45. For the circuit of Fig. 13.65, $v_s = 117 \sin 500t$ V. Calculate v_2 if the terminals marked a and b are (a) left open-circuited; (b) short-circuited; (c) bridged by a 2 Ω resistor.

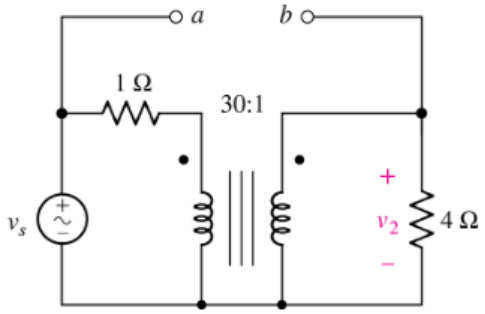
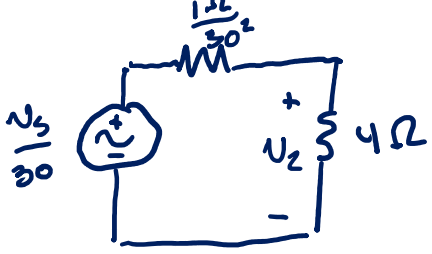


FIGURE 13.65

a) Reflect v_s & the 1Ω resistor through the transformer



$$v_2 = \frac{v_s}{30}\left(\frac{4}{4 + \frac{1}{30^2}}\right) \approx 1$$

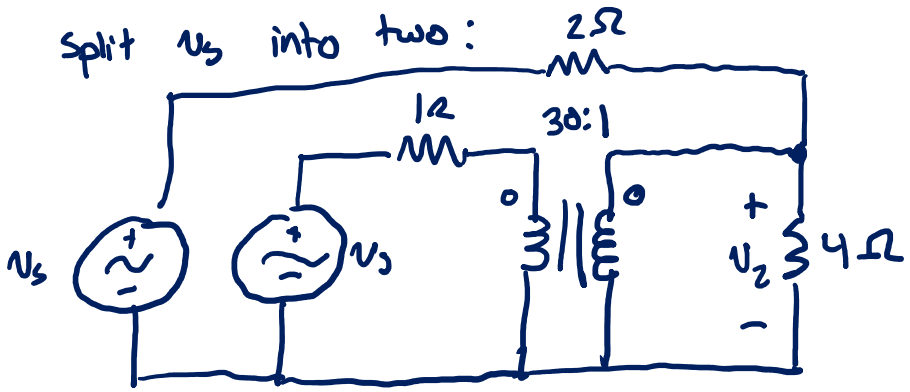
$$v_2 \approx \frac{v_s}{30} = 3.9 \sin 500t \text{ V}$$

exact amplitude : 3.899

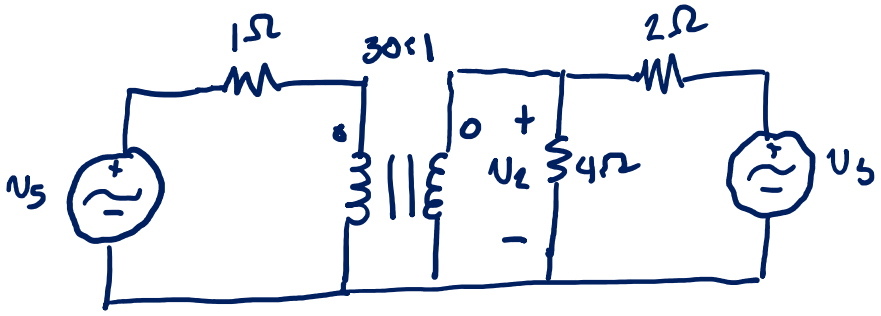
b) When shorted, $v_s = v_2$

$$v_2 = 117 \sin 500t \text{ V}$$

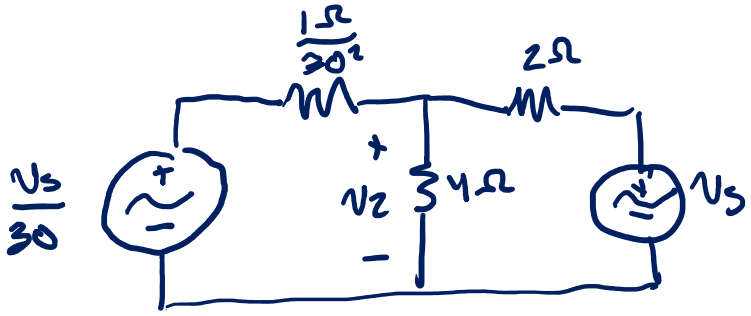
c) split v_s into two:



Redraw:



Reflect the left side through the transformer



Superposition:

$$v_2 = \frac{v_s}{30}\underbrace{\frac{4\|2}{\frac{1}{30^2}+4\|2}}_{\approx 1} + v_s\underbrace{\frac{4\|\frac{1}{30^2}}{2+4\|\frac{1}{30^2}}}_{\approx 0}$$

$$\boxed{v_2 \approx \frac{v_s}{30} = 3.9\sin 500t}$$

exact: $3.96\sin 500t$