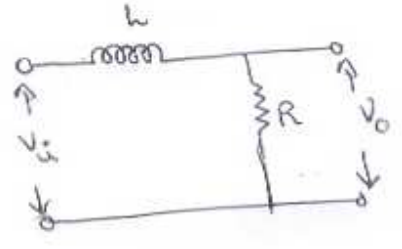
2.RL CIRCUITS:

The response of RL circuit is same as RC circuit if
(1) in an RC circuit, resistor is replaced by an inductor and capacitor is replaced by an resistor (2) the time constant of RC circuit (RC) is equal to the time constant of RL circuit(L/R).
Same as RC circuits, RL circuits are also two types

1. Low pass RL circuit
2. high pass RL circuit

low pass RL circuit: in an RL circuit if inductor is in series with the input voltage signal and a resistor is in shunt with the output then that circuit is named as low pass RL circuit.



Operation : we know $X_L = 2\pi f L$
If frequency of input signal is low ,inductive reactance is low , Then inductor is replaced with an short circuit .so output voltage is same as input voltage.

Similarly If frequency of input signal is high ,inductive reactance is high ,then inductor is replaced with an open circuit .so output voltage is zero.

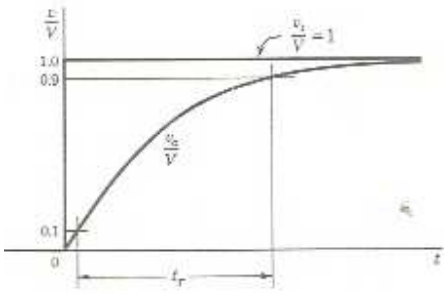
Hence it behaves like a low pass RL circuit.

Step voltage input :
For an low pass RL circuit we know Vo = I R

Case(i): for step voltage input we know for t<0 , Vi = 0 V , I = 0 A so Vo = 0 V

Case(ii): at $t=0^-$ (immediately before t=0)still output voltage is zero
but at $t=0^+$(immediately after t=0) , Vi = V Volts , I = 0 A so Vo = 0 Volts
because current flowing through inductor can not changes instantaneously.

case(iii): for t>0 , current through inductor increases exponentially, so output is a raising exponential.
Here $Vo(t) = V(1-e^{-tR/L})$
Time constant of an low pass RL circuit is L/R(by neglecting source resistance).
If time constant is high then output takes more time to reach final value similarly
If time constant is low then output takes less time to reach final value.



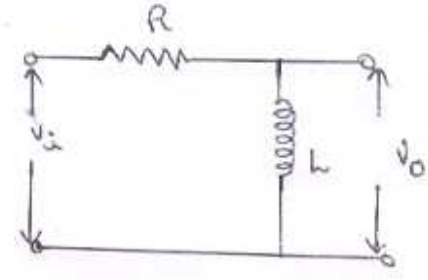
High pass RL circuit: in an RL circuit if resistor is in series with the input voltage signal and a inductor is in shunt with the output then that circuit is named as high pass RL circuit.

Operation : we know $X_L = 2\pi f L$

If frequency of input signal is low ,inductive reactance is low ,then inductor is replaced with an short circuit .so output voltage is zero.

Similarly If frequency of input signal is high , inductive reactance is high ,then inductor is replaced with an open circuit .so output voltage is same as input voltage.

Hence it behaves like a high pass RL circuit.



Step voltage input :

For an high pass RL circuit we know Vo is voltage across an inductor

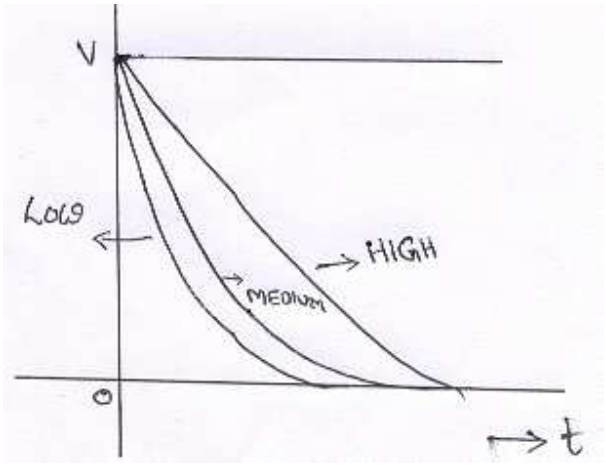
Case(i): for step voltage input we know for t<0 , Vi = 0 V , so Vo = 0 V

Case(ii): at $t=0^-$ (immediately before t=0)still output voltage is zero
but at $t=0^+$(immediately after t=0) , Vi = V Volts , so Vo = V Volts
because current flowing through inductor can not changes instantaneously(here inductor is replaced with an open circuit).

case(iii): for t>0 , current through inductor increases exponentially, so output is a decaying exponential.

Here $Vo(t) = Ve^{-tR/L}$
Time constant of an low pass RL circuit is L/R(by neglecting source resistance).
If time constant is high then output takes more time to reach final value similarly
If time constant is low then output takes less time to reach final value.

Output waveforms for different time constants is shown below



For practical applications RC circuits are preferable compared to RL circuits(since size of an inductor is large)