AP CHEMISTRY • EXERCISE SHEET

7.10 The Reaction Quotient and Le Chatelier's Principle

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

Objective

Build the skills to answer exam questions on **the reaction quotient and Le Chatelier's principle** —using Q vs K to explain a shift.

You must be able to:

- show how a stress changes Q relative to K
- predict the shift that restores $Q = K$
- connect the Q/K view to Le Chatelier

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

A stress changes Q

Adding or removing a species instantly changes Q but not K. The system then shifts to bring Q back to K —the quantitative reason behind Le Chatelier.

A worked concentration change

At equilibrium $Q = K$. **Add reactant** $\rightarrow$ the denominator grows $\rightarrow$ Q **drops below** K $\rightarrow$ reaction shifts **forward** until $Q = K$ again.

Removing a product

Remove product $\rightarrow$ the numerator shrinks $\rightarrow$ Q drops below K $\rightarrow$ shifts **forward** to remake product.

Why temperature is different

Concentration and pressure changes move Q toward a fixed K. A **temperature** change instead changes K **itself**, so the system shifts to reach the new K.

2 Practice

Now apply the methods above.

2.1 Adding a reactant makes Q do what (relative to K)? [1]

2.2 If $Q < K$ after a stress, which way does the reaction shift? [1]

2.3 Does adding a reactant change K? [1]

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3 Exam-style questions

3.1 Removing a product from an equilibrium causes Q to [1]

- **A** rise above K
- **B** fall below K
- **C** stay equal to K
- **D** become zero

3.2 For $\mathrm{A} \rightleftharpoons \mathrm{B}$ at equilibrium, more B is suddenly added.

(a) State how Q changes relative to K. [1]

(b) State the direction of shift and explain using Q and K. [2]

3.3 Explain why a concentration change shifts the equilibrium but leaves K unchanged, whereas a temperature change alters K. [2]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **7.10 The Reaction Quotient and Le Chatelier's Principle** lesson on the **Learn** page;
- read the **The Reaction Quotient and Le Chatelier's Principle** section of the AP Chemistry handout on the **Know** page.

Solutions

2.1 Q falls below K.

2.2 Forward (toward products).

2.3 No.

3.1 B —removing a product lowers the numerator, so Q falls below K.

3.2 (a) Q rises above K (more product in the numerator). (b) Shifts **reverse** (toward A), because $Q > K$ so the reaction consumes B to bring Q back down to K.

3.3 Concentration changes only move the current Q; the reaction shifts to restore the same K. Temperature changes the equilibrium position by changing K itself (since K depends on temperature).