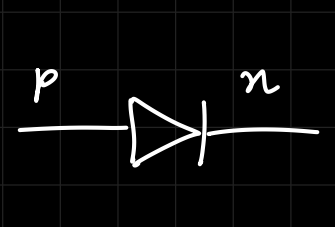
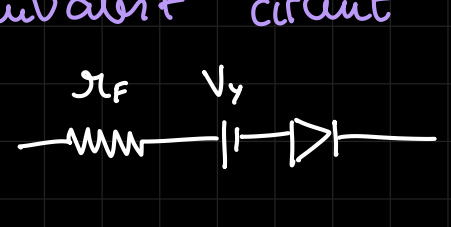
* Tut : 2

PN Junction diode



* diode equivalent circuit



Silicon diode : 0.7V
Germanium diode : 0.3V
Gallium Arsenide diode : 1.3V
Ideal diode : 0V

r_f : forward resistance
V_γ : cutoff voltage

$r_{ac} = r_f = \eta \frac{V_T}{I_L}$

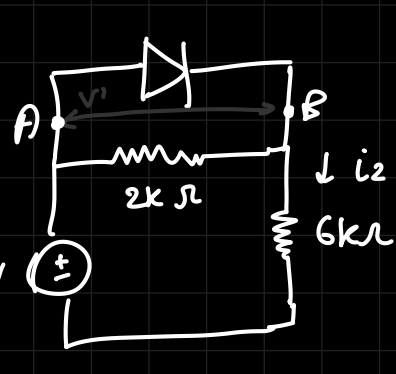
η : utility factor
V_T = 25mV : thermally generated voltage

Bohrsman const =1.38 × 10^{-23} J/K ; temp (Kelvin) : room temp → 298K

$V_T = \frac{KT}{q}$; q → magnitude of charge = 1.6 × 10^{-19} C

≈ 25mV at room temperature

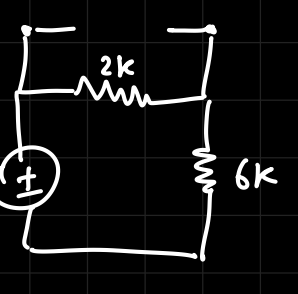
Q1) V_{on} = 0.7V
diode "on" voltage
current i_2 (mm)



ⓐ if V' > 0.7V,
diode is on
diode replaced by equivalent cutoff voltage
forward bias

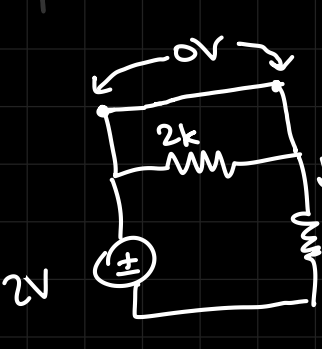
$V_{AB} = 2 \times \frac{2000}{2000+6000} = 0.5V$

diode is always off → oc



$i(t) = \frac{2}{8000} = 0.25mA$

ⓑ for ideal case → diode is always on
because 0.5V > 0V always
replaced by equivalent voltage cutoff

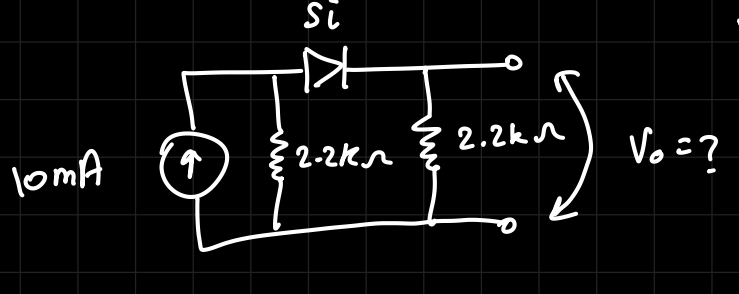


$i(t) = \frac{2}{6000} = 0.33mA$

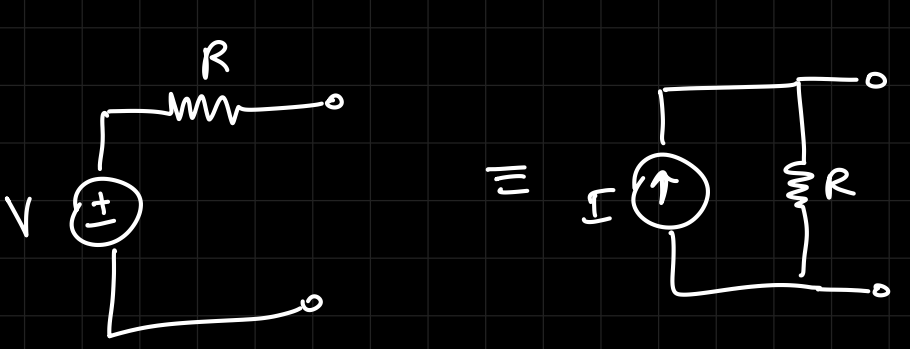
we apper voltage at 2kΩ is 0.5V
and since 0.5 > 0, diode is always on

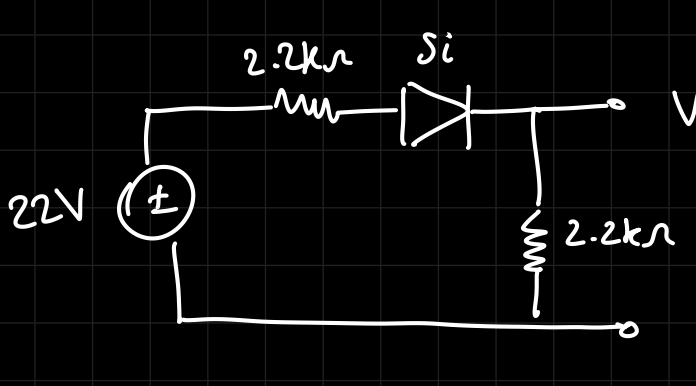
Q2) output voltage V_o, diode current I_D ?

note : diode senses only voltage SRC
V_{Th} = 0.7V

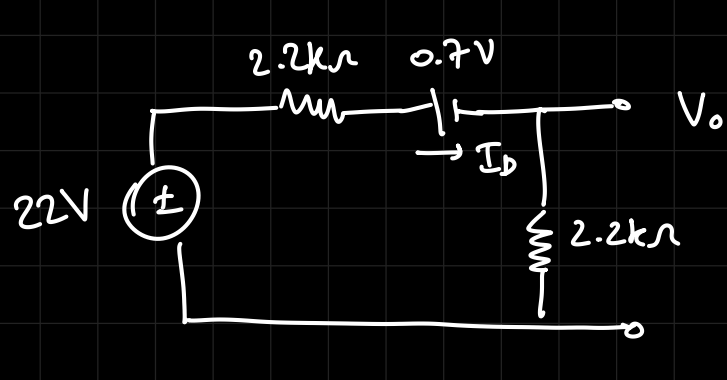


norton → thevenin
SOURCE TRANSFORMATION





diode always on because 22 > 0.7



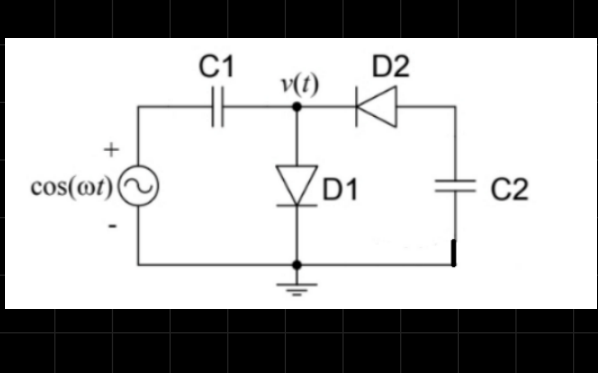
$-22 + 2.2 I_D + 0.7 + 2.2 I_D = 0$

$I_D = \frac{21.3}{4.4} mA = 4.84 mA$

$V_o = I_D R = 4.84 \times 2.2$

V_o = 10.648 V

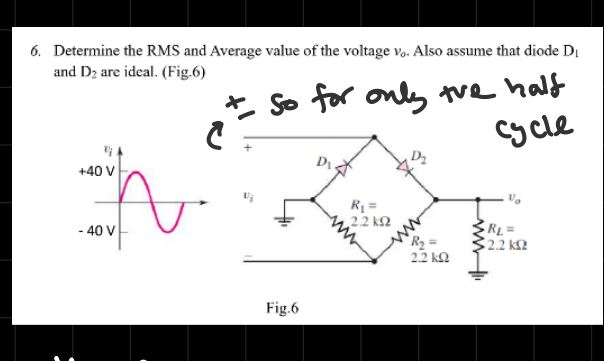
Q3)

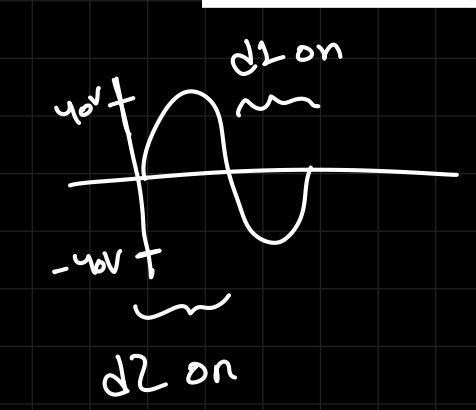


v(t) = ?

diodes and cap are ideal in this ckt

Q6)



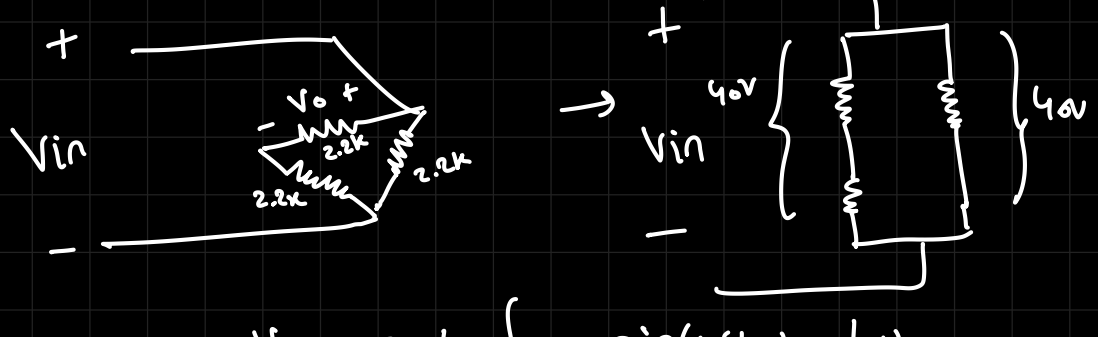


AC input

$V_{RMS} = \frac{V_o}{\sqrt{2}}$

$V_{avg} = \frac{2V_o}{\pi}$

for ideal diode, the short ckt volt = 0V



$V_{avg} = \frac{1}{T} \int_{<T>} V_m \sin(\omega t)\, d\omega t$

$= \frac{V_m}{\pi} [-\cos(\omega t)]_0^{\pi}$

$= \frac{V_m}{\pi} [-\cos(\pi) + \cos(0)]$

$= \frac{2V_m}{\pi}$

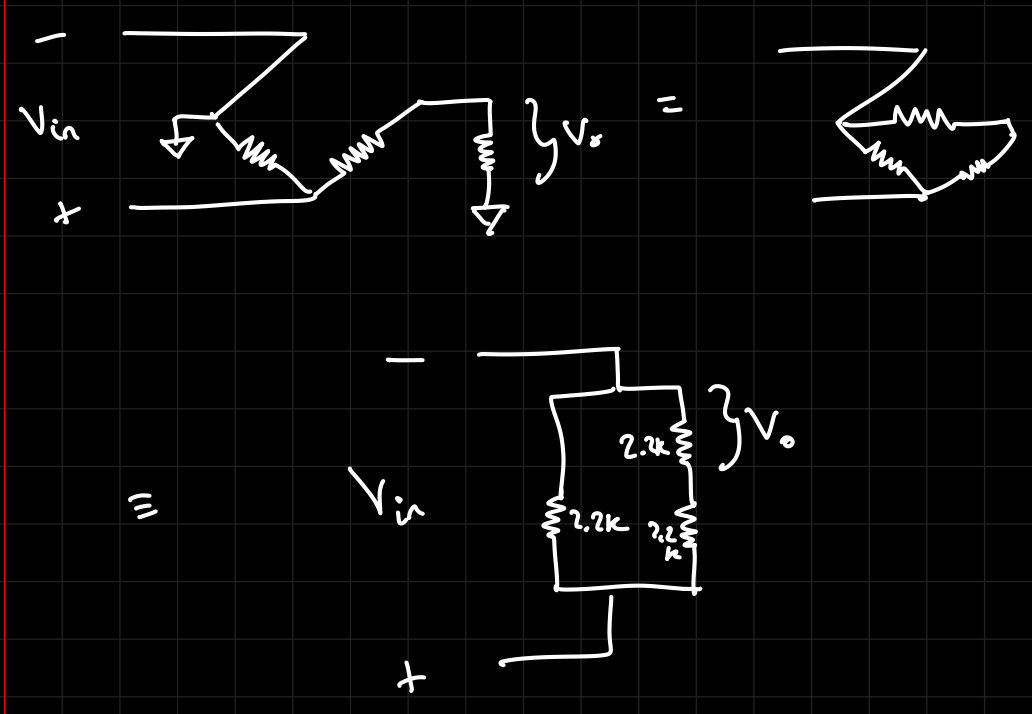
$V_o = \frac{40 \times 2.2k}{4.4k} = 20V$

$V_{RMS} = \frac{20}{\sqrt{2}} V = 10\sqrt{2} V = 14.14 V$

$V_{avg} = \frac{40}{\pi} = 12.7V$

don't leave in √2 form
solve it

for the negative half cycle (not needed according to ques)

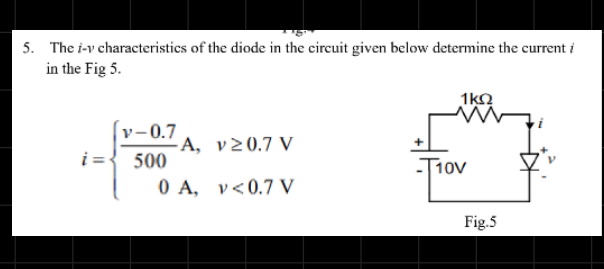


$V_o = \frac{-40 \times 2.2k}{4.4k} = -20V$

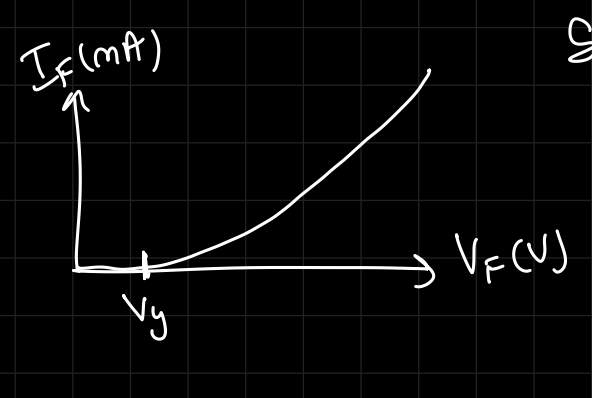
$V_{RMS} = \frac{-20}{\sqrt{2}} V = -14.14V$

$V_{avg} = \frac{-20 \times 2}{\pi} = \frac{-40}{\pi} = \frac{40}{3.14} \approx -12.7V$

Q5)

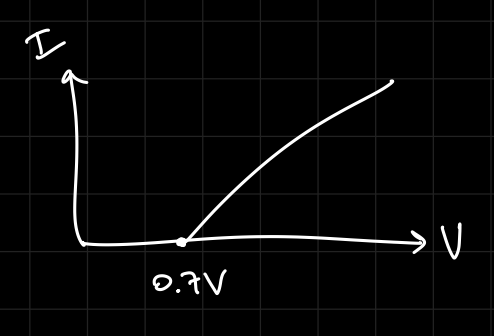


not a silicon diode



general diode → exponential V-I characteristic

but in the ques V-I characteristic is linear
so not a silicon diode

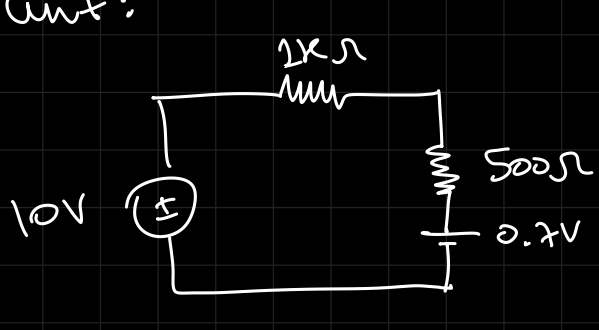


ques diode → which will have greater slope

for V ≥ 0.7V → $i = \frac{V - 0.7}{500}$

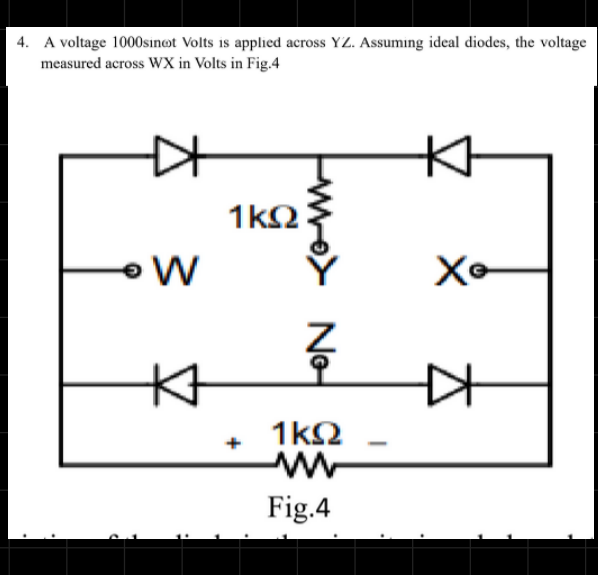
$500 i + 0.7 = V$
$500 di + 0 = dV$
$\frac{dV}{di} = 500 Ω$ (Resistance) offered by the PN junction diode

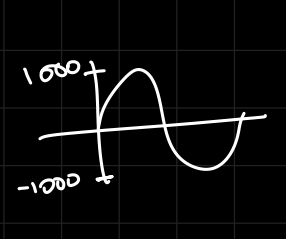
circuit :



$-10 + 0.7 + 1500 i = 0$
$i = \frac{9.3}{1.5} mA = 6.2mA$

Q4)





for +ve half cycle,
all diodes are off
all oc
→ 0V

for -ve half cycle
all are short ckt
→ 0V

overall = 0V

reality : for Si diode → 4 × 0.7
⇒ 2.8 V