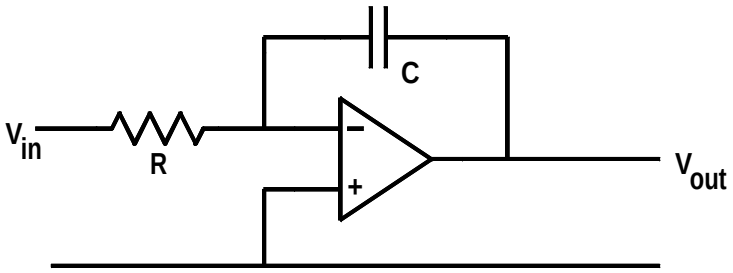
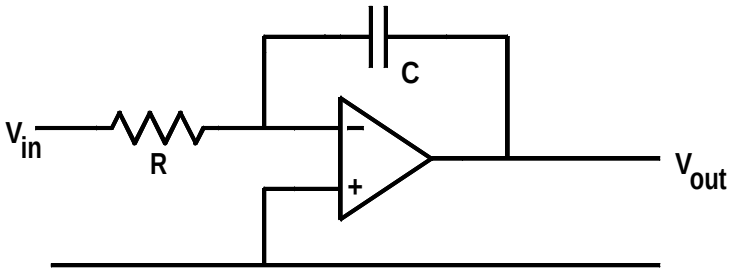


- The output from an integrator circuit is given by:—

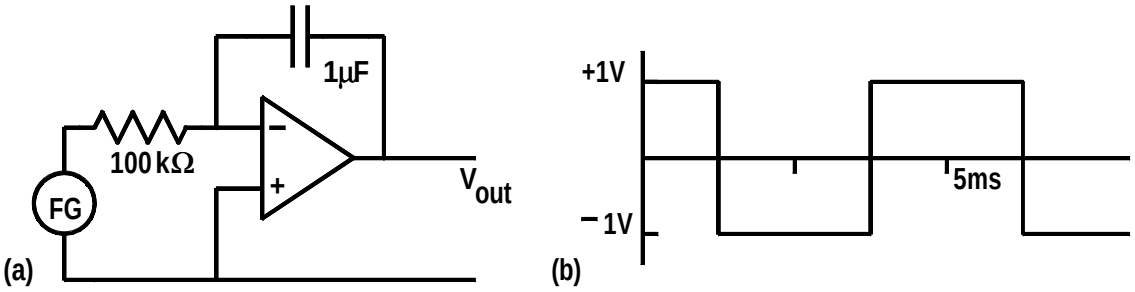
$$V_{out} = -\frac{1}{CR}\int V_{in}dt$$

- Output voltage is time integral of the input voltage



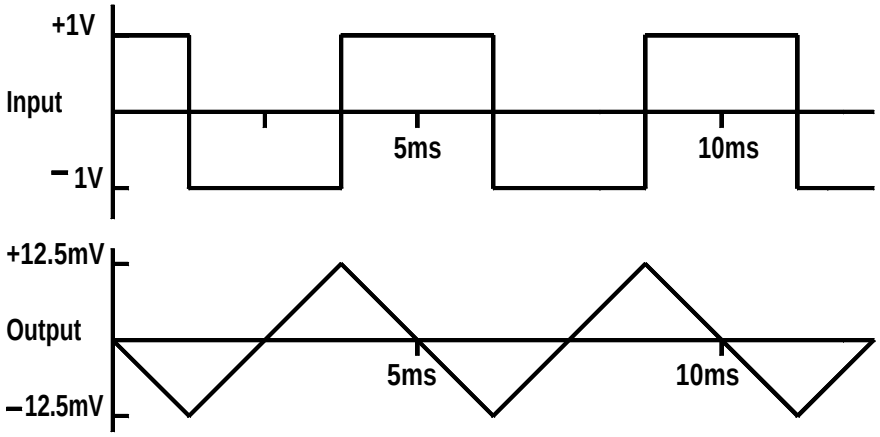
Also uses $Q = C \times V$, But argument is reversed.

$$\begin{aligned}
\text{Input current,} \quad I_{in} &= \frac{V_{in}}{R} \\
\text{and also} \quad Q &= \int I_{in} dt \\
\text{Output voltage} \quad V_{out} &= -\frac{Q}{C} \\
&= -\frac{1}{C} \int_0^t I_{in} dt \\
&= -\frac{1}{C} \int_0^t \frac{V_{in}}{R} dt \\
&= -\frac{1}{CR} \int_0^t V_{in} dt
\end{aligned}$$



Function generator, FG, is set to give an output square waveform of frequency $200Hz$ and of amplitude $1V$.

Calculate the output voltage waveform and sketch the waveform



$$CR = 1\mu F \times 100k\Omega = 10^{-6} \times 10^{5} = 0.1sec$$

We then use the equation for the integrator

$$\begin{aligned} V_{out} &= -\frac{1}{CR}\int_0^t V_{in}dt \\ &= -\frac{1}{0.1}\int_0^t V_{in}dt \\ &= -10\int_0^t V_{in}dt \end{aligned}$$

V_{in} is constant for 1.25ms at $+1V$ and then
V_{in} is constant for 2.5ms at $-1V$ and then
V_{in} is constant for 2.5ms at $+1V$ and then
V_{in} is constant for 2.5ms at $-1V$ and then
etc.

At the end of the first $\frac{1}{4}$ segment of the waveform at $t = 1.25ms$

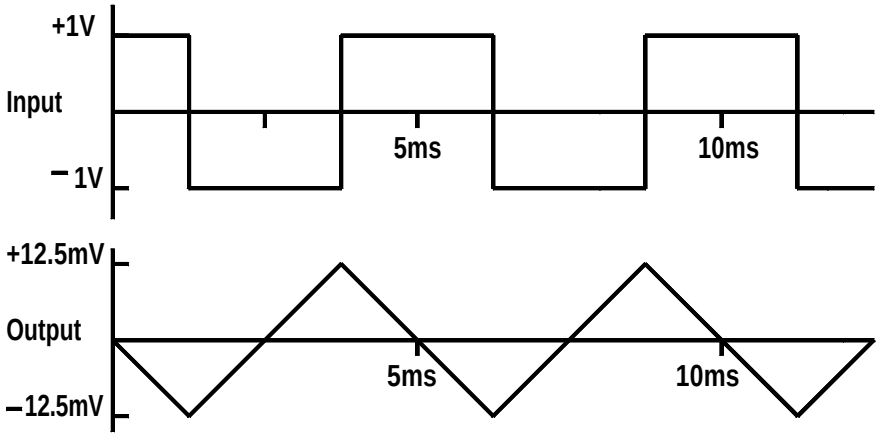
$$V_{out} = -10 \times 1V \times 1.25 \times 10^{-3} = -12.5mV$$

During the next 5ms, the output changes by

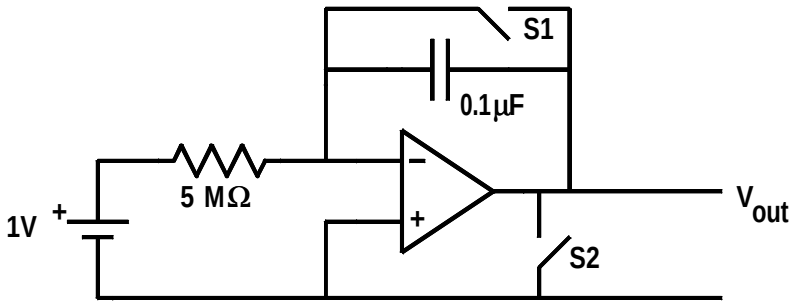
$$\Delta V_{out} = -10 \times (-1V) \times 2.5 \times 10^{-3} = +25mV$$

During the next 5ms, the output changes by

$$\Delta V_{out} = -10 \times (1V) \times 2.5 \times 10^{-3} = -25mV$$

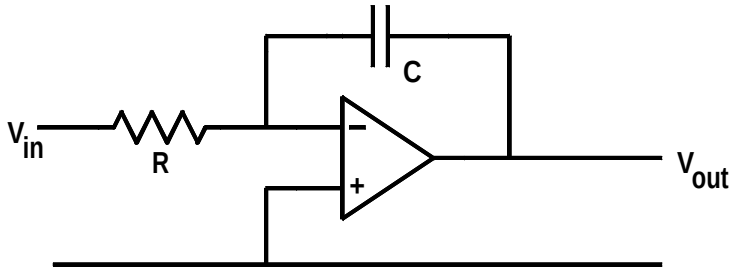


You should note the inversion:—
when the input is greater than $0V$, the output decreases,
when the input is less than $0V$, the output increases.



The two switches in the circuit in Figure 45.4 are opened at time $t = 0$. Calculate the output voltage as a function of time for time from $t = 0$ to $t = 30$seconds.

Do the calculations accurately describe the variation of the actual output voltage? If not, why not?


C
V_{in}
R
−
+
V_{out}