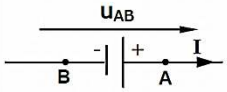
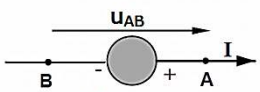
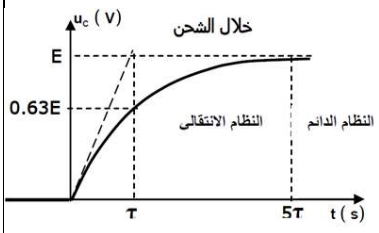
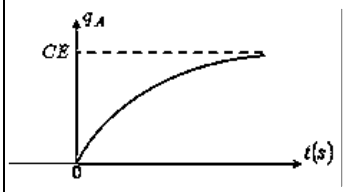
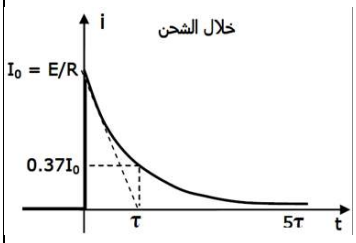
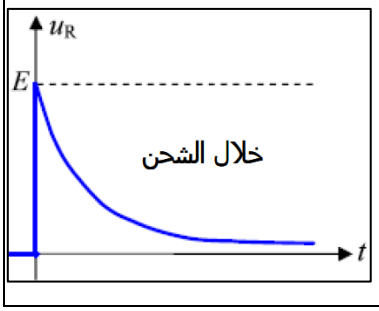
1- علاقات اساسية:

	
$U_{AB} = E - r\,I$ مـــــولد	$U_{AB} = E$ مـــولد مثالي

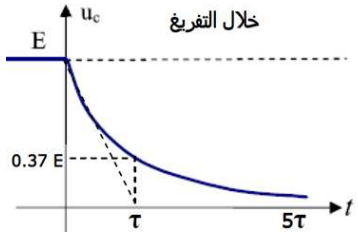
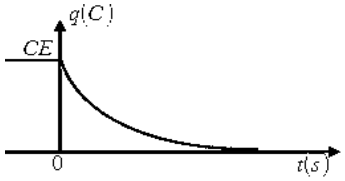
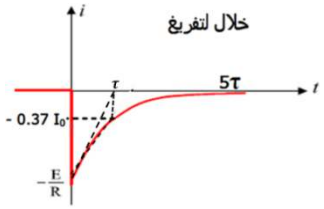
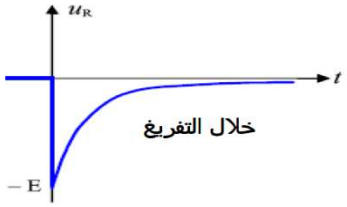
$C = C_1 + C_2 + C_3$		$q = u_C C$	
$C = \varepsilon \frac{S}{d}$		$i = \frac{dq}{dt}$	
$u_R = Ri$		$i = \frac{q}{t}$	
$\tau = RC$		$\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$	

2- المعادلات التفاضلية خلال الشحن:

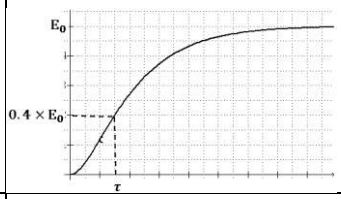
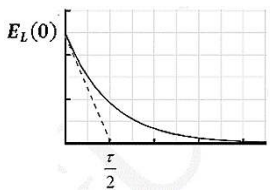
	$u_C = E\left(1 - e^{-\frac{t}{\tau}}\right)$	$u_R + u_C = E$ $\Rightarrow Ri + u_C = E$ $\Rightarrow R\frac{dq}{dt} + u_C = E$ $\Rightarrow R\frac{d(u_C C)}{dt} + u_C = E$ $\Rightarrow RC\frac{du_C}{dt} + u_C = E$	u_C
	$q = Q_0\left(1 - e^{-\frac{t}{\tau}}\right)$ $q = EC\left(1 - e^{-\frac{t}{\tau}}\right)$	$u_R + u_C = E$ $\Rightarrow Ri + u_C = E$ $\Rightarrow R\frac{dq}{dt} + \frac{q}{C} = E$ $\Rightarrow RC\frac{dq}{dt} + q = EC$	q
	$i = i_0\, e^{-\frac{t}{RC}}$ $i = \frac{E}{R}\, e^{-\frac{t}{RC}}$	$u_R + u_C = E$ $\Rightarrow Ri + \frac{q}{C} = E$ $\Rightarrow \frac{Rdi}{dt} + \frac{dq}{Cdt} = 0$ $\Rightarrow \frac{Rdi}{dt} + \frac{i}{C} = 0$ $\Rightarrow RC\frac{di}{dt} + i = 0$	i
	$u_R = E\, e^{-\frac{t}{RC}}$	$u_R + u_C = E$ $\Rightarrow u_R + \frac{q}{C} = E$ $\Rightarrow \frac{du_R}{dt} + \frac{dq}{Cdt} = 0$ $\Rightarrow \frac{du_R}{dt} + \frac{1}{C} i = 0$ $\Rightarrow \frac{du_R}{dt} + \frac{u_R}{RC} = 0$	u_R

قلم الجزائر
WWW.DZPEN.COM

-3

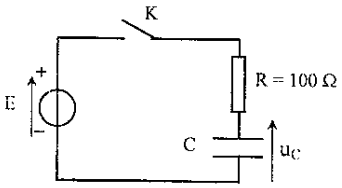
	$u_C = Ee^{-\frac{t}{\tau}}$	$u_R + u_C = 0$ $\Rightarrow Ri + u_C = 0$ $\Rightarrow R\frac{dq}{dt} + u_C = 0$ $\Rightarrow R\frac{d(u_C C)}{dt} + u_C = 0$ $\Rightarrow RC\frac{du_C}{dt} + u_C = 0$	u_C
	$q = Q_0 e^{-\frac{t}{\tau}}$ $q = ECe^{-\frac{t}{\tau}}$	$u_R + u_C = 0$ $\Rightarrow Ri + u_C = 0$ $\Rightarrow R\frac{dq}{dt} + \frac{q}{C} = 0$ $\Rightarrow RC\frac{dq}{dt} + q = 0$	q
	$i = -\frac{E}{R}\, e^{-\frac{t}{RC}}$ $i = -i_0\, e^{-\frac{t}{RC}}$	$u_R + u_C = 0$ $\Rightarrow Ri + \frac{q}{C} = 0$ $\Rightarrow \frac{Rdi}{dt} + \frac{dq}{Cdt} = 0$ $\Rightarrow \frac{Rdi}{dt} + \frac{i}{C} = 0$ $\Rightarrow RC\frac{di}{dt} + i = 0$	i
	$u_R = -E\, e^{-\frac{t}{RC}}$	$u_R + u_C = 0$ $\Rightarrow u_R + \frac{q}{C} = 0$ $\Rightarrow \frac{du_R}{dt} + \frac{dq}{Cdt} = 0$ $\Rightarrow \frac{du_R}{dt} + \frac{1}{C}i = 0$ $\Rightarrow \frac{du_R}{dt} + \frac{u_R}{RC} = 0$	u_R

-4

$t_{\frac{1}{2}} = \tau\, ln\left(\frac{\sqrt{2}}{\sqrt{2}-1}\right)$		$E_{(C)} = \frac{1}{2}qu_C$ $E_c(t) = \frac{1}{2}Cu_C{}^2 = \frac{1}{2}CE^2\left(1 - e^{-\frac{t}{\tau}}\right)^2$ $E_{max} = \frac{1}{2}CE^2$	
$t_{\frac{1}{2}} = \frac{\tau}{2}\ln 2$		$E_c(t) = \frac{1}{2}Cu_C{}^2 = \frac{1}{2}CE^2e^{-\frac{2t}{\tau}}$	

قلم الجزائر
WWW.DZPEN.COM

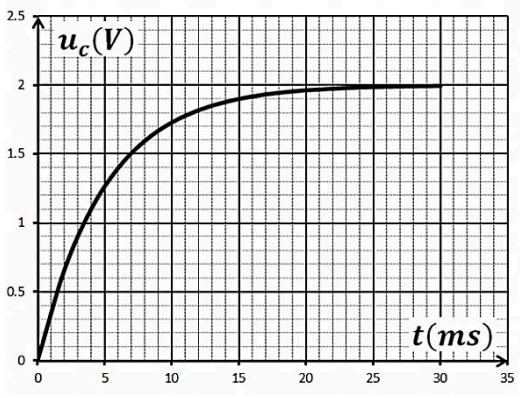
E



K $t = 0$

$u_c(t) = f(t)$

-1



-2

$u_c(t)$

-3

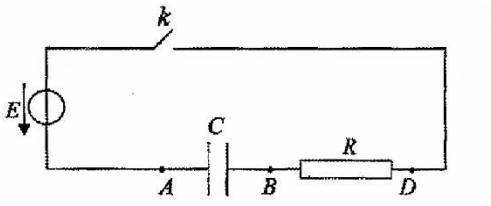
$u_c(t)$

$u_c(t) = E\left(1 - e^{-\frac{t}{\tau}}\right)$ -4

τ E $u_c(\tau) = 0.63E$ -5

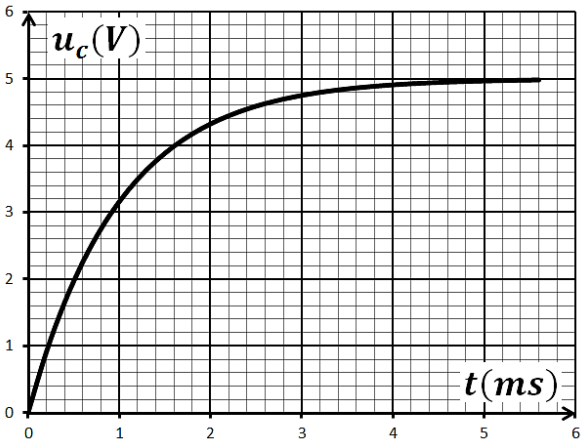
C -6

2



C $R = 100\Omega$ -

$E = 5V$ -



B A -1

-2

u_c -3

τ A B $u_c = A + Be^{-\frac{t}{\tau}}$ -4

C τ -5

-6

-7

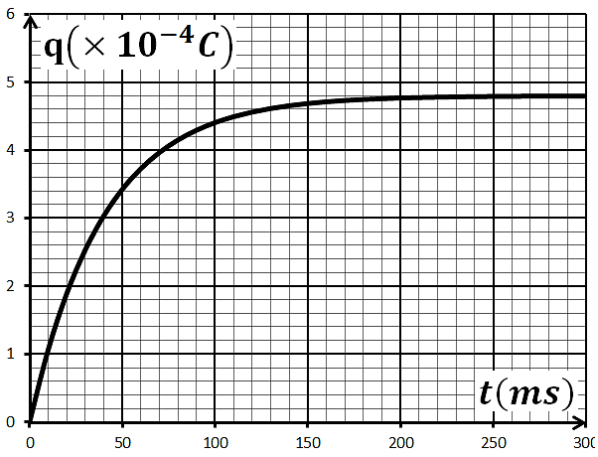
$C = \varepsilon\frac{d}{S}$, $C = \varepsilon\frac{S}{d}$, $C = \frac{S}{\varepsilon\ d}$ -

ε d S

قلم الجزائر
WWW.DZPEN.COM

2013 3

C $R = 1k\Omega$ E



$t = 0$ K K

-1

$q(t)$ -2

$q(t) = Ae^{\alpha t} + B$ -3

α A , B -

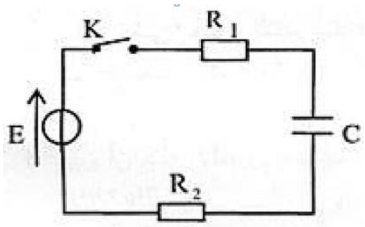
t q(t) -4

τ -

E -

$t = 200ms$ -

2016 4

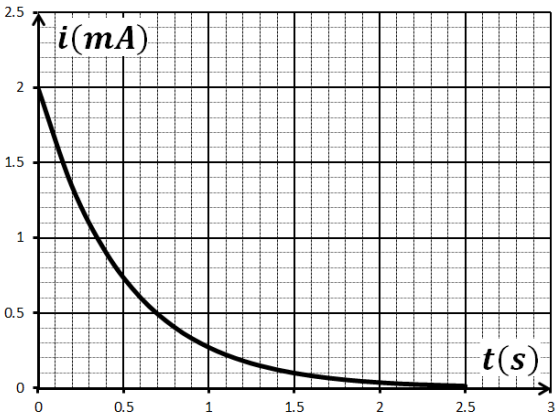


C

$R_2 = R_1 = 1k\Omega$ K E

$t = 0$ $4k\Omega$

-1



$i(t)$

$i(t) = \alpha e^{-\beta t}$

E C R_2 R_1 β α

-2

$i(t)$

E C τ -3

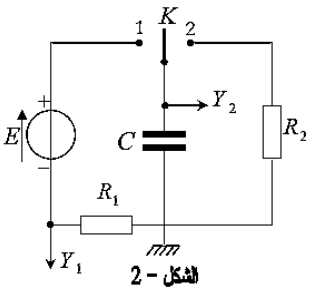
$E_c(t)$ -4

2014 5

C E

K $R_2 = 2K\Omega$ $R_1 = 1K\Omega$

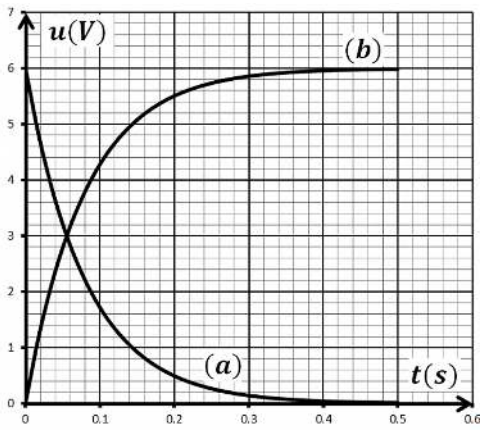
Y_2 Y_1



الشكل - 2

قلم الجزائر
WWW.DZPEN.COM

Y_2 Y_1 1 K -1



(b) (a) -2

Y_1 -

- τ_1 -

C E -3

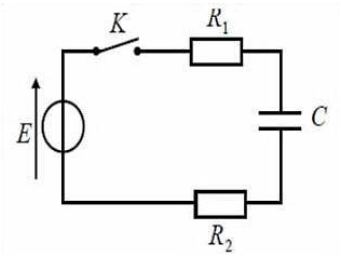
$t \geq 0.6s$ $t = 0$ $i(t)$ -4

2 -5

τ_1 τ_2 -

$t = \tau_2$ R_2 ب-

6



E

K . $R_2 = 4k\Omega$ $R_1 = 1k\Omega$ C

-1

-2

-3

-4

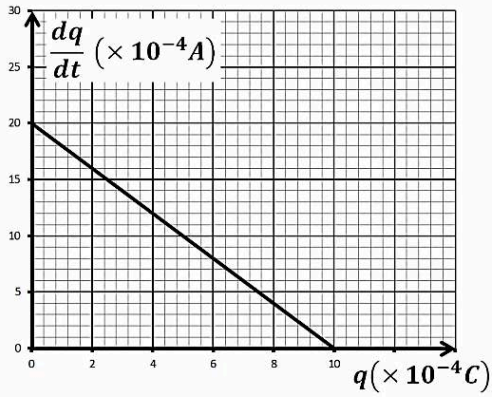
$\frac{dq}{dt} + \alpha q + \beta = 0$

α, β -

τ -5

τ •

•



$\frac{dq}{dt}$ -6

τ -

C -

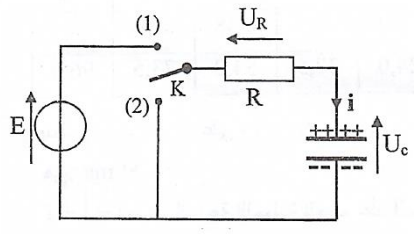
E

-7

E_0

$\frac{E_0}{2}$ τ

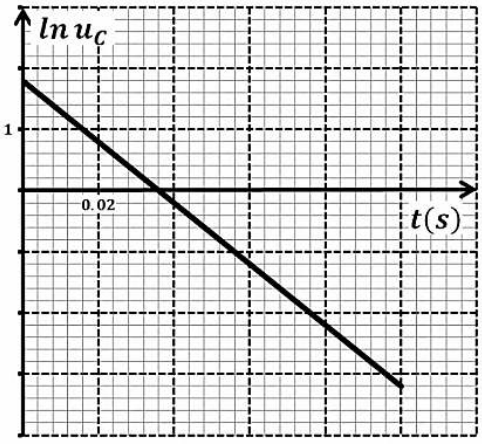
قلم الجزائر
WWW.DZPEN.COM



$R = 10k\Omega$ E

K C

$t = 0$ (2) (1)



-1

u_C -2

$$u_C + \frac{1}{\alpha} \times \frac{du_C}{dt} = 0$$

$u_C = Ae^{-\alpha t}$ -3

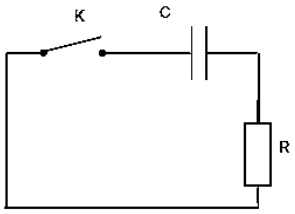
E C R α A

t $ln\,u_C$ -4

$ln\,u_C = f(t)$ -

E C α -

$t = 2.5\tau$ -5



C $E = 12V$ C

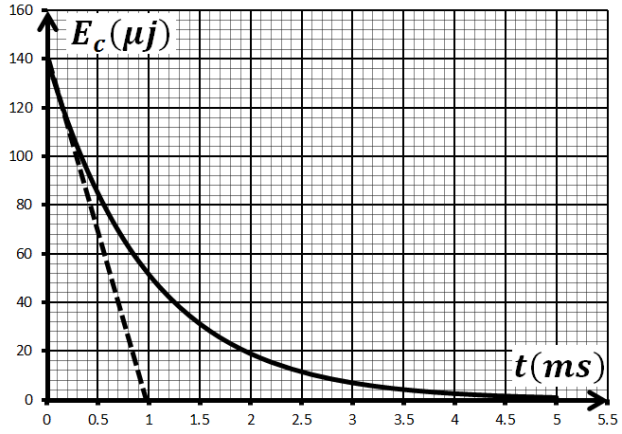
$R = 1k\Omega$

$t = 0$ K -1

$u_C(t)$ -

α A $u_C(t) = Ae^{\alpha t}$ -

$E_C(t)$ -2



$E_C(t)$ -3

$E_C(0)$ -

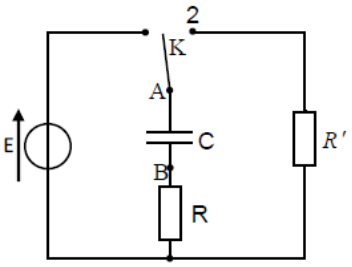
$t = 0ms$ -

$t = \frac{\tau}{2}$

C τ -

$t_{1/2} = \frac{\tau}{2} \ln 2$ -4

قلم الجزائر
WWW.DZPEN.COM



$R = R` = 470\Omega$ C

K E

$t = 0$ 1 -1

u_R u_c -

q $q = q_A$ u_R u_c -

E R C α A $q_A = A(1 - e^{-\alpha t})$ -

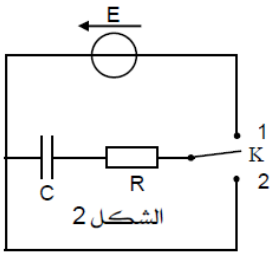
E $5V$ -

C $E_C = 5mJ$ -

2 -2

-

K 2 1 -



2010 10

C

$E = 5V$ -

K $R = 120\Omega$ -

u_C

1 $t = 0$

$t(ms)$	0	4	8	16	20	24	32	40	48	60	68	80
$u_C(V)$	0	1	2	3.3	3.8	4.1	4.5	4.8	4.9	5	5	5

$u_C = f(t)$ -1

C RC τ

-2

$R = 120\Omega$ $C` > C$ $C`$ -

$R` < 120\Omega$ $C`` = C$ $C``$ -

u_C 2 1 •

$\frac{dq(t)}{dt} + \frac{1}{RC}q(t) = \frac{E}{R}$ $q(t)$ -3

قلم الجزائر
WWW.DZPEN.COM

α β A $q_A = Ae^{\alpha t} + \beta$

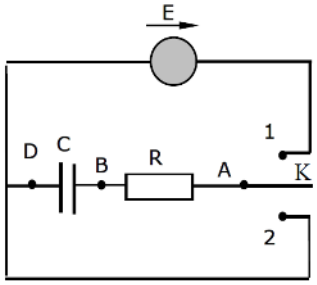
2 -4

E_0 $t = 0$ -

$E = \frac{E_0}{2}$ -

2016 **11**

$R = 10k\Omega$ $C = 100nF$



K $E = 5V$

(1) **.I**

-1

u_{BD} u_{AB}

-2

$u_{BD}(t)$

b A $u_{BD}(t) = E + Ae^{-bt}$ -3

-4

$u_{BD} = f(t)$ $u_{BD}(t)$ -5

(2) **.II**

-1

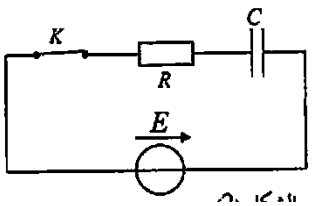
(1) C' -2

-

$3.75 \times 10^{-6} joules$

$1nF = 10^{-9}F$ C'

2015 **12**



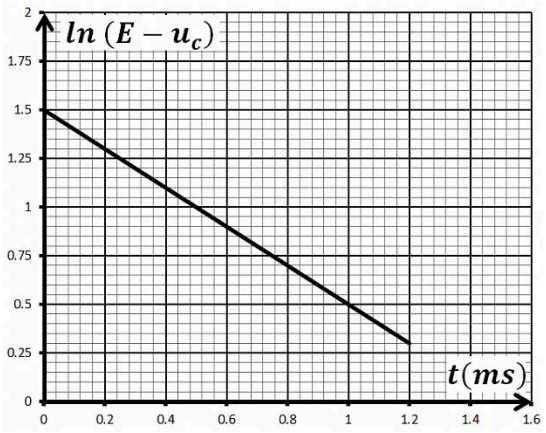
E $R = 100\ \Omega$

-1

$u_C(t)$ -2

τ A $u_C(t) = A\left(1 - e^{-\frac{t}{\tau}}\right)$ -3

قلم الجزائر
WWW.DZPEN.COM



$ln(E-u_C)=-\frac{1}{\tau}t+ln\,E$ -4

$ln(E-u_C)$ -5

E -

C τ -

$E_C(t)$ -6

$t=\tau$ $E_C(\tau)$

$E_C(\infty)$

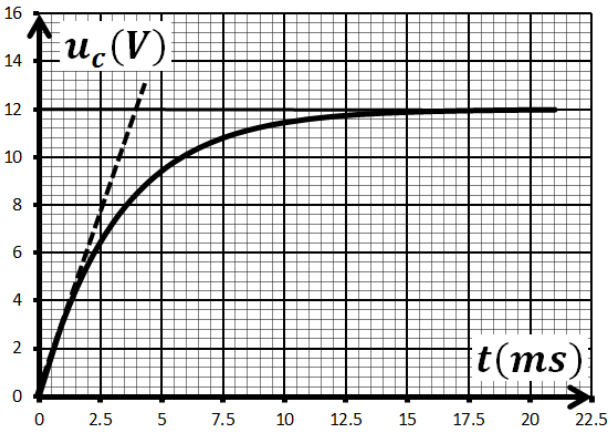
$\frac{E_C(\tau)}{E_C(\infty)}$ -

C' $\tau'=\frac{\tau}{4}$ C' -7

2016 **13**

$u_c(t)$

C



K E R

-1

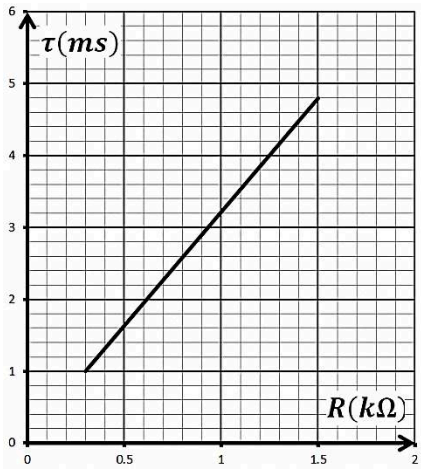
$t=0$ K -2

$R=R_1$

-

B A $u_c(t)=A(1-e^{-Bt})$ -

3



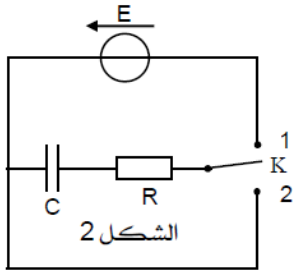
$R>R_1$ $u_c=f(t)$ -

τ R -3

R_1 C -

C_2 $C_1=1\mu F$ -

قلم الجزائر
WWW.DZPEN.COM



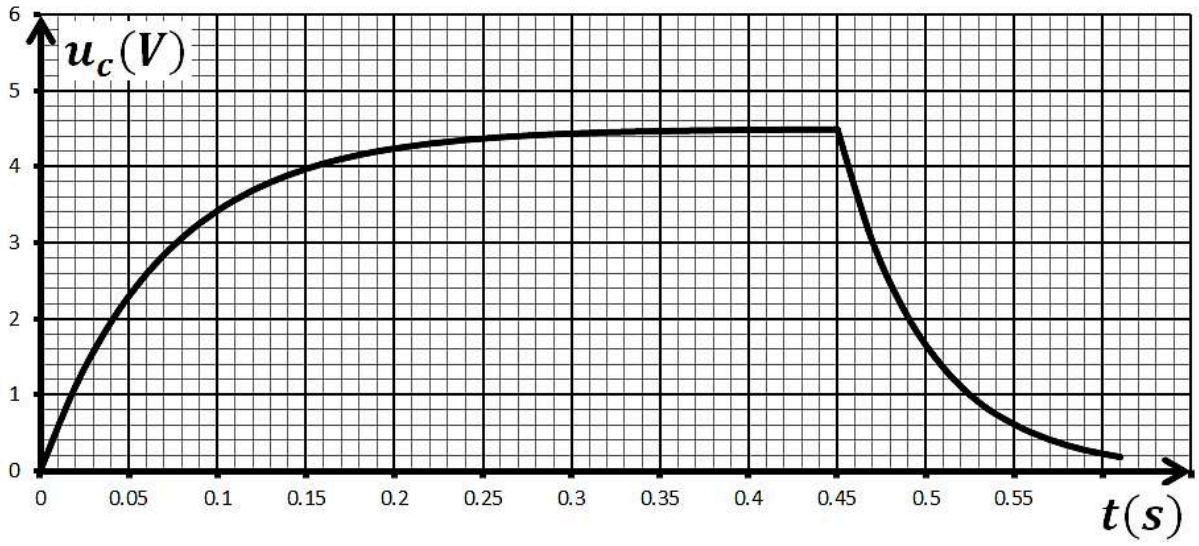
الشكل 2

r $E = 4.5V$

K $C = 0.01F$ R

1 $t = 0$

$u_c(t)$ $ExAo$ 2 $t = 0.45s$



.i

-1

u_c -2

B A $u_c = \frac{A}{B}(1 - e^{-Bt})$ -3

τ -4

τ -5

E_{c_0} -6

.ii

τ' -1

$r = \frac{\tau - \tau'}{C}$ -2

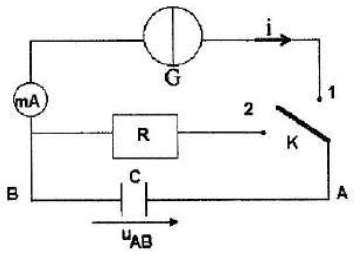
R -3

E_R $u_c = Ee^{-\frac{t-0.45}{\tau'}}$ -4

$$E_R = E_{c_0}\left(1 - e^{-\frac{2(t-0.45)}{\tau'}}\right)$$

$t = 0.5s$ -

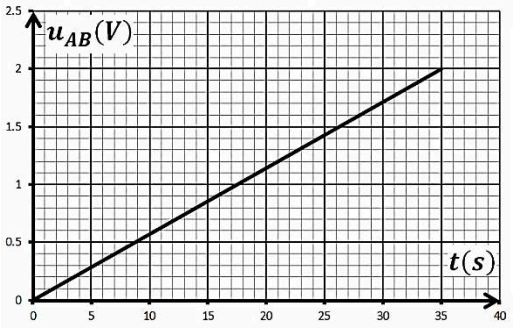
قلم الجزائر
WWW.DZPEN.COM



C

-

-



(1) $t = 0s$ -1

$i = 0.31mA$ G

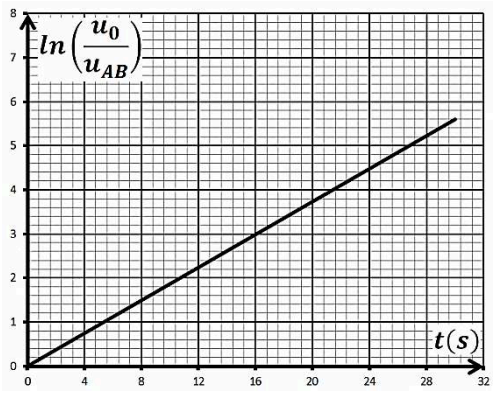
u_{AB} $ExAO$

t

i u_{AB} -

t C

. C -



$U_0 = 1.6V$ -1

$t = 0s$ (2)

$R = 1K\Omega$

$u_{AB} = U_0\, e^{\frac{-t}{\tau}}$ u_{AB} -

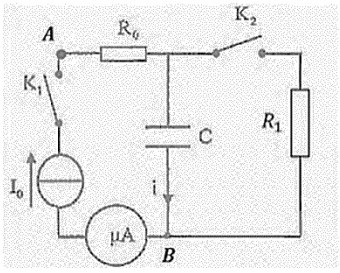
u_{AB} $ExAO$ ب-

t

τ

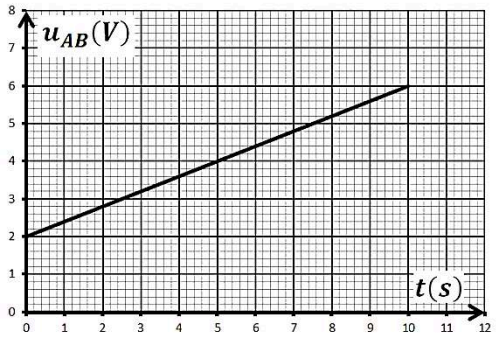
.C

16



R_1 R_0 C

K_2 K_1 $I_0 = 4\mu A$



K_1 $t = 0$ K_2 1

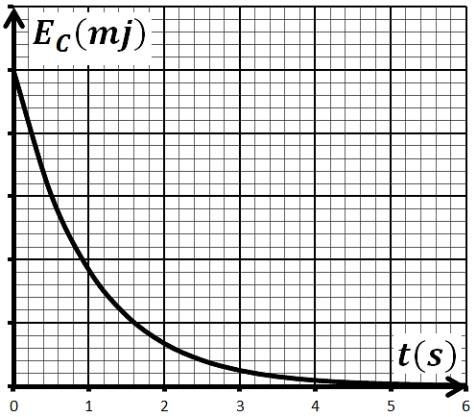
R_0 -

-

$u_0 = 10V$

قلم الجزائر
WWW.DZPEN.COM

K_2 K_1 $u_0 = 10V$ 2



-

$u_C(t)$

$u_C(t) = u_0 e^{\frac{-t}{\tau}}$ -

-

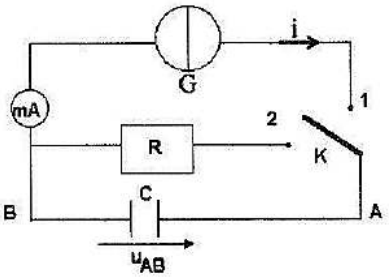
-

R_1 τ -

-

$t = 0.05s$ R_1

17



RC

C $i = 0.15mA$

K $R = 1k\Omega$

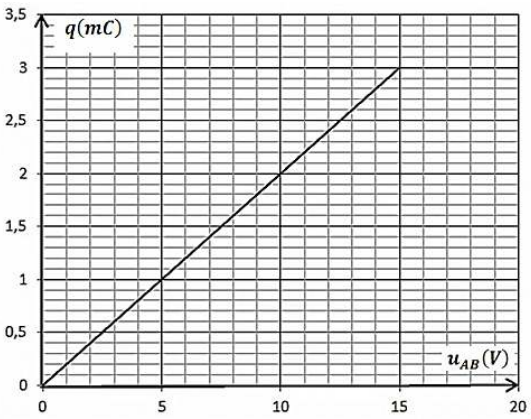
1 .i

C -

-

$u_0 = 15V$

2 .ii



u_{AB} -

-

$(R_1 + R_2)C\frac{du_{AB}}{dt} + u_{AB} = 0$

β α $u_{AB} = \alpha e^{\beta t}$ -

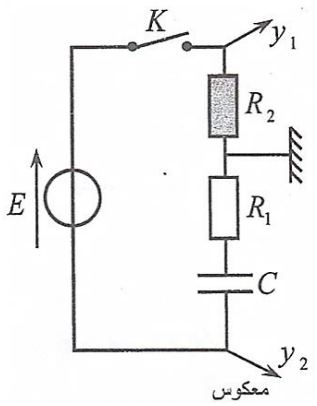
τ -

-

-

-

قلم الجزائر
WWW.DZPEN.COM

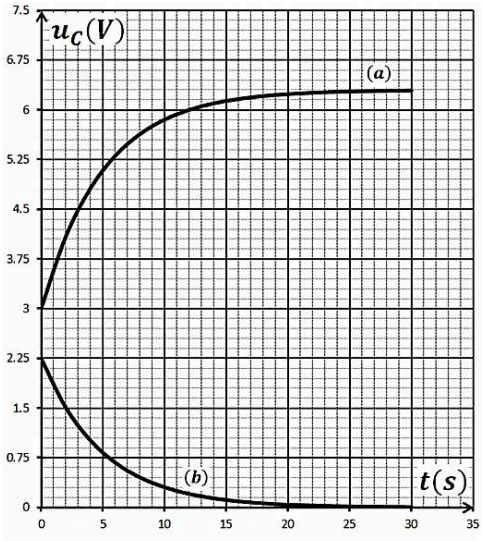


E -

C -

R_2 $R_1 = 1k\Omega$ -

K -



(b) (a) $t = 0$ K

-1

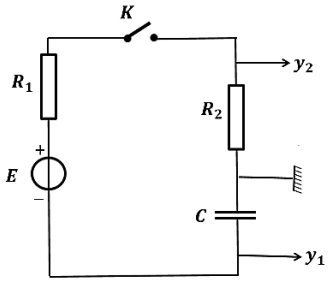
u_c -2

I_0 -3

R_2 $t = 0$ -4

C R_2 I_0 E R_2 R_1 E

-5



19

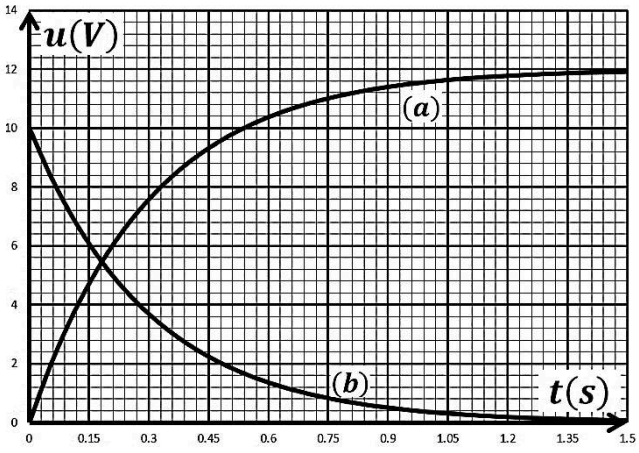
E -

R_1 $R_2 = 500\Omega$ -

K C -

K $t = 0$

-



-

R_2 u_{R_2}

قلم الجزائر
WWW.DZPEN.COM

R_1 B A $u_{R_2} = Ae^{-Bt}$ -

E C R_2

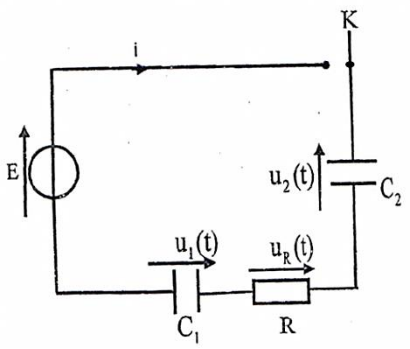
τ -

C E R_1 -

-

-

2016 20



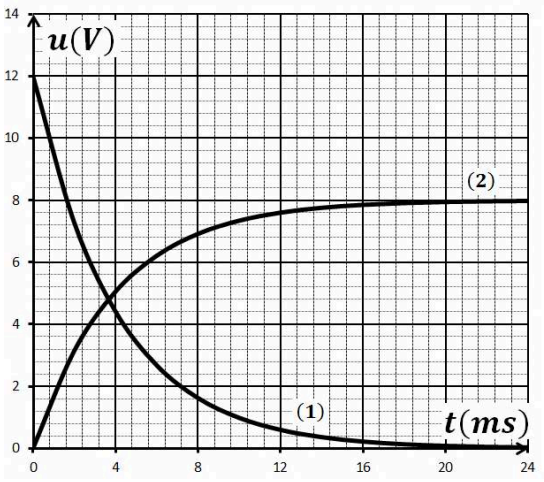
RC

-

$C_2 = 2\mu F$ C_1 -

$R = 3k\Omega$ -

K -



(1)

$C_e = \frac{C_1 \times C_2}{C_1 + C_2}$ -1

C_2 u_{C_2} -2

$\frac{du_{C_2}}{dt} + \frac{1}{RC_e}u_{C_2} = \frac{E}{RC_2}$

A $u_{C_2}(t) = A(1 - e^{\alpha t})$ -3

α

$u_R(t)$ $u_{C_2}(t)$ -4

-

τ E -

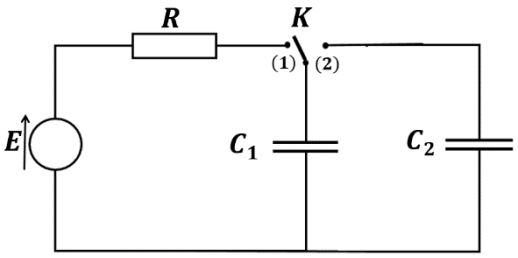
$u_{C_{2f}}$ $u_{C_{1f}}$ -

C_1 -

C_1 -

قلم الجزائر
WWW.DZPEN.COM

التمرين 21:



E

$R = 1k\Omega$

K $C_2 = 200\mu F$ C_1

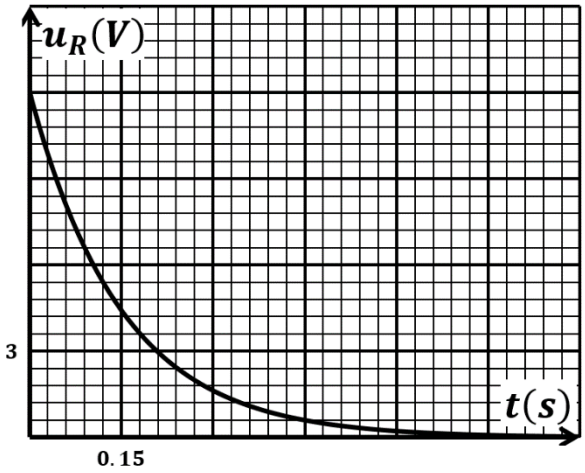
$t = 0$ 1 **.I**

u_R

-1

-2

-3



-4

u_{c_1}

$$u_{c_1}(t) = E\left(1 - e^{-\frac{t}{\tau}}\right)$$

$u_R(t)$

τ E -5

C_1

C_1 -6

$u_{c_1} = u_{c_2}$ 2 **.II**

$$Q_0 = q_{c_1} + q_{c_2}$$

C_2 C_1 q_{c_2} q_{c_1} -1

-2

-3

-4

قلم الجزائر
WWW.DZPEN.COM