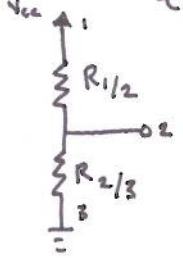
7.21.14

HW: Potentiometers

KEY

① Refer to the pot. diagram below to answer a) through e). Fill out the table throughout this question.



$R_{1/2}$	$R_{2/3}$	θ
R_p	$0 \cdot R_p$	$0 \cdot \theta_f$
$\frac{1}{2}R_p$	$\frac{1}{2}R_p$	$\frac{1}{2} \cdot \theta_f$
$\frac{1}{4}R_p$	$\frac{3}{4}R_p$	$\frac{3}{4} \cdot \theta_f$
$0 R_p$	R_p	θ_f

a) what does $R_{1/2}$ plus $R_{2/3}$ equal?

$R_{1/2} + R_{2/3} = \boxed{R_p}$

b) what is $R_{1/2}$ a function of?

$R_{1/2} = f(?)$

$\boxed{R_{1/2} = f(\theta)}$

c) With $\theta = 0$, what is $R_{1/2}$? ($R_{1/2}(\theta=0) = ?$)

look at table values and will see that

$\boxed{R_{1/2}(\theta=0) = R_p}$

d) what is the range of θ? $\theta \in [\_, \_]$ $\boxed{\theta \in [0, \theta_f]}$

θ has the range of 0 to θ_f; 0 is the min & θ_f is the max

"has range"

e) In symbols, what does $R_{1/2}(\theta)$ equal? Write the formula in the format of $R_{1/2}(\theta) = ?$

$R_{1/2}(\theta) = R_p - R_{2/3}(\theta)$; $R_{2/3}(\theta) = C \cdot \theta$ → need C

$R_{2/3}(\theta = \theta_f) = R_p = C \cdot \theta_f \rightarrow C = \frac{R_p}{\theta_f}$

$R_{1/2}(\theta) = R_p - \frac{R_p}{\theta_f} \cdot \theta \rightarrow \boxed{R_{1/2}(\theta) = R_p(1 - \theta/\theta_f)}$

② 

Given that: $V_{cc} = 20\,V$, $R_p = 5\,k\Omega$, and $V_{out}(\theta = 0) = 0\,V$;

a) what is V_{out} when $\theta = \frac{1}{2}\theta_f$? ($V_{out}(\theta = \frac{1}{2}\theta_f) = ?$)

when $\theta = \frac{1}{2}\theta_f$, $R_{1/2} = R_{2/3} = \frac{1}{2}R_p$;

$R_{1/2}$ is a voltage divider w/ an even split since R's are equal → $V_{out} = \frac{V_{cc}}{2}$

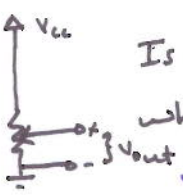
$\boxed{V_{out} = 10\,V}$

b) what is V_{out} when $\theta = \frac{2}{3}\theta_f$? $V_{out} = \frac{2}{3}V_{cc} = \frac{2}{3} \cdot 20V$

$\boxed{V_{out} = \frac{40}{3}\,V}$

c(Q) what is V_{out} as a function of θ_f? write the general formula.

$\boxed{V_{out} = V_{2/3} = \frac{\theta}{\theta_f} V_{cc}}$

③ 

Is V_{out} a function of θ? With equations and words, show why or why not. V_{out} is a function of θ, by the equation $V_{out} = \frac{\theta}{\theta_f} V_{cc}$. We know this to be true because a pot. is a variable resistor, and by $V = IR$, voltage depends on R. If $R = f(\theta)$ and $V = f(R)$, then by the transitive property, $V = f(\theta)$.

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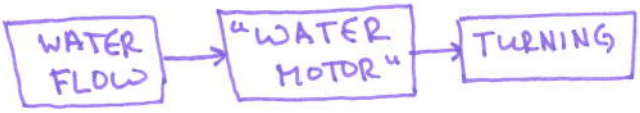
④ θ can go from 0° to 60°, for a 5 kΩ pot. ($R_p = 5\,k\Omega$).
What is C (the constant) for our pot, including UNITS?
From 1e, we know that $C = \frac{R_p}{\theta_f}$; $C = \frac{5\,k\Omega}{60°} = \frac{1\,k\Omega}{12°}$

$$C = \frac{83.3\,\Omega}{DEG}$$

⑤ Use an analogy between water and electricity to think about a motor.

a) Draw a system diagram for a motor, with at least one input and one output.

b) Draw a system diagram for a "water land" motor (thinking about what the component would be), using a one-to-one replacement of the diagram you drew for part a.



c) Describe in at least one sentence what the output of your water analogous motor is. If the analogous water motor is initially at rest, once an input of water flow is applied, the once stationary device will turn.

d) What could the water analogous device be? List at least one device and explain your rationale.
The device could be a water wheel, that spins/turns when water is passed over/through the wheel.

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