ancient Mesoamerica, the Mayans used a base 20 system with a combination of three kinds of symbols to represent each digit. A dot meant one, a line meant five, and a shell served as zero. How many shells, dots, and lines, respectively, are contained in the Mayan representation of the base ten number 378?

ANSWER: ZERO, SIX, SIX [EB]

TOSS-UP

7) BIOLOGY *Short Answer* What is the fundamental structural and functional unit of the kidneys?

ANSWER: NEPHRON [GKD]

BONUS

7) BIOLOGY *Short Answer* Identify all of the following three digestive enzymes that would produce glucose as a product:

1) Chymotrypsin **[*kye-mo-TRIP-sin*]**
2) Lactase
3) Lipase

ANSWER: 2 ONLY (ACCEPT: LACTASE) [GKD]

TOSS-UP

8) CHEMISTRY *Multiple Choice* Which of the following graphs would be linear?

W) Plotting concentration versus time for a first order reaction

X) Plotting the natural log of concentration versus time for a first order reaction

Y) Plotting concentration versus time for a second order reaction

Z) Plotting the natural log of concentration versus time for a second order reaction

ANSWER: X) PLOTTING THE NATURAL LOG OF CONCENTRATION VERSUS TIME FOR A FIRST ORDER REACTION [GKD]

BONUS

8) CHEMISTRY *Short Answer* By name or number, order the following three ionic salts in order of decreasing lattice energy:

1) Sodium chloride
2) Potassium chloride
3) Magnesium oxide

ANSWER: 3, 1, 2 (ACCEPT: MAGNESIUM OXIDE, SODIUM CHLORIDE, POTASSIUM CHLORIDE) [EB]

TOSS-UP

9) EARTH AND SPACE *Short Answer* Given a wind coming from the northeast, 45 degrees from true north, what will be the direction of the resulting Ekman transport, with respect to true north, in the Northern hemisphere?

ANSWER: 45 DEGREES WEST OF TRUE NORTH (ACCEPT: 45 DEGREES NORTHWEST) [EB]

BONUS

9) EARTH AND SPACE *Short Answer* What is the name of the deposits of unsorted and unlayered till found specifically at the sides of a glacier?

ANSWER: LATERAL MORAINE (DO NOT ACCEPT: MORAINE) [EB]

TOSS-UP

10) MATH *Short Answer* What is the length of the short base of a trapezoid with a long base of 13, a side length of 13, and a height of 12.

ANSWER: 3 [MD]

BONUS

10) MATH *Short Answer* What is the quantity one plus i end quantity raised to the sixth power?

ANSWER: -8i [MD]

TOSS-UP

11) PHYSICS *Short Answer* What is the SI unit for the strength of a magnetic field?

ANSWER: TESLA [AC]

BONUS

11) PHYSICS *Short Answer* A 4 kilogram block is placed at the top of a 40 meter long ramp that is inclined 30 degrees from the horizontal. Treating the acceleration due to gravity as ten meters per second squared, how long, in seconds, does it take for the block to slide to the bottom of the ramp?

ANSWER: 4 [AC]

TOSS-UP

12) ENERGY *Short Answer* Davidson HS B team members are studying evolution and natural selection. What type of selection is exhibited by the black-bellied seedcracker, a species of bird where individuals with small beaks or large beaks are evolutionarily favored, while individuals with medium beaks are not?

ANSWER: DISRUPTIVE (ACCEPT: DIVERSIFYING) [EB]

BONUS

12) ENERGY *Short Answer* Davidson HS A team members are studying the properties of transition metals. Identify all of the following three transition metals you would expect to form ions in the +3 oxidation state:

1) Iron
2) Zinc
3) Cobalt

ANSWER: 1 AND 3 (ACCEPT: IRON AND COBALT) [GKD]

TOSS-UP

13) BIOLOGY *Multiple Choice* Which of the following interspecific interactions does not benefit either species?

W) Mutualism

X) Commensalism **[*kuh-MEN-suh-lih-zim*]**

Y) Ammensalism **[*uh-MEN-suh-lih-zim*]**

Z) Predation

ANSWER: Y) AMMENSALISM [GKD]

BONUS

13) BIOLOGY *Short Answer* In what type of survivorship is death rate independent of age?

ANSWER: TYPE II [GKD]

TOSS-UP

14) CHEMISTRY *Short Answer* By name or number, identify all of the following three compounds that are polar:

1) Sulfur tetrafluoride
2) Sulfur hexafluoride
3) Sulfur dioxide

ANSWER: 1 AND 3 (ACCEPT: SULFUR TETRAFLUORIDE AND SULFUR DIOXIDE) [EB]

BONUS

14) CHEMISTRY *Short Answer* If half a liter of 0.5 molar phosphoric acid is titrated with one liter of a sodium hydroxide solution, what is the molarity of the sodium hydroxide solution, to two significant figures?

ANSWER: 0.75 [EB]

TOSS-UP

15) EARTH AND SPACE *Short Answer* What are the names for the pointer stars in the Big Dipper that are often used to locate Polaris?

ANSWER: MERAK AND DUBHE **[*DOOB-huh*]** [EB]

BONUS

15) EARTH AND SPACE *Short Answer* Order the following three eons from most recent to oldest:

1) Hadean
2) Archean **[*are-KEY-in*]**
3) Phanerozoic **[*fan-er-oh-ZO-ic*]**

ANSWER: 3, 2, 1 (ACCEPT: PHANEROZOIC, ARCHEAN, HADEAN) [EB]

TOSS-UP

16) MATH *Short Answer* Determine the sum of the integers from 10 to 40 inclusive.

ANSWER: 775 [SG]

BONUS

16) MATH *Multiple Choice* Alan has a list of every integer power of 4. He adds the reciprocal of each number on his list. What sum does he get?

W) 1/3
X) 4/3
Y) 2
Z) Infinity

ANSWER: X) 4/3 [MD]

TOSS-UP

17) PHYSICS *Multiple Choice* A ball is attached to the edge of an initially rotating disk. The disk undergoes a constant, nonzero angular acceleration. Which of the following directions cannot describe the ball's acceleration vector?

W) With a component in the direction of tangential velocity and a component pointing towards the center

X) With a component opposite the direction of tangential velocity and a component pointing towards the center

Y) Having a magnitude greater than the magnitude of its tangential acceleration

Z) Pointing directly towards the center of the disk

ANSWER: Z) POINTING DIRECTLY TOWARDS THE CENTER OF THE DISK [AC]

BONUS

17) PHYSICS *Multiple Choice* Which of the following is true about magnetic fields?

W) Unlike electric fields, magnetic fields only attract other magnetic fields, not repel

X) Changing magnetic fields can change the current through a wire

Y) Magnetic field line always point away from magnets

Z) Magnetic fields drop with the cube of distance

ANSWER: X) CHANGING MAGNETIC FIELDS CAN CHANGE THE CURRENT THROUGH A WIRE [AC]

TOSS-UP

18) ENERGY *Multiple Choice* Davidson HS A Team Members are studying particle physics. Which of the following particles is a fermion?

W) Photon

X) Muon **[*MEW-on*]**

Y) Gluon

Z) Higgs

ANSWER: X) MUON [GKD]

BONUS

18) ENERGY *Short Answer* Davidson MS C Team members are currently studying atmospheric convective cells. At the intersection of the Hadley and the Ferrel cells, the sinking of warming air leads to increased evaporation and the formation of deserts. At what degree of latitude does this take place?

ANSWER: 30 DEGREES (ACCEPT: 30 DEGREES NORTH AND SOUTH) [EB]

TOSS-UP

19) BIOLOGY *Multiple Choice* What layer of cells is found just inside of the endodermis and is the formation site of lateral roots?

W) Pericycle

X) Procambium

Y) Ground meristem

Z) Pith

ANSWER: W) PERICYCLE [GKD]

BONUS

19) BIOLOGY *Short Answer* What enzyme, used in C_4 and CAM plants to limit photorespiration, has a much higher affinity for CO_2 than RuBisCO?

ANSWER: PEP CARBOXYLASE [GKD]

TOSS-UP

20) CHEMISTRY *Short Answer* Which law of thermodynamics states that the entropy of the universe will always increase?

ANSWER: SECOND LAW [GKD]

BONUS

20) CHEMISTRY *Multiple Choice* What are the molecular and electron domain geometries, respectively, of ammonia?

W) Tetrahedral, trigonal bipyramidal

X) Tetrahedral, trigonal pyramidal

Y) Trigonal bipyramidal, tetrahedral

Z) Trigonal pyramidal, tetrahedral

ANSWER: Z) TRIGONAL PYRAMIDAL, TETRAHEDRAL [EB]

TOSS-UP

21) EARTH AND SPACE *Multiple Choice* Which of the following mineral groups is most common in the Earth's crust?

W) Sulfate

X) Silicate

Y) Oxide

Z) Carbonate

ANSWER: X) SILICATE [EB]

BONUS

21) EARTH AND SPACE *Multiple Choice* In which of the following ocean zones would you most likely find infauna?

W) Epipelagic

X) Mesopelagic

Y) Benthic

Z) Photic

ANSWER: Y) BENTHIC [EB]

TOSS-UP

22) MATH *Multiple Choice* Determine the number of zeros after the last nonzero digit of 30!.

W) 4

X) 5

Y) 6

Z) 7

ANSWER: Z) 7 [SG]

BONUS

22) MATH *Multiple Choice* 5% of the population is positive for COVID-19, and COVID tests have a 1% false positive rate. If a person tests positive for COVID, which of the following is closest to the probability that they actually contracted the virus?

W) 65%

X) 75%

Y) 85%

Z) 95%

ANSWER: Y) 85% [GKD]

TOSS-UP

23) PHYSICS *Short Answer* Which famous physicist predicted the existence of antimatter with his namesake equation?

ANSWER: DIRAC (ACCEPT: PAUL DIRAC) [AC]

BONUS

23) PHYSICS *Short Answer* Given the speed of light as three times ten to the eighth meters per second, what is the frequency in Hertz, to two significant figures and in scientific notation, of an orange photon with a wavelength of 6.0 times ten to the second power nanometers?

ANSWER: $5.0 * 10^{14}$ HERTZ [EB]
