

Middle School
Set 7

TOSS-UP

1) Life Science – *Short Answer* Microtubules, microfilaments, and intermediate filaments together form what network of support structures for the cell?

ANSWER: CYTOSKELETON

BONUS

1) Life Science – *Multiple Choice* Within a given codon, which of the following mutations would have the highest likelihood of being a synonymous alteration within the resulting amino acid?

- W) Substitution of a base in the third position
- X) Deletion of a base in the third position
- Y) Substitution of a base in the first position
- Z) Deletion of a base in the first position

ANSWER: W) SUBSTITUTION OF A BASE IN THE THIRD POSITION

TOSS-UP

2) Math – *Multiple Choice* Which of the following is a negation of the statement “ A is a subset of B ”?

- W) B is a subset of A
- X) All elements of A are in B
- Y) No elements of A are in B
- Z) Some elements of A are not in B

ANSWER: Z) SOME ELEMENTS OF A ARE NOT IN B

BONUS

2) Math – *Short Answer* If z varies directly as x and inversely as y , and $z = 4$ when $x = 10$ and $y = 7$, what is z when $x = 2$ and $y = 9$?

ANSWER: 28/45

TOSS-UP

3) Physical Science – *Short Answer* What theory, proposed by Einstein, explains gravity in terms of the properties of space and time?

ANSWER: GENERAL THEORY OF RELATIVITY (ACCEPT: GENERAL RELATIVITY; do not accept: THEORY OF RELATIVITY, SPECIAL THEORY OF RELATIVITY)

BONUS

3) Physical Science – *Multiple Choice* In an ideal monatomic gas, which of the following is closest to the average energy per particle, in units of Boltzmann's constant times temperature?

- W) 1
- X) $3/2$
- Y) 2
- Z) $5/2$

ANSWER: X) $3/2$

TOSS-UP

4) Earth and Space – *Multiple Choice* Aa [**AH-ah**] and pahoehoe [**pah-HOH-ay-HOH-ay**] are types of lava flows most associated with what type of magma?

- W) Mafic [**MAY-fik**]
- X) Felsic
- Y) Intermediate
- Z) Ultramafic

ANSWER: W) MAFIC

BONUS

4) Earth and Space – *Short Answer* A wave approaches a shoreline at an oblique angle, causing the wave to slow, begin to break, and bend parallel to the shoreline. This is an example of what physical phenomenon?

ANSWER: REFRACTION

TOSS-UP

5) Energy – *Multiple Choice* Scientists at Lawrence Berkeley National Lab are studying enzymes responsible for fat metabolism. In what animal organelle are these enzymes most active?

- W) Cytosol
- X) Mitochondrion
- Y) Nucleus
- Z) Smooth ER

ANSWER: X) MITOCHONDRION

BONUS

5) Energy – *Short Answer* Scientists at Pacific Northwest National Lab are studying the metabolomes *[meh-TAB-ah-loamz]* of various tissues and organisms. Identify all of the following three molecules or structures that are considered part of the metabolome: 1) Estrogen; 2) Glutamate; 3) Myosin.

ANSWER: 1, 2

TOSS-UP

6) Life Science – *Multiple Choice* Cellulose and glycogen are examples of what type of macromolecule?

- W) Protein
- X) Lipid
- Y) Carbohydrate
- Z) Nucleic acid

ANSWER: Y) CARBOHYDRATE

BONUS

6) Life Science – *Short Answer* Some birds will form a social bond with the first object they see after birth. What is the term for this type of learning?

ANSWER: IMPRINTING



TOSS-UP

7) Math – *Short Answer* If the minute hand on your clock is 15 centimeters long, how many centimeters is the angular distance its tip travels in 48 minutes?

ANSWER: 24π

BONUS

7) Math – *Short Answer* In the arithmetic sequence with second term -5 and fourth term 7 , what is the 221st term?

ANSWER: 1309

TOSS-UP

8) Physical Science – *Multiple Choice* Which of the following substances possesses network covalent bonding?

- W) Solid gold
- X) Graphite
- Y) Sodium chloride
- Z) Brass

ANSWER: X) GRAPHITE

BONUS

8) Physical Science – *Short Answer* Identify all of the following three molecules that are considered polar: 1) Water; 2) Octane; 3) Methanol.

ANSWER: 1, 3

TOSS-UP

9) Earth and Space – *Short Answer* What is the term for substellar "failed" stars that have a mass between 12 and 80 Jupiter masses?

ANSWER: BROWN DWARFS

BONUS

9) Earth and Space – *Short Answer* Place the following three stages of a Sun-like main-sequence star's evolution in chronological order:
1) Helium flash; 2) White dwarf; 3) Asymptotic *[ay-sim-TAW-dik]* giant branch.

ANSWER: 1, 3, 2

TOSS-UP

10) Energy – *Short Answer* Scientists supported by the Department of Energy are studying superfluidity, a phenomenon first observed by cooling what noble gas to nearly absolute zero?

ANSWER: HELIUM

BONUS

10) Energy – *Short Answer* Scientists at Argonne National Lab are studying fcc crystal structures. In the fcc lattice, how many lattice points are there per unit cell?

ANSWER: 4

TOSS-UP

11) Life Science – *Short Answer* What enzyme secreted by the stomach is responsible for the first step of protein digestion?

ANSWER: PEPSIN (ACCEPT: PEPSINOGEN)

BONUS

11) Life Science – *Short Answer* What is the evolutionary term for the type of behavior that imposes a cost on the organism that is performing it but benefits another individual?

ANSWER: ALTRUISM (ACCEPT: ALTRUISTIC)

TOSS-UP

12) Math – *Short Answer* One night, Jane started reading at the top of page 146 in her latest science fiction book and finished at the bottom of page 279. How many pages did she read?

ANSWER: 134

BONUS

12) Math – *Short Answer* How many three-digit integers are multiples of 23?

ANSWER: 39

TOSS-UP

13) Physical Science – *Short Answer* Consider a transformer with 100 turns on the primary side and 400 turns on the secondary. If the current into the primary is 60 amperes, then, in amperes, what will be the current on the secondary side?

ANSWER: 15

BONUS

13) Physical Science – *Short Answer* A power lifter performs a clean and jerk, lifting a 250-kilogram barbell vertically by 2 meters. In joules, how much work did he perform on the barbell?

ANSWER: 4900

TOSS-UP

14) Earth and Space – *Multiple Choice* Which of the following is closest to the apparent magnitude of the full Moon?

- W) –26
- X) –13
- Y) –4
- Z) 5

ANSWER: X) –13

BONUS

14) Earth and Space – *Short Answer* You set up a long-exposure camera during the night and center it around the North Star. After viewing the photograph, you see that every star has traced out an arc that is a quarter of a circle. To the nearest hour, how long did you expose the photograph?

ANSWER: 6



TOSS-UP

15) Energy – *Short Answer* Scientists at Pacific Northwest National Lab are developing sodium-ion batteries. Identify all of the following three statements that are true of these batteries: 1) Relative to lithium-ion batteries, they have a lower cost of raw materials; 2) Relative to lead-acid batteries, they have a high energy density; 3) Relative to lithium-ion batteries, they are much more efficient.

ANSWER: 1, 2

BONUS

15) Energy – *Short Answer* Scientists at the DIII-D **[D3D]** National Fusion Facility are studying nuclear fusion. In what state of matter is the substance they are fusing?

ANSWER: PLASMA