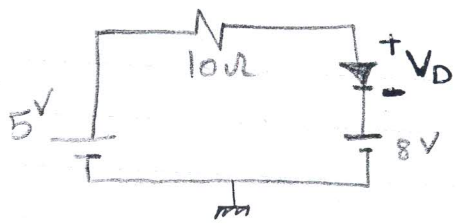
Homework Problems Soln: Ch02 (Diode App.)

5-8

a)



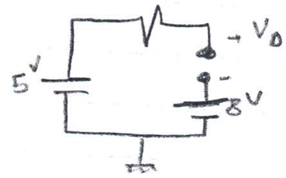
6 → Practical model

7 → ideal model

8 → complete model

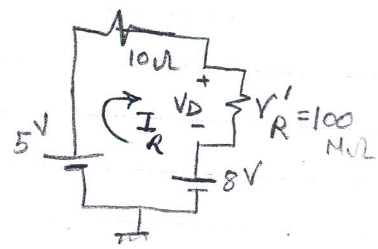
5 The diode is reverse-biased

6 , 7 : $V_D = V_R = 5 - 8 = \boxed{-3^V}$



8 $V_D = I_R \, r_R'$

$I_R = \frac{5-8}{10+100\times10^6} = \frac{-3}{10+100\times10^6} = -2.999\times10^{-8}$



∴ $V_D = -2.999$ volt $\simeq -3$ V

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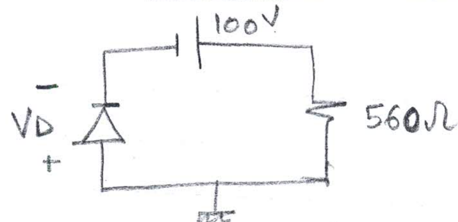
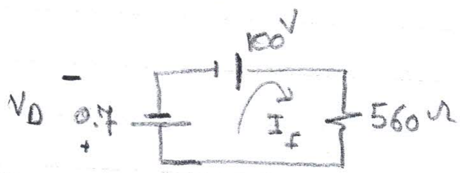
b)



5 Forward biased

6

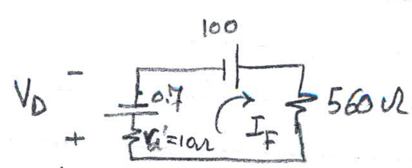


$\boxed{V_D = V_F = 0.7^V}$, $I_f = \frac{100-0.7}{560\Omega}$ A

7

$\boxed{V_D = V_F = 0\text{ V}}$, $I_f = \frac{100}{560}$ A

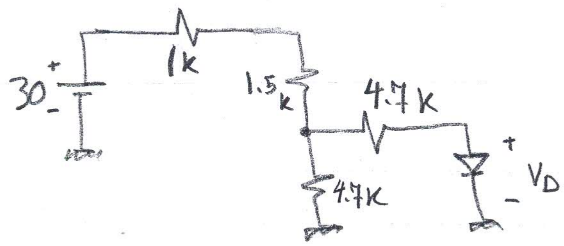
8



$V_D = 0.7 + I_f r_d'$, $I_f = \frac{100-0.7}{10+560} = 174.21$ mA

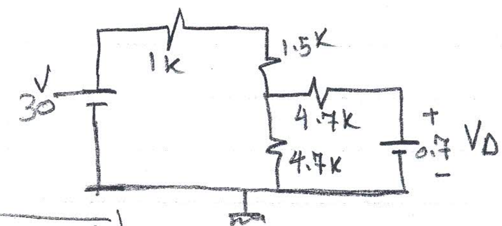
∴ $V_D = 2.442$ V

c)



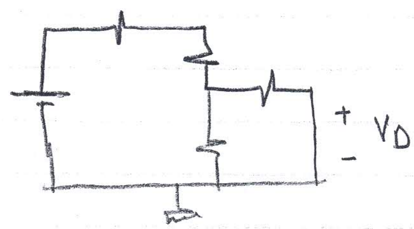
5 Forward - biased

6



$\boxed{V_D = V_F = 0.7\,V}$

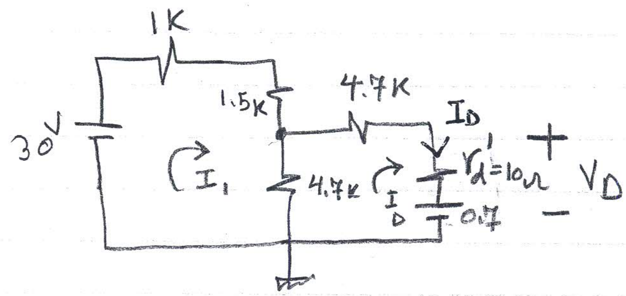
7



$\boxed{V_D = 0\,V}$

8

$V_D = 0.7 + I_D r_d'$



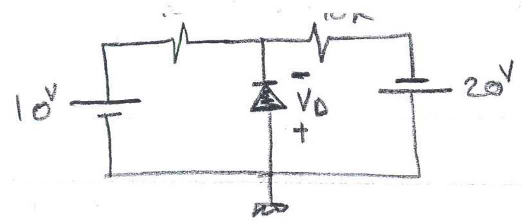
$(1+1.5)k\, I_1 + 4.7k(I_1 - I_D) - 30 = 0$ or $7.2k\, I_1 - 4.7k\, I_D = 30$

$(4.7k + 10) I_D + 0.7 + 4.7k(I_D - I_1) = 0$ or $-4.7k\, I_1 + 9410\, I_D = -0.7$

$\therefore I_D = 2.97753\,mA$

$\boxed{V_D = 0.7298\ V}$

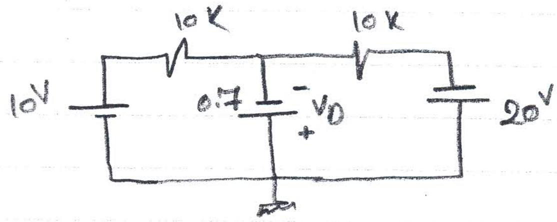
d)



5) Forward biased

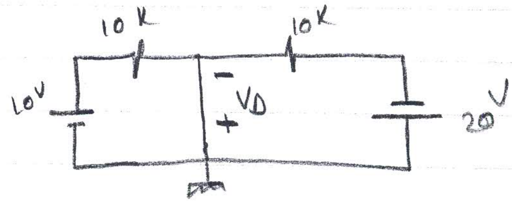
6)

$V_D = V_F = 0.7^V$



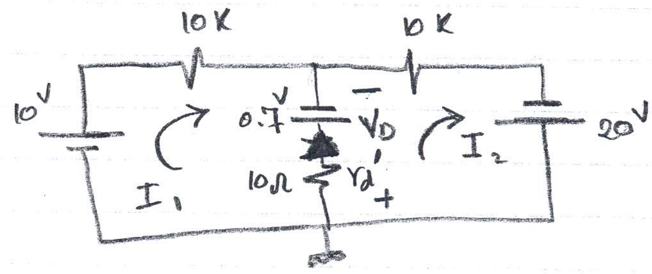
7)

$V_D = 0^V$



8)

$V_D = 0.7 + (I_2 - I_1)\, r_d'$



$\therefore$ $10k\, I_1 - 0.7 + (I_1 - I_2)\, 10 - 10^V = 0$ or $1.01\,k\, I_1 - 0.01^k I_2 = 10.7$

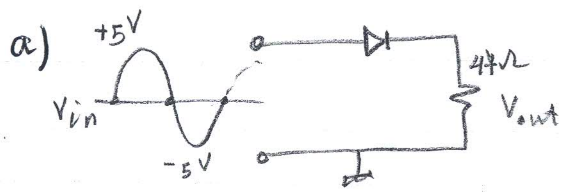
$10k\, I_2 - 20 + (I_2 - I_1)\, 10 + 0.7 = 0$ or $-0.01k\, I_1 + 1.01k\, I_2 = 19.3$

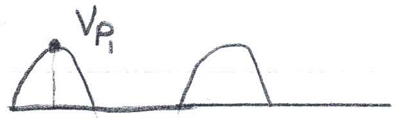
$\therefore I_1 = 10.784\,mA, \quad I_2 = 19.2157\,mA$

$\therefore \boxed{V_D = 0.7843\ V}$

9

a)

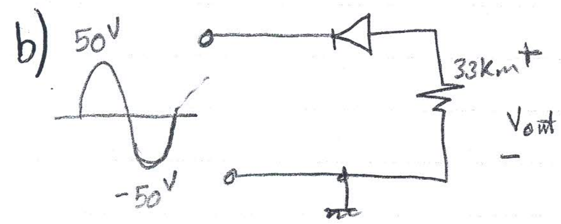


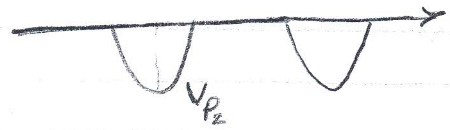


$V_{P_1} = 5^V$, in case of ideal model

$V_{P_1} = 5 - 0.7 = 4.3^V$, in case of practical model

b)





$V_{P_2} = -50^V$, in case of ideal model of diode

$V_{P_2} = -49.3^V$, " " " practical model " "

$= 0.7 - 50$

10

a) $PIV = +V_{P_1}(in) = +5^V$

b) $PIV = +V_{P_2}(in) = +50\,V$

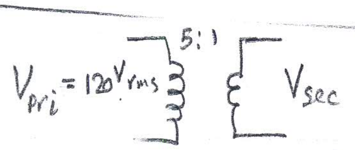
11

$$V_{Avg} = \frac{V_P}{\pi} = \frac{200}{\pi} \simeq \boxed{63.662\ V}$$

as

$$V_{Avg} = \frac{1}{2\pi}\int_0^{2\pi} V_P \sin t\, dt = \frac{V_P}{2\pi}\int_0^{\pi} \sin t\, dt = \frac{V_P}{2\pi}\left[-\cos t\Big|_0^{\pi}\right] = \frac{V_P}{\pi}$$

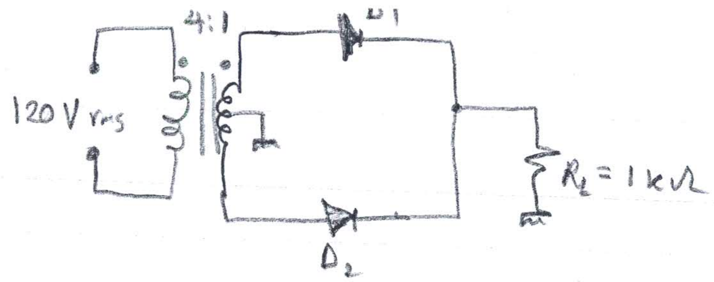
13



turns ratio "n" $= \frac{N_{sec}}{N_{pri}} = \frac{1}{5} = \frac{V_{sec}}{V_{pri}}$

$\therefore V_{sec} = \frac{1}{5} V_{pri}$ $\quad \therefore \boxed{V_{sec} = 24\,V\ rms}$

16



; $n = \frac{1}{4}$

a) The circuit is a center-tapped full-wave rectifier

b) $V_{rms}(sec) = n\, V_{rms}(pri) = \frac{1}{4} \times 120 = 30\ V$ rms

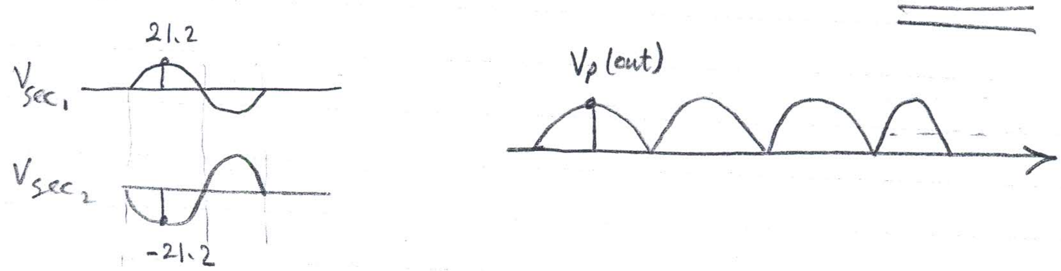
$\because\ V_p = \sqrt{2}\, V_{rms}$

$\therefore\ V_p(sec) = \sqrt{2} \times 30 = 42.43\ V \simeq \underline{42.4\ V}$

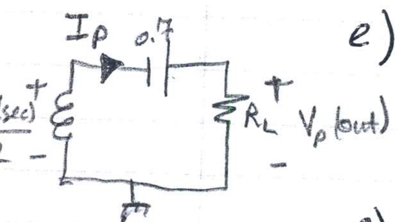
c) Peak voltage across each half $= \frac{V_p}{2} = 21.213\ V$

$\simeq \underline{21.2\ V}$

d)



$V_{R_L}(P) = V_p(out) = 21.2 - 0.7 = \underline{20.5\ V}$

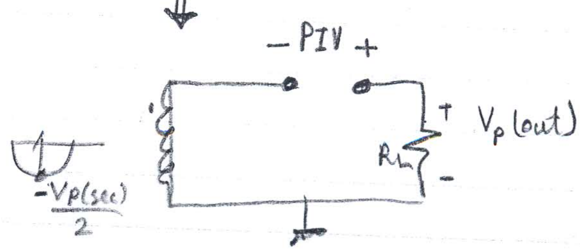


e) $I_p(D) = \dfrac{\frac{V_p(sec)}{2} - 0.7}{R_L} = \dfrac{21.2 - 0.7}{1K} = \underline{20.5\ mA}$

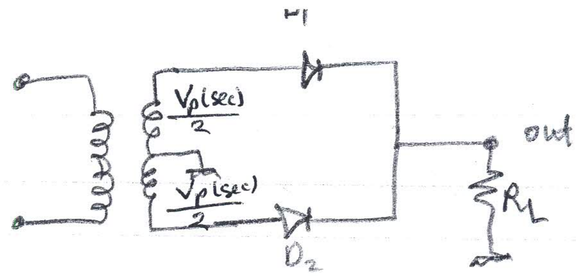
f) $PIV = V_p(out) - \left(\dfrac{-V_p(sec)}{2}\right)$; in inverse-biased case

$= 20.5 - (-21.2) = \underline{41.7\ V}$

$\Downarrow$



$\boxed{17}$



$V_{Avg}(out) = 120V$

for a full-wave rectifier

$$V_{AVG} = \frac{2V_p}{\pi}$$

$$\therefore V_p(out) = \frac{\pi}{2} V_{AVG}(out) = \frac{\pi}{2} * 120 = 60\pi \ V$$

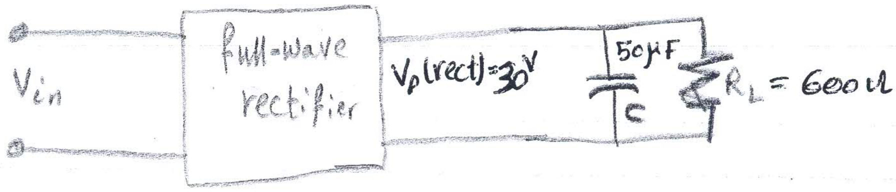
$$\because V_p(out) = \frac{V_p(sec)}{2} - 0.7$$

$$\therefore \frac{V_p(sec)}{2} = V_p(out) + 0.7$$

$$\therefore \frac{V_p(sec)}{2} = 60\pi + 0.7 \cong 188.496 + 0.7$$

$$\cong \boxed{189.2 \ V}$$

23



Let frequency of input signal = 60 hz

$\therefore f(rect) = 120$ hz

$\therefore V_r(pp) = \dfrac{V_p(rect)}{f C R_L} = \dfrac{30}{(120)(50 \times 10^{-6})(600)}$

$\therefore V_r(pp) = 8.33$ V $\rightarrow 8\frac{1}{3}$

$V_{DC} = \left(1 - \dfrac{1}{2 f R_L C}\right) V_p(rect)$

$= \left[1 - \dfrac{1}{2 \times 120 \times 600 \times 50 \times 10^{-6}}\right](30)$

$\therefore V_{DC} = 25.83$ V

24

$\therefore$ ripple factor $(r) = \dfrac{V_r(pp)}{V_{DC}} = 32.25\%$

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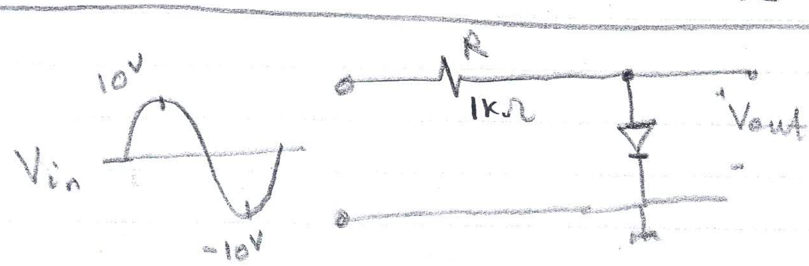
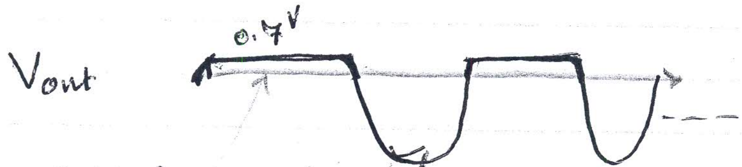


$\Rightarrow$ +ve clipper



when $V_D = V_{in} \geq 0.7$ ← D is forward-biased

$\therefore V_{out} = V_F = 0.7^V$

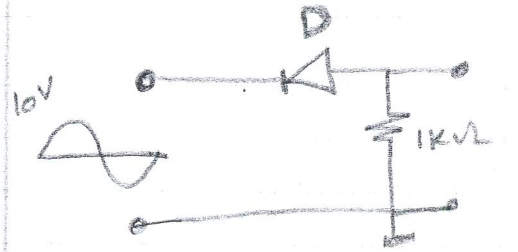
-10^V

D is reverse-biased $\Rightarrow$ open circuit

$\therefore V_{out} = V_{in}$

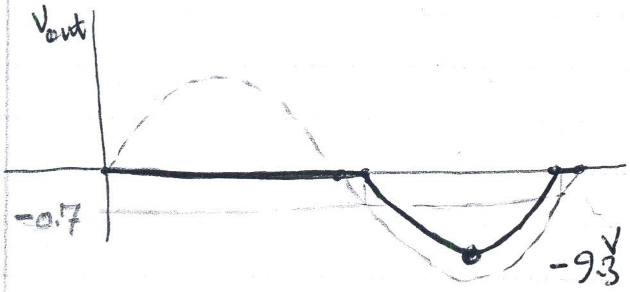
33

a)

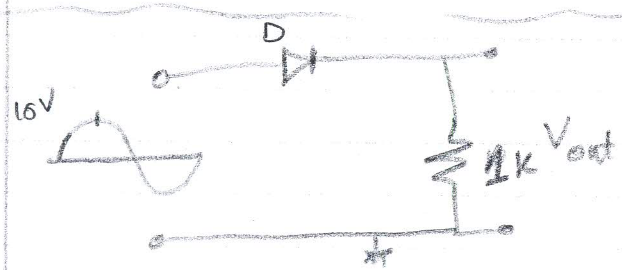


D is forward biased if: $V_{in} \leq -0.7$

↳ $V_{out} = 0.7 + V_{in}$

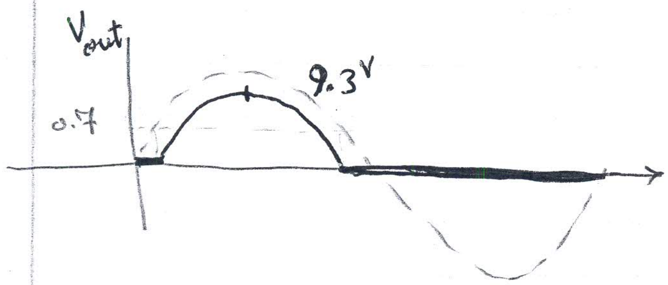


b)

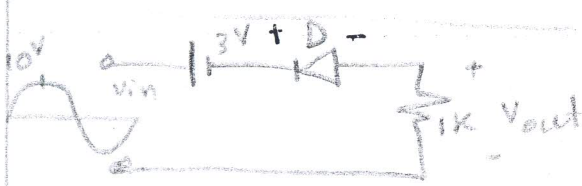


D is F.B. if: $V_{in} \geq 0.7$

↳ $V_{out} = V_{in} - 0.7$



c)

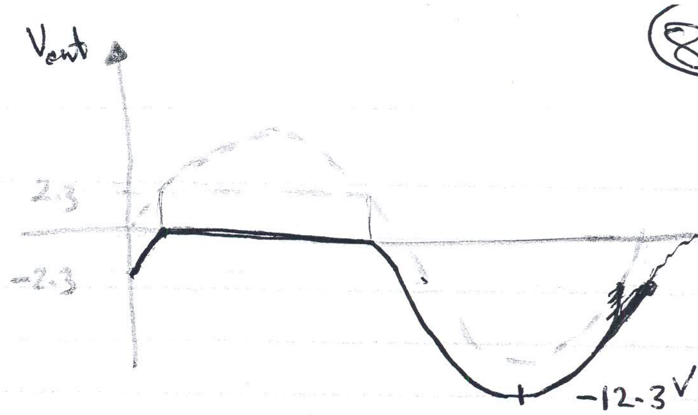


D is F.B.: $V_D = -3 + V_{in} \leq -0.7$

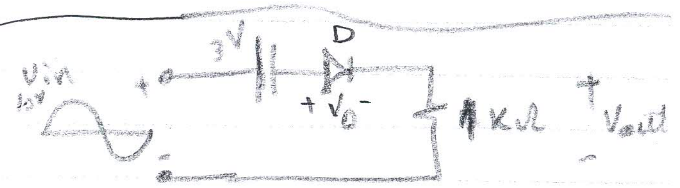
i.e $V_{in} \leq 2.3V$

↳ $V_{out} = \cancel{0.7} - 3 + V_{in}$

$= -2.3 + V_{in}$



d)

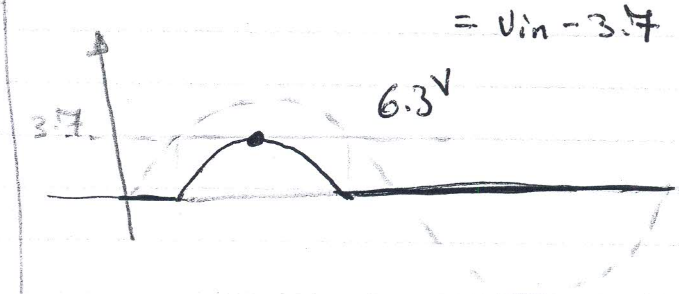


D is F.B.: $V_D = -3 + V_{in} \geq 0.7$

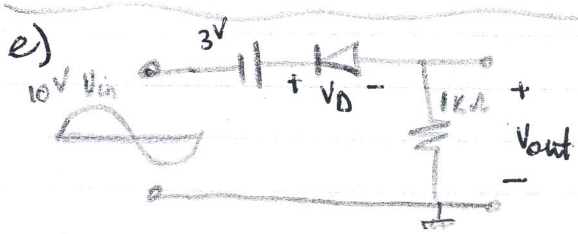
$V_{in} \geq 3.7V$

↳ $V_{out} = -0.7 - 3 + V_{in}$

$= V_{in} - 3.7$



e)



D is F.B:

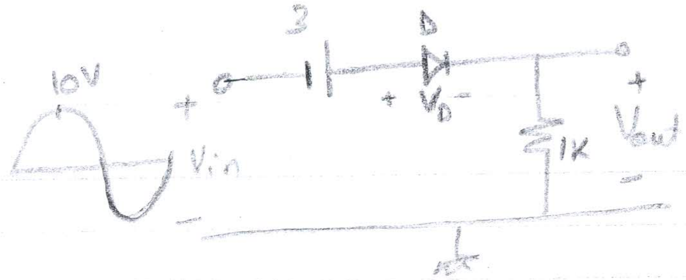
$V_D = 3 + V_{in} \leq -0.7$

i.e $V_{in} \leq -3.7$

↳ $V_{out} = 0.7 + 3 + V_{in}$

$= 3.7 + V_{in}$

f)

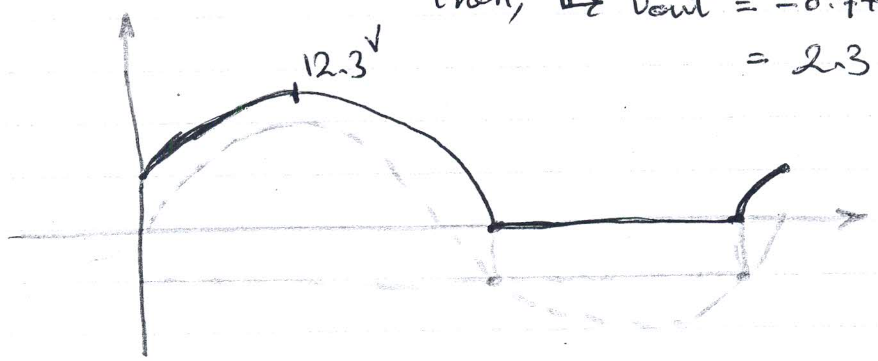


D is forward-biased : $V_D = 3 + V_{in} \geq 0.7$

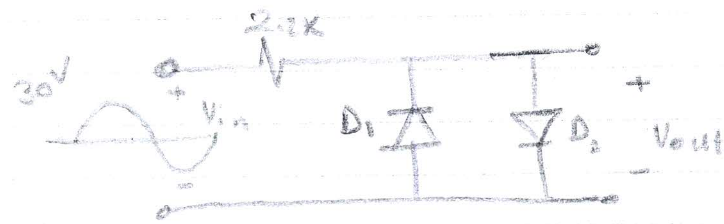
$V_{in} \geq -2.3^V$

then, $\hookrightarrow V_{out} = -0.7 + 3 + V_{in}$

$= 2.3 + V_{in}$



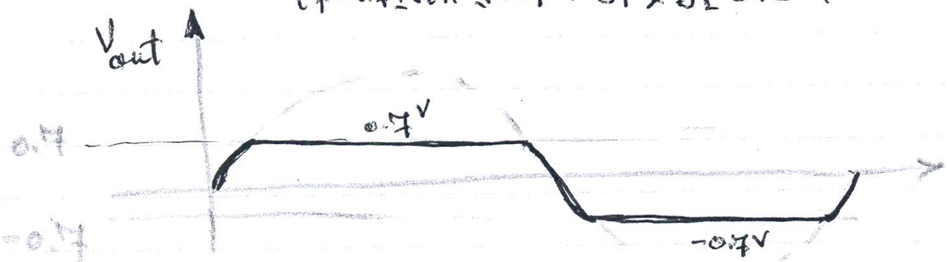
$\boxed{35}$ a)



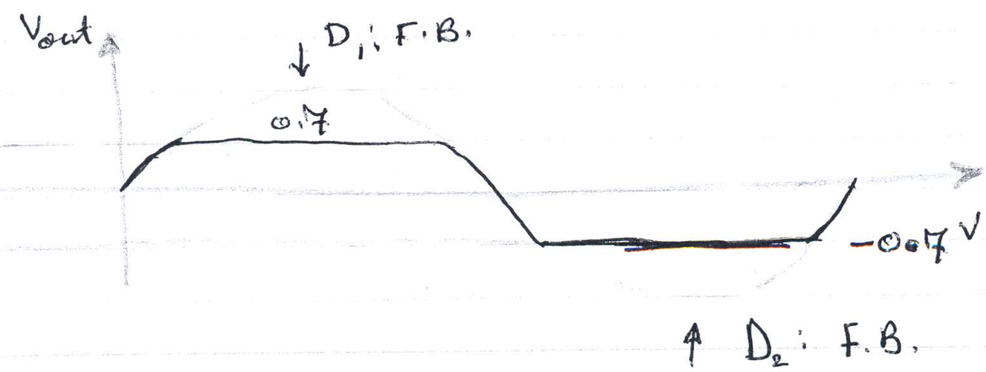
D_1 is F.B. : $V_{in} \leq -0.7 \Rightarrow V_{out} = -0.7^V$

D_2 is F.B. : $V_{in} \geq 0.7 \Rightarrow V_{out} = 0.7^V$

if $-0.7 \leq V_{in} \leq 0.7 \rightarrow D_1$ & D_2 are R.B. $\Rightarrow V_{out} = V_{in}$



b)



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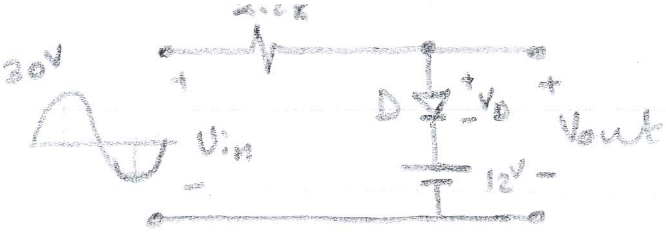
a)

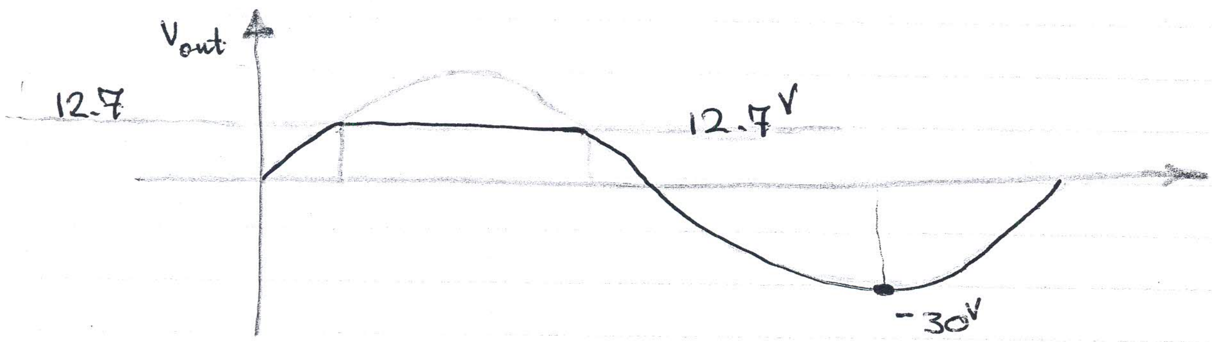


D is forward-biased : $V_D = V_{in} - 12 \geq 0.7$

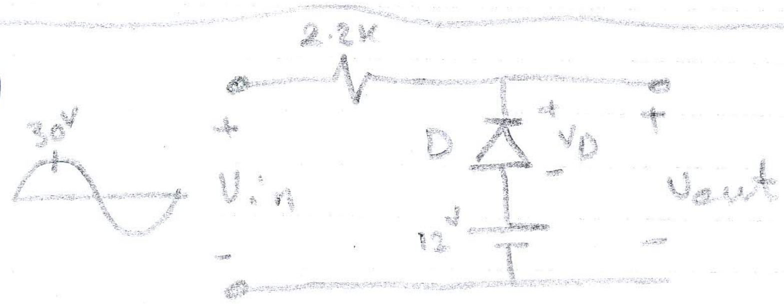
$V_{in} \geq 12.7$

$\rightarrow$ $V_{out} = 0.7 + 12 = 12.7^V$

if $V_{in} < 12.7^V$, D is R.B. $\Rightarrow$ $V_{out} = V_{in}$



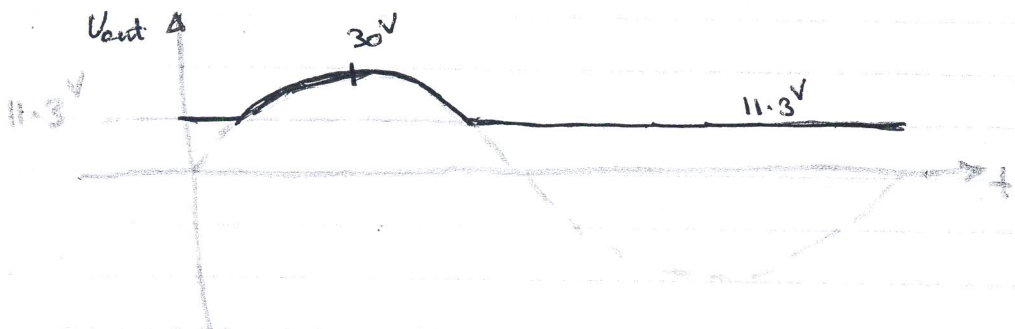
b)



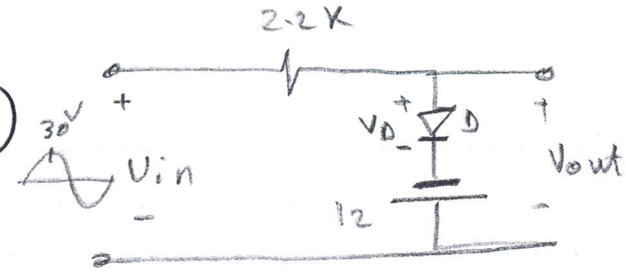
D is F.B. : $V_D = V_{in} - 12 \leq -0.7 \longrightarrow V_{in} \leq 11.3$

$\rightarrow$ $V_{out} = -0.7 + 12 = 11.3^V$

if $V_{in} > 11.3^V$; D is R-B; $\rightarrow V_{out} = V_{in}$



c)



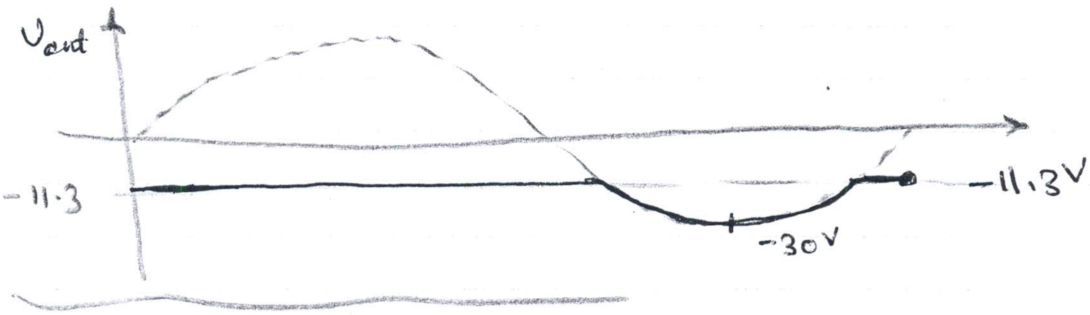
D is F-B:

$V_D = V_{in} + 12 \geq 0.7$

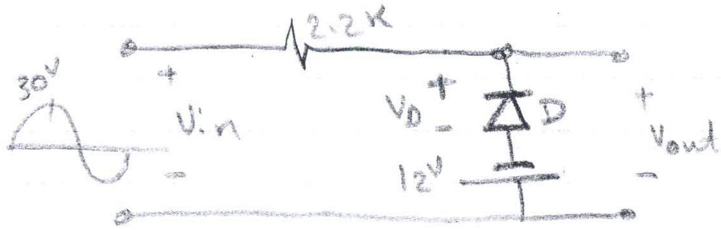
$\therefore V_{in} \geq -11.3^V$

↳ $V_{out} = 0.7 - 12 = -11.3^V$

@ $V_{in} < -11.3 \longrightarrow$ D is R-B: $V_{out} = V_{in}$



d)



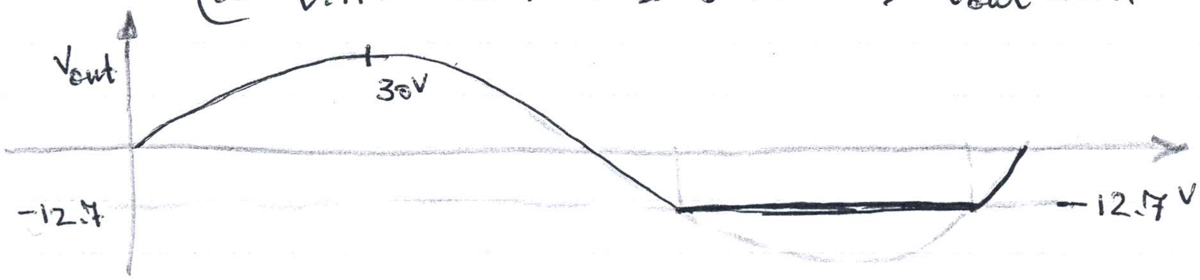
D is F-B:

$V_D = V_{in} + 12 \leq -0.7$

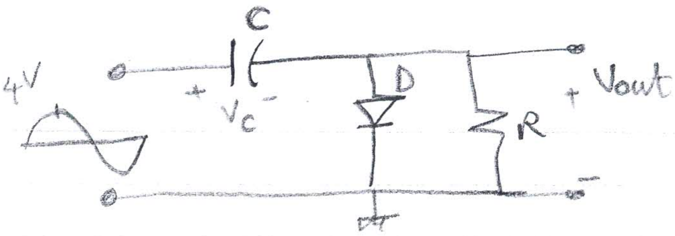
$V_{in} \leq -12.7^V$

↳ $V_{out} = -12.7^V$

@ $V_{in} > -12.7^V$, D is R-B $\longrightarrow V_{out} = V_{in}$



39 a)



after charging: $V_c = V_p(in) - 0.7$

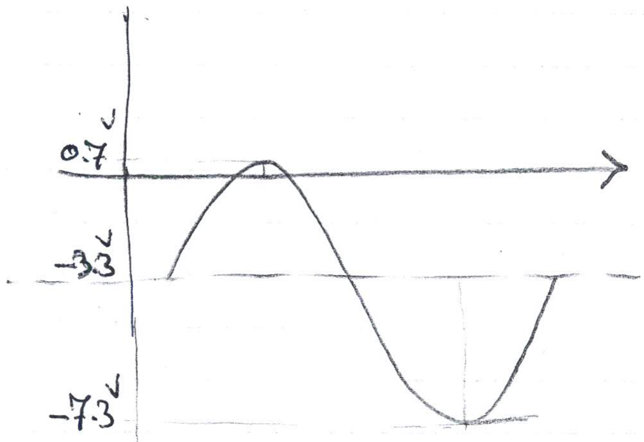
when D is R-B: $V_{out} = V_{in} - V_c = V_{in} - V_p(in) + 0.7$

$\therefore V_{DC} \simeq -V_p(in) + 0.7 = -4 + 0.7 = -3.3^V$

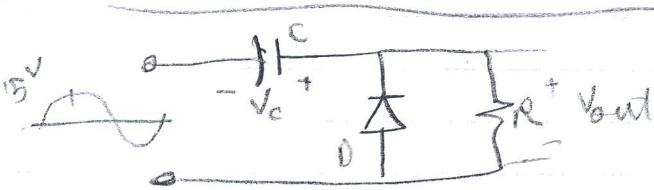
$V_p^-(out) = V_p^-(in) - V_p(in) + 0.7 = -7.3^V$

$V_p^+(out) = V_p^+(in) - V_p(in) + 0.7 = 0.7^V$

output is a sine-wave as follows:



b)

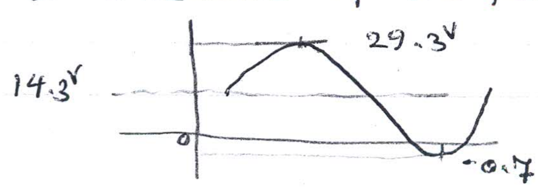


after charging: $V_c = +V_p(in) - 0.7$

when D is R-B: $V_{out} = V_{in} + V_c = V_{in} + V_p(in) - 0.7$

$\therefore V_{DC} \simeq V_p(in) - 0.7 = 14.3^V$

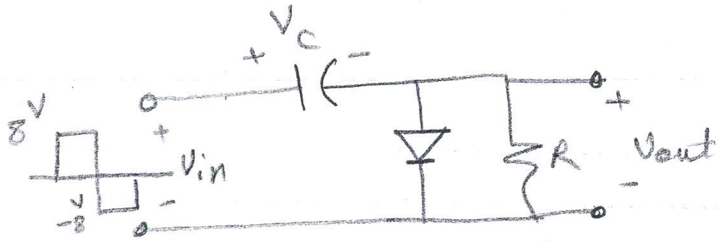
output is a sine-wave of the form:



$V_p^+(out) = 29.3^V$

$V_p^-(out) = -0.7^V$

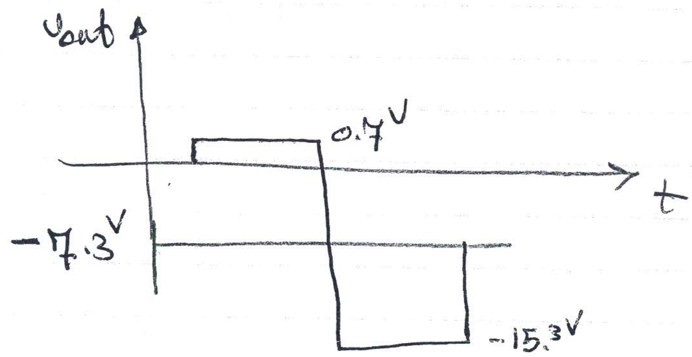
c)



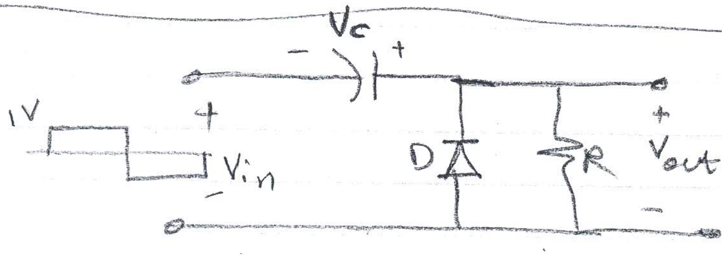
$$V_{DC} \cong -V_C = -(V_p(in) - 0.7)$$
$$= -8 + 0.7 = -7.3^V$$

$$V_p^+(out) = V_p^+(in) - V_p(in) + 0.7$$
$$= 8 - 8 + 0.7 = 0.7^V$$
$$V_p^-(out) = V_p^-(out) - V_p(in) + 0.7$$
$$= -8 - 8 + 0.7 = -15.3^V$$

the output is a square wave of the form:



d)



$V_{out} = V_C + V_{in}$

$\Rightarrow$ +ve clamping

$$V_{DC} \cong V_p(in) - 0.7 = 1 - 0.7 = 0.3^V$$

$$V_p^+(out) = 1 + 0.3 = 1.3^V$$
$$V_p^-(out) = -1 + 0.3 = -0.7^V$$

The output is a square wave of the form: