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FORENAME(S): DEREK

12 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners cannot read more illegible script or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
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1	Student Number	P151664
2	Title of Examination Paper	CIRCUIT DESIGN ANALYSIS
3	Module Code	MSX00736
4	Date and Time of Examination	9/5/18 1200
5	Examination Venue	TOWNHILL GYM
6	Seat Number	G030
7	Number of Answer Books handed in	ONE

List the numbers of the questions you have attempted	Office Use
1	11
2	3 1/2
3	4
4	11 1/2
5	10
Total	40 / 42

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95.2 %

$$\frac{40}{42}$$

Gayz

1 (a) Class AB amplifier using BJT in push-pull configuration. (1)

(b) ~~R_{E1}~~
 R_{E2} Base bias, to drop remainder of V_{CC} after losing $0.7V$ across D_2 + provide I_B of Q_2

R_1 = Base bias to drop remainder of $-V_{CC}/2$ after losing $0.7V$ across D_1 + provide I_B of Q_1 ✓

D_1 = Allows base of Q_1 to rise to $0.7V$ placing Quiescent point of Q_1 into start of linear conduction ✓

D_2 = Allows base of Q_2 to rise to $-0.7V$ placing quiescent point of Q_2 into start of linear conduction ✓

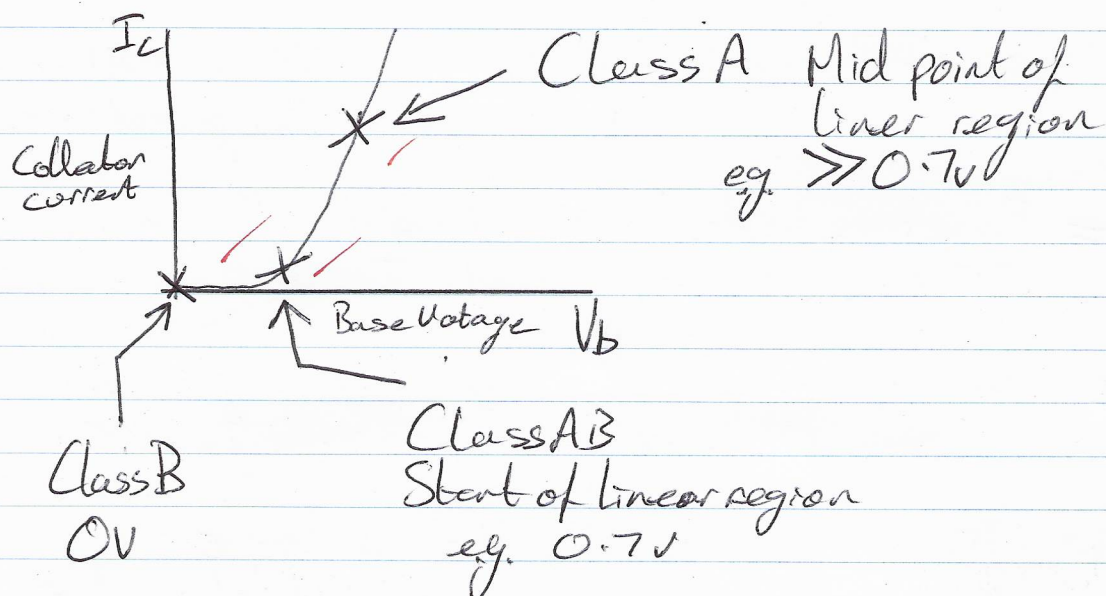
C_1 = DC Block / AC Pass to prevent DC bias of Q_1 base feeding back to V_s Also to pass V_s signal to Q_1 base ✓

C_2 = DC Block / AC Pass to prevent DC bias of Q_2 base feeding back to V_s Also to pass V_s signal to Q_2 base ✓

C_o = DC Block / AC Pass to prevent V_{EQ1} & V_{EQ2} from leaking to load, R_L . To pass amplified AC signal to load R_L ✓ (4)

(c)

1 ©



Attribute	Class A	Class AB	Class B
Distortion	Low ✓	Low ✓	High/Crossover ✓
Efficiency	Low ✓	MED ✓	HIGHER ✓
Gain	GOOD VOLTAGE ✓	VOLTAGE CURRENT ✓	LOW VOLTAGE GAIN HIGH CURRENT ✓
Conducts	360° ✓	$> 180^\circ < 360^\circ$ ✓	180° ✓

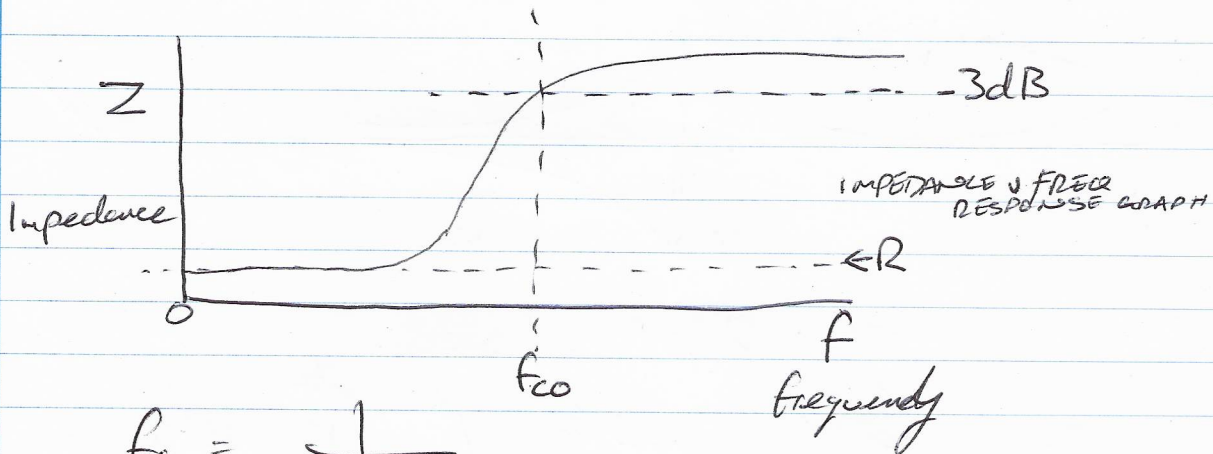
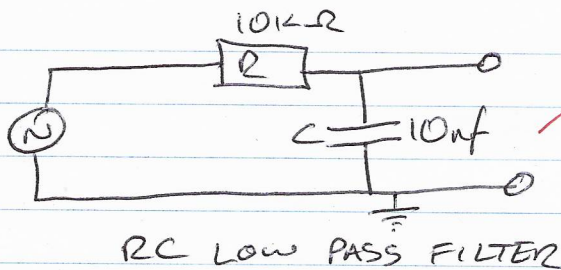
Class A BIAS is set to the midpoint in the linear region as such the transistor is permanently conducting even without signal input this is inefficient but high quality low distortion amplification. 360° conduction
HIGH QUIESCENT CURRENT

Class B. Transistor is turned off, the first 0.7V of each $\frac{1}{2}$ waveform is wasted in the non linear section, this will burn on the transistor but create crossover distortion. 180° conduction
NO QUIESCENT CURRENT

Class AB Both transistors are biased at the start of the linear region. as such they will both conduct for $> 180^\circ$ and have both transistors using a LOW QUIESCENT CURRENT

6.

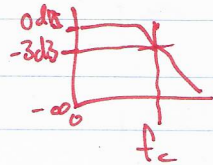
20



$$f_{co} = \frac{1}{2\pi RC}$$

was expecting graph to be:-

$$f_{co} = \frac{1}{2\pi \times 10k \times 10nF} = 1.591 \text{ kHz}$$



The lower freq's will see the capacitor as a very high reactance and not short to earth, they will pass through the filter losing only to the $10k\Omega$ resistor.

The higher frequencies will lose to the resistor and then see the capacitor as a low reactance short to ground and dissipate.

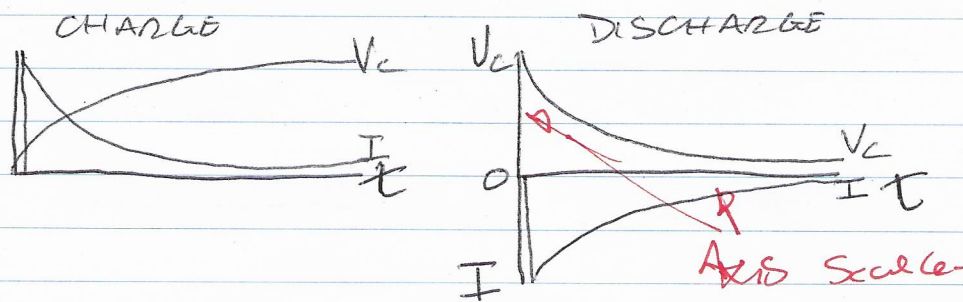
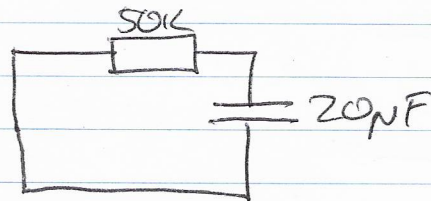
This change happens in the mid freq's and reaches a $-3dB$ point at the cut on freq. of 1.591 kHz for these values.

At the cut on freq the impedance of the RC circuit is found by

$$Z = R + jX_c = R + \frac{1}{j2\pi fC} = 10k\Omega - j10k\Omega$$

(5/2)

3 a



$$\tau = RC = 50k \times 20nF = 1 \text{ sec}$$

t	$-\frac{t}{\tau}$	$e^{-\frac{t}{\tau}}$	$1 - e^{-\frac{t}{\tau}}$	$V_{\text{max}} \times e^{-\frac{t}{\tau}}$	$I_{\text{max}} \times e^{-\frac{t}{\tau}}$
0	0	1	0	10V	-200 μ A
1sec	-1	0.3679	0.6321	3.679	-73.58 μ A
2sec	-2	0.1353	0.8647	1.353	-27.06 μ A
3sec	-3	0.0498	0.9502	0.498	-9.96 μ A
4sec	-4	0.0183	0.9817	0.183	-3.66 μ A
5sec	-5	0.0067	0.9933	0.067	-1.34 μ A

$$V_{\text{Cmax}} = 10V$$

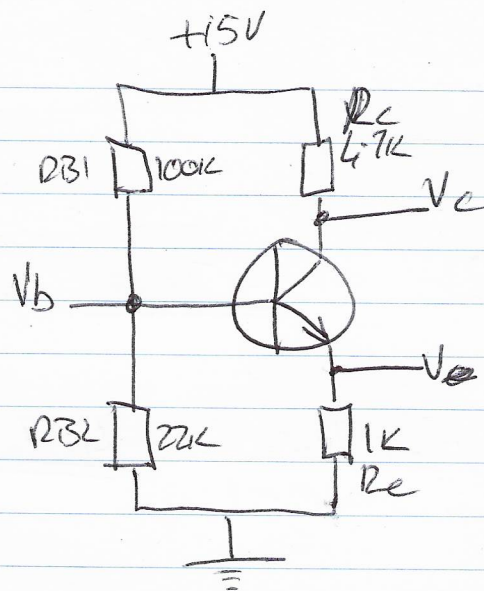
$$I_{\text{max}} = \frac{V}{R} = \frac{10}{50k} = 200\mu A$$

$$\therefore \text{ @ } 3 \text{ secs } V_c = \underline{0.498V}$$

The discharge graph above shows the Voltage across C_1 as at max at time zero. this voltage will dissipate according to $V_{\text{max}} \times e^{-\frac{t}{\tau}}$ in $5RC$ time constants (generally accepted). This charged capacitor discharging will show an instantaneous reverse current to the charge current direction that will dissipate at $-I_{\text{max}} \times e^{-\frac{t}{\tau}}$

4.

a)



$$V_b = V_{cc} \times \frac{R_{B2}}{R_{B1} + R_{B2}} = 15V \times \frac{22k}{100k + 22k} = \underline{2.705V}$$

b) Assuming 0.7V V_{be} drop

$$\text{then } V_e = V_b - 0.7V = 2.705V - 0.7V = \underline{2.005V}$$

c) $V_c = ?$

$$I_e = \frac{V_e}{R_e} = \frac{2.005V}{1k\Omega} = 2.005mA$$

$$I_e \approx I_c \therefore I_c \approx 2.005mA$$

$$V_{RC} = I_c \times R_c = 2.005mA \times 4.7k\Omega = 9.4235V$$

$$V_c = V_{cc} - V_{RC} = 15V - 9.4235V = \underline{5.5765V}$$

$$\therefore V_c = \underline{5.5765V}$$

d) $R_{in} = R_{B1} // R_{B2} // R_e \cdot \beta_e$

$$= 100k // 22k // 1k \cdot 100 = \underline{15.277k\Omega}$$

4 (d)

Cont

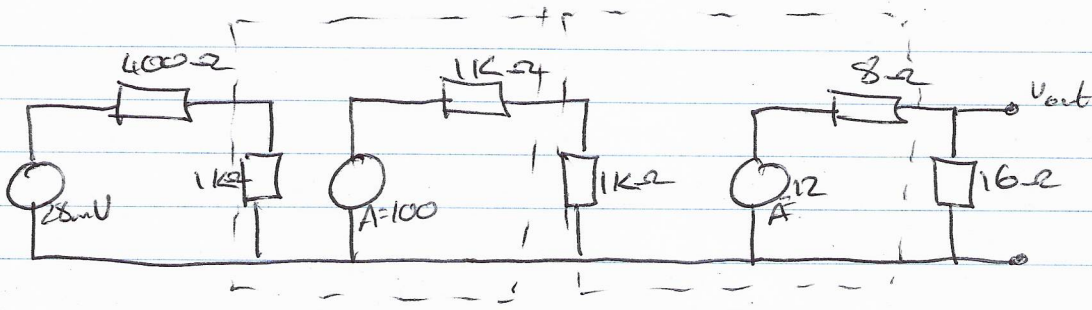
$$R_{out} = R_C = \underline{\underline{4.7k\Omega}} \quad \checkmark \quad (2)$$

$$A_v = -\frac{R_C}{R_E} = -\frac{4.7k\Omega}{1k\Omega} = -\underline{\underline{4.7}} \quad \checkmark \quad (1\frac{1}{2})$$

$$(1\frac{1}{2})$$

5.

a)



$$\text{Amp. input} = 28\text{mV}_{pp} \times \frac{1\text{k}}{1.4\text{k}} = 20\text{mV} \quad \checkmark$$

$$\text{Amp. gain} = 20\text{mV} \times 100 = 2\text{V} \quad \checkmark$$

$$\text{Amp2 input} = 2\text{V} \times \frac{1\text{k}}{2\text{k}} = 1\text{V} \quad \checkmark$$

$$\text{Amp2 gain} = 1\text{V} \times 12 = 12\text{V} \quad \checkmark$$

$$\text{LOAD} = 12\text{V} \times \frac{16}{24} = 8\text{V}_{p-p} \quad \checkmark$$

$$\therefore V_{\text{LOAD}} = 8\text{V}_{p-p} \quad \checkmark$$

$$V_{\text{LOAD}_{\text{RMS}}} = V_{\text{LOAD}_{p-p}} \times \frac{\sqrt{2}}{2} = 8\text{V} \times 0.707 = 5.656\text{V}_{\text{RMS}} \quad \checkmark$$

$$P_{\text{LOAD}} = \frac{V_{\text{RMS}}^2}{R} = \frac{5.656\text{V}_{\text{RMS}}^2}{16} = \frac{31.99}{16} = 1.999\text{W} \quad \checkmark$$

8.



Question No.

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5(b) In an AC amplifier input and output capacitors are chosen to block the loss of DC bias conditions whilst also having negligible reactance at the freq.s of interest within the amplifier.

~~∴ The capacitors have no effect on the~~

Therefore with the capacitors having no reactance they will have no effect on the ^{equivalent} circuit impedance that is shown on a Thevenin Equivalent circuit.

✓
(2)