UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATION, APRIL 2005

First Year – Civil, Industrial, Mechanical and Materials Engineering Programs

ECE 110H1 S – ELECTRICAL FUNDAMENTALS

Exam. Type: A

Examiners – L. de Windt and B. Wang

NAME : (PLEASE PRINT)	FAMILY NAME	GIVEN NAME
STUDENT NUMBER :		

EXAMINATION TYPE : Type A – Paper for which no data are permitted other than the information printed on the examination paper.

CALCULATORS : ONLY Non-programmable scientific type allowed (models as specified in the Faculty Calendar).

DURATION : 2.5 hours

INSTRUCTIONS :

- DO NOT UNSTAPLE THIS EXAM. BOOK.
- Answer all ten questions.
- All ten questions are of equal weight.
- All work is to be done on these pages. Show methods, compute numerical results when requested and state units.
- Place your final answer in the corresponding box. You may use the back of the preceding page for rough work.

$e = 1.6 \times 10^{-19}$C, $\epsilon_o = 8.85 \times 10^{-12}$ F/m, $\mu_o = 4\pi \times 10^{-7}$ H/m

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

Question 1 (10 marks)

Six charges are equally spaced in a circle of radius 5m as shown in Figure 1. Determine the total electric field $\vec{E}_T$, at the center of the circle, due to the six charges.

$q_1 = q_4 = +250nC$
$q_2 = q_3 = -100nC$
$q_5 = q_6 = +100nC$

$\vec{E}_T =$

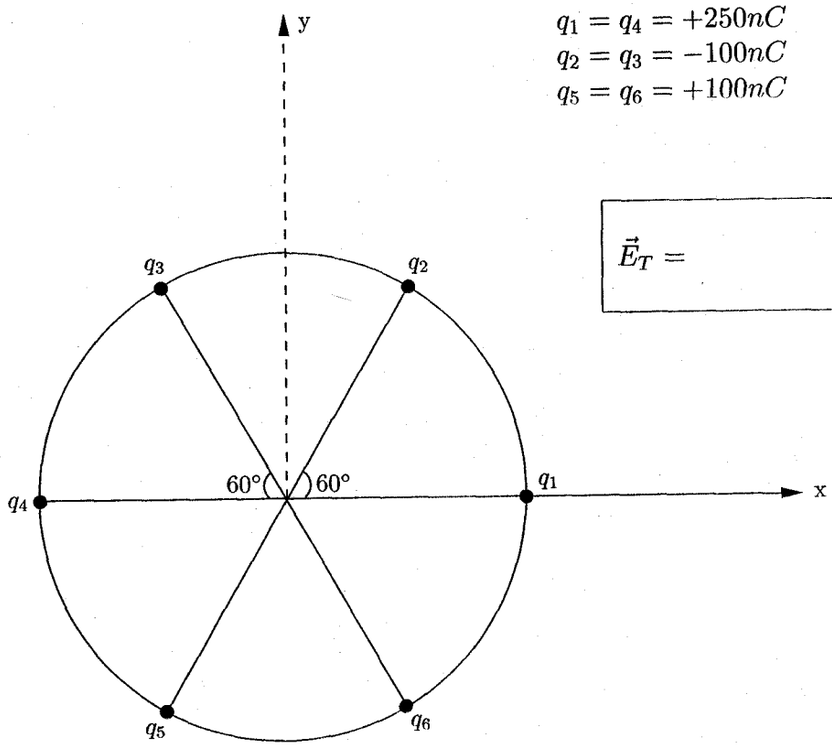

Figure 1

Question 2 (10 marks)

Two very long wires are located at $(-1, 0)$m and $(1, 0)$m. Wire #1 carries 10A into the page and wire #2 carries 10A out of the page as shown in Figure 2. Determine the total magnetic field $\vec{B}_T$ due to both currents at the point (0,1)m.

$\vec{B}_T =$

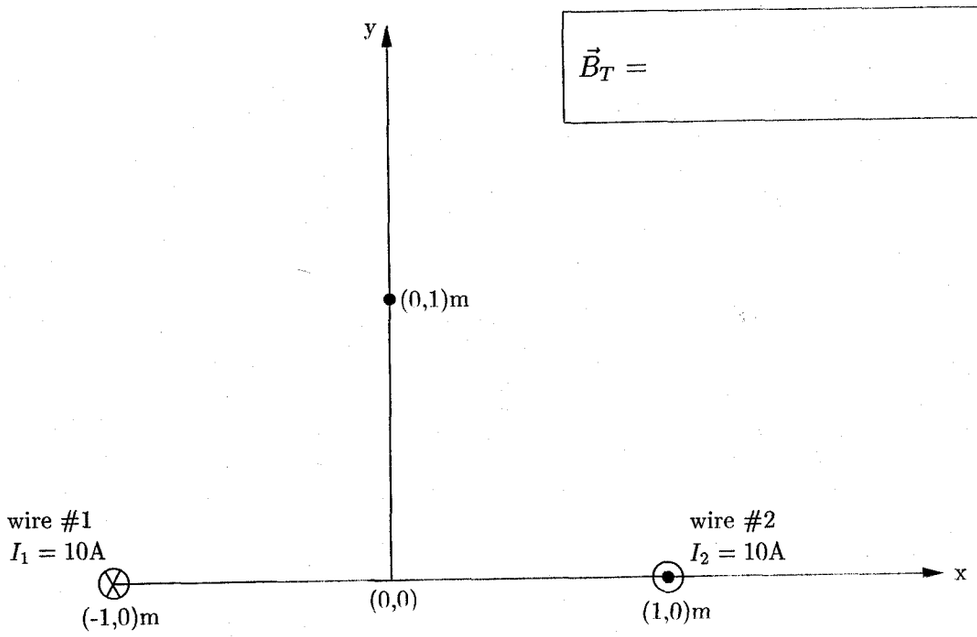

Figure 2

Question 3 (10 marks)

The DC source in the circuit shown in Figure 3, supplies 600 watts. Determine R_1 and R_2.

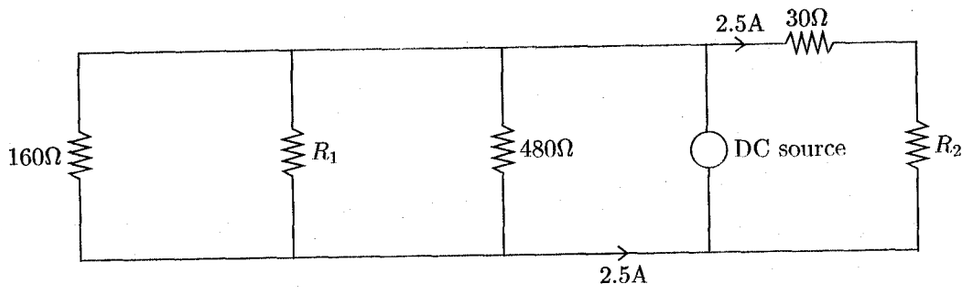

Figure 3

$R_1 =$

$R_2 =$

Question 4 (10 marks)

For the circuit shown in Figure 4, is the 0.5A current source supplying or absorbing power and how much?

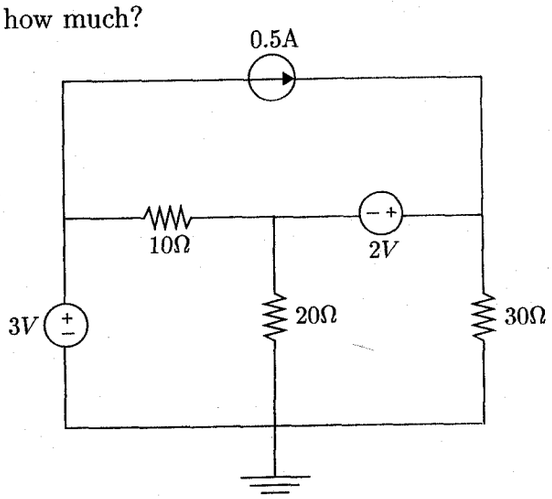

Figure 4

$P_{0.5A}$ =

☐ Absorbed ☐ Supplied

Question 5 (10 marks)

For the circuit shown in Figure 5, assume the operational amplifier is ideal and operating in the linear region. Determine the output voltage V_0.

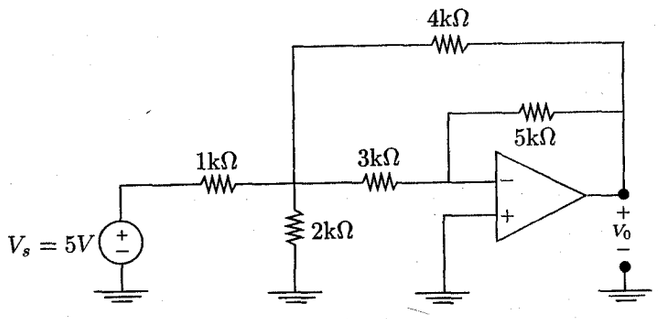

Figure 5

$V_0 =$

Question 6 (10 marks)

A linear circuit is driven by an independent voltage source (V_s) and an independent current source (I_s). When the current source is turned off while the voltage source is set to $10V$, the output voltage is at $3.5V$. When the current source is set to $1A$ while the voltage source remains at $10V$, the output voltage is now at $0.5V$. Express the output voltage in turns of the voltage source (V_s) and the current source (I_s).

$V_0 =$

Question 7 (10 marks)

When a 100Ω resistor is connected across two-terminals of a linear circuit, the output voltage across the 100Ω resistor is at $10V$. When a 200Ω resistor is connected across the two-terminals, the output voltage is at $12V$. How much current would this linear circuit deliver to a 250Ω resistor?

$I =$

Question 8 (10 marks)

The switch in the circuit shown in Figure 6 below has been opened for a long time. At $t = 0$ the switch is closed. Determine:

a) the current $i_0(0^-)$ (3 marks)
b) the current $i_0(0^+)$ (3 marks)
c) the current $i_0(t)$ for $t \geq 0$ (4 marks)

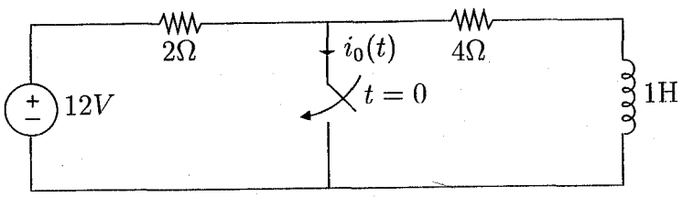

Figure 6

a) $i_0(0^-) =$

b) $i_0(0^+) =$

c) $i_0(t) =$

Question 9 (10 marks)

The circuit in Figure 7 is in sinusoidal steady-state. Express the current through the capacitor as a function of time.

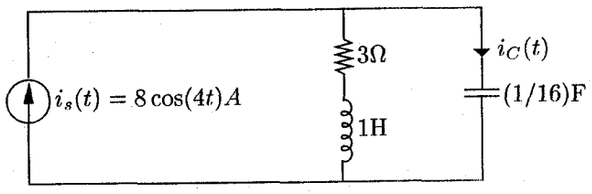

Figure 7

$i_C(t) =$

Question 10 (10 marks)

An electrical load absorbs an average power of 8kw at a lagging power factor of 0.8. Find the complex power of the load.

S =