YEAR 12 CHEMISTRY - EQUILIBRIUM WORKSHEET 1

REACTION	CHANGE	OBSERVATIONS	POSITION OF EQUILIBRIUM	EXPLANATION
$H_{2(g)}$ + $I_{2(g)} \rightleftharpoons 2\ HI_{(g)}$ colourless violet colourless (purple)	Remove some HI at constant volume			
$Cu(H_2O)_4{}^{2+}{}_{(aq)}$ + $4\ C\ell^-{}_{(aq)} \rightleftharpoons$ blue colourless $CuC\ell_4{}^{2-}{}_{(aq)}$ + $4\ H_2O_{(\ell)}$ yellow	Remove some $C\ell^-{}_{(aq)}$			
$N_{2(g)} + 3\ H_{2(g)} \rightleftharpoons 2\ NH_{3(g)}$ all colourless ΔH –ve	Decrease the temperature			
$2\ NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$ ΔH -ve brown colourless	Raise the temperature			
$2\ CrO_4{}^{2-}{}_{(aq)}$ + $2\ H^+{}_{(aq)} \rightleftharpoons$ yellow $Cr_2O_7{}^{2-}{}_{(aq)}$ + $H_2O_{(\ell)}$ Orange	Add $OH^-{}_{(aq)}$			

YEAR 12 CHEMISTRY - EQUILIBRIUM WORKSHEET 2

REACTION	CHANGE	OBSERVATIONS	POSITION OF EQUILIBRIUM	EXPLANATION
$2\ NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$ ΔH -ve brown colourless	Reduce the volume of the container			
$N_{2(g)} + 3\ H_{2(g)} \rightleftharpoons 2\ NH_{3(g)}$ all colourless ΔH –ve	Increase the volume of the container			
$CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$ white white colourless ΔH +ve	Reduce the temperature			
$2\ CrO_4{}^{2-}{}_{(aq)} + 2\ H^+{}_{(aq)} \rightleftharpoons$ yellow $Cr_2O_7{}^{2-}{}_{(aq)} + H_2O_{(\ell)}$ Orange	Increase the concentration of $CrO_4{}^{2-}{}_{(aq)}$			
$H_{2(g)} + I_{2(g)} \rightleftharpoons 2\ HI_{(g)}$ colourless violet colourless	Add more H_2 at constant volume			

YEAR 12 CHEMISTRY - EQUILIBRIUM WORKSHEET 3

REACTION	CHANGE	OBSERVATIONS	POSITION OF EQUILIBRIUM	EXPLANATION
$Cu(H_2O)_4{}^{2+}{}_{(aq)} + 4\ C\ell^-{}_{(aq)} \rightleftharpoons$ blue colourless $CuC\ell_4{}^{2-}{}_{(aq)} + 4\ H_2O_{(\ell)}$ yellow	Add water			
$H_{2(g)} + I_{2(g)} \rightleftharpoons 2\ HI_{(g)}$ colourless violet colourless	Reduce the volume of the container			
$I_{2(g)} \rightleftharpoons I_{2(s)}$ violet black ΔH -ve	Remove some $I_{2(s)}$			
$I_{2(g)} \rightleftharpoons I_{2(s)}$ violet black ΔH -ve	Increase the volume of the container			
$I_{2(g)} \rightleftharpoons I_{2(s)}$ violet black ΔH -ve	Increase the temperature			

YEAR 12 CHEMISTRY - EQUILIBRIUM WORKSHEET 1

REACTION	CHANGE	OBSERVATIONS	POSITION OF EQUILIBRIUM	EXPLANATION
$H_{2(g)}$ + $I_{2(g)} \rightleftharpoons 2\,HI_{(g)}$ colourless violet colourless	Remove some HI at constant volume	Solution would become lighter	$\rightarrow$	System trying to increase the HI concentration
$Cu(H_2O)_4{}^{2+}{}_{(aq)} + 4\,C\ell^-{}_{(aq)} \rightleftharpoons$ blue colourless $CuC\ell_4{}^{2-}{}_{(aq)} + 4\,H_2O_{(\ell)}$ yellow	Remove Some $C\ell^-{}_{(aq)}$	Solution would become bluer	$\leftarrow$	Trying to increase the chloride ion concentration
$N_{2(g)} + 3\,H_{2(g)} \rightleftharpoons 2\,NH_{3(g)}$ all colourless ΔH –ve	Decrease the temperature	No visual observations	$\rightarrow$	Trying to increase the temperature so it would favour the exothermic reaction
$2\,NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$ ΔH -ve brown colourless	Raise the temperature	Go Darker Brown	$\leftarrow$	Trying to decrease the temperature to it will favour the endothermic reaction
$2\,CrO_4{}^{2-}{}_{(aq)} + 2\,H^+{}_{(aq)} \rightleftharpoons$ yellow $Cr_2O_7{}^{2-}{}_{(aq)} + H_2O_{(\ell)}$ Orange	Add $OH^-{}_{(aq)}$	Become yellower	$\leftarrow$	H^+ ion concentration will decrease due to reaction with OH^-, so system will be trying to increase the H^+ ions

YEAR 12 CHEMISTRY - EQUILIBRIUM WORKSHEET 2

REACTION	CHANGE	OBSERVATIONS	POSITION OF EQUILIBRIUM	EXPLANATION
$2\,NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$ ΔH -ve brown colourless	Reduce the volume of the container	Colour will fade	$\longrightarrow$	Trying to decrease the pressure so it will favour the side with less molecules
$N_{2(g)} + 3\,H_{2(g)} \rightleftharpoons 2\,NH_{3(g)}$ all colourless ΔH –ve	Increase the volume of the container	No visual observations	$\longleftarrow$	Trying to increase the pressure so favour the side with more molecules
$CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$ white white colourless ΔH +ve	Reduce the temperature	No visual observations	$\longleftarrow$	Trying to increase the temperature so it will favour the exothermic reaction
$2\,CrO_4^{2-}{}_{(aq)} + 2\,H^+{}_{(aq)} \rightleftharpoons$ yellow $Cr_2O_7^{2-}{}_{(aq)} + H_2O_{(\ell)}$ Orange	Increase the concentration of $CrO_4^{2-}{}_{(aq)}$	From yellow to orange	$\longrightarrow$	Trying to decrease the chromate ion concentration so it will favout the forward reaction
$H_{2(g)} + I_{2(g)} \rightleftharpoons 2\,HI_{(g)}$ colourless violet colourless	Add more H_2 at constant volume	Colour will fade	$\longrightarrow$	Trying to decrease the hydrogen gas concentration so favour the forward reaction .

YEAR 12 CHEMISTRY - EQUILIBRIUM WORKSHEET 3

REACTION	CHANGE	OBSERVATIONS	POSITION OF EQUILIBRIUM	EXPLANATION
$Cu(H_2O)_4{}^{2+}{}_{(aq)} + 4\,C\ell^-{}_{(aq)} \rightleftharpoons CuC\ell_4{}^{2-}{}_{(aq)} + 4\,H_2O_{(\ell)}$ blue, colourless, yellow	Add water	Become blue	←	
$H_{2(g)} + I_{2(g)} \rightleftharpoons 2\,HI_{(g)}$ colourless violet colourless	Reduce the volume of the container	No change- depending on the volume decrease it may look a little darker	No change	No change
$I_{2(g)} \rightleftharpoons I_{2(s)}$ violet black ΔH -ve	Remove $I_{2(s)}$ ✓ Some	No change	No change	No Change
$I_{2(g)} \rightleftharpoons I_{2(s)}$ violet black ΔH -ve	Increase the volume of the container	Become a little lighter, more purple	←	Trying to increase pressure so favour reverse reaction
$I_{2(g)} \rightleftharpoons I_{2(s)}$ violet black ΔH -ve	Increase the temperature	More violet	←	Trying to decrease temperature to favour the endothermic reaction.

Comparing Factors affecting Rate and Position of Equilibrium

	Reaction Rate			Position of equilibrium
	Forward rate	Reverse rate	Explanation	Explanation
Temperature (mean $E_K = \frac{1}{2}mv^2$)				
Increasing the temperature				
Decreasing the temperature				
Concentration (number of particles/moles)				
Increasing the concentration				
Decreasing the concentration				
Gas Pressure ($P \equiv n$)				
Increasing the pressure or (decreasing the volume)				
Decreasing the pressure or (increasing the volume)				
Note: if the numbers of moles on both sides of a gaseous equilibrium system are equal, altering the pressure has no effect on the position of equilibrium because the concentrations of all species are altered (changed) by an equal amount.				
Degree of subdivision (surface area)				
Increasing the surface area				
Decreasing the surface area				
Catalyst				
Addition of a catalyst				

Comparing Factors affecting Rate and Position of Equilibrium

	Reaction Rate			Position of equilibrium
	Forward rate	**Reverse rate**	**Explanation**	**Explanation**
Temperature (mean $E_K = \frac{1}{2}mv^2$)				
Increasing the temperature	Increased	Increased	Increases the mean E_K ($\frac{1}{2}$ mv^2) of the particles, hence more collisions and more particles with $E \geq E_A$.	Pushes the position of equilibrium towards the endothermic process i.e. the absorption of heat. Both reaction rates are higher when equilibrium is restored. Since K_{eq} is temperature dependent, K_{eq} has a different value when equilibrium is re-established.
Decreasing the temperature	Decreased	Decreased	Decreases the mean E_K ($\frac{1}{2}$ mv^2) of the particles the, hence less collisions and less particles with $E \geq E_A$.	Pushes the position of equilibrium towards the exothermic process i.e. production of heat. Both reaction rates are lower when equilibrium is restored. Since K_{eq} is temperature dependent, K_{eq} has a different value when equilibrium is re-established.
Concentration (number of particles/moles)				
Increasing the concentration	Increased	Increased	Increases the number of particles, hence more collisions.	Pushes the position of equilibrium towards the process which decreases the concentration. Both reaction rates are higher when equilibrium is restored. K_{eq} = constant value.
Decreasing the concentration	Decreased	Decreased	Decreases the number of particles, hence less collisions.	Pushes the position of equilibrium towards the process which increases the concentration. Both reaction rates are lower when equilibrium is restored. K_{eq} = constant value.
Gas Pressure ($P \equiv n$)				
Increasing the pressure or (decreasing the volume)	Increased	Increased	Increases the number of particles, hence more collisions.	Pushes the position of equilibrium towards the process which decreases the pressure i.e. in the direction with less moles. Both reaction rates are higher when equilibrium is restored. K_{eq} = constant value.
Decreasing the pressure or (increasing the volume)	Decreased	Decreased	Decreases the number of particles, hence less collisions.	Pushes the position of equilibrium towards the process which increases the concentration i.e. in the direction with more moles. Both reaction rates are lower when equilibrium is restored. K_{eq} = constant value.
Note: if the numbers of moles on both sides of a gaseous equilibrium system are equal, altering the pressure has no effect on the position of equilibrium because the concentrations of all species are altered (changed) by an equal amount.				
Degree of subdivision (surface area)				
Increasing the surface area	Increased	Increased	Increased number of particles on surface, hence more can collide.	Not applicable to equilibrium systems as solids have a constant concentration.
Decreasing the surface area	Decreased	Decreased	Decreased number of particles on surface, hence less can collide.	Not applicable to equilibrium systems as solids have a constant concentration.
Catalyst				
Addition of a catalyst	Increased	Increased	Lowers E_A, hence more particles with $E \geq E_A$	No effect on the position of equilibrium, however both forward and reverse rates are increased when equilibrium is established.