

1. At constant temperature, increasing solution concentration primarily changes which feature?
 - ☐ Every particle's energy by the same factor
 - ☐ Frequency of reactant collisions
 - ☐ The activation energy of the original pathway
2. After a disturbance, which statement describes a new equilibrium?
 - ☐ The reactions stop once the new concentrations are reached
 - ☐ The forward and reverse rates both become zero
 - ☐ The forward and reverse rates become equal again
3. Why does a higher-boiling component generally condense lower in the column?
 - ☐ It cools more slowly, so it condenses further up the column
 - ☐ The lower region is hotter and it condenses before reaching cooler regions
 - ☐ Higher-boiling molecules are smaller, so they sink to the bottom
4. What is retained when bromine adds to an alkene?
 - ☐ Its carbon skeleton and original hydrogen atoms
 - ☐ Its carbon-carbon double bond unchanged
 - ☐ No bromine atoms in the product
5. What forms from ethanoic acid and ethanol in the taught reaction?
 - ☐ Only carbon dioxide
 - ☐ An alkane and hydrogen
 - ☐ Ethyl ethanoate and water
6. A double-stranded DNA model has 24 paired positions. Count all its nucleotides.
_____ nucleotides
7. A supplied record has eight clear positives out of ten trials. Calculate positive percentage.
_____ %
8. Six of eight supplied white-precipitate samples dissolve in excess sodium hydroxide. Calculate their percentage.
_____ %

9. A supplied linear zero-background calibration has signal 20 at 2 mg/L and 40 at 4 mg/L. Read concentration for signal 35.

_____ mg/L

10. Disposable energy is 15 units per task; reusable energy is 40 initially plus 5 per task. At which first whole task does reuse use strictly less energy?

_____ tasks

1. Frequency of reactant collisions

Higher concentration packs more reactant particles into the same volume, so collisions happen more often - frequency is what changes. The activation energy and the particles' energy distribution are untouched at constant temperature.

2. The forward and reverse rates become equal again

After a disturbance the system shifts until the forward and reverse rates match again - that equality defines the new equilibrium. The favoured direction does not run alone, and the new concentrations generally differ from the originals.

3. The lower region is hotter and it condenses before reaching cooler regions

The column is hottest at the bottom. A high-boiling component condenses as soon as the vapour cools below its boiling point - which happens low in the column - while low-boiling vapours rise to cooler regions before condensing.

4. Its carbon skeleton and original hydrogen atoms

Addition keeps the whole alkene skeleton: one bromine joins each double-bonded carbon and the C=C becomes C-C, with every original hydrogen untouched. The product is a dibromoalkane, so the double bond is NOT retained.

5. Ethyl ethanoate and water

Acid plus alcohol gives an ester plus water: ethanoic acid and ethanol form ethyl ethanoate and water. No carbon dioxide, alkane or hydrogen is involved.

6. 48 nucleotides

The result is 48 nucleotides. Known: 24 paired positions, each holding one nucleotide from each of the two chains. Total nucleotides = $24 \times 2 = 48$ nucleotides.

7. 80 %

The result is 80 %. Known: 8 clear positives out of 10 trials. Use percentage = positives / trials $\times 100$. Percentage = $8/10 \times 100 = 80\%$. The proportion describes outcomes, not hydrogen purity.

8. 75 %

The result is 75 %. Known: 6 of 8 white-precipitate samples dissolve in excess sodium hydroxide. Use percentage = dissolving / total $\times 100$. Percentage = $6/8 \times 100 = 75\%$. This is a sample count, not a composition figure for any sample.

9. 3.5 mg/L

The result is 3.5 mg/L. Known: signal 20 at 2 mg/L and 40 at 4 mg/L, linear through zero. Signal per concentration = 10 per mg/L. At signal 35: concentration = $35/10 = 3.5$ mg/L. The calibration line turns the signal into a concentration.

10. 5 tasks

$15n = 40 + 5n$ gives $10n = 40$, so equality is $n = 4$. Strictly less reusable energy starts at task 5: 65 units versus 75 units. Do not report equality at 4 as a strict saving.