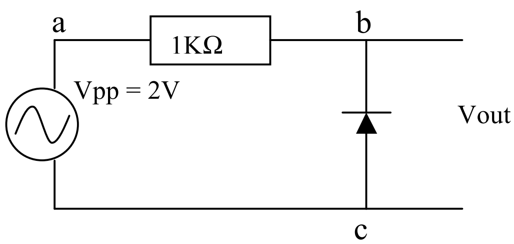
PHYS-321 **ELECTRONICS QUIZ-2** **4-17-09**

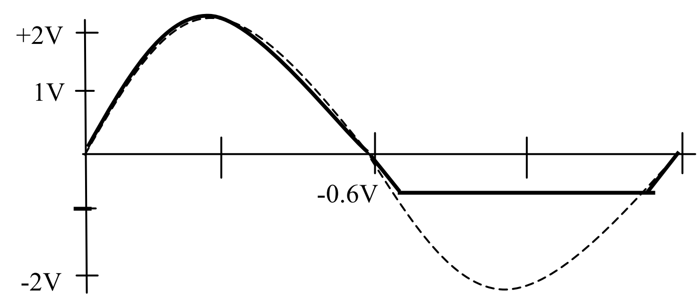
Read each problem carefully. Show your work for full credit. Place a box around your final answer(s).

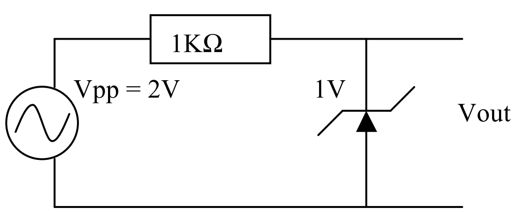
#1- Intrinsic semiconductors like Silicon-14 or Germanium-32 are doped with p or n type dopants. Identify the dopants and semiconductors below with a check.

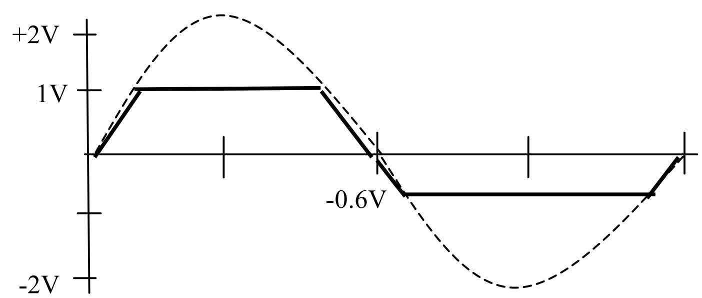
Element	Electron Structure	n-type	p-type	Intrinsic
B_5	(He)2s2 2p1		x	
Al_{13}	(Ne)3s2 3p1		x	
Si_{14}	(Ne)3s2 3p2			x
P_{15}	(Ne)3s2 3p3	x		
Ga_{31}	(Ar)3d10 4s2 4p1		x	
Ge_{32}	(Ar)3d10 4s2 4p2			x
As_{33}	(Ar)3d10 4s2 4p3	x		
In_{49}	(Kr)4d10 5s2 5p1		x	

#2- A 2Vpp sine wave (dotted line) is applied to the diode circuits. Sketch Vout for the circuits through one sine-wave cycle. Label the voltage levels carefully.





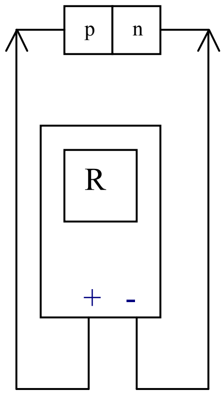




Case-1: The diode is reversed biased on the 1st half-cycle.and has infinte resistance. All voltage is dropped across it, implying no current flow, Vac=Vb. On the negative voltage down cycle the same occurs until the voltage Vbc~ -0.6V and the resistance across the diode drops to zero . Vbc remains at -0.6V

Case-2: The zener diode is reversed biased on the positive half-cycle holding Vbc to a maximum of 1V. On the negative cycle the zener acts as a normal diode (similar to case-1) following the supply voltage until Vbc=-0.6V.

#3-



In this configuration the resistance meter reads a **HIGH** or **LOW** resistance for the diode? Explain.

LOW - The diode is forward biased so a small resistance to current flow!

#4- An amplifier has a common mode rejection ratio of cmrr=60db and a gain of Av=150. If a differential signal of 2mV is applied to the input along with an unwanted common mode noise of 10mV, what is the amplitude of the signal and noise at the output?

S = ____________

N= ____________

60db=10^3

Av = 150 for true signal Vsignal = 2mV x 150 = **300mV$_p$ or 600mV$_{pp}$**

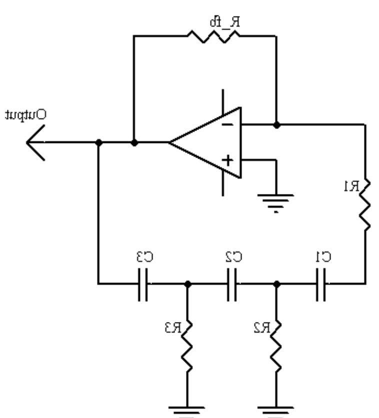
Av = 150 / 10^3 for common mode noise Vnoise=(10+10)mV 150 x10^{-3} =**3.0mV$_{pp}$**

~10mV x 150 x10^{-3} = **1.5mV$_p$**

#5- What is the frequency of the phase shift oscillator shown below. Given R1=R2=R3=1kΩ and C1=C2=C3= 10pf. Also give Rfb.

f = ________________

Rfb = ________________

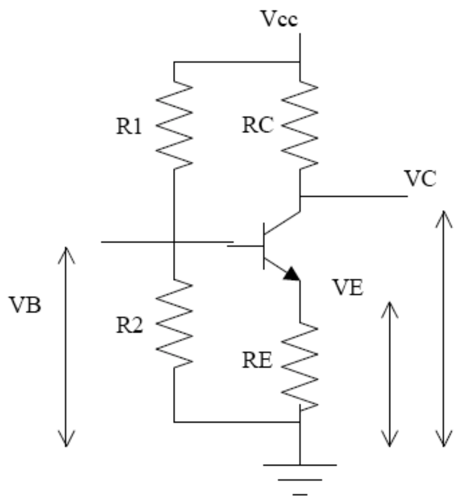


$f = 1/2\pi RC\sqrt{6}$ = 6.5MHz

Rfb = 30R= 30kΩ

#6- Design a common emitter transistor amplifier with gain of -100 and input impedance of 12KΩ using an npn transistor β= 100. Place your resistor parameters in the boxes.

Vcc	RC	RE	R1	R2
+24V				



Vcc= +24 V   Choose VC = midrange = 12V

Rin = 12K = β RE → **RE = 120Ω**

Gain = -RC/RE → **RC = 12KΩ**

iC = (Vcc – VC)/ RC = (24-12)/ 12K = 1.0 mA

Let R2 = 10 RE = **1200Ω**

VE =iE RE ~ iC RE = (.001A)(120 Ω) = 0.12 V
VB = VE + 0.6 V = 0.72 V

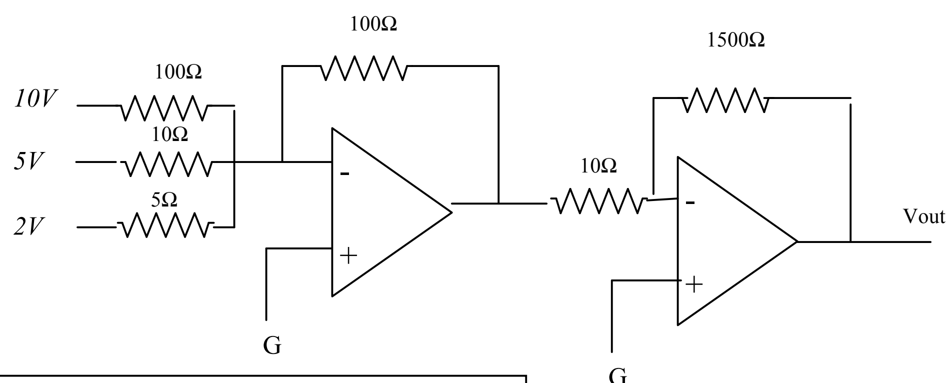
VB = Vcc [R2/(R1+R2)] or R1+R2 = R2/(VB/Vcc)
R1 = R2/(VB/Vcc) –R2 ~ (24 / 0.72)R2 = 40k**Ω**

OR

i2 = VB/R2 = (0.72V/1200 **Ω**) =0.0006A
iB = iC/β = (1mA/100) = 1.e-5 A
i1 = iB + i2 = (1.e-5 + .0006)A = 0.00061 A

R1 = (Vcc-VB)/ i1 = (24 – 0.72)/00.00061A ~ 40k**Ω**

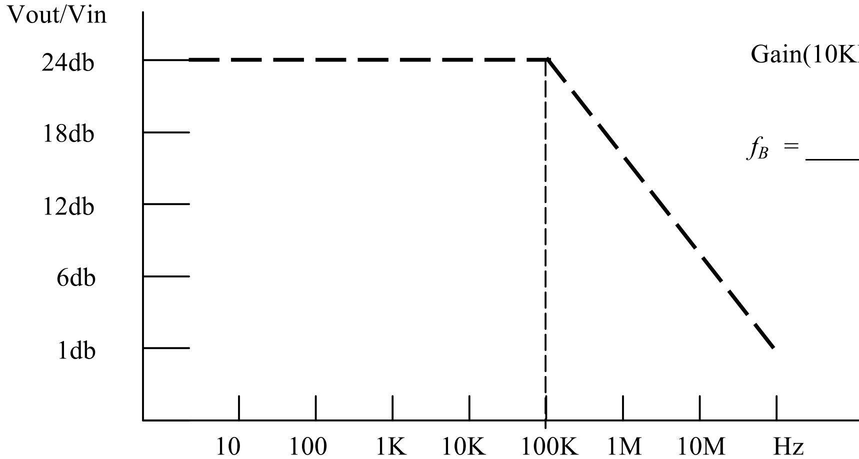
#7- What is the output voltage of this OP-AMP circuit?   Vout = ____________________



V1 = -10(100/100) -5(100/10) - 2(100/5) = -100V

Vout = - (-100V) (-1500/10) = 15000 V

#8- The gain versus frequency of an amplifier is shown below. What is the gain of this amplifier at f = 10KHz? What is the break frequency f_B of the amplifier ?



Gain(10KHz) = ___________(number)

f_B = ____________

24 db = 20 log(Vout/Vin)
gain = Vout/Vin = 10^(24/20) = $10^{1.2}$ = **15.8**

fb = frequency when gain drops by a factor of 2 or -6db.
db = 20log(gain/2) = **17.9 db** → **fb ~ 800kHz-1MHz**