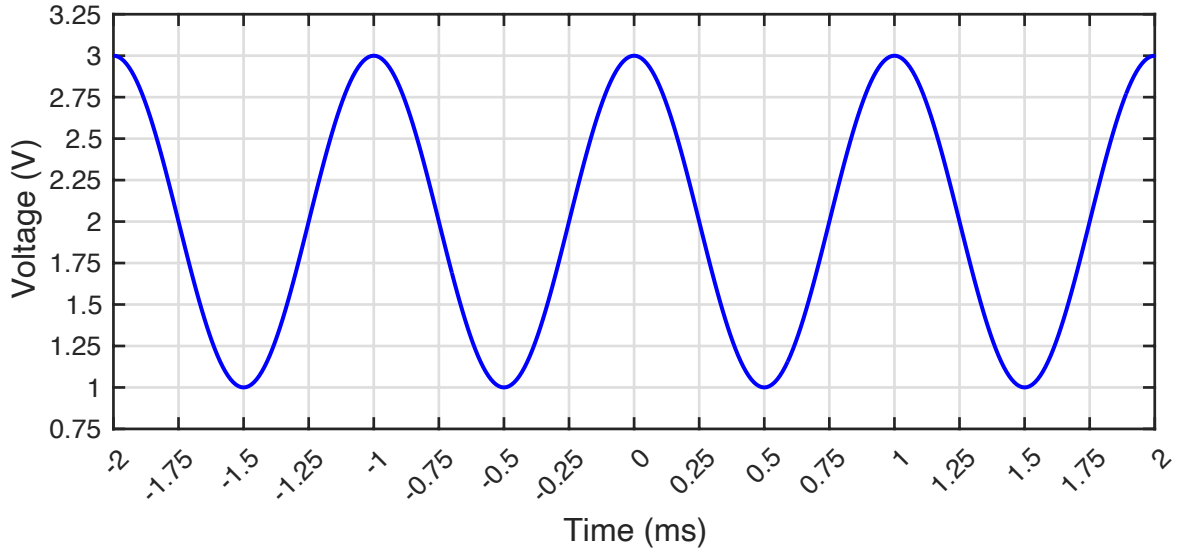
Homework 5

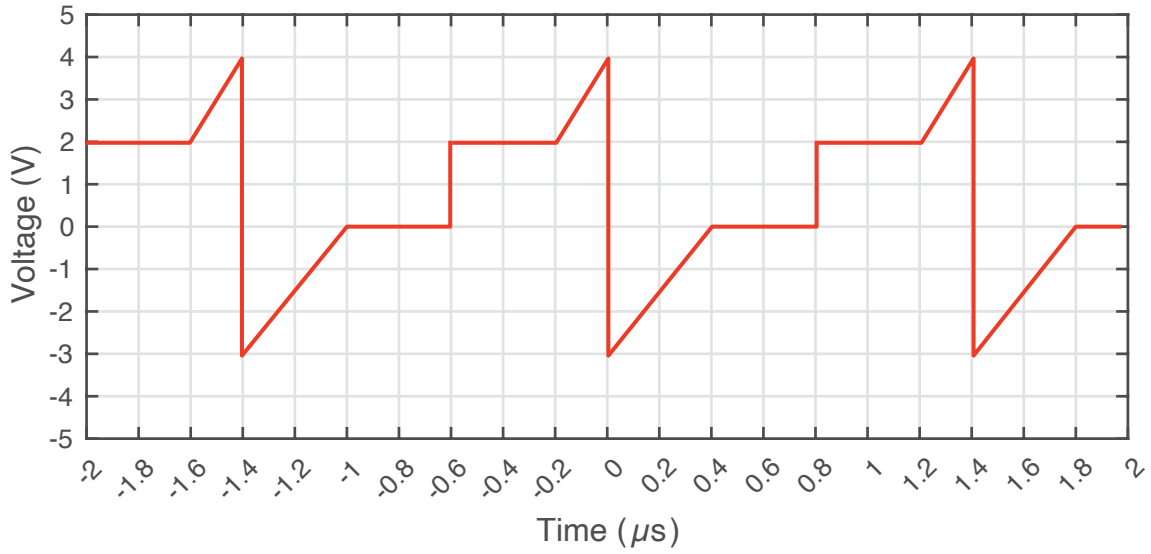
Clearly describe the reasoning behind the work done in each problem.

SOLVE 5 OF ANY OF THE FOLLOWING PROBLEMS.

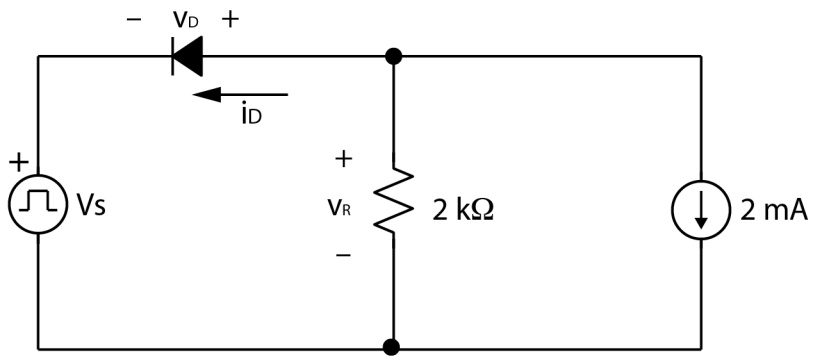
Problem 1: (*20 points*)
The plot below shows the signal v(t). Determine: V_{DC}, A, f, and θ. Write v(t) in the form of:
$v(t) = V_{DC} + A\cos(2\pi f\, t + \theta)$.



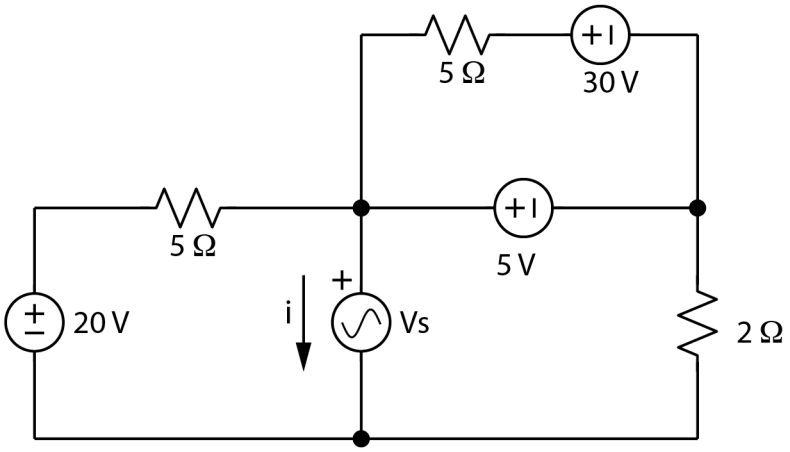
Problem 2: (*20 points*)
For the plot below, find voltage peak to peak $V_{p\text{-}p}$, DC voltage V_{DC}, period T, and frequency f.



Problem 3: (*20 points*)
For the circuit below the input is a -6V to +6V rectangular pulse train with 75% duty cycle. Plot $V_R(t)$, $V_D(t)$, and $i_D(t)$. $V\gamma$ = 2 V.

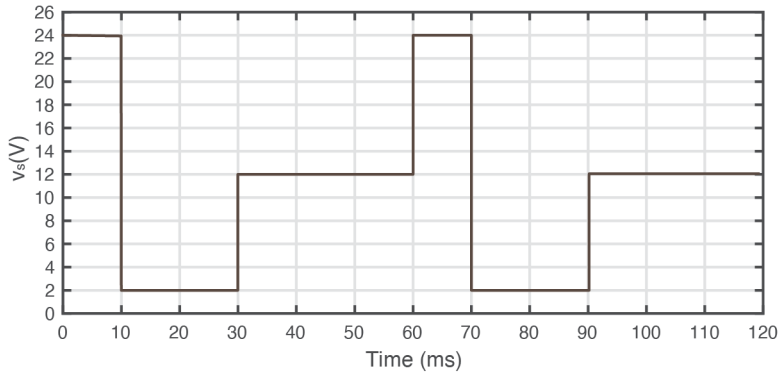


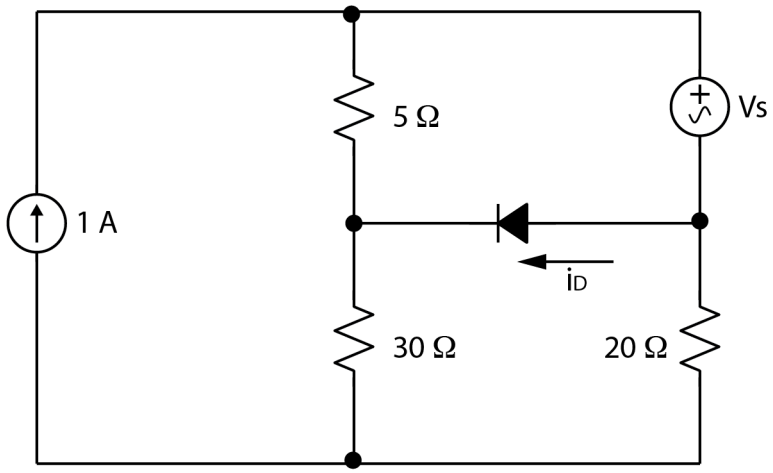
Problem 4: (*20 points*)
In the circuit below, $v_s(t)$ = 20 cos(200t). Find i(t) and the DC value of this current.



Problem 5: (*20 points*)
Find the DC value of the current $i(t) = [12\cos^2(10t) + 6\cos^2(20t) + 24\cos(30t)]$ mA.

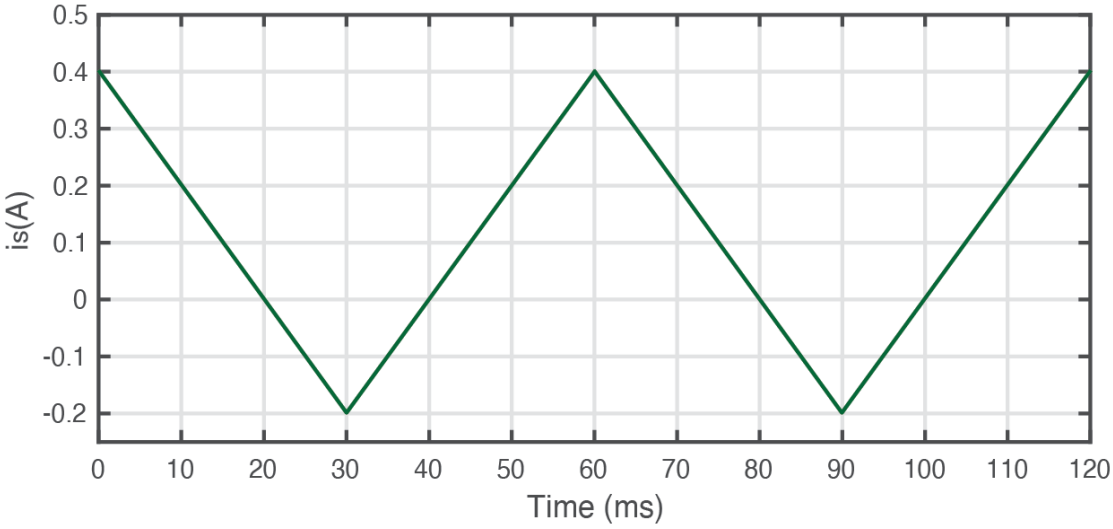
Problem 6: (*30 points*)
For the circuit below plot $i_D(t)$ using the given $v_s(t)$. $V\gamma = 1$ V.

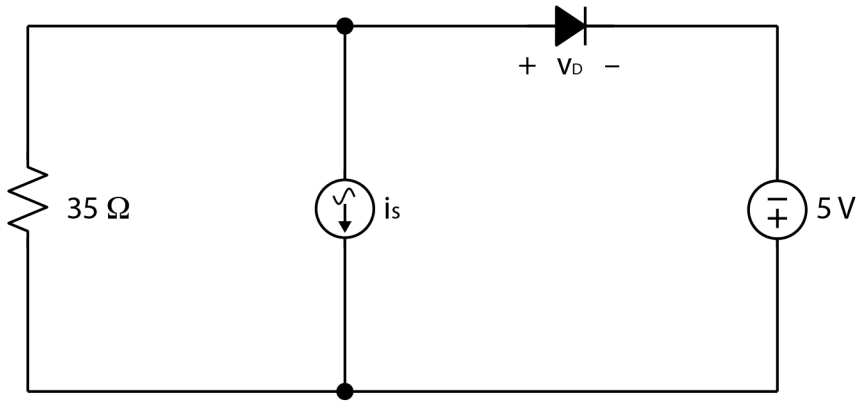




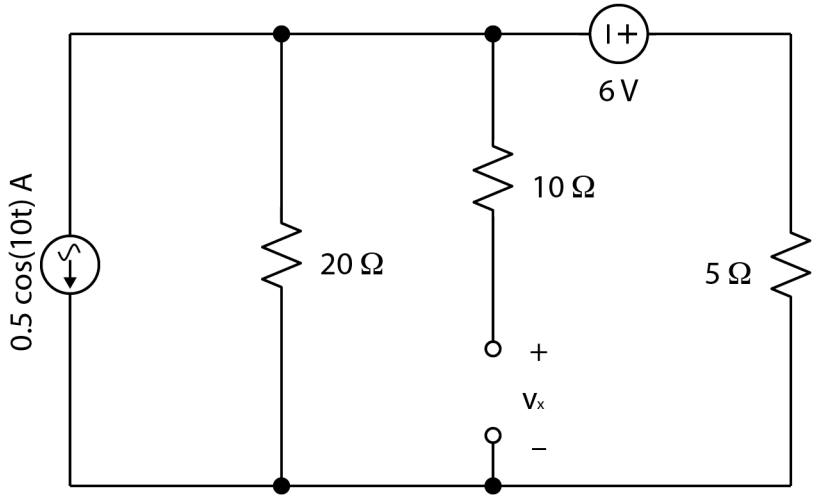
Problem 7: (*30 points*)

For the circuit below plot $v_D(t)$ using the given $i_s(t)$. $V\gamma$ = 1.5 V.





Problem 8: (*30 points*)
Solve for $v_x(t)$, and the DC value of v_x.



Problem One

$V_{DC} = 2v$

$A = 1v$

$f = \frac{1}{1ms}$

$= 1000s$

$\theta = 0s$

$V(t) = 2 + cos(2000\pi t)$

Problem Two

$V_{pp} = 2v$

$T = 1.4\mu s$

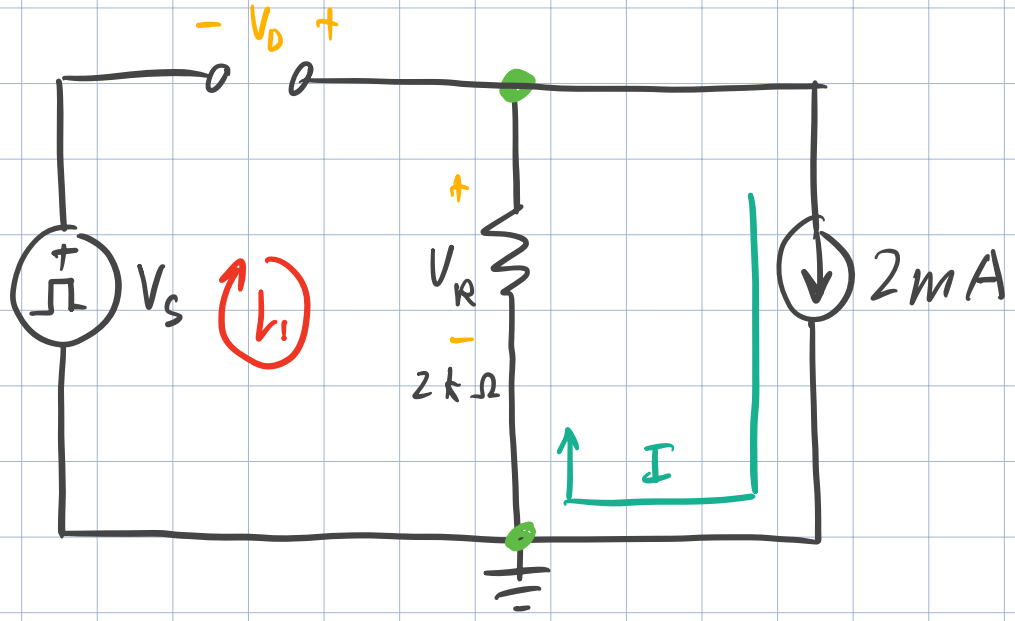
$f = 0.714\mu s$

$V_{DC} = \frac{-\frac{1}{2}(0.4 \cdot 3) + (0.6 \cdot 2) + \frac{1}{2}(0.2 \cdot 2)}{1.4}$

$= 0.571v$

Problem Three

Start with diode off and solve for diode on, V_R, V_D, and i_D



1 backyards - 1 current source = 1 unknown

$$V_R = -0.002 \cdot 2000$$

$$= -4\,V$$

KVL on L_1

$$V_S + V_D - V_R = 0$$

$$V_S + V_D + 4 = 0$$

$$V_D = -V_S - 4$$

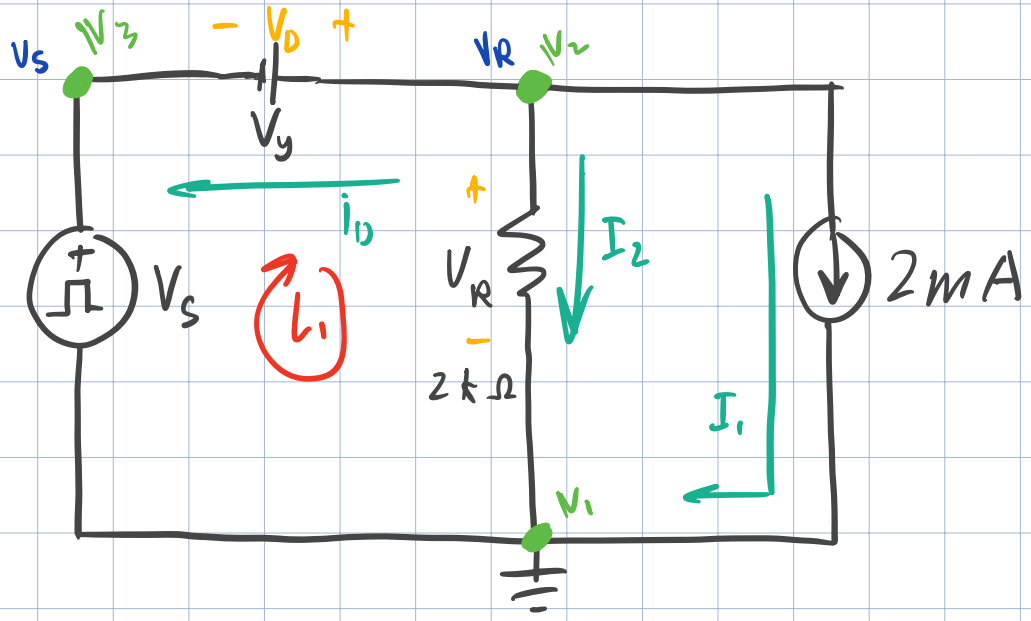
Dicde is on when $V_D \geq V_y$

$-V_s - 4 \geq 2$

$-V_s \geq 6$

$V_s \leq -6$

Solve for V_R, V_D, and i_D when dicde is on



Solve for V_s

Kvl on L_1

$V_s + V_y - V_R = 0$

$V_R = V_s + 2$

Solve for i_D

Node Voltage

Kcl at V_1

$$I_1 + \frac{V_R - 0}{2000} + i_D = 0$$

$$0.002 + \frac{V_S + 2}{2000} + i_D = 0$$

$$4 + V_S + 2 + 2000 i_D = 0$$

$$i_D = \frac{-V_S - 6}{2000}$$

Solve for V_D

$$V_D = V_R - V_S$$

$$= V_S + 2 - V_S$$

$$= 2V$$

When V_S is 6 diode is off and

$$V_R = -4V$$

$$V_D = -10V$$

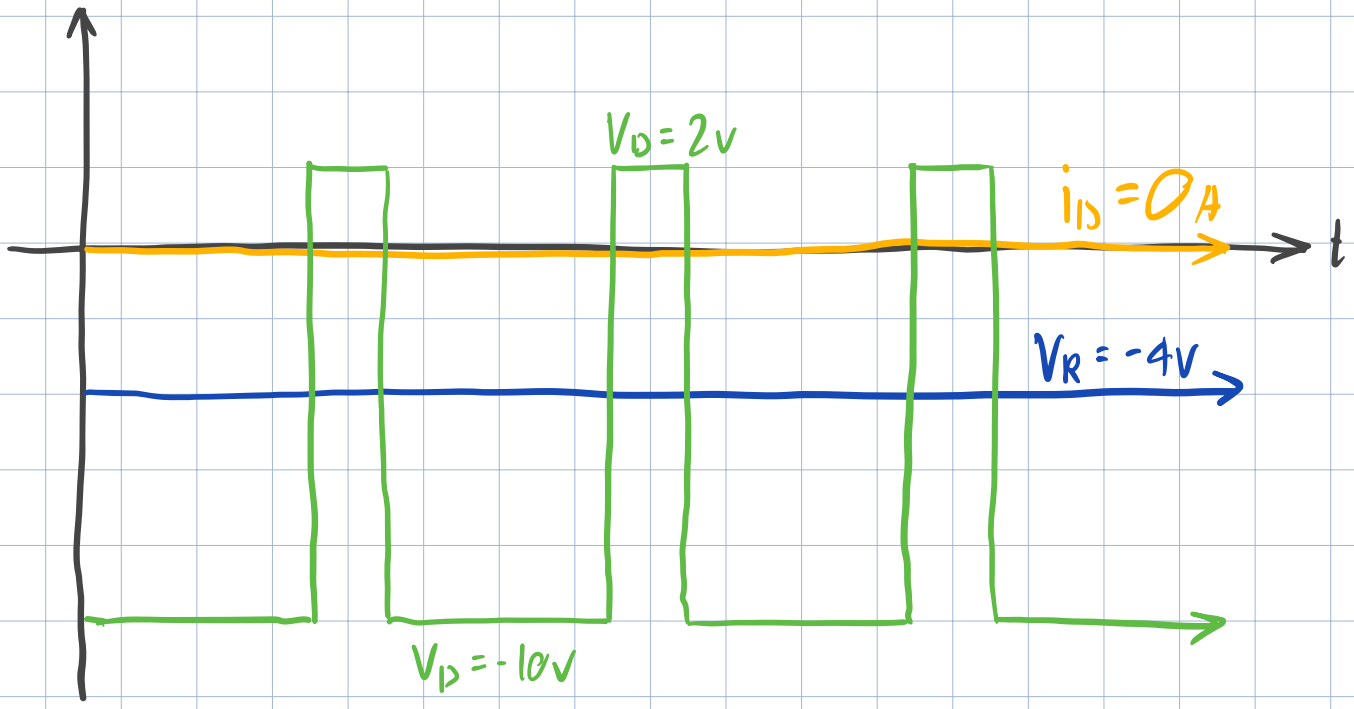
$$i_D = 0A$$

When V_S is -6 dicde is on and

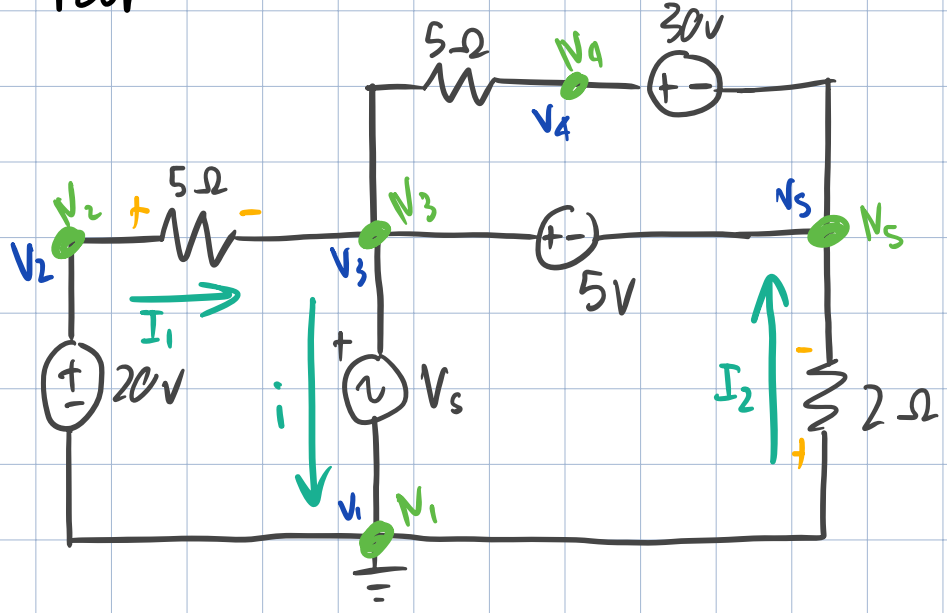
$V_R = -4V$

$V_D = 2V$

$i_D = 0A$



Problem Four



5 nodes - 1 grand - 4 voltage sources = 0 unknowns

$V_1 = 0\ V$

$V_2 = 20\ V$

$V_3 = V_s$

$V_5 = V_s - 5$

KCL at V_3

$$i = I_1 + I_2$$

$$i = \frac{V_2 - V_3}{5} + \frac{V_1 - V_5}{2}$$

$$10i = 2(V_2 - V_3) + 5(V_1 - V_5)$$

$$10i = 2(20 - V_s) + 5(-V_s + 5)$$

$$10i = 40 - 2V_s - 5V_s + 25$$

$$10i = 65 - 7V_s$$

$$10i = 65 - 7(20\cos(2\omega t))$$

$$10i = 65 - 140\cos(2\omega t)$$

$$2i = 13 - 28\cos(200t)$$

$$i = \frac{13}{2} - 14\cos(200t)$$

Problem Five

$$i_{DC} = \frac{1}{T}\int_0^T i(t)\,dt$$

$$= \frac{1}{T}\int_0^T 12\cos^2(10t) + 6\cos^2(20t) + 24\cos(30t)\,dt$$

$$= \frac{1}{T}\int_0^T 12\left(\frac{1+\cos(10t)}{2}\right) + 6\left(\frac{1+\cos(20t)}{2}\right) + 24\cos(30t)\,dt$$

$$= \frac{1}{T}\int_0^T 6(1+\cos(10t)) + 3(1+\cos(20t)) + 24\cos(30t)\,dt$$

$$= \frac{3}{T}\int_0^T 2 + 2\cos(10t) + 1 + \cos(20t) + 8\cos(30t)\,dt$$

$$= \frac{3}{T}\left[2t + 2\sin(10t) + t + 2\sin(20t) + 240\sin(30t)\right]\Big|_0^T$$

$$= \frac{3}{T}[3t]\Big|_0^T$$

$$= \frac{3}{T}\cdot 3T$$

$$= 9\text{ mA}$$