2022 MIT Science Bowl High School Invitational
Tiebreak Round 8

TOSSUP

1) CHEMISTRY *Multiple Choice* Catherine is studying the first-order photoisomerization of an alkene by plotting a graph of the logarithm of concentration of reactant against time. Which of the following must be true about Catherine's graph as temperature is increased?

W) The graph slopes further up
X) The graph slopes further down
Y) The graph's y-intercept increases
Z) The graph's y-intercept decreases

ANSWER: X) The graph slopes further down

TOSS UP

2) EARTH AND SPACE *Short Answer* By name or number, order the following three stars from leftmost to rightmost as they appear on the HR diagram:

1) Arcturus
2) Betelgeuse
3) Rigel

ANSWER: 3, 1, 2

TOSS UP

3) PHYSICS *Short Answer* In 1935, Einstein, Podolsky, and Rosen pointed out their famous paradox that quantum mechanics is nonlocal, and suggested that a hidden-variable theory could heal this nonlocality. However, what result in 1964 showed that quantum mechanics is inconsistent with any local hidden-variable theory?

ANSWER: Bell's theorem (ACCEPT: Bell's inequality)

TOSS UP

4) BIOLOGY *Multiple Choice* Which of the following brain structures forms from the diencephalon (*DYE-en-SEH-fuh-lon*)?

W) Cerebrum (*sur-EE-bruhm*)
X) Thalamus (*THA-luh-muhs*)
Y) Pons (*paanz*)
Z) Medulla oblongata (*muh-DUH-luh ah-bluhng-GAH-tuh*)

ANSWER: X) Thalamus

TOSS UP

5) MATH *Short Answer* Let $p(i)$ denote the i-th smallest prime, where $p(1) = 2$. By name or number, identify all of the following that CANNOT be true of $p(i+1) - p(i)$:

1) The difference is odd
2) The difference is four less than the sixth power of an integer
3) The difference is greater than $p(i)$

ANSWER: 3 only
