BITS, PILANI - DUBAI CAMPUS

KNOWLEDGE VILLAGE, DUBAI

III-Year I- Semester 2005- 2006

COMPREHENSIVE EXAMINATION (Closed Book)

COURSE TITLE: ANALOG ELECTRONICS **COURSE NO: EEE UC364**

DURATION: 3 Hours **Date: 04-01-05** **MARKS: 60** **Weightage: 30%**

NOTE:

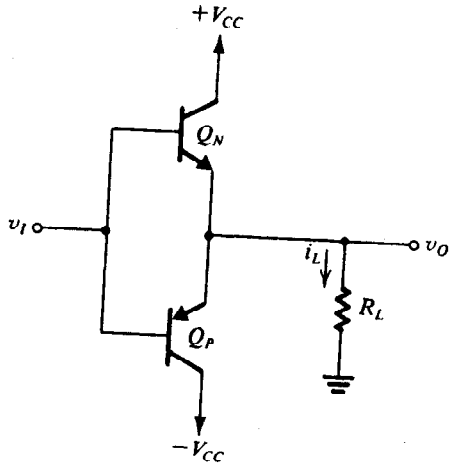
i. Answer all Questions.
ii. Assume any missing data suitably
iii. Answer all parts of question in continuation
iv. Do not leave any blank page in between the answers
v. All questions carry equal marks

---

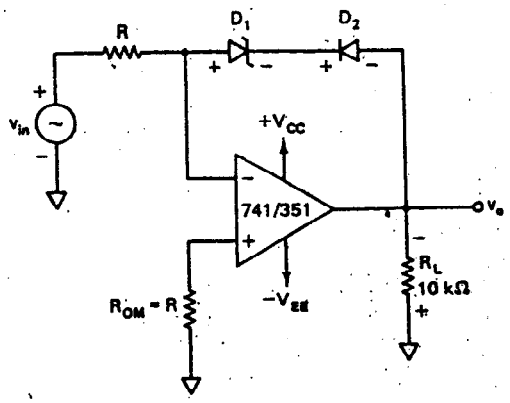
1) A differentiator utilizes an ideal op-amp, a 10KΩ resistor, and a 0.01μF capacitor. What is the frequency f_O (in Hz) at which it's input and output sine wave signals have equal magnitude? What is the output signal for a 1-V peak-to-peak sine wave input with frequency equal to $10f_O$?

2) A zener diode exhibits a constant voltage of 5.6 V for currents greater than five times the knee current. I_{ZK} is specified to be 1 mA. The zener is to be used in the design of a shunt regulator fed from a 15 V supply. The load current varies over the range of 0mA to 15mA. Find a suitable value for the resistor. What is the maximum power dissipation of the diode?

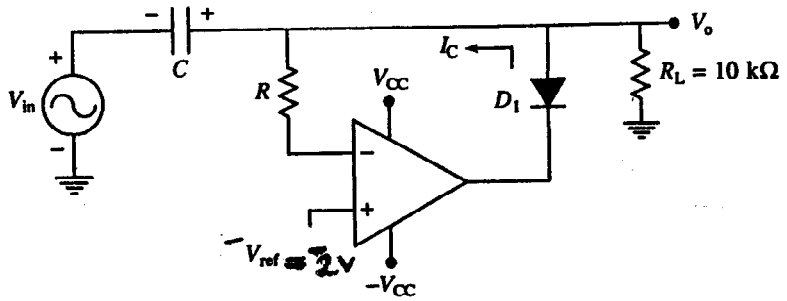
3) (a)Mention one application of LM 380 with a neat sketch.
In the following circuit $V_{cc} = 6V$ and $R_L = 4\Omega$. If the output is a sinusoid with 4.5V peak amplitude, find
b) The power efficiency obtained at this output voltage
c) The peak currents supplied by V_I, assuming that $\beta_N = \beta_P = 50$
d) The maximum power that each transistor must be capable of dissipating safely.



4) (a)In the following circuit V_{in} = 100 mv peak sine wave at 100 Hz, R = 1 KΩ, and D1is a 6.2V Zener. The op-amp is a 741 with supply voltages = ± 12V. Assume that the voltage drop across the forward biased diode is 0.7V. Draw input and output voltage waveforms with all voltages marked.



(b) Draw input and output voltage waveforms with all voltages marked for the following circuit.-V_{ref}= -2V, Vp = 2V



5) Explain the working of a successive approximation register A/D converter with a neat sketch. Take analog input as 13.6V.Find what is the digital output. Show the full table.

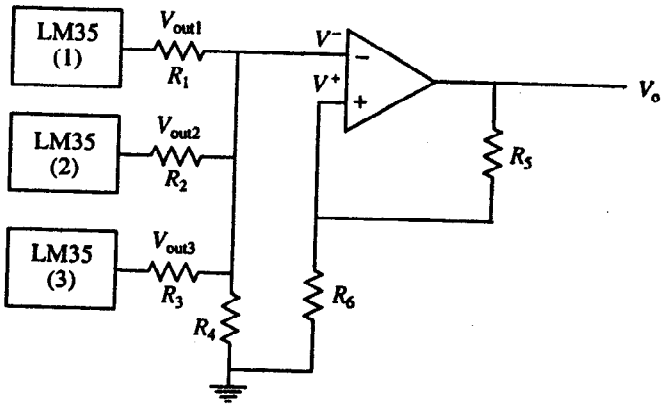
6) (a)Explain the basic working principle of self generating thermal energy sensors?

For the following circuit, find

b) V^+ & V^- in terms of the output voltages of LM35 temperature sensors.

c) the output voltage V_O in terms of the output voltages of LM35 temperature sensors.

Assume ideal op-amp and $R_1 = R_2 = R_3 = R$, $R_4 = R_6$ and $R_5 = R/3$

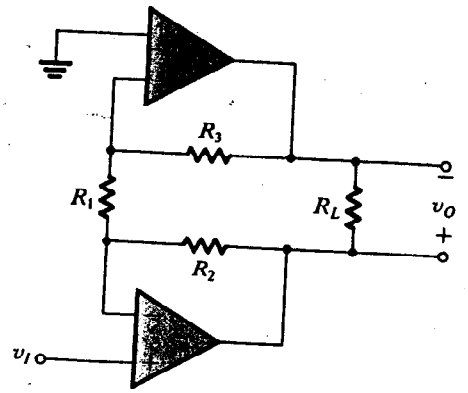


7) A coil having an inductance of 10μH is intended for applications around 1-MHz frequency. Its Q is specified to be 200. What is the value of the capacitor required to produce resonance at 1-MHz? If the band width is increased by 1 KHz, determine the value of the load resistance.

8) Design and sketch a narrow band pass filter with all component values so that $f_c = 2$kHz, $Q = 20$, and $A_F = 10$. Change the center frequency to 1kHz, keeping A_F and the bandwidth constant. Choose $C_1 = C_2 = C = 0.01\mu F$

9) Draw output waveform and capacitor waveform for an astable multivibrator circuit using 555 timer. Derive an expression for duty cycle.

10) An alternative bridge amplifier configuration, with high input resistance, is shown in figure. (Note the similarity of this circuit to the front end of the instrumentation amplifier).



a) What is the gain V_O/V_I?

(please turn over)

b) For op-amps (using $\pm$15 V supplies) that limit at $\pm$13V (peak), what is the largest sine wave you can provide across R_L?

c) Using 1 kΩ as the smallest resistor, find resistor values that make $V_o / V_I = 10V/V$

BITS, PILANI - DUBAI CAMPUS

KNOWLEDGE VILLAGE, DUBAI

III-Year I- Semester 2005- 2006

TEST – II (OPEN BOOK)

ONLY TEXT BOOK AND CLASS NOTES ALLOWED

COURSE NO: EEE UC364
TIME: 50 minutes

COURSE TITLE: ANALOG ELECTRONICS
MARKS: 25 , WEIGHTAGE:(10%)

NOTE: (Answer all Questions
Assume any missing data suitably))

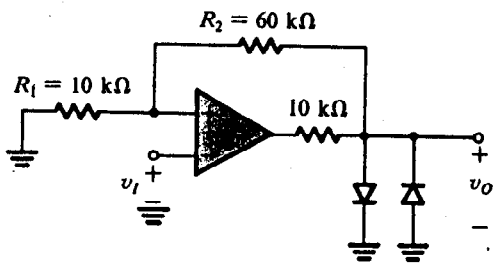
---

1) In a monostable multivibrator circuit(using 555) charging capacitor = 1nF
(a) Find the value of R that result in an output pulse of 10μs duration.
(b) If the 555 timer used in (a) is powered with $V_{cc} = 15V$ and assuming that V_{TH} can be varied externally (i.e., it need not remain equal to 2/3 V_{cc}) find it's required value so that the pulse width is increased to 20 μs , with other conditions the same as in (a) [5 marks]

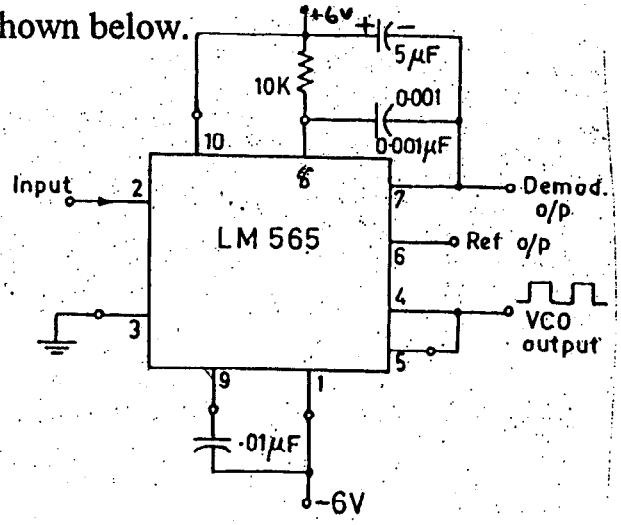
2) A shunt regulator utilizes a zener diode whose voltage is 5.1v at a current of 50mA and whose incremental resistance is 7Ω. The diode is fed from a supply of 15v nominal voltage through a 200Ω resistor. What is the output voltage at no load? Find the line regulation and load regulation. [5 marks]

3) Design a triangular waveform generator using comparator and integrator so that $f_0 = 1KHz$ and $V_0 = 6V(p\text{-}p)$. Supply voltage is +15V and $V_{sat} = 14V$. Take $R_1 = 10K\Omega$, $C_1 = 0.1\mu F$ [5 marks]

4) For the following circuit sketch and label the transfer characteristic $v_O - v_I$. The diodes are assumed to have a constant 0.7V drop when conducting, and the op-amp saturates at ±12V. What is the maximum diode current? [5 Marks]



5) Refer to the circuit shown below.



Calculate & show the relationship between f_o, Δf_L & Δf_C by clearly indicating all boundary values. [5 marks]

B

BITS, PILANI - DUBAI CAMPUS

KNOWLEDGE VILLAGE, DUBAI

III-Year I- Semester 2005- 2006

QUIZ-I (Closed Book)

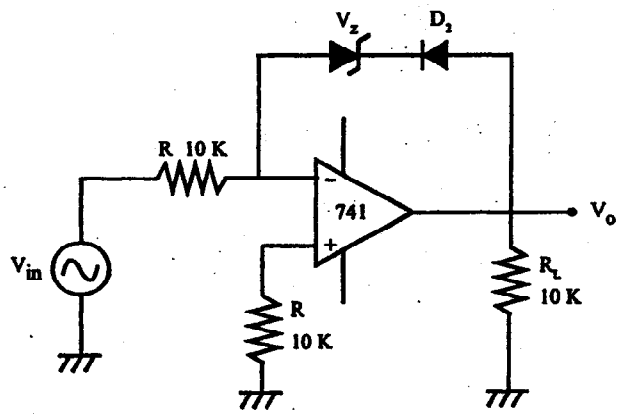
COURSE TITLE: ANALOG ELECTRONICS (EEE UC364)

DURATION: 30 minutes **Date: 27-10-2005** **MARKS: 10**

NAME: **ID NO:**

1) Op-amps with high slew rate are used in clipping circuits (TRUE / FALSE) [1 Mark]

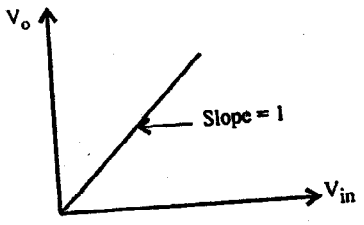
2) Modify the circuit(by adding components , not by removing) to get output waveform limited to $(V_Z + V_D)$and $-(V_Z + V_D)$ [2 Marks]



3) For a particular phase shift oscillator the following specifications are given: C = 0.1μF, R = 3.9kΩ and R_F/R_1 = 29. Determine the frequency of oscillation. [1 Mark]

4) What happens to the output of a monostable circuit if a trigger signal is applied when the circuit is in quasi-stable state? [1 Mark]

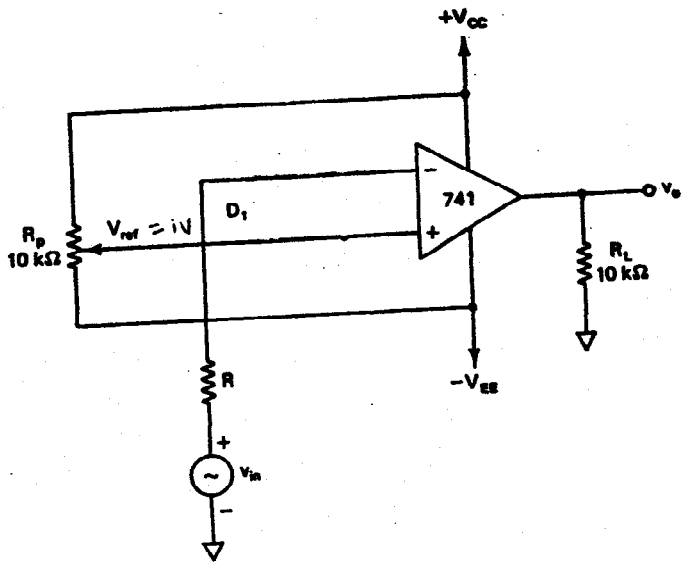
5) Mention the name of the circuit that is used to produce the following characteristics from a sine wave? [1 Mark]



6) What is the superiority of op-amp rectifier over ordinary rectifiers? [1 Mark]

7) In a Schmitt trigger LTP = -3V and UTP = 3V, $\pm V_{sat}$ = 13V. Find the values of R_1 and R_2. [1 Mark]

8) In the following circuit Vp = 3V. Draw both input and output waveforms. [2 Marks]



BITS, PILANI - DUBAI CAMPUS
KNOWLEDGE VILLAGE, DUBAI
III-Year I- Semester 2005- 2006

COURSE NO: EEE UC364
TIME: 50 minutes

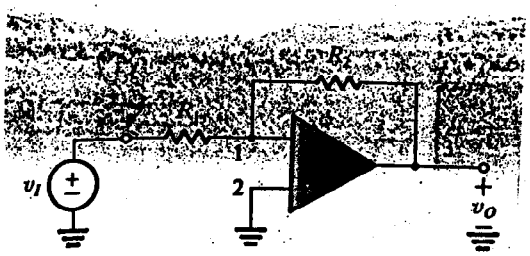
COURSE TITLE: ANALOG ELECTRONICS
MARKS: 25 **WEIGHTAGE:(10%)**

NOTE: (Answer all Questions, Data provided are complete)

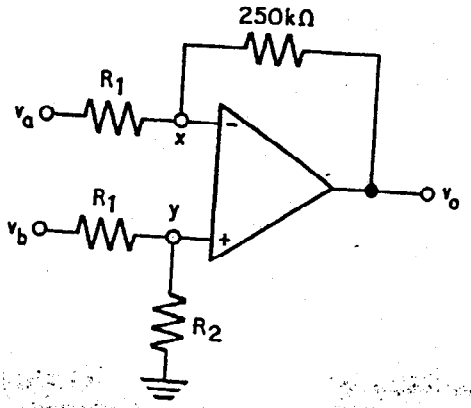
---

1) Design an integrator that has unity gain frequency of 1 krad/s(ώ= 1 krad/s)and an input resistance(R) of 100 kΩ. Sketch the output you would expect for the situation in which, with output initially at 0V, a 2V 2ms pulse is applied to the input. Characterize the output that results when a sine wave 2 sin 1000t is applied to the input? [6 marks]

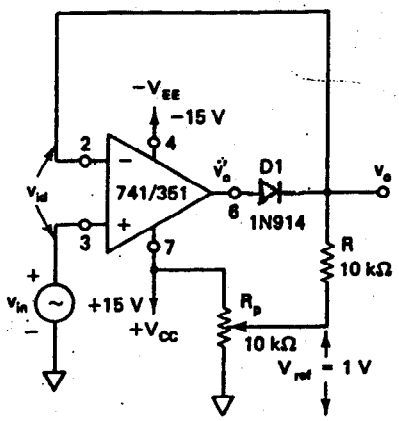
2) In the given circuit assume ideal op-amp, design an inverting amplifier with a gain of 26 dB having the largest possible input resistance under the constraint of having to use resistors no larger than 10MΩ. What is the input resistance of your design? [5 marks]



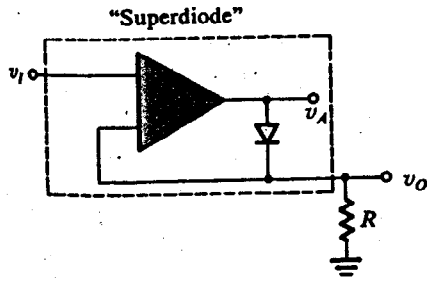
3) In the following circuit find the values of R_1 and R_2 for the output to be $v_0 = -5v_a + 3v_b$ [4 marks]



4) In the following circuit V_{in} = 2V(peak). Draw both input and output waveforms. [4 marks]



5) The following circuit can be made to have gain by connecting a resistor R_2 in place of the short circuit between the cathode of the diode and the negative input terminal of the op-amp, and a resistor R_1 between the negative input terminal of the op-amp and ground. Design the circuit for a gain of 2. For a 10V peak -to-peak input sine wave, what is the average output voltage resulting? Draw the output waveform. Mark amplitude and time. [6 marks]



BITS, PILANI – DUBAI CAMPUS
KNOWLEDGE VILLAGE, DUBAI
III-Year I-Semester 2005-2006

COURSE NO: EEE UC364 | **COURSE TITLE: ANALOG ELECTRONICS**
TIME: 50 minutes | **MARKS: 20** | **WEIGHTAGE:(10%)**

NOTE: (Answer all Questions, Data provided are complete)

---

(1) $R_{in} = R$, Thus $R = 100K\Omega$

$$\frac{1}{\omega R_c} = 1$$

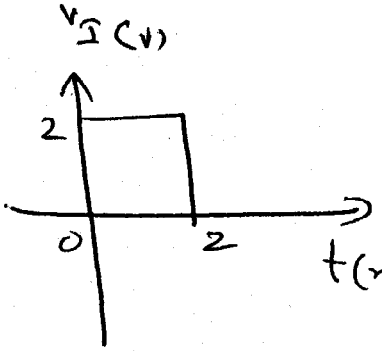
$$\omega = \frac{1}{Rc} = 1000$$

$$c = \frac{1}{1000 \times 100K} = 10nF \qquad (1M)$$

with a 2V - 2ms pulse at the i/p, the o/p falls linearly until t = 2ms at which $V_o = V_I$, $V_o = -\frac{I}{c}t = \frac{-2}{Rc}t$

where t = 2ms

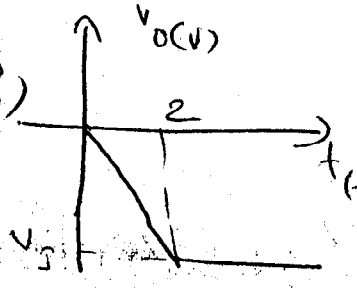
Thus $V_I = -4V$ (2M)



with $V_I = 2 \sin 1000t$ applied at the i/p

$$V_o(t) = 2 \times \frac{1}{1000 \times 10^{-3}} \sin(1000t + 90^0)$$

$$V_o(t) = 2 \sin(1000t + 90^0)$$ (2M)



(1M)

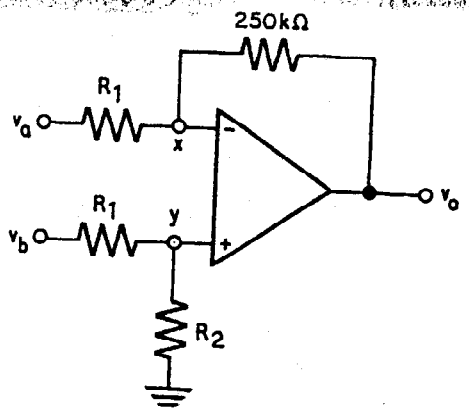


Fig. 7.69

Solution. We shall use superposition.

(a) When v_b is short circuited, i.e. $v_b = 0$

$$\frac{v_o}{v_{oa}} = -\frac{250}{R_1} = -5$$

or

$$R_1 = 50 \text{ k}\Omega$$

(b) When v_a is short circuited, i.e. $v_a = 0$

$$v_x = \left(\frac{50}{50 + 250}\right) v_{ob} = (1/6)\, v_{ob}$$

$$v_y = \left(\frac{R_2}{50 + R_2}\right) v_b$$

But

$$v_x = v_y$$

or

$$\left(\frac{1}{6}\right) v_{ob} = \left(\frac{R_2}{50 + R_2}\right) v_b$$

But

$$v_{ob} = 3v_b$$

Therefore

$$(1/6) \times 3 = \frac{R_2}{50 + R_2}$$

or

$$R_2 = 50 \text{ k}\Omega$$

These values of R_1 and R_2 will yield the output as specified.

(2) $20 \log|G_1| = 26\text{dB}$.

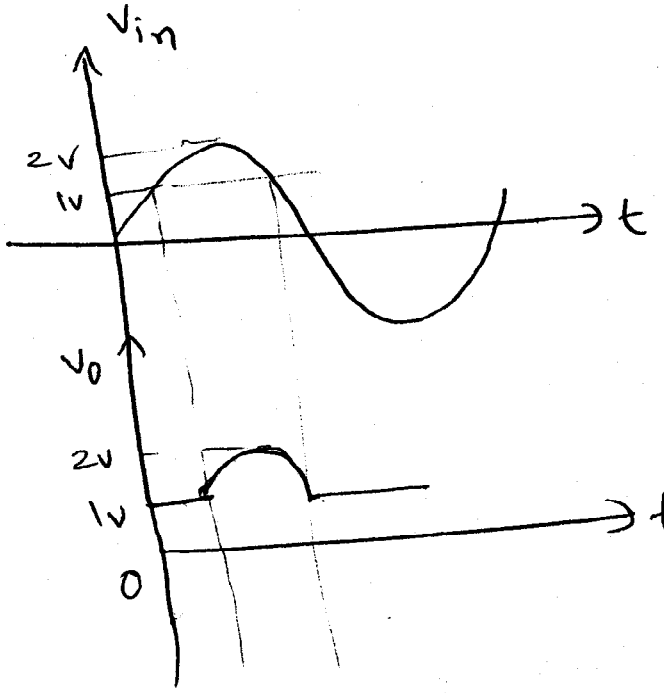
$$G = -19.95\,V/V = \frac{V_o}{V_i} = \frac{-R_2}{R_1}$$

$$R_2 = 19.95\,R_1 \leq 10M\Omega \qquad (2M)$$

for largest possible i/p resistance, select $R_2 = 10M\Omega$, $R_1 \cong 500K\Omega$ (2M)

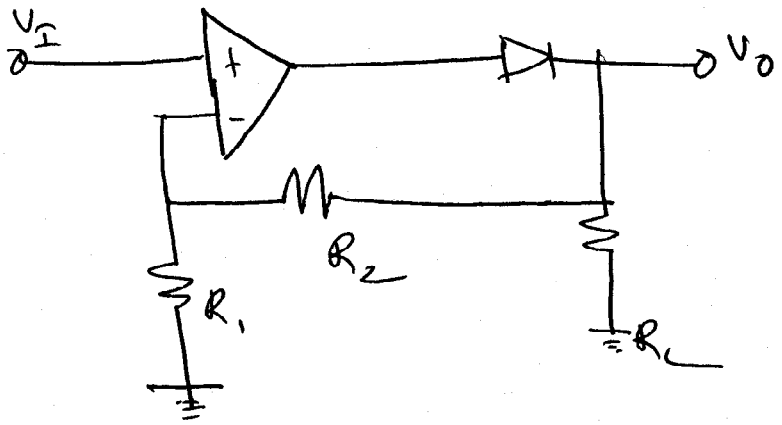
$$R_{in} = \underline{500K\Omega}. \qquad (1M)$$

(4)



(4M)

(5)



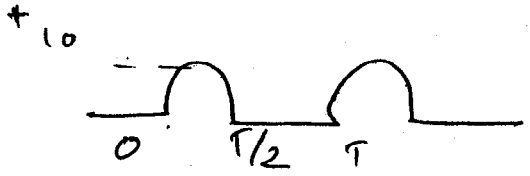
(1M)

for $V_I \geq 0$

$$V_0 = \left(1 + \frac{R_2}{R_1}\right) V_I$$

for a gain of 2, $R_1 = R_2 = 10K\Omega$ (2M)

for $V_I = 10V_{pp}$ sine wave $V_0 \rightarrow$



(2M)

$$\text{Avg} = \frac{1}{T} \int_0^{T/2} 10 \sin \frac{2\pi}{T} t \, dt$$

$$= \frac{1}{T} \times \frac{T}{2\pi} \cos \frac{2\pi}{T} t \, (-10) \Big|_{t_0}^{T/2}$$

$$= \frac{-10}{2\pi} (\cos \pi - \cos 0)$$

$$= 10/\pi = \underline{3.18V}$$

(2M)