問題２

以下の問に答えよ．図中の記号は凡例に従う．ωは角周波数，tは時刻を表す．必要であれば図１の角度を用いよ．

(1) 図２に示す回路について以下の問(1-1)から問(1-5)に答えよ．

(1-1) 電流$i(t)$を求めよ．

(1-2) 電圧$v_R(t)$，$v_L(t)$，$v_C(t)$を求めよ．

(1-3) 図３のフェーザ図に交流電圧源$v_S(t)$のフェーザV_Sが示されている．図３を解答用紙に書き写し，$v_R(t)$，$v_L(t)$，$v_C(t)$のフェーザを描け．

(1-4) 有効電力P，無効電力Q，皮相電力S，力率PFを求めよ．

(1-5) 図２に示す回路のa-b間に素子を１つ挿入すると力率が１になった．その素子の種類と値を答えよ．

(2) 図４に示す回路において抵抗R_Lが最大電力を消費するとき，R_Lの値と最大電力を有効数字２桁で求めよ．なお，図４の中の理想変圧器は巻き数比が4:1である．

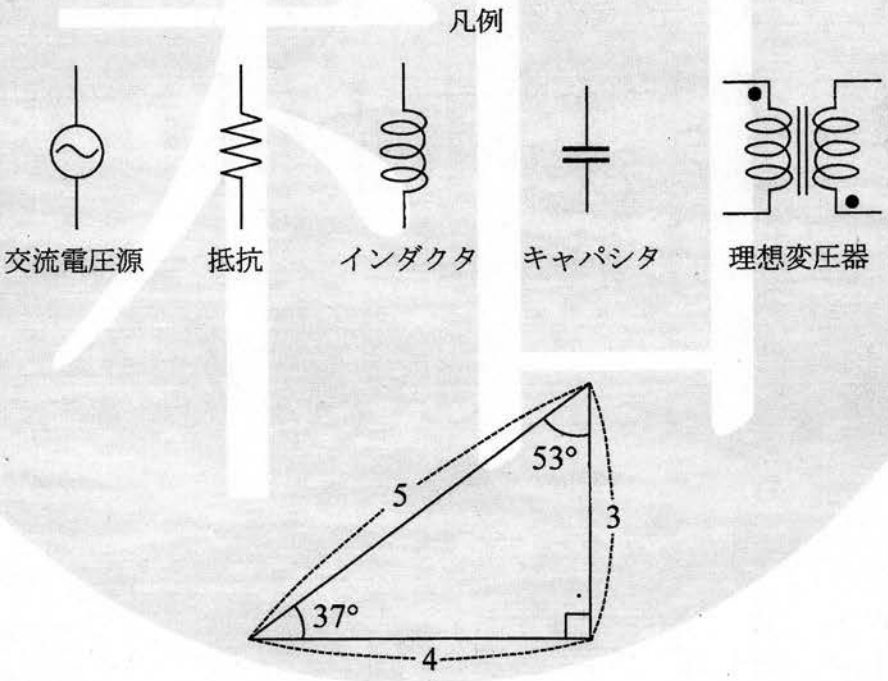


図１

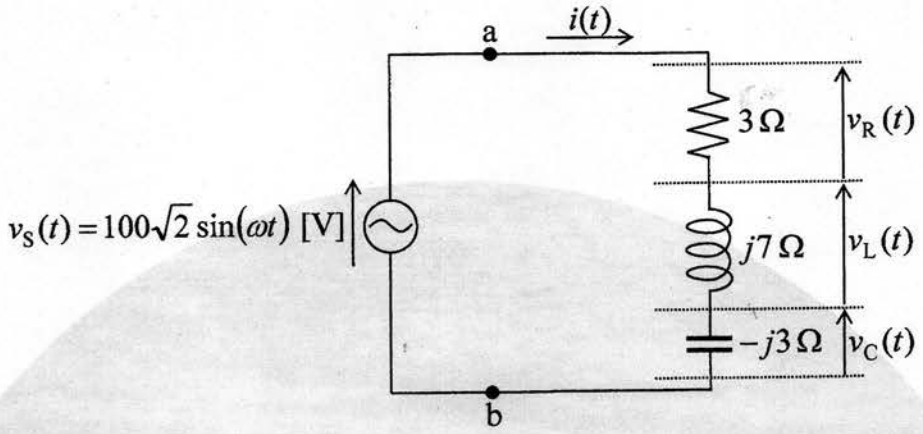

a
i(t)
3 Ω
v_R(t)
v_S(t) = 100√2 sin(ωt) [V]
jL ω
v_L(t)
−j/(Cω)
v_C(t)
b

図 2

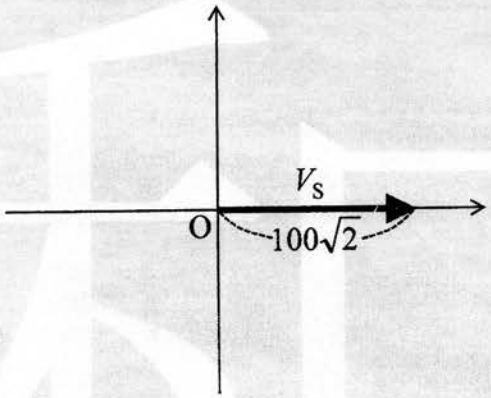

V_S
O
100√2

図 3

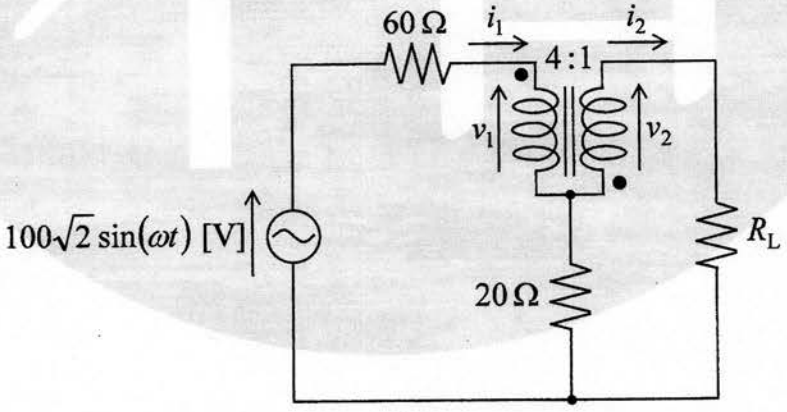

60 Ω
i_1
i_2
4 : 1
v_1
v_2
100√2 sin(ωt) [V]
R_L
20 Ω

図 4

Problem 2

Answer the following questions. Symbols in the figures can be found in the legend. ω is the angular frequency and t is the time. If necessary, use the angles in Fig. 1.

(1) Answer the following questions from (1-1) to (1-5) on the circuit shown in Fig. 2.

(1-1) Find the current $i(t)$.

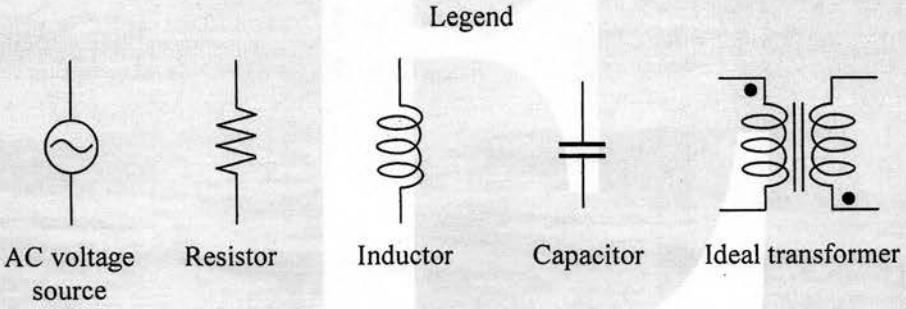
(1-2) Find the voltages $v_R(t)$, $v_L(t)$, and $v_C(t)$.

(1-3) Phasor V_S of the AC voltage source $v_S(t)$ is shown in the phasor diagram in Fig. 3. Copy Fig. 3 to the answer sheet and draw the phasors of $v_R(t)$, $v_L(t)$, and $v_C(t)$.

(1-4) Find the active power P, the reactive power Q, the apparent power S, and the power factor PF.

(1-5) When an element is inserted between a and b in the circuit shown in Fig. 2, the power factor of 1 is achieved. Determine the type of the element and its value.

(2) When the resistor R_L consumes the maximum power in the circuit shown in Fig. 4, determine the value of R_L and the maximum power with two significant digits. The ideal transformer in Fig. 4 has the turns ratio of 4:1.



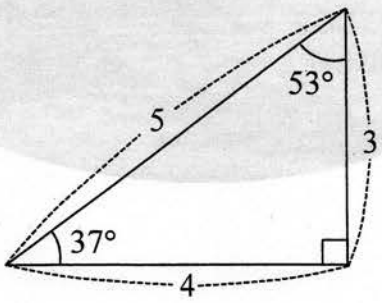


Fig. 1

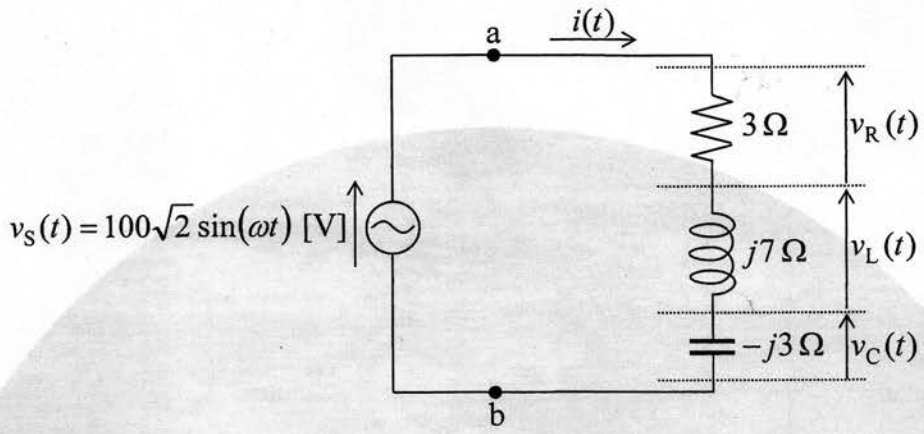


Fig. 2

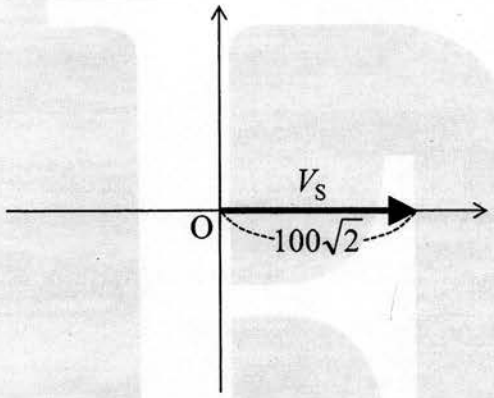


Fig. 3

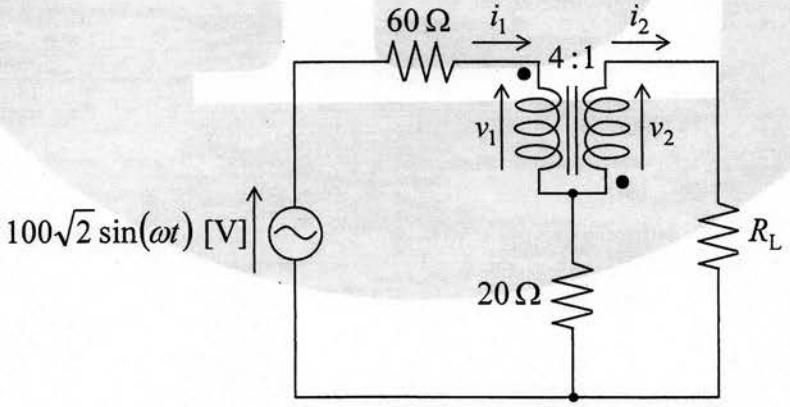


Fig. 4