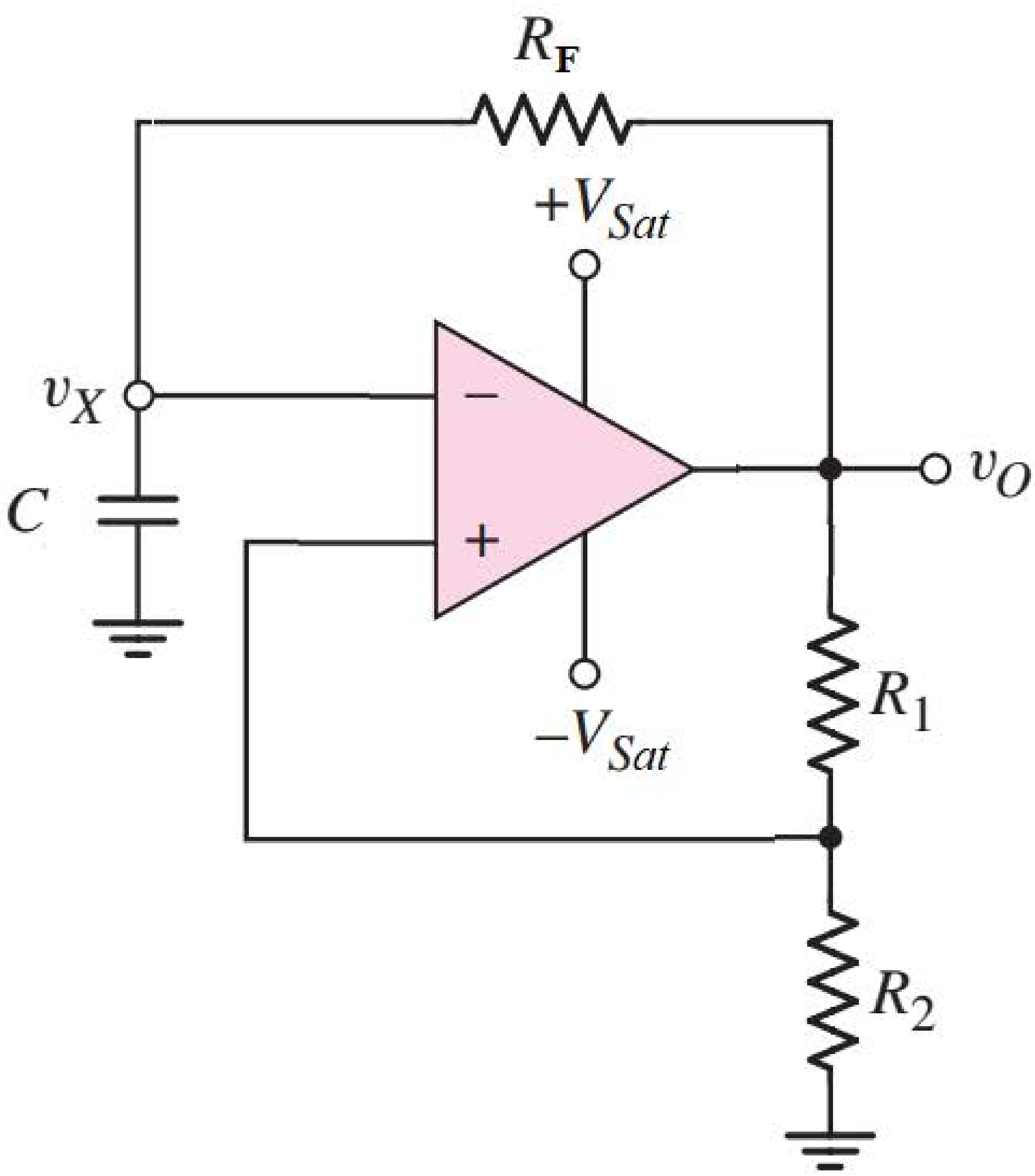
Homework 8.1

Homework due Sep 2, 2022 23:59 +06 Completed

Bookmark this page

HW 8.1.1

6.0/6.0 points (graded)



Now in the square wave generator $R_1 = 200k\Omega, R_2 = 172k\Omega$ and $+V_{sat} = 20V$ and $-V_{sat} = -20V$

Find out the upper threshold voltage.

9.2473 ✔

9.2473

Find out the lower threshold voltage.

-9.2473 ✔

-9.2473

Find the total time period T in ms if $R_f C = 10ms$

20.0126 ✔

20.0126

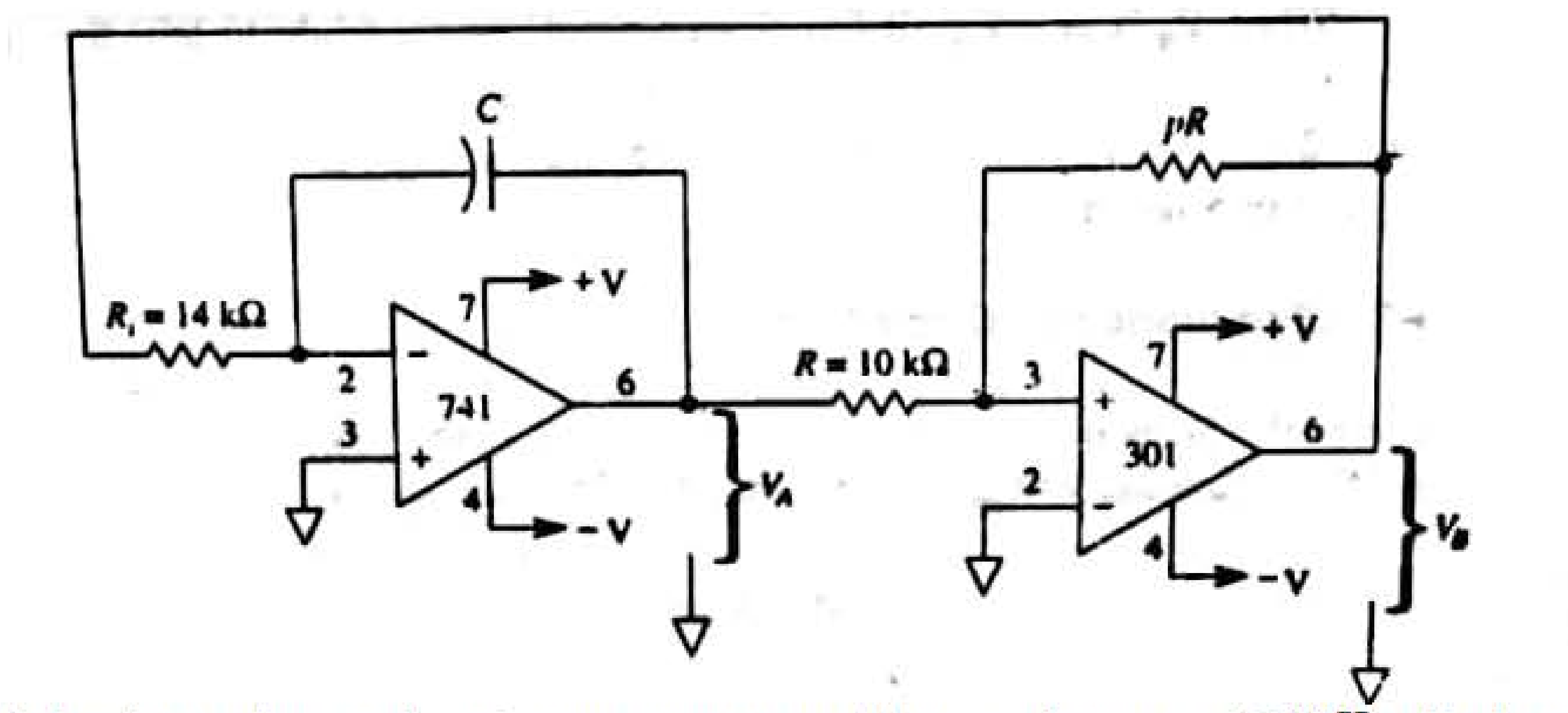
Homework 8.2

Homework due Sep 2, 2022 23:59 +06 Completed

Bookmark this page

HW 8.2.1

5.0/5.0 points (graded)



In the picture above a triangular wave generator oscillates at a frequency of $500Hz$ with the peak value of approximately $5V$. Moreover, the effective value for $+V_{sat} = 14.2V$ and $-V_{sat} = -13.8V$.

Calculate the required value for pR in $k\Omega$

27.6

27.6

Calculate the required value for C in μF

0.1

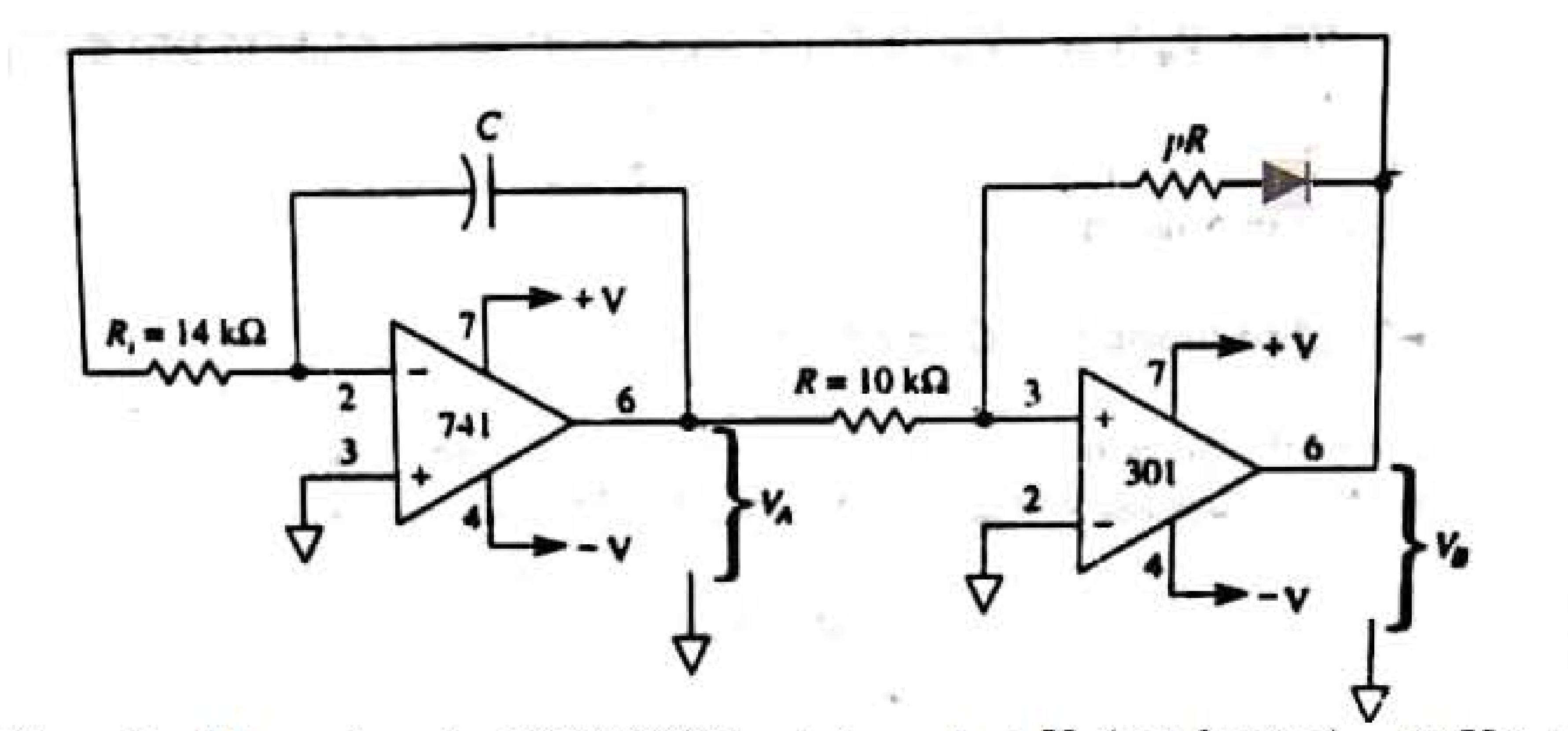
0.1

Save | Show answer

Submit You have used 1 of 5 attempts

HW 8.2.2

5.0/5.0 points (graded)



We updated the previous circuit (HW 8.2.1) by placing a diode $V_D\,(conducting) = 0.6V$ right after the pR resistor.

Find the approximate peak value of the voltage V_{UT} in V.

4.7826

4.7826

Find the new frequency f in kHz.

1

1

Save | Show answer

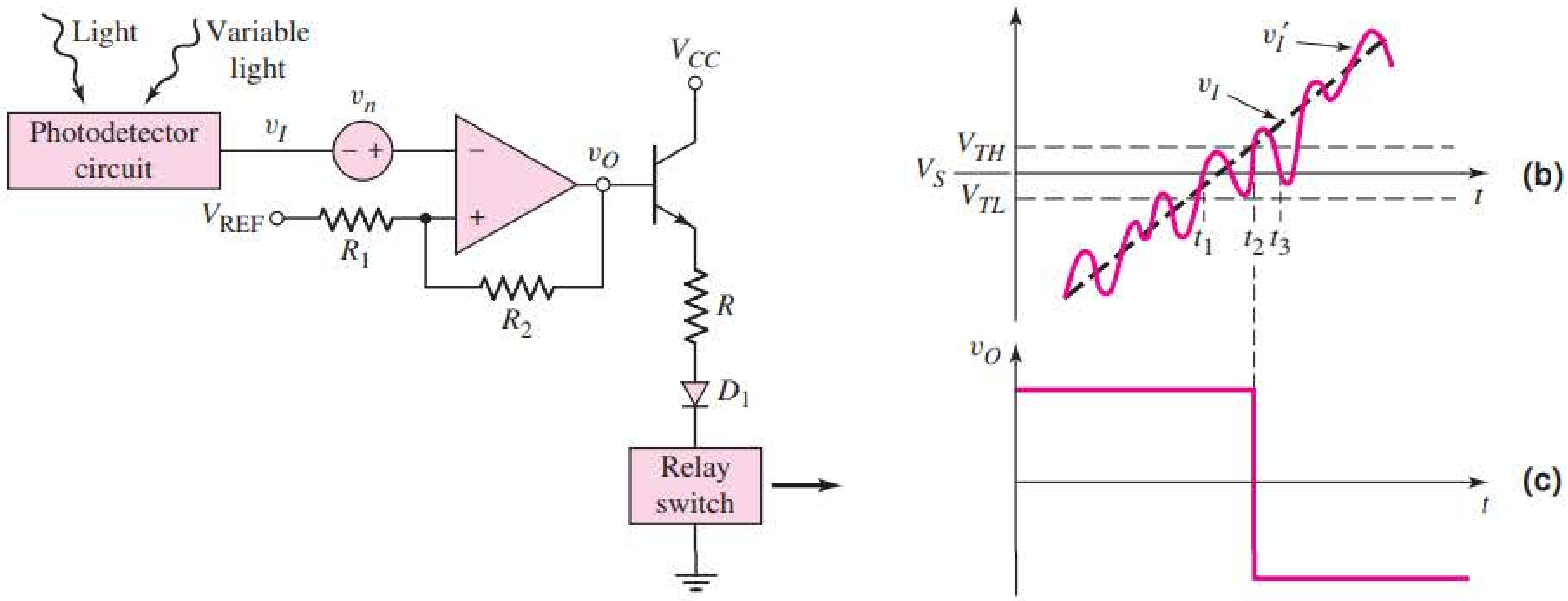
Homework 8.3

Homework due Sep 2, 2022 23:59 +06 Completed

Bookmark this page

HW 8.3.1

10.0/10.0 points (graded)



(a)

Here assume conduction voltage of diode is $V_\gamma = 0.7V$ and for the switching transistor $V_{BE}(on) = 0.7V$ and β_F is very large.

Design the street light control circuit shown in the above figure such that the switching voltage is $V_S = 2V$ and the hysteresis width is $200mV$. Assume $V_H = 10V$ and $V_L = -6V$.

Find the resistances in $k\Omega$. You can assume the value of one resistance.

R_1

1

R_2

79

Find the value of V_{REF} in V.

2.025316

2.025316

Suppose, the current through resistance R is $150\mu A$ when $v_O = V_H$ and relay switch resistance is 330Ω .

Find the value of R in $k\Omega$.

57.0033

57.0033

Save

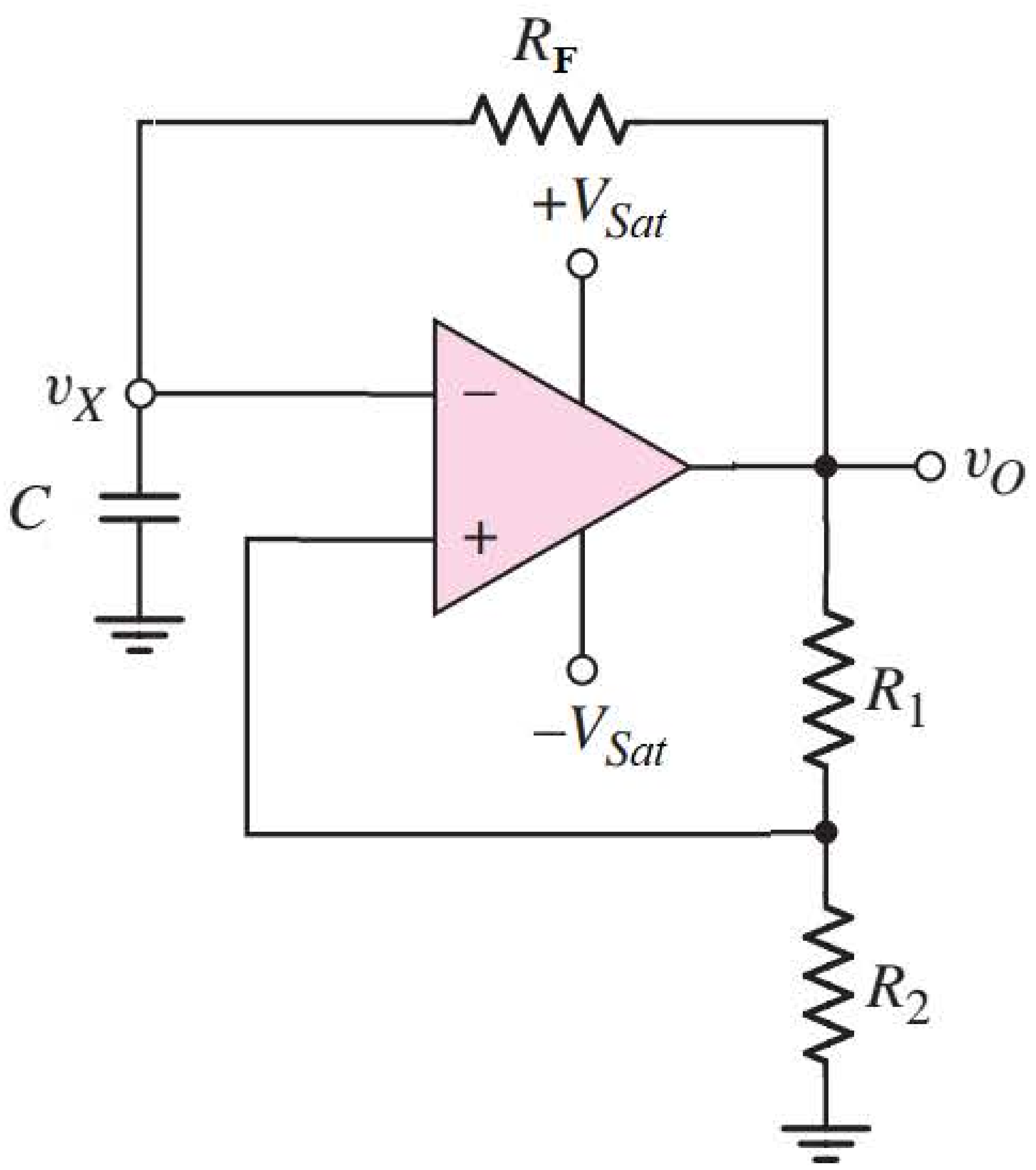
Homework 8.4

Homework due Sep 2, 2022 23:59 +06 Completed

Bookmark this page

HW 8.4.1

24.0/24.0 points (graded)



Design a square wave generator such that it has frequency $4kHz$ and duty cycle 30%.

Find the resistances in $k\Omega$, capacitance in μF, voltage in V. Use minus sign while submitting the value of $-V_{Sat}$, it may or may not have same absolute value of $+V_{Sat}$. You can assume any value if needed.

R_1

1 ✔

R_2

0.26 ✔

C

0.01 ✔

R_F

25 ✔

$+V_{Sat}$

1 ✔

$-V_{Sat}$

-0.345 ✔

Save

8.1

Upper threshold voltage.

$$V_{TU} = +V_{sat} \times \frac{R_2}{R_1+R_2}$$

$$= 20 \times \frac{172}{372} = 9.2473 \text{ V}$$

Lower threshold voltage.

$$V_{TL} = -V_{sat} \times \frac{R_2}{R_1+R_2}$$

$$= -20 \times \frac{172}{372} = -9.2473 \text{ V}$$

$$T_1 = \tau \ln\left(\frac{(+V_{sat}) - V_{TL}}{(+V_{sat} - V_{TU})}\right)$$

$$= R_f C \ln\left(\frac{(+V_{sat}) - V_{TL}}{(+V_{sat} - V_{TU})}\right)$$

$$= 10 \text{ ms} \times \ln\left(\frac{20+9.2473}{20-9.2473}\right) = 10.006 \text{ ms}$$

$$T_2 = \tau \ln\left(\frac{(-V_{sat}) - V_{TU}}{(-V_{sat} - V_{TL}}\right)$$

$$= R_f C \ln\left(\frac{(-V_{sat}) - V_{TU}}{(-V_{sat} - V_{T2}}\right)$$

$$= 10ms \times \ln\left(\frac{-20 - 9.2473}{-20 + 9.2473}\right)$$

$$= 10.006 \text{ ms}$$

$\therefore$ Total time $= t_1 + t_2 = 20.0126 \text{ ms}$

8.2.1

$$f = 500\,Hz = 0.5\,kHz$$

$$T = \frac{1}{f} = \frac{1}{0.5} = 2ms \; ; \; V_{UT} \approx 5V$$

$$V_{UT} = -\left(\frac{-V_{sat}}{P}\right) = -\left(\frac{-13.8}{P}\right)$$

$$\Rightarrow P = \frac{13.8}{5} = 2.76$$

$$\therefore PR = 2.76 \times 10 = \boxed{27.6\,k\Omega}$$

$$f = \frac{P}{4R_iC} = \frac{2.76}{4 \times 14 \times C}$$

$$\Rightarrow C = \frac{2.76}{4 \times 14 \times 500} = \boxed{0.1\,\mu F}$$

8.2.2

$$V_{UT} \approx -\left(\frac{-V_{sat}+0.6}{P}\right)$$

$$= \frac{13.2}{2.76} = 4.7826\ V$$

new frequency $= 0.5 \times 2$

$= 1KH_z$

8.3.1

hysteresis width $= V_{TH} - V_{TL}$

$$= \left(V_H \times \frac{R_1}{R_1+R_2}\right) - \left(V_L \times \frac{R_1}{R_1+R_2}\right)$$

$$\Rightarrow 200\times10^{-3} = (V_H - V_L) \times \frac{R_1}{R_1+R_2}$$

$$\Rightarrow 200\times10^{-3} = (10+6) \times \frac{1}{1+\frac{R_2}{R_1}}$$

$$\Rightarrow \frac{R_2}{R_1} = \frac{16}{200\times10^{-3}} - 1 = 80 - 1 = 79$$

$\boxed{R_1 = 1K\Omega}$ $\boxed{R_2 = 79\ K\Omega}$

$$V_{Ref} = V_S \times \frac{R_1+R_2}{R_2} = 2\times 1.01265V$$

$$\boxed{= 2.025316\ V}$$

$$V_x = 150\times10^{-6}\times330 = 0.0495\ V$$

$$V_y = V_x + 0.7 = 0.7495V$$

$$R = \frac{V_H - V_y - 0.7}{150 \times 10^{-6}} = \frac{10 - 0.7495 - 0.7}{150 \times 10^{-6}}$$

$$\boxed{= 57.0033\, K\Omega}$$

8.4.1

frequency $= 4\,KHz$

$$\therefore T = \frac{1}{f} = \frac{1}{4 \times 10^3} = 0.25\,ms$$

duty cycle $= 30\%$

$$\therefore T_1 = (30\%) \times T = \frac{30}{100} \times 0.25$$

$$= 0.075\,ms$$

$$\therefore T_2 = T - T_1 = 0.25 - 0.075 = 0.175\,ms$$

Assume that,

$\tau = T = 0.25\,ms$, $\boxed{C = 0.01\,\mu F}$, $\boxed{R_F = 25\,k\Omega}$

$$\therefore T_1 = \tau \ln \left(\frac{V_H - V_{LT}}{V_H - V_{UT}} \right)$$

$$= \tau \ln \left(\frac{V_H - V_L \left(\frac{R_2}{R_1 + R_2} \right)}{V_H - V_H \left(\frac{R_2}{R_1 + R_2} \right)} \right)$$

$$\Rightarrow e^{\frac{T_1}{\tau}} = \frac{V_H - \frac{V_L R_2}{R_1 + R_2}}{V_H \left(1 - \frac{R_2}{R_1 + R_2} \right)}$$

$$\Rightarrow e^{\frac{T_1}{\tau}} = \frac{V_H - \frac{V_L R_2}{R_1 + R_2}}{\frac{V_H R_1}{R_1 + R_2}}$$

$$\Rightarrow e^{\frac{T_1}{\tau}} = \frac{R_1 + R_2}{R_1} - \frac{V_L R_2}{V_H R_1}$$

$$\Rightarrow e^{\frac{0.075}{0.25}} = \left(1 + \frac{R_2}{R_1} \right) - \frac{V_L}{V_H} \left(\frac{R_2}{R_1} \right)$$

$\frac{R_2}{R_1} \rightarrow x$, $\frac{V_L}{V_H} \rightarrow y$, $\frac{R_2}{R_1} \rightarrow x$

$$\Rightarrow e^{0.3} = (1 + x) - xy \quad \text{—— (i)}$$

$$\therefore T_2 = \tau \ln\left(\frac{V_L - V_{UT}}{V_L - V_{LT}}\right)$$

$$\Rightarrow e^{\frac{T_2}{\tau}} = \frac{R_1 + R_2}{R_1} - \frac{V_H}{V_2}\,\frac{R_2}{R_1}$$

$$\Rightarrow e^{\frac{0.175}{0.25}} = \left(1 + \frac{R_2}{R_1}\right) - \frac{1}{\frac{V_L}{V_H}} \times \frac{R_2}{R_1}$$

$$\Rightarrow e^{0.7} = (1+x) - \left(\frac{x}{y}\right) \text{ —— (ii)}$$

(i) $\Rightarrow$

$$e^{0.3} = (1+x) - xy$$

$$\therefore y = \frac{1 + x - e^{0.3}}{x}$$

(ii) $\Rightarrow$

$$e^{0.7} = (1+x) - \left(\frac{x}{\frac{1+x-e^{0.3}}{x}}\right)$$

$$\Rightarrow e^{0.7} = (1+x) - \frac{x^2}{1+x-e^{0.3}}$$

$\therefore x = 0.26$

$$\therefore y = \frac{1+0.26-e^{0.3}}{0.26} = -0.3456$$

$$\therefore \frac{R_2}{R_1} = x \Rightarrow \frac{R_2}{R_1} = 0.26$$

$$\therefore \frac{V_L}{V_H} = y \Rightarrow \frac{V_L}{V_H} = -0.3456$$

$\therefore R_1 = \boxed{1\ k\Omega}$ $\quad R_2 = \boxed{0.26\ k\Omega}$

$\boxed{+V_{sat} = 1V}$, $\boxed{-V_{sat} = -0.3456V}$