ECE 201 – Fall 2013
Exam 1
Sept. 17, 2013

Section 2: Pekarek (3:30 pm)
Section 4: Jiao (1:30 pm)
Section 5: Lin (11:30 am)

Instructions

1. DO NOT START UNTIL TOLD TO DO SO.
2. Write your name, division, professor, and student ID# (PUID) on both your scantron sheet and your work-out sheet.
3. This is a CLOSED BOOKS and CLOSED NOTES exam.
4. This exam has two parts:

   Part A contains 9 multiple-choice questions, each worth 10 points. There is only one correct answer to each question. Only answers marked on your scantron sheet will be graded. Partial credits will NOT to be given to Part A.

   Part B contains 1 work-out problem worth 10 points. Only answers written on the work-out sheet will be graded. Clearly show intermediate steps in order to receive partial credits.
5. Calculators are allowed (but not necessary). Please clear any formulas, text, or other information from your calculator memory prior to the exam.
6. If extra scratch paper is needed, use back of test pages. If extra work-out sheet is needed, ask the instructor.
7. Cheating will not be tolerated. Cheating in this exam will result in an F in the course.
8. If you cannot solve a question, be sure to look at the other ones and come back to it if time permits.
9. As described in the course syllabus, we must certify that every student who receives a passing grade in this course has satisfied each of the course outcomes. On this exam, you have the opportunity to satisfy the following outcomes. (See the course syllabus for a complete description of each outcome.) On the chart below, we list the criteria we use for determining whether you have satisfied these course outcomes. You only need to satisfy the outcomes once during the course, so any outcomes that you satisfied previously will remain satisfied, independent of your performance on this exam.

Course Outcome	Exam Questions	Minimum correct answers required to satisfy the course outcome
i	1-10	6

PART A: 9 Multi-Choice Questions

IMPORTANT: Only answers marked on your scantron sheet will be graded!!!

One correct answer for each question.

1. Fig. 1(a) illustrates the charge flow in a conductor. Assume you are sitting on the right side of the cross-section boundary and are recording the total amount of net charges that have passed across the boundary. Your measurement is shown in Fig. 1(b) for time 0<t<3 seconds.

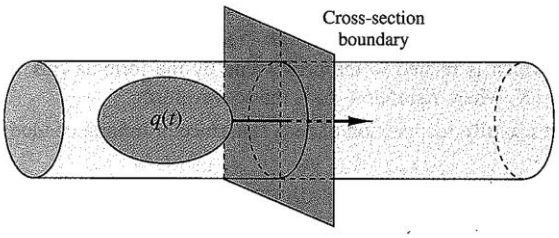


Fig. 1(a)

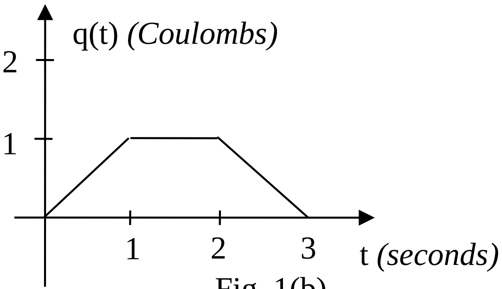
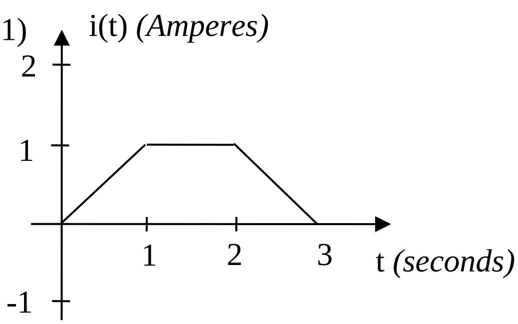


Fig. 1(b)

Assume the reference current direction is shown in Fig. 1(a), which of the following figures shows the correct current flow?

$i(t) = \frac{d}{dt} q(t)$

1)



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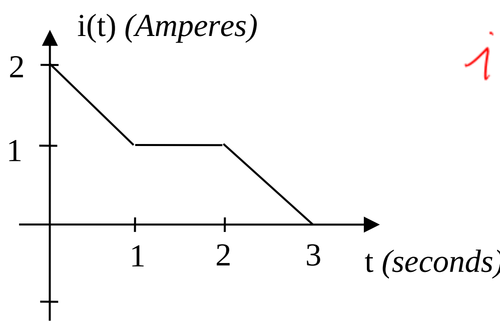
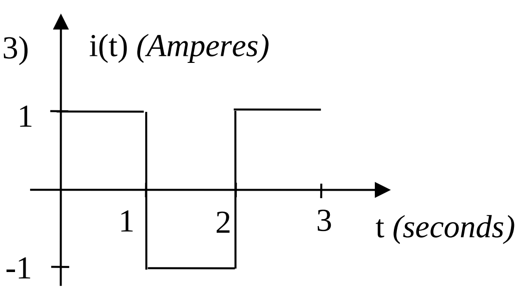


3)



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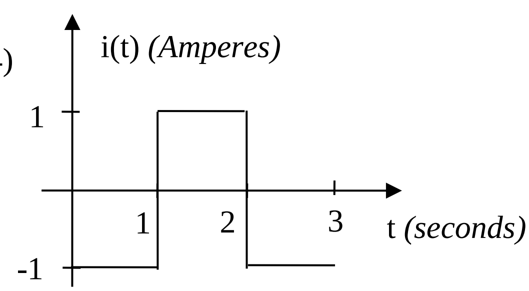
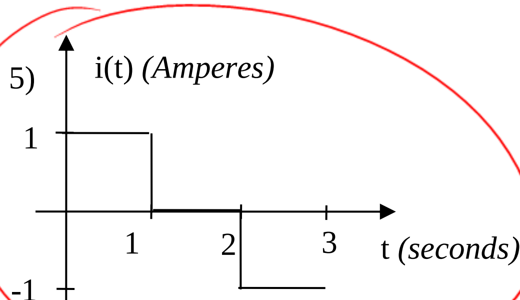
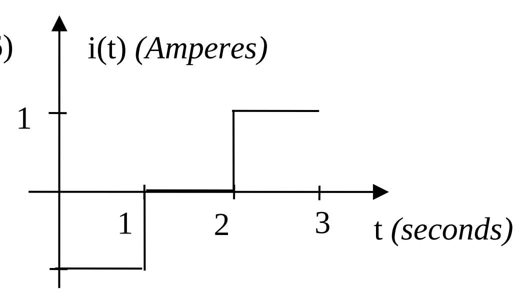


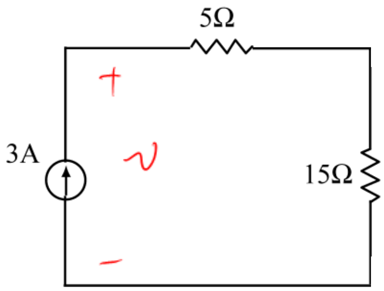
5)



6)



2. The power delivered by the 3A current source is



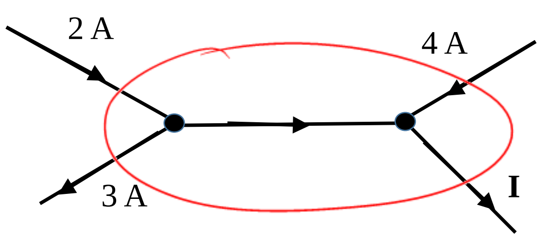
V = 3 × 20 = 60 V

P = 3 × 60 = 180 W

1) 15W 2) −15W 3) 90W 4) −90W

5) 180W 6) −180W 7) None of the above

3. Find current I in the following figure.



Use a Gaussian surface :

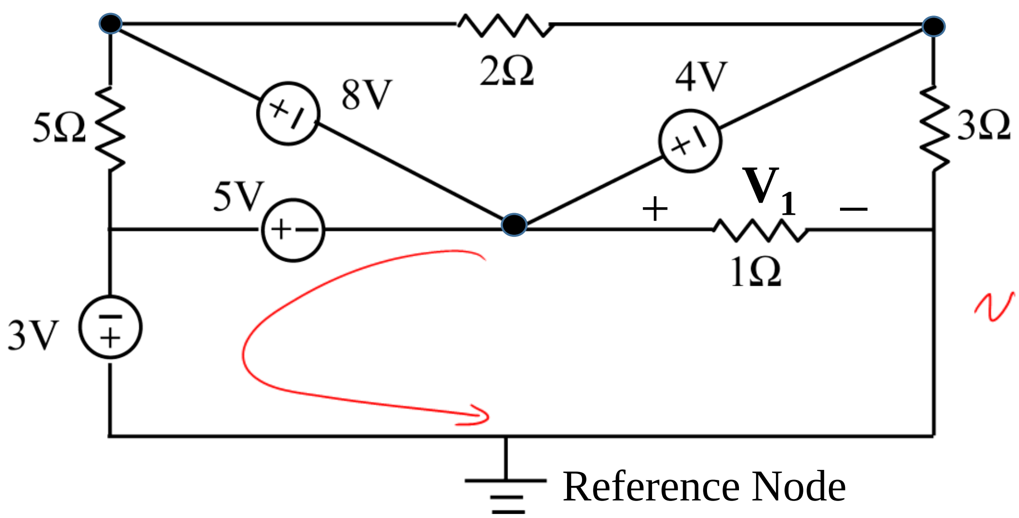
2 + 4 = 3 + I

I = 3A

1) 1A 2) 9A 3) 5A 4) −1A

5) 2A 6) 6A 7) 3A

4. For the circuit shown below, find the voltage drop V_1 across the 1Ω resistor along the marked reference direction.



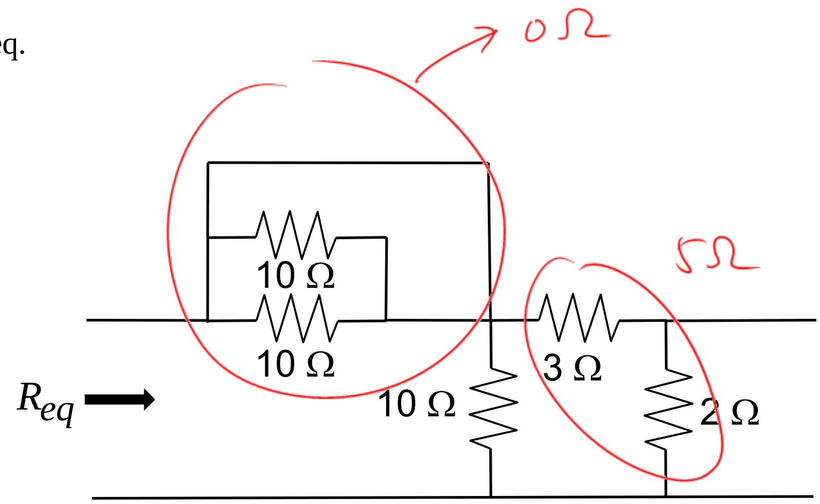
$v_1 = (-5) + (-3)$

$= -8V$

1) −5V 2) 5V 3) 3V 4) −3V

5) 8V 6) −8V 7) 4V

5. Determine Req.

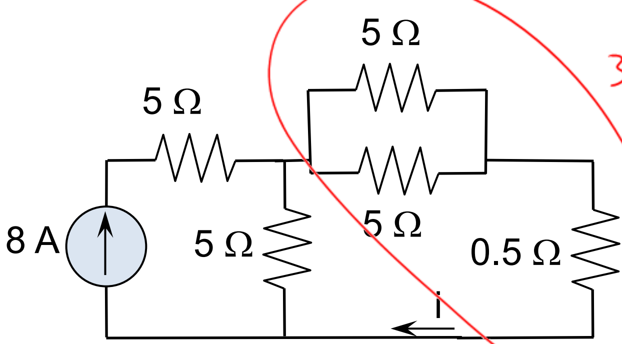


(1) 2 Ω (2) 5 Ω (3) 2/3 Ω (4) 0 Ω

(5) 55/9 Ω (6) 3 Ω (7) 5.5 Ω (8) none of the above

$$Req = 10 // 5 = \frac{10 \times 5}{10+5} = \frac{10}{3}\,\Omega$$

6. Determine the current i



3Ω

$5\Omega \,//\, 5\Omega = 2.5\Omega$

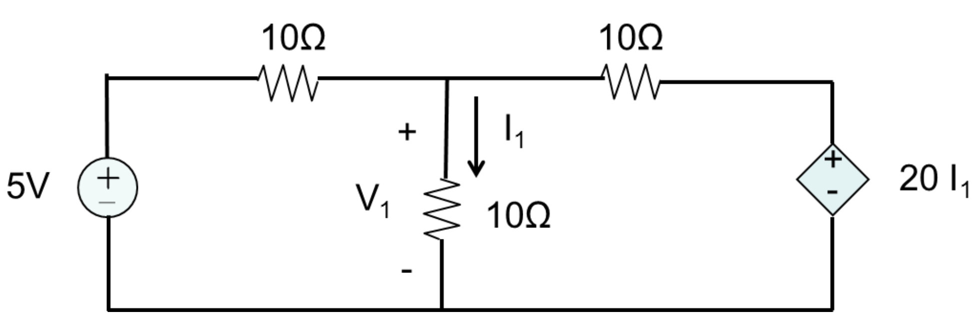
By I-division

$I = 8 \times \frac{5}{3+5} = 5A$

(1) 3 A (2) 8 A (3) 16 A (4) -4 A

(5) 5 A (6) -8 A (7) 4 A (8) none of the above

7. In the circuit shown below, find V_1 (in Volts).



(1) 1V (2) 5/3 V (3) 2V (4) 2.5V

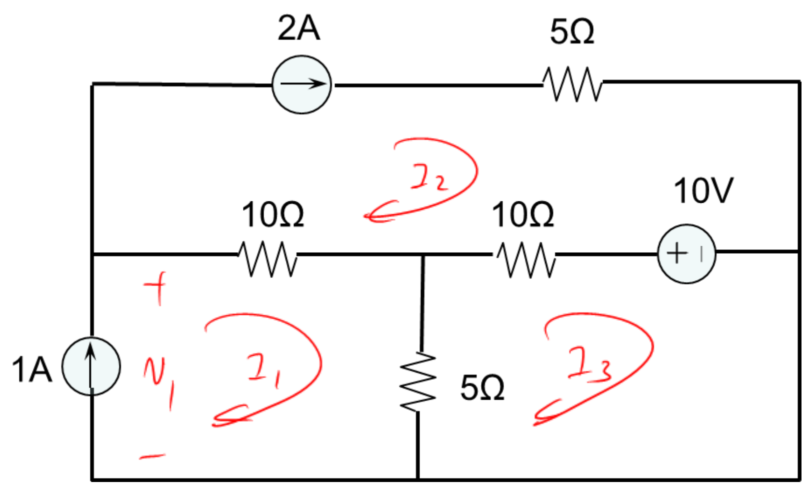
(5) 5V (6) 10V (7) 12V (8) none of the above

Use nodal analysis :

$$\begin{cases} \frac{V_1 - 5}{10} + \frac{V_1}{10} + \frac{V_1 - 20I_1}{10} = 0 \\ I_1 = \frac{V_1}{10} \end{cases}$$

$$\Rightarrow \frac{V_1}{10} = \frac{5}{10}, \quad V_1 = 5V$$

8. In the circuit shown below, find the power (in Watts) delivered by the 1A current source on the left. (***Hint:*** You may consider using loop/mesh analysis.)



(1) 15W (2) 12W (3) 10W (4) 0W

(5) -15W (6) -12W (7) -10W (8) none of the above

$I_1 = 1A, \quad I_2 = 2A$

loop I_3: $10(I_3 - I_2) + 10 + 5(I_3 - I_1) = 0$

$\Rightarrow 15 I_3 - 10 I_2 - 5 I_1 + 10 = 0$

$15 I_3 - 20 - 5 + 10 = 0$

$15 I_3 = 15$

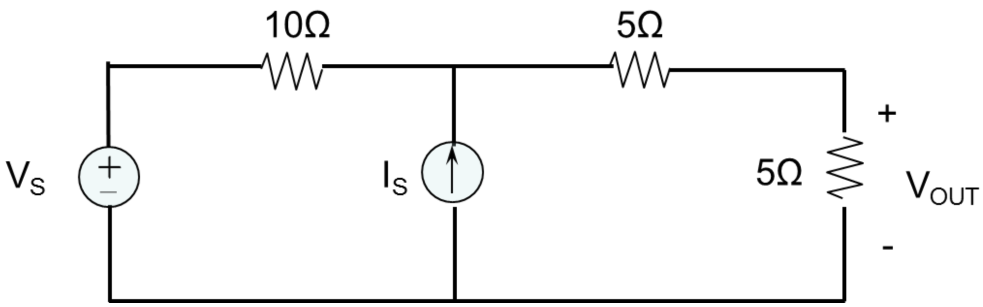
$I_3 = 1A$

Hence: $v_1 = 10(I_1 - I_2) + 5(I_1 - I_3)$

$= -10V$

$P = (-10) \times 1 = -10W$

9. In the circuit shown below, V_{out} can be written as a linear combination of V_S and I_S, i.e., $V_{out} = \alpha\, V_S + \beta\, I_S$. What are the correct values for α and β?



(1) $\alpha = \frac{1}{4}, \beta = \frac{5}{2}\Omega$

(2) $\alpha = \frac{1}{4}, \beta = 5\Omega$

(3) $\alpha = \frac{1}{2}, \beta = \frac{5}{2}\ \Omega$

(4) $\alpha = \frac{1}{2}, \beta = 5\Omega$

(5) $\alpha = \frac{1}{2}, \beta = \frac{1}{2}\ \Omega$

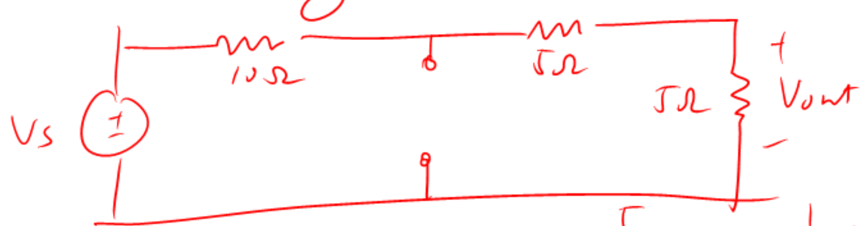
(6) $\alpha = 0, \beta = \frac{1}{2}\Omega$

(7) $\alpha = \frac{1}{20}, \beta = \frac{1}{2}\ \Omega$

(8) $\alpha = \frac{1}{20}, \beta = 5\Omega$

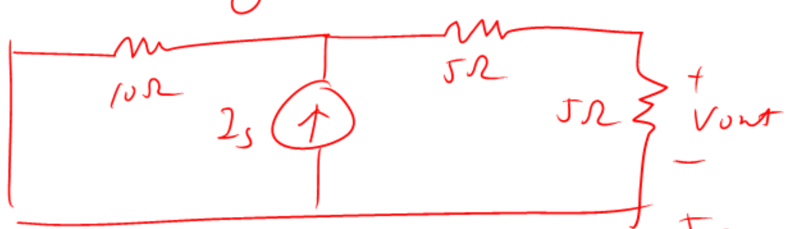
Use superposition:

① Contribution by V_s



$$V_{out} = V_s \cdot \frac{5}{10+5+5} = \frac{1}{4} V_s$$

② Contribution by I_s



$$V_{out} = I_s \times \frac{1}{2} \times 5 = \frac{5}{2} I_s$$

PART B: 1 Work-Out Question

IMPORTANT: Only answers written on your workout sheet will be graded!!!

Clearly show intermediate steps in order to receive partial credits.

Make sure you write your name, division, professor, PUID on the work-out sheet.

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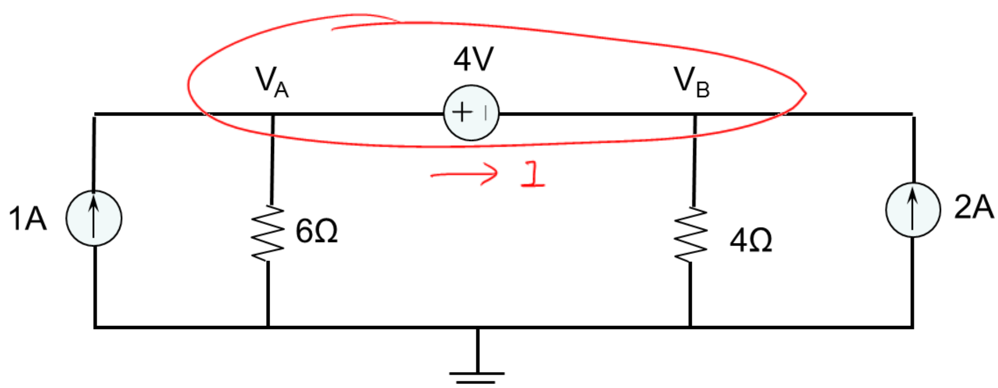
1. Use ***nodal analysis*** to find V_A and V_B in the circuit below.



Use super-node:

$$\begin{cases} (-1) + \dfrac{V_A}{6} + \dfrac{V_B}{4} + (-2) = 0 & ① \\ V_A - V_B = 4 & ② \end{cases}$$

$12 \times ① \Rightarrow \quad 2V_A + 3V_B = 36 \quad ③$

$③ + ② \times 3 \Rightarrow \quad 5V_A = 48$

$$\begin{cases} V_A = 9.6\,V \\ V_B = 5.6\,V \end{cases}$$

Or, use modified nodal analysis:

Node V_A: $\quad (-1) + \dfrac{V_A}{6} + I = 0 \quad ①'$

Node V_B: $\quad (-I) + \dfrac{V_B}{4} + (-2) = 0 \quad ②'$

$$V_A - V_B = 4 \quad ③'$$

$①' + ②' \Rightarrow \quad \dfrac{V_A}{6} + \dfrac{V_B}{4} = 3$

$\Rightarrow \quad 2V_A + 3V_B = 36 \quad ④'$

$③' \times 3 + ④' \Rightarrow \quad 5V_A = 48, \quad V_A = 9.6\,V$

$$V_B = V_A - 4 = 5.6\,V$$