AP Chemistry Kinetics Practice

Choose one answer per question. Circle A, B, C, or D.

1. A simulation plots the concentration of reactant X against time as X becomes a product. Which feature shows that X is disappearing fastest in the first five seconds?
   A. The line has its steepest downward slope then.
   B. The concentration is highest then.
   C. The line is horizontal then.
   D. The line has its shallowest downward slope then.

2. The vertical axis of a concentration graph is in mol/L, and the horizontal axis is in seconds. Which units describe the slope?
   A. mol·s/L
   B. L/(mol·s)
   C. mol/(L·s)
   D. mol/L

3. Two otherwise identical particle simulations run at different temperatures. Which statement explains why the hotter model can reach a product faster?
   A. Each reactant molecule is heavier.
   B. A larger fraction of collisions has enough energy to cross the barrier.
   C. There is a smaller fraction of high-energy collisions.
   D. Heating removes the energy difference between reactants and products.

4. Two drawings show equal masses of an inert model solid. One drawing splits the solid into many smaller pieces. Which quantity is greater in that drawing?
   A. Density of the solid
   B. Mass of solid present
   C. Average size of each piece
   D. Surface area available for contact

5. Two energy profiles have the same reactant and product energies. One route has a lower highest barrier measured from the reactants. Which conclusion follows in the usual catalyst model?
   A. The catalyst makes the products have higher energy.
   B. The catalyst provides an alternative pathway.
   C. The catalyst changes the overall energy difference.
   D. The catalyst removes the products from the system.

6. In a fictional run, [X] drops from 0.36 to 0.24 mol/L in 30 seconds. What is the positive average disappearance rate of X over that interval?

A. 0.0040 mol/(L·s)
B. 0.012 mol/(L·s)
C. 0.120 mol/(L·s)
D. 4.0 mol/(L·s)

7. For the model reaction 2 X → 3 Y, Y forms at 0.060 mol/(L·s). At what positive rate is X disappearing at that instant?

A. 0.090 mol/(L·s)
B. 0.020 mol/(L·s)
C. 0.060 mol/(L·s)
D. 0.040 mol/(L·s)

8. A simulation follows rate = $k[X][Y]^2$. The researcher halves [X] and doubles [Y] while keeping k fixed. What happens to the initial rate?

A. It falls to half.
B. It stays the same.
C. It doubles.
D. It quadruples.

9. Three simulations plot [X], ln[X], and 1/[X] against time. Only 1/[X] produces a straight line. What order does that result support for a one-reactant model?

A. Second order
B. Zero order
C. First order
D. Third order

10. Model M starts at twice the concentration of model N. Both follow first-order decay with the same rate constant. How do their half-lives compare?

A. Their half-lives differ by the starting concentration.
B. M’s half-life is twice as long.
C. N’s half-life is twice as long.
D. They are equal.

11. A model obeys rate = $k[X]^2[Y]$, with rate in mol/(L·s) and each concentration in mol/L. Which units must k have?

A. 1/s
B. L/(mol·s)
C. $L^2/(mol^2 \cdot s)$
D. $mol^2/(L^2 \cdot s)$

12. A diagram shows step 1, X + Y → I, and step 2, I + Y → Z. Which overall model and intermediate follow from those two steps?

A. X + Y → Z, with I as an intermediate
B. X + 2 Y → Z, with I as an intermediate
C. X + 2 Y → Z + I, with Y as an intermediate
D. X + 2 I → Z, with Y as an intermediate

13. For a simulated first-order decay, [X] starts at 0.640 mol/L and the half-life is 8 minutes. If the model runs for 24 minutes, what concentration remains?

A. 0.320 mol/L
B. 0.160 mol/L
C. 0.240 mol/L
D. 0.080 mol/L

14. For a first-order model, ln[X] decreases from −1.00 to −1.60 over 20 seconds. What are the rate constant and approximate half-life?

A. 0.030 s^{-1} and 23 s
B. 0.030 s^{-1} and 46 s
C. 0.60 s^{-1} and 1.2 s
D. 0.60 s^{-1} and 23 s

15. A fictional model has a fast equilibrium X + Y ⇌ I with K = [I]/([X][Y]), followed by slow I + Y → Z. Which initial-rate law results if the slow step controls the rate?

A. Rate = $k_2K[X][Y]$
B. Rate = $k_2K[X]^2[Y]$
C. Rate = $k_2K[X][Y]^2$
D. Rate = $k_2[X]/(K[Y])$