**Quiz 1**

# Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work. Where appropriate answers should be boxed for clarity, written to the correct number of significant figures, and, include the proper units.

1. Consider the reaction: NH4HS (s) $⇌$ NH3 (g) + H2S (g)

At a certain temperature, Kc = 8.5 × 10-3. A reaction mixture at this temperature containing solid ammonium bisulfide has 0.166 M ammonia and hydrogen sulfide (8 points).

* 1. Will more of the solid form or will some of the existing solid decompose as equilibrium is reached? Explain.

$$Q\_{c}=\left[NH\_{3}\right]\left[H\_{2}S\right]$$

$$Q\_{c}=\left(0.166 M\right)\left(0.166 M\right)=0.027556 ≈2.76×10^{-2} $$

Q > K, so the reaction will shift to the left and more solid will form.

1. Dilute exactly 10.0 mL of 2.2 M acetic acid to 25.0 mL. What is the new concentration of the acetic acid (4 points)?

$$M\_{1}V\_{1}=M\_{2}V\_{2}⇒M\_{2}=\frac{M\_{1}V\_{1}}{V\_{2}}=\frac{(2.2 M)(10.0 mL)}{(25.0 mL)}=0.88 M $$

1. The interhalogen compound ClF3 is prepared in a two-step fluorination of chlorine gas (8 points):
	* 1. Cl2 (g) + F2 (g) $⇌$ ClF (g)
		2. ClF (g) + F2 (g) $⇌$ ClF3 (g)
2. Balance each step and write the overall equation.

Cl2 (g) + F2 (g) $⇌$ 2 ClF (g) $Q\_{1}=\frac{\left[ClF\right]^{2}}{\left[Cl\_{2}\right][F\_{2}]}$

+ (ClF (g) + F2 (g) $⇌$ ClF3 (g) ) **× 2** $Q\_{2}=\frac{\left[ClF\_{3}\right]^{2}}{\left[ClF\right]^{2}[F\_{2}]^{2}}$

Cl2 (g) + 3 F2 (g) $⇌$ 2 ClF3 (g) $Q\_{overall}=\frac{\left[ClF\_{3}\right]^{2}}{\left[Cl\_{2}\right][F\_{2}]^{3}}$

1. Show that the overall Qc equals the products of the Qc’s for the individual steps.

$$Q\_{overall}=Q\_{1}×Q\_{2}=\frac{\left[ClF\right]^{2}}{\left[Cl\_{2}\right][F\_{2}]}×\frac{\left[ClF\_{3}\right]^{2}}{\left[ClF\right]^{2}[F\_{2}]^{2}}=\frac{\left[ClF\_{3}\right]^{2}}{\left[Cl\_{2}\right][F\_{2}]^{3}}$$

Or another solution that does not remove the intermediate of ClF:

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		2. ClF (g) + F2 (g) $⇌$ ClF3 (g)
2. Balance each step and write the overall equation.

Cl2 (g) + F2 (g) $⇌$ **2** ClF (g) $Q\_{1}=\frac{\left[ClF\right]^{2}}{\left[Cl\_{2}\right][F\_{2}]}$

+ ClF (g) + F2 (g) $⇌$ ClF3 (g) $Q\_{2}=\frac{\left[ClF\_{3}\right]}{\left[ClF\right][F\_{2}]}$

Cl2 (g) + 2 F2 (g) + ClF (g) $⇌$ ClF3 (g) + 2 ClF (g) simplify:

Cl2 (g) + 2 F2 (g) $⇌$ ClF3 (g) + ClF (g) $Q\_{overall}=\frac{\left[ClF\_{3}\right][ClF]}{\left[Cl\_{2}\right][F\_{2}]^{2}}$

1. Show that the overall Qc equals the products of the Qc’s for the individual steps.

$$Q\_{overall}=Q\_{1}×Q\_{2}=\frac{\left[ClF\right]^{2}}{\left[Cl\_{2}\right][F\_{2}]}×\frac{\left[ClF\_{3}\right]}{\left[ClF\right][F\_{2}]}=\frac{\left[ClF\_{3}\right][ClF]}{\left[Cl\_{2}\right][F\_{2}]^{2}}$$