

Unit 3

Equilibrium and pH

Go to question

- 1 When a reversible chemical reaction is at equilibrium, a catalyst is then added,
- 2 In which of the following would the equilibrium shift to the left if the pressure was increased?
- 3 The addition of more CN^- ions to this equilibrium will....
- 4 Increasing the temperature will result in the equilibrium
- 5 Identify the change that will cause the greater volume of hydrogen gas.
- 6 Ammonia solution is described as a weak alkaline because in water.....
- 7 A liquid has a pH value of 8. What is the concentration of $\text{OH}^-_{(\text{aq})}$ ions present in mol^{-1} ?
- 8 A fully ionised acid diluted with the addition of water. Which of the following would not be true?



1 When a reversible chemical reaction is at equilibrium, a catalyst is then added,

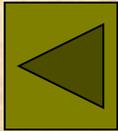
- a. The forward and backward reactions will proceed at different rates.
- b. The forward reaction rate increases.
- c. The position of the equilibrium shifts to the right.
- d. The position of the equilibrium remains unchanged.



a hint!!!!

1st hint

Does a catalyst change the equilibrium position?



2nd hint

A catalyst does not alter the concentrations of the reactants and products substances at equilibrium.



When a reversible chemical reaction is at equilibrium, a catalyst is then added

Correct because.....

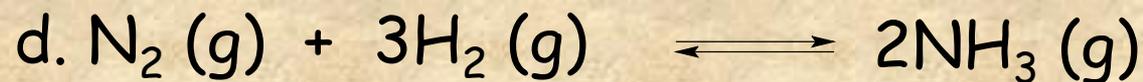
Catalysts do not change the equilibrium position. Catalysts speed up **both** the forward **and** backward reactions.

So the equilibrium will be reached **quicker but** the amounts of the products and reactants will stay the same.

The position of the equilibrium remains unchanged.



2 In which of the following reaction would the equilibrium shift to the left if the pressure was increased?



a hint!!!!

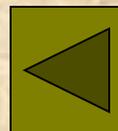
1st hint

Le Chatelier's principle states if a system in equilibrium is subject to a change, processes occur which tend to counteract the change imposed.



2nd hint

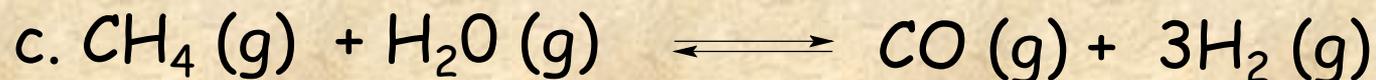
What happens to gas pressure when you change the number of gas molecules.



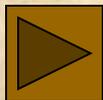
In which of the following would the equilibrium shift to the left if the pressure was increased?

Correct because.....

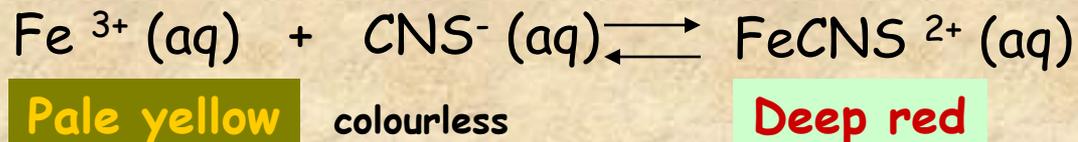
An equilibrium position shifts to try to cancel out any changes you introduce. If pressure is increased the equilibrium must shift to try and reduce this, in the direction of the least number of gas molecules.



2 moles of gas molecules 4 moles of gas molecules



3 The addition of more CNS^- ions to this equilibrium will



- Have no noticeable effect.
- Increase the amount of pale yellow seen
- Increase the amount of deep red seen
- The overall colour of the solution will lighten



a hint!!!!

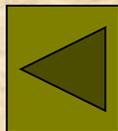
1st hint

Le Chatelier's principle states if a system in equilibrium is subject to a change, processes occur which tend to counteract the change imposed.



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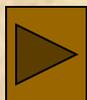
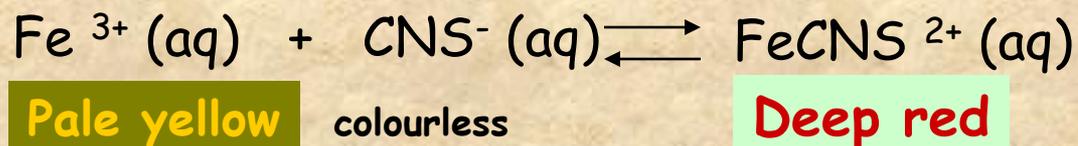
What happens to gas pressure when you change the number of gas molecules.



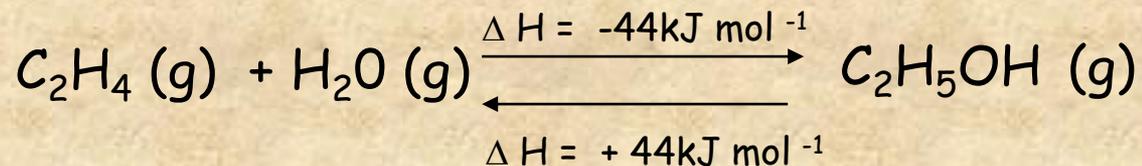
The addition of more CNS^- ions to this equilibrium will

Correct because.....

Changing the concentration will cause the equilibrium to respond in a way to re-establish the equilibrium. By adding CNS^- ions the equilibrium will move to the right causing concentration of the FeCNS^{2+} increases, and an **increase the amount of deep red** colour seen



4 Increasing the temperature will result in the equilibrium



- a. Moving to the right
- b. Moving to the left
- c. Not changing
- d. being reached faster.



a hint!!!!

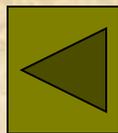
1st hint

Le Chatelier's principle states if a system in equilibrium is subject to a change, processes occur which tend to counteract the change imposed.



2nd hint

How would this equilibrium remove the additional heat?

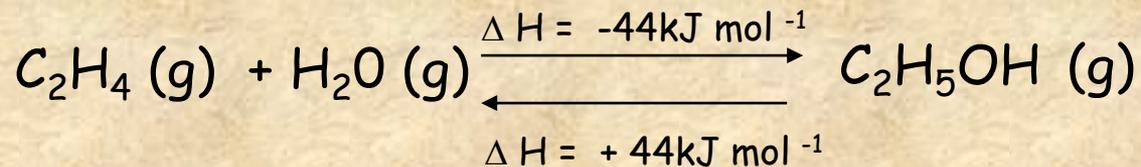


Increasing the temperature will result in the equilibrium

Correct because.....

The concentrations of reactants and products in an equilibrium mixture will alter as to counteract any changes in volume, concentration and temperature.

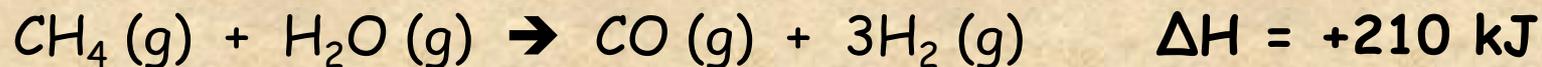
Increasing the temperature favours the **endothermic** reaction.



So the equilibrium will **move to the left**, $+\Delta H$.



5 Identify the change that will cause the greater volume of hydrogen gas to be produced.



	Pressure	Temperature
a.	increase	increase
b.	increase	decrease
c.	decrease	decrease
d.	decrease	increase



a hint!!!!

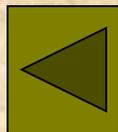
1st hint

Consider how changing the temperature would shift the equilibrium. The forward reaction is endothermic.



2nd hint

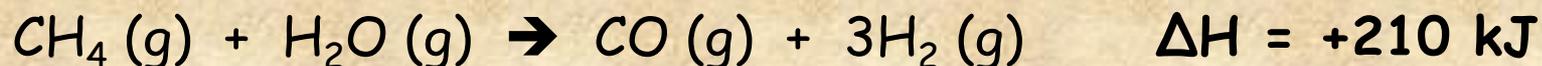
Consider how changing pressure would change the total number of molecules.



Identify the change that will cause the greater volume of hydrogen gas.

Correct because.....

Decreasing the pressure will cause a shift to the right (creating more gas molecules) The forward reaction is endothermic, so **increasing** the temperature will cause the equilibrium to shift to the right (removing the extra heat)



	Pressure	Temperature
	increase	increase
	increase	decrease
	decrease	decrease
	decrease	increase



6 Ammonia solution is described as a weak alkali because in water

a. It has a pH of about 9

b. It is not very soluble in water.

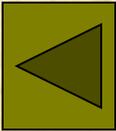
c. There is partial ionisation of the NH_3 molecule.

d. It also produces H^+ ions, which use up some of the OH^- ions.



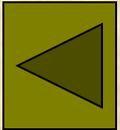
a hint!!!!

What happens to NH_4OH in the presence of H_2O ? What ions are produced?



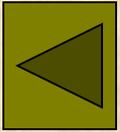
a hint!!!!

Ammonia is very soluble in water!!



a hint!!!!

This is a statement of fact, not an explanation!



Ammonia solution is described as a weak alkaline because in water

Correct because.....

There is **partial ionisation of the NH_3** molecule. Ammonia is a weak base because it is incompletely ionised in solution.



7 A liquid has a pH value of 8. What is the concentration of $\text{OH}^-_{(\text{aq})}$ ions present in mol l^{-1} ?

a. $1 \times 10^{-8} \text{ mol l}^{-1}$

b. $1 \times 10^{-10} \text{ mol l}^{-1}$

c. $1 \times 10^{-6} \text{ mol l}^{-1}$

d. $1 \times 10^{-4} \text{ mol l}^{-1}$



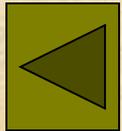
a hint!!!!



1st hint

Ionic Product for water

$$= [\text{H}^+] (\text{aq}) \times [\text{OH}^-] (\text{aq}) = 10^{-14} \text{ mol}^2 \text{ l}^{-2}$$



2nd hint

$$\text{pH} = [\text{H}^+] (\text{aq})$$



A liquid has a pH value of 8. What is the concentration of OH^- (aq) ions present in mol l^{-1} ?

Correct because.....

$$\begin{aligned}\text{Ionic Product for water} &= [\text{H}^+] (\text{aq}) \times [\text{OH}^-] (\text{aq}) = 10^{-7} \times 10^{-7} \\ &= 10^{-14} \text{ mol}^2 \text{ l}^{-2}\end{aligned}$$

$$[\text{H}^+] (\text{aq}) \times [\text{OH}^-] (\text{aq}) = 10^{-14} \text{ mol}^2 \text{ l}^{-2}$$

$$10^{-8} \times [\text{OH}^-] = 10^{-14}$$

$$[\text{OH}^-] = 10^{-14} / 10^{-8}$$

$$= 1 \times 10^{-6} \text{ mol l}^{-1}$$



8 A fully ionised acid was diluted by the addition of water. Which of the following would **not** be true?

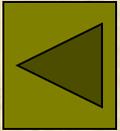
- a. The rate of reaction with magnesium would change.
- b. The amount of alkali needed to neutralise the acid would change.
- c. The pH value would not change.
- d. The electrical conductivity would change.



a hint!!!!

1st hint

What happens to the pH of a solution when water is added?



2nd hint

$\text{pH} = -\log[\text{H}^+]$ (aq) and this would change with the addition of water



A fully ionised acid diluted with the addition of water.
Which of the following **would not be true**.

Correct because.....

Adding water to an acid will change the $[H^+]$. The value will decrease with the addition of water, pH is a measure of the hydrogen ion concentration.

So the pH value **will** change, it would increase.

