Show terms used in calculations and show intermediate answers in order to get partial credit if your final answers are wrong. Problem 1 is 2x the other problems.

1. Circuit Frequency Response. For each circuit;
   a) Compute the break frequency in Hz.
   b) Find the output voltage in peak volts at mid-band frequency.
   c) Convert the mid-band voltage to a voltage gain in dB.
   d) Sketch the output voltage in dB vs. Hz using Bode straight-line approximation. Label the slope of each line segment (dB/decade).

For Circuit 1:
\[ f = \frac{1}{2\pi RC} = \frac{1}{2\pi} \cdot 1300 \cdot 1 \text{u} = 122.4 \text{ Hz} \]
\[ \frac{V_o}{V_1} \text{ midband} = \frac{800}{1300} = 0.615 \]
\[ 20\text{dB}\cdot\log 0.615 = -4.22 \text{ dB} \]
\[ \text{d) } 0 \text{ dB/decade} \]

For Circuit 2:
\[ f = \frac{1}{2\pi RC} = \frac{1}{2\pi} \cdot 192.3 \cdot 20 \text{u} = 41.4 \text{ Hz} \]
\[ \frac{V_o}{V_1} \text{ midband} = \frac{5000}{5200} = 0.962 \]
\[ 20\text{dB}\cdot\log 0.962 = -0.34 \text{ dB} \]
\[ \text{d) } -20 \text{ dB/decade} \]
2. For the amplifier circuit below determine the voltage gain, $Vo/Vs$, at mid-band frequencies.

Beta = 200

IB = (14-0.7)/600K = 22.2 uA
IE = (1+200)IB = 4.46 mA
re = 26mV/4.46mA = 5.83 ohms
Vo = - (1 + $\beta$)ib*RC
Vs = ib*(Rs + (RB/((1+ $\beta$)re))

$Vo/Vs = - 157.7$
3. For the differential amplifier below find,

a) Common mode gain
b) Differential mode gain

\( \beta = 75 \)

IR3 = \( \frac{20 - 0.7}{1K} = 19.3 \text{ mA} \)

IE1 = \( \frac{19.3 \text{ mA}}{2} = 9.65 \text{ mA} \)

\( re = \frac{26 \text{ mV}}{IE1} = 2.7 \text{ ohms} \)

\( Ac = \frac{\beta R1}{(1+\beta)(re + 2R3)} = 0.94 \)

\( Ad = \frac{R1}{re} = 370 \)
4. For the circuit below determine the value of $C_T$ to use in finding the upper half-power frequency. As connected the gain of $U1 = -50$.

\[
CT = C1 + (1 - A)C2
\]

\[
CT = 30 + 51*7 = 387\text{pF}
\]

Scores
1. ______
2. ______
3. ______
4. ______