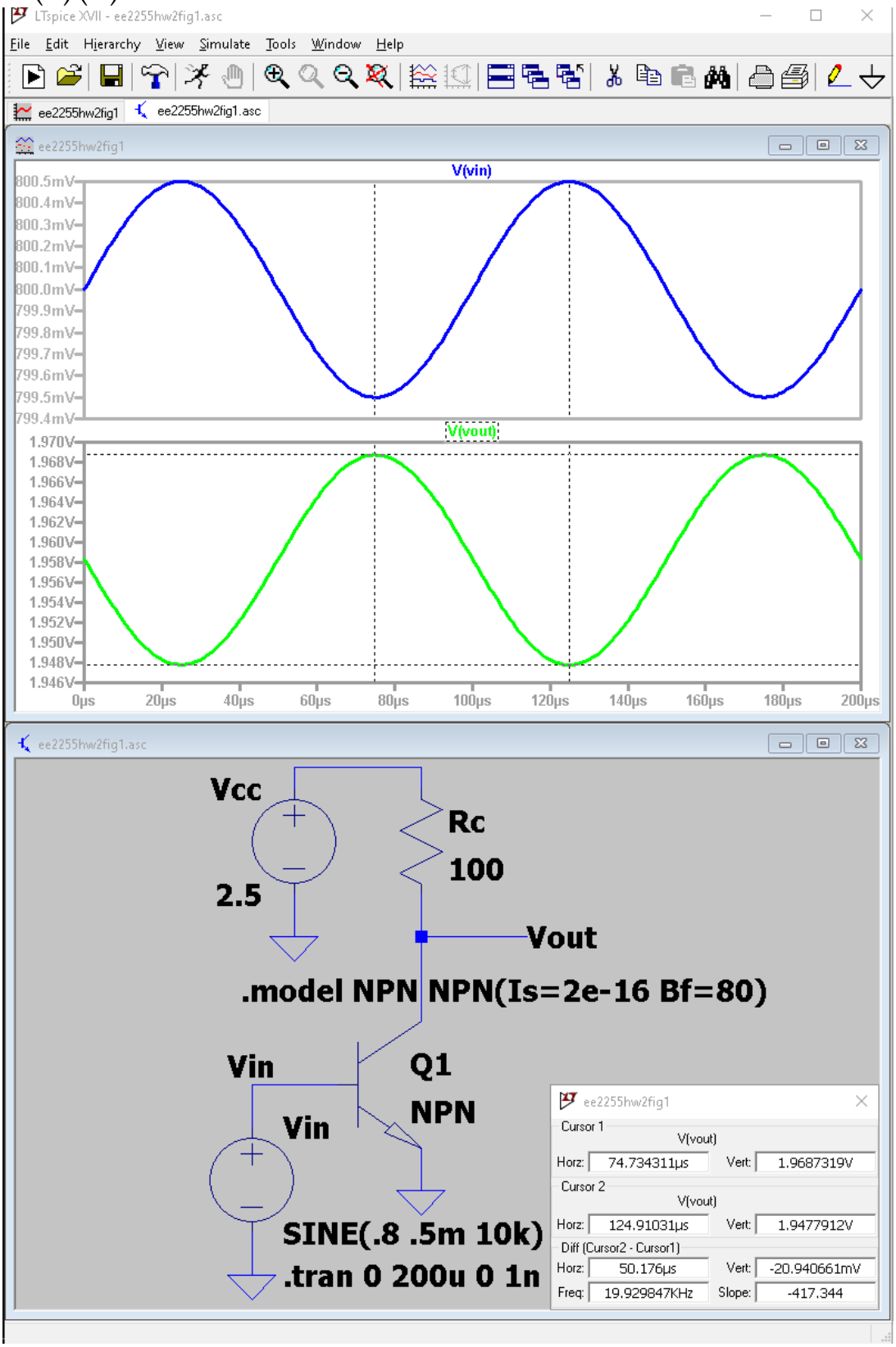
108061112 林靖 hw2

1.(a)(b)



1.(c)

$$g_m \cdot R_C$$

$$= \frac{1}{V_T} I_S \exp \frac{V_{BE}}{V_T} \cdot R_C$$

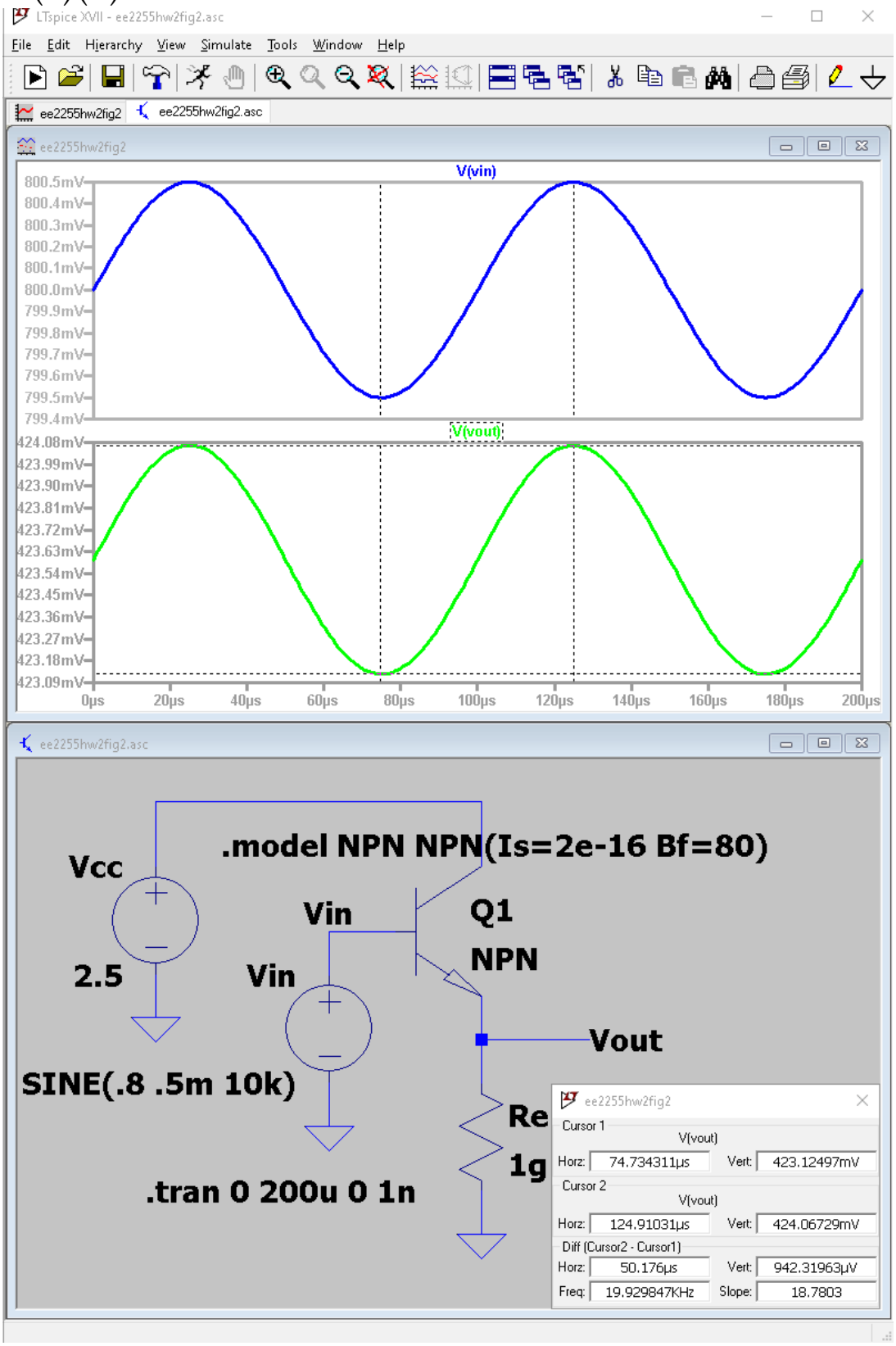
$$= \frac{1}{26mV} 2 \cdot 10^{-16} A \exp \frac{0.8V}{26mV} \cdot 100\Omega$$

$$= 17.740$$

1.(d)

SPICE voltage gain = (1.9687319 – 1.9477912) / 0.001 = 20.941
small signal model voltage gain = 17.740
relative error = (20.941 - 17.740) / 20.941 = 0.15

2.(a)(b)


LTspice XVII - ee2255hw2fig2.asc
File Edit Hierarchy View Simulate Tools Window Help
ee2255hw2fig2
ee2255hw2fig2.asc
V(vin)
800.5mV
800.4mV
800.3mV
800.2mV
800.1mV
800.0mV
799.9mV
799.8mV
799.7mV
799.6mV
799.5mV
799.4mV
V(vout)
424.08mV
423.99mV
423.90mV
423.81mV
423.72mV
423.63mV
423.54mV
423.45mV
423.36mV
423.27mV
423.18mV
423.09mV
0µs 20µs 40µs 60µs 80µs 100µs 120µs 140µs 160µs 180µs 200µs
ee2255hw2fig2.asc
.model NPN NPN(Is=2e-16 Bf=80)
Vcc
2.5
Vin
Vin
Q1
NPN
Vout
SINE(.8 .5m 10k)
Re
1g
.tran 0 200u 0 1n
ee2255hw2fig2
Cursor 1
V(vout)
Horz: 74.734311µs
Vert: 423.12497mV
Cursor 2
V(vout)
Horz: 124.91031µs
Vert: 424.06729mV
Diff (Cursor2 - Cursor1)
Horz: 50.176µs
Vert: 942.31963µV
Freq: 19.929847KHz
Slope: 18.7803

2.(c)

$$\frac{R_E}{R_E + \frac{1}{g_m}}$$

$$= \frac{R_E}{R_E + \frac{1}{\frac{1}{V_T} I_S \exp \frac{V_{BE}}{V_T}}}$$

$$= \frac{1\,G\Omega}{1\,G\Omega + \frac{1}{\frac{1}{26\,mV} 2 \cdot 10^{-16} A \exp \frac{0.8\,V}{26\,mV}}}$$

$$= 0.99999$$

2.(d)

SPICE voltage gain = (0.42406729 - 0.42312497) / 0.001 = 0.94232

small signal model voltage gain = 0.99999

relative error = (0.94232 - 0.99999) / 0.94232 = -0.06