- $$\omega' + \frac{1}{\tau}\omega = \frac{A}{\tau}v$$
-
- ω =________________________________
- v = ________________________________
-
- A = ____
- τ ____.

Motor Differential Equation

$$\omega' + \frac{1}{\tau}\omega = \frac{m}{\tau}v$$

ω = speed of the motor

$\frac{\text{revolutions}}{\text{minute}}$ (RPM)

τ = time constant

second

m = motor's gain

$\frac{\text{RPM}}{\text{V}}$

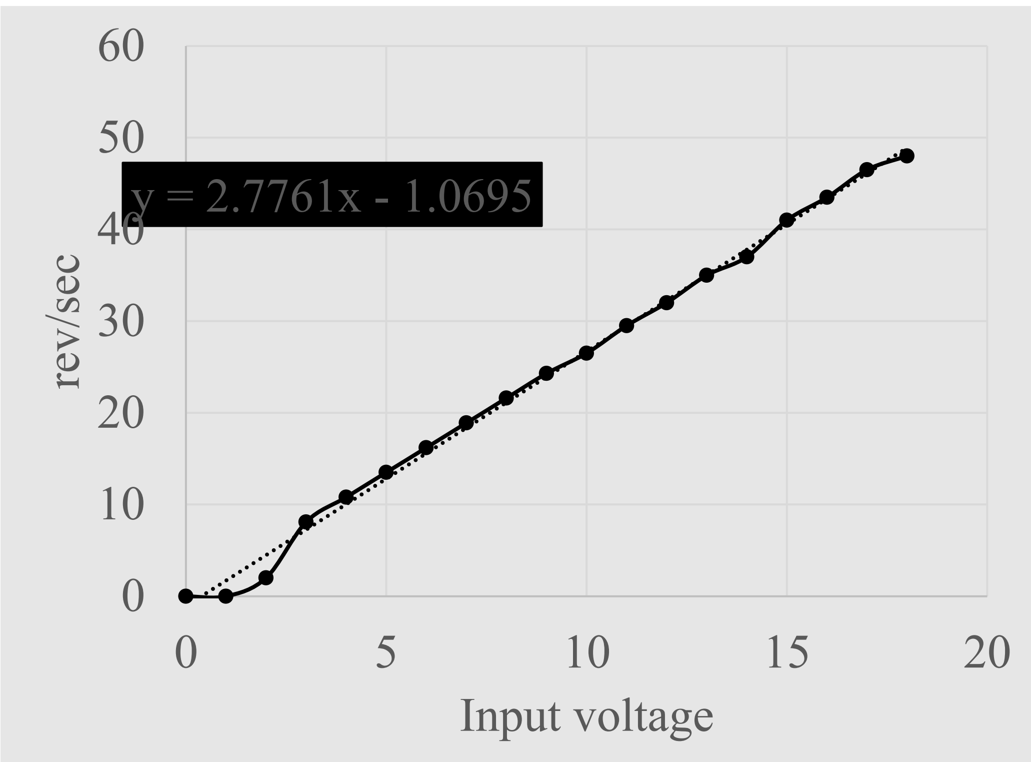
v = applied voltage

Motor Differential Equation

$$\omega' + \frac{1}{\tau}\omega = \frac{m}{\tau}v$$

ω = speed of the motor

$\frac{\text{revolutions}}{\text{minute}}$ (RPM)



τ = time constant

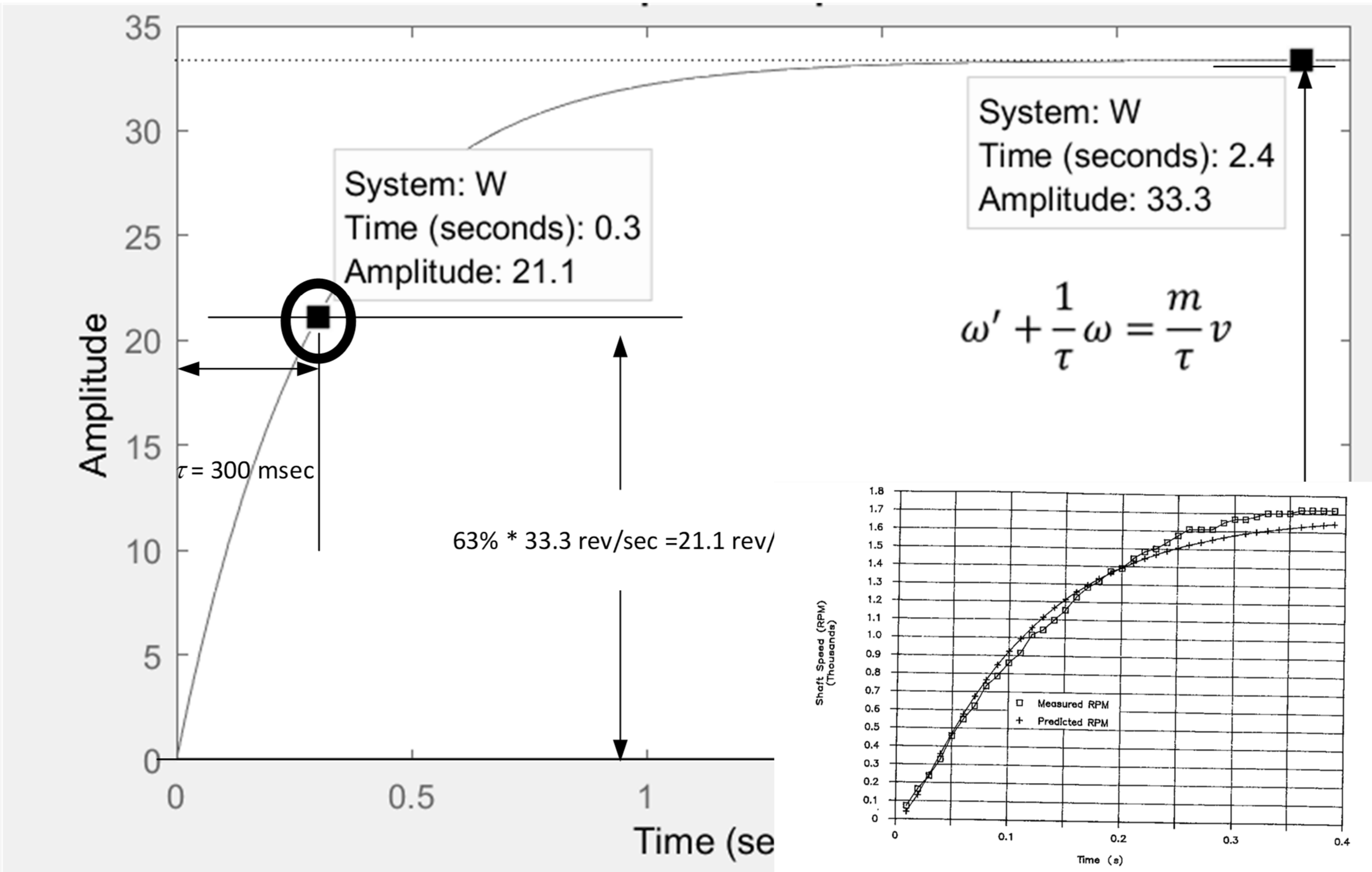
second

m = motor's gain

$\frac{\text{RPM}}{\text{V}}$

v = applied voltage

12 V step => Time Constant

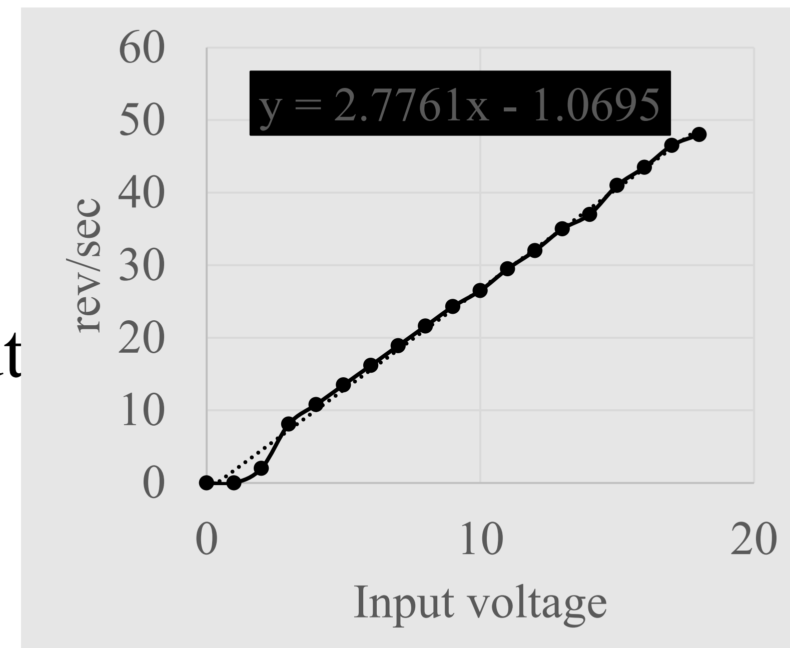


$$\omega' + \frac{1}{\tau}\omega = \frac{m}{\tau}v$$

$$\omega' + \underline{\hspace{3cm}}\,\omega = \underline{\hspace{3.5cm}} \times V$$

ω in rev/sec.   Input in volts

Output starts at _______, _____V input
and ends at _______, ______V input.



$$\omega' + \frac{1}{\tau}\omega = \frac{A}{\tau}v$$

10. $sF(s) - f(0)$ $\quad$ $\frac{df(t)}{dt}$

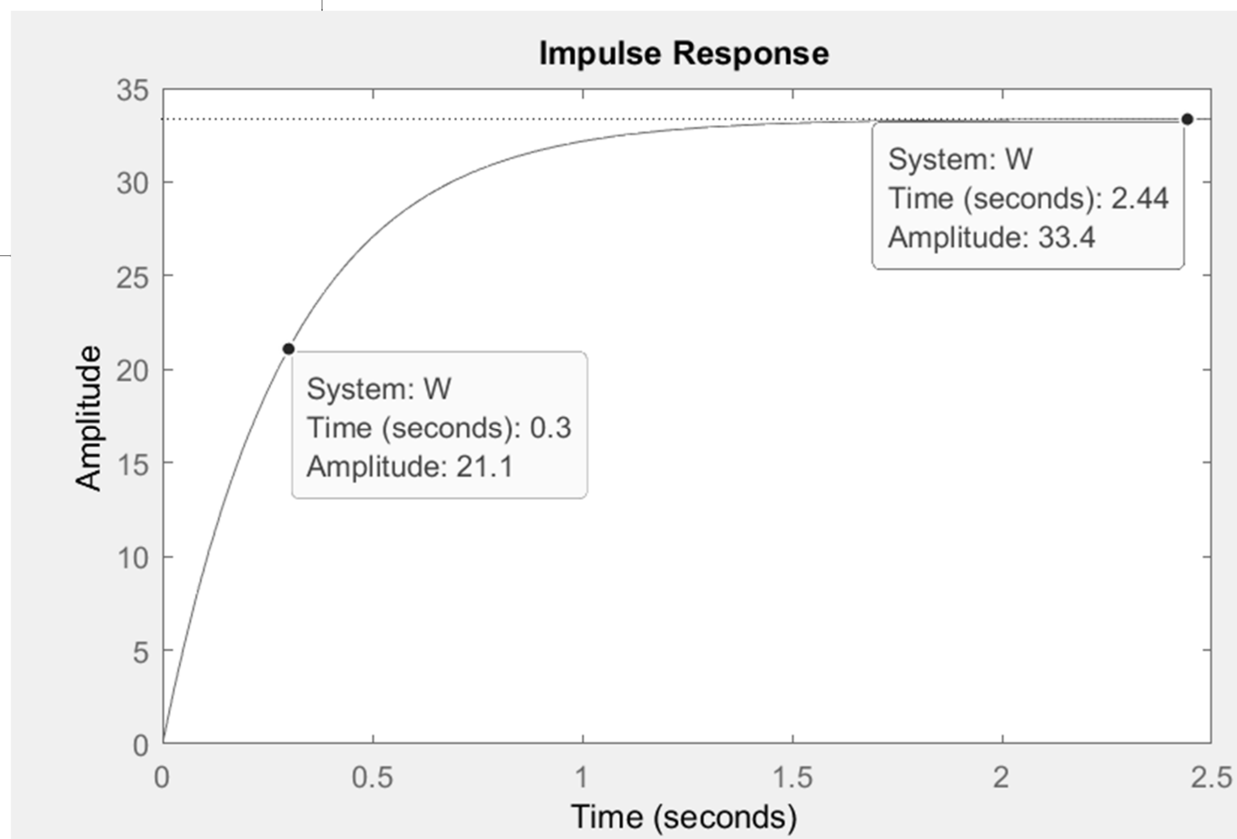
Transform into the Laplace domain.

Transfer function $\frac{W}{V} =$

Motor's response to a 12 V step

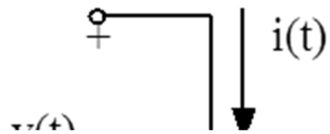
3.	$\frac{1}{s}$	$U(t) = \begin{cases} 0 & t < 0 \\ 1 & t \geqslant 0 \end{cases}$	Unit step
17a.	$\frac{A}{s(\tau s + 1)}$	$A(1 - e^{-t/\tau})$	First-order system response to a step input

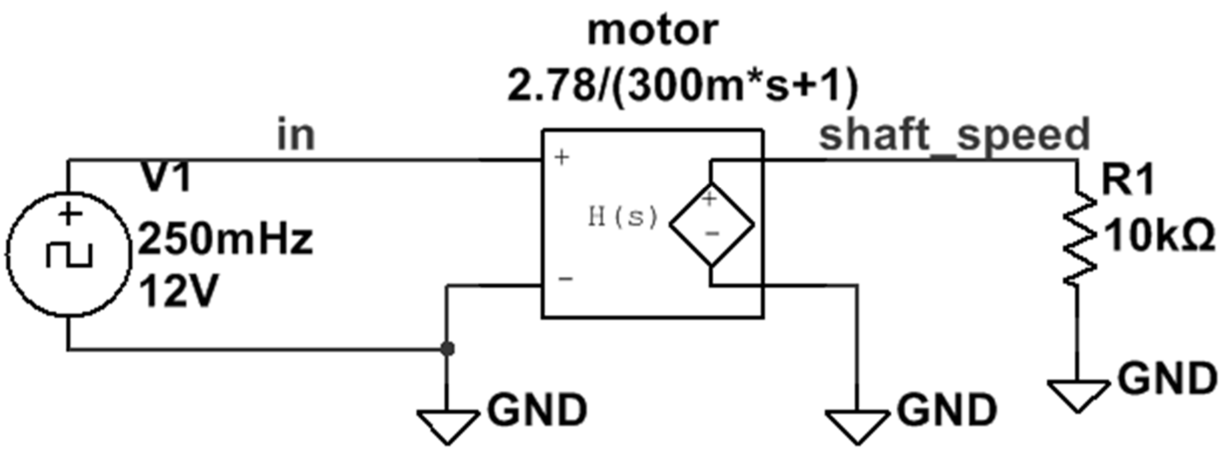
```
clc
clear

s=tf('s')
tau=0.3;
m=2.78;



W=m*12/(s*(tau*s+1));


ltiview('impulse',W)
```

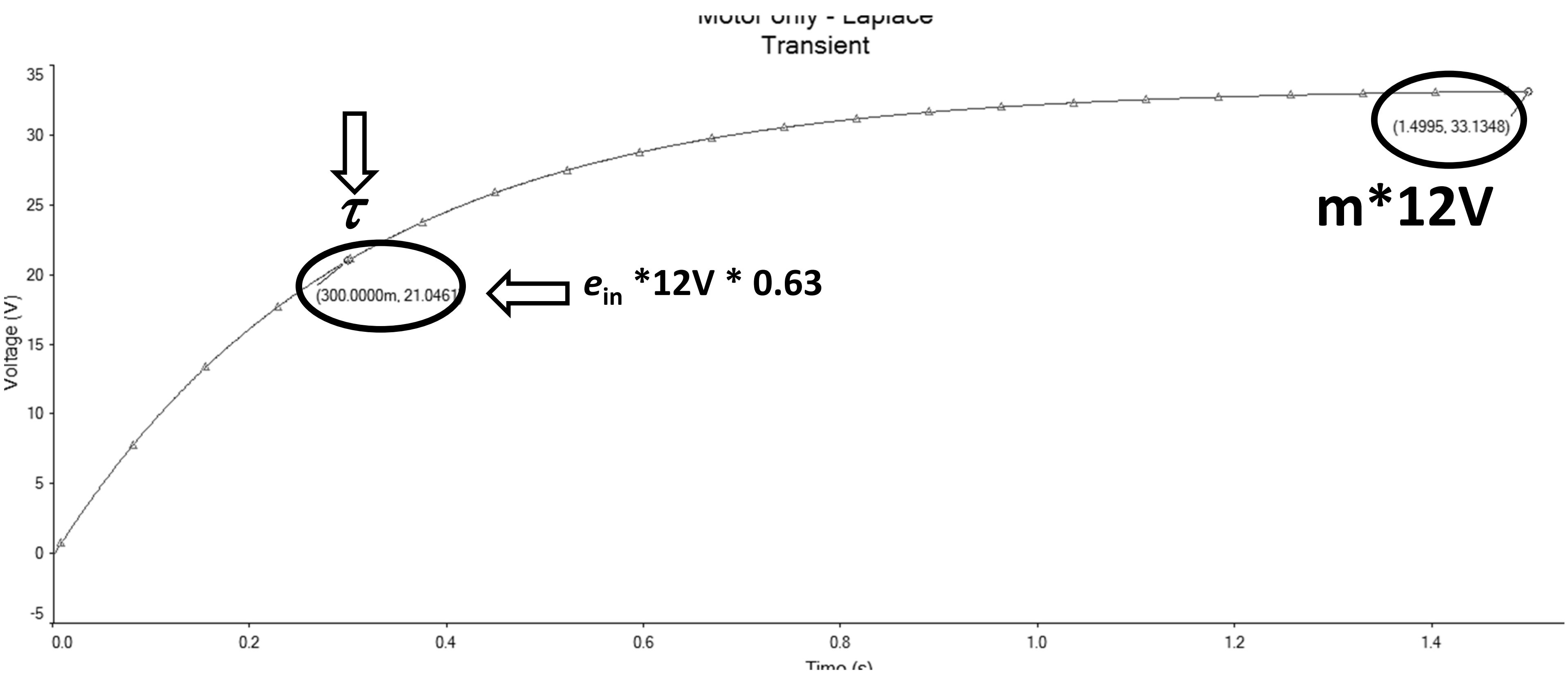


First Order Lag Element

$A = 2.78$ rev/sec /V $\quad \tau = 0.3$ sec







Motor only - Laplace
Transient
Voltage (V)
Time (s)
35
30
25
20
15
10
5
0
-5
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
(300.0000m, 21.0461)
(1.4995, 33.1348)
τ
e_{in} *12V * 0.63
m*12V

$$\omega' + \frac{1}{\tau}\omega = \frac{A}{\tau}v$$ with initial speed

as

$$\omega' + \frac{1}{\tau}\omega = \frac{m}{\tau}v$$

ω = speed of the motor (RPM)
ω_0 = initial speed (RPM)
τ = time constant (sec)
m = motor's gain $\left(\frac{\text{RPM}}{\text{V}}\right)$
v = applied voltage (V)

This equation transforms into the Laplace domain as

$$sW - \omega_0 + \frac{1}{\tau}W = \frac{m}{\tau}V$$

Adding w_0 to both sides $\quad W + \frac{1}{\tau}W = \frac{m}{\tau}V + \omega_0$

Multiplying by τ $\quad s\tau W + W = mV + \tau\omega_0$

Factoring out W $\quad W(\tau s + 1) = mV + \tau\omega_0$

Dividing by the term in ( ) $\quad W = \frac{mV}{(\tau s+1)} + \frac{\tau\omega_0}{(\tau s+1)}$

$$W = \frac{mV}{(\tau s+1)} + \frac{\tau\omega_0}{(\tau s+1)}$$

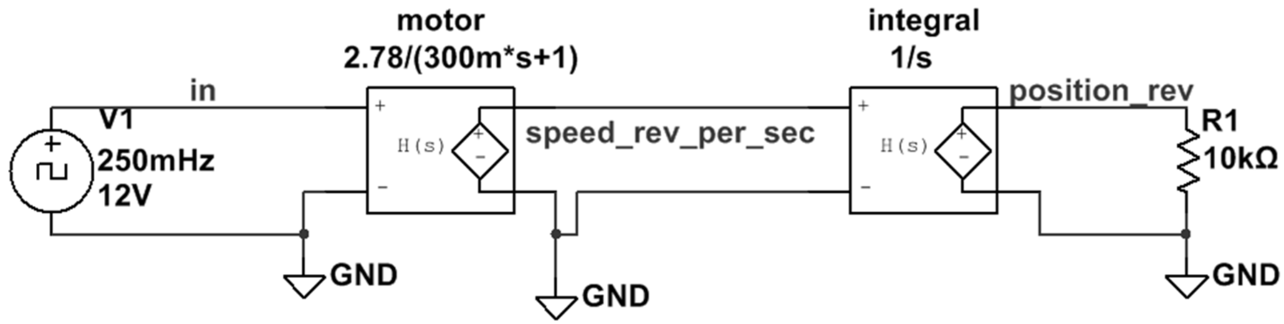
3.	$\frac{1}{s}$	$U(t) = \begin{cases} 0 & t < 0 \\ 1 & t \geqslant 0 \end{cases}$	Unit step
17a.	$\frac{A}{s(\tau s + 1)}$	$A(1 - e^{-t/\tau})$	First-order system response to a step input

Position

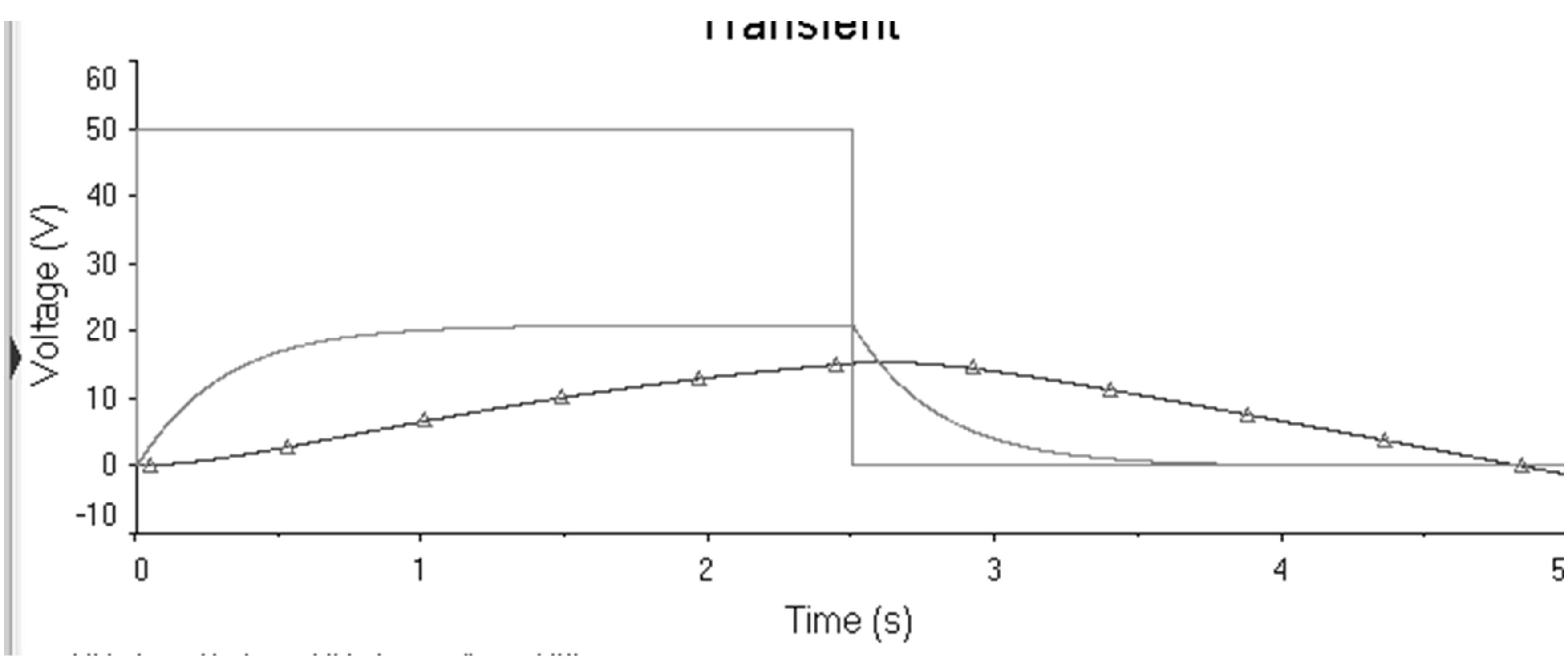
Shaft speed = $\omega = \_\_\_\_\_\_\_ = \text{rate of change of angular position}$

18a.	$\dfrac{A}{s^2(\tau s + 1)}$	$A\tau\left(e^{-t/\tau} + \dfrac{t}{\tau} - 1\right)$	First-order system response to a ramp input

Position ?????

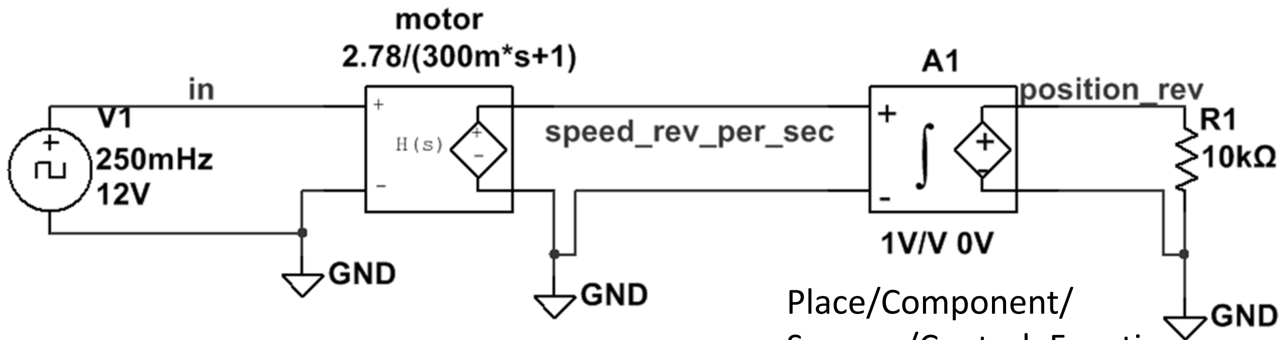


motor
2.78/(300m*s+1)
integral
1/s
in
V1
250mHz
12V
H(s)
speed_rev_per_sec
H(s)
position_rev
R1
10kΩ
GND
GND
GND



Transient
Voltage (V)
60
50
40
30
20
10
0
-10
0
1
2
3
4
5
Time (s)

Position correct



Place/Component/
Sources/Control_Function
Voltage_Integrator