NEW ZEALAND MARITIME SCHOOL

NZ Diploma in Marine Electro-technology (NZ2894)

(STCW 1978 A-III/6, as amended in 2010)

Electro-Technical Officer, Year 2 Cadets, 2020.

Course Code
942.573 – PR01.

Course Title
Marine Electro-technology Science, Electronics and Electrical Machines.
Practical Assessment.

Format
Written/Construction/Programming assignment including diagrams/software and marked Competent (C) or Not-Yet Competent (NYC). Weighting = 50%.

Due Date
To be submitted by email to nick.cossar@manukau.ac.nz for the due date of 23/02/2020.

Tutor
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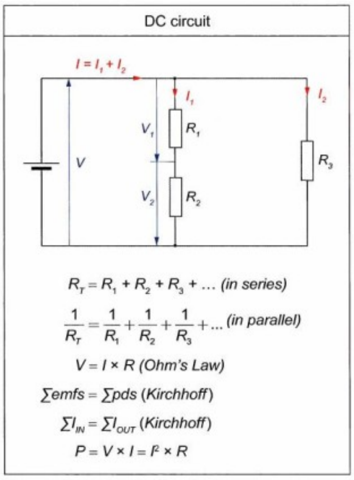
Student ID: 190000929

Date: 03/02/2020

Outcome 1: **Solve the following circuits and confirm your results using Circuitmaker software. Submit drawings and your Circuitmaker files.**

- DC circuit, Page 2, Hall, Practical Marine Knowledge 3rd Edition.



$$i_1 = \frac{110\,V}{(6\,\Omega + 5\,\Omega)} = 10\,A$$

$$i_2 = \frac{110\,V}{5.5\,\Omega} = 20\,A$$

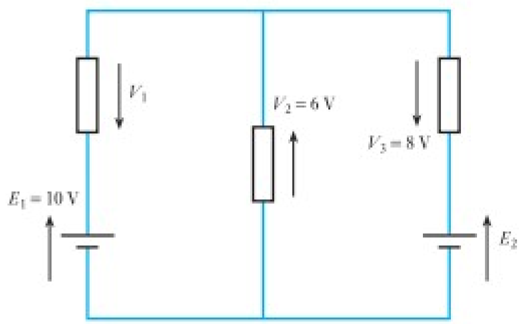
$$I_{total} = i_1 + i_2 = 10\,A + 20\,A = 30\,A$$

$$P = V \times I = 110\,V \times 30\,A = 3300\,W$$

$$v_{r_1} = i \times R = 10\,A \times 6\,\Omega = 60\,V$$

- DC Circuit, Example 3.15, Figure 3.36, Page 49, Hughes Electrical and Electronic Technology 10th Edition.

Figure 3.36 shows a network with two sources of e.m.f. Calculate the voltage V_1 and the e.m.f. E_2.



(Left Loop)

$$E_1 = V_1 + V_2 = 10\,A$$

$$V_1 = E_1 - V_2 = 10 - 6 = 4\,V$$

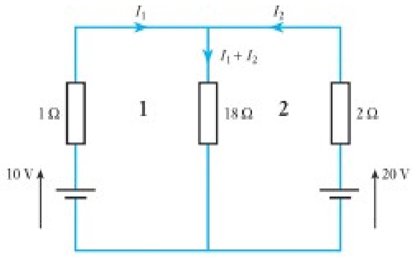
(Right Loop)

$$E_2 = V_2 + V_3 = 6\,V + 8\,V = 14\,V$$

**Note: R_3 is 4x larger than R_2 and R_1, which are the same value. In this file, they are 1k, 1k and 4k respectively.*

- DC Circuit, Example 4.7, Figure 4.10, Page 68, Hughes Electrical and Electronic Technology 10th Edition.

Calculate the currents in the network shown in Fig. 4.10.



$$20 = 18 I_1 + 20 I_2$$
$$10 = 19 I_1 + 18 I_2$$

$$-(18 I_1) - 20 I_2 = -20$$
$$-(19 I_1) - 18 I_2 = -10$$

$$\frac{-56 I_2}{19} = \frac{-200}{19}$$

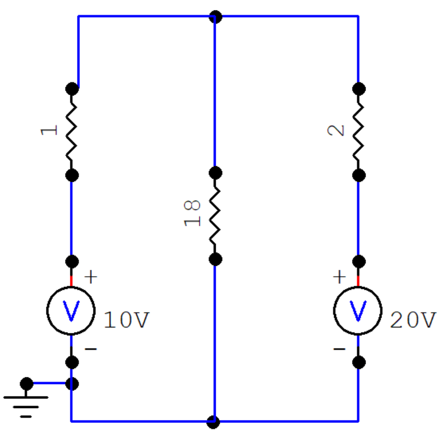
$$7 I_2 = 25$$

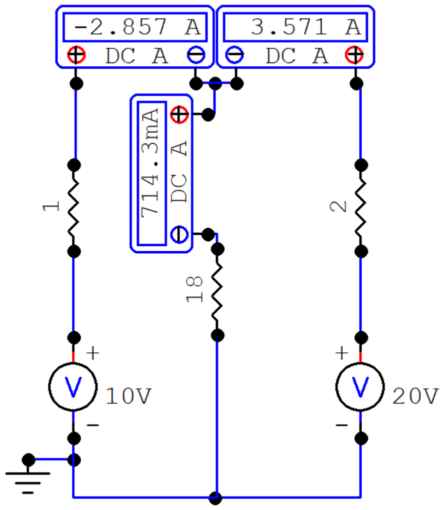
$$I_2 = \frac{25}{7}$$

$$19 I_1 = \frac{-380}{7}$$

$$I_1 = \frac{-20}{7}$$

$$I_1 = -2.8571\, A$$
$$I_2 = 3.571\, A$$





- DC Circuit, Example 4.9, Figure 4.12, Page 69, Hughes Electrical and Electronic Technology 10th Edition.

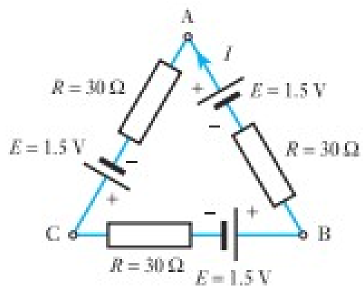


Fig. 4.12 Circuit diagram for Example 4.9

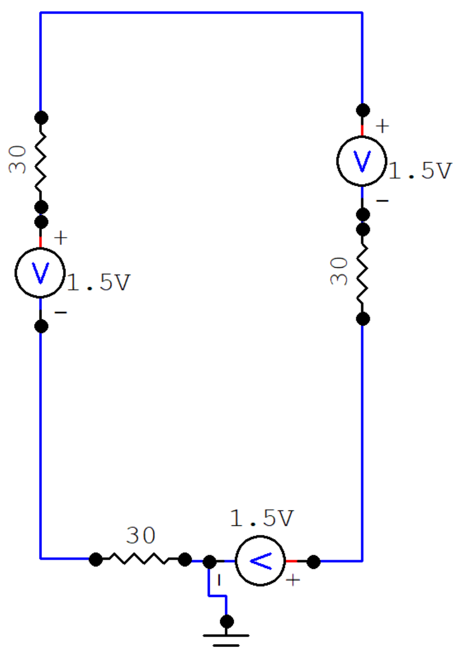
$$total\ e.m.f. = 3 \times 1.5V = 4.5V$$

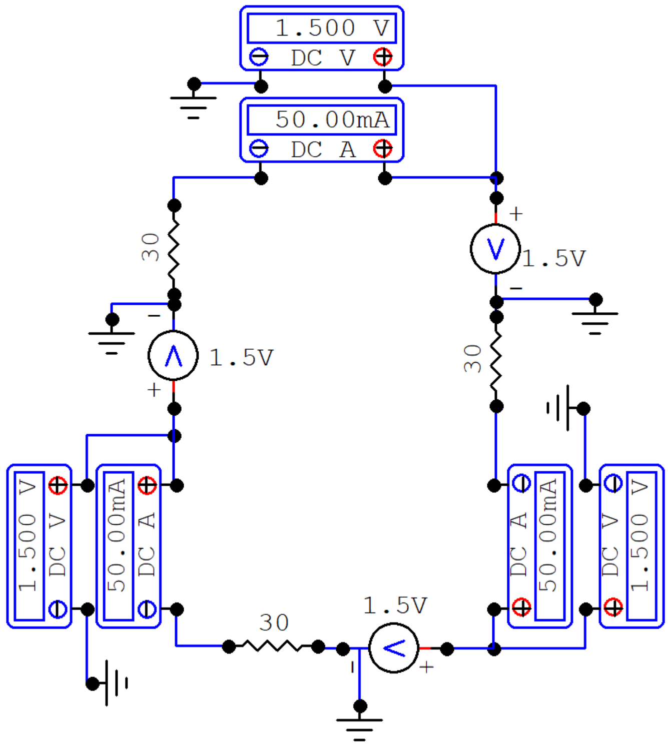
$$total\ resistance = 30 + 30 + 30 = 90\,\Omega$$

$$total\ current = \frac{4.5V}{90\,\Omega} = 0.05\,A$$

$$\Delta V = 0.05 \times 30 = 1.5V$$

(i.e. no differential between points… you just connected three batteries in series)





- AC Circuit Single Phase, Example 10.1, Figure 10.13, Page 231, Hughes Electrical and Electronic Technology 10th Edition.

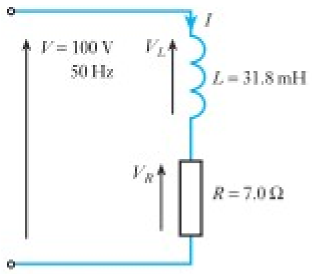


Fig. 10.13 Circuit diagram for Example 10.1

$$X_L = 2\pi f L = 2\pi\, 50 \times 0.0318\, H = 10\,\Omega\ \textit{Resistive Equivalent}$$

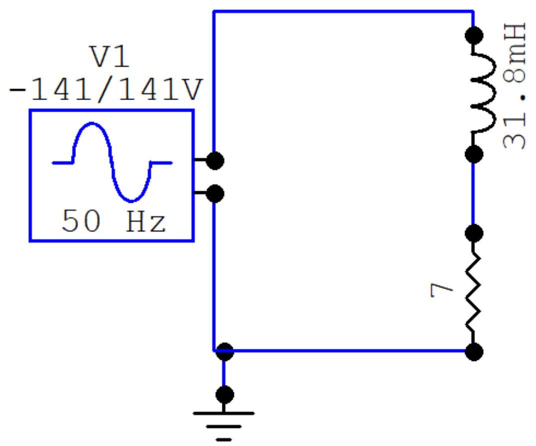
$$a^2 + b^2 = c^2$$

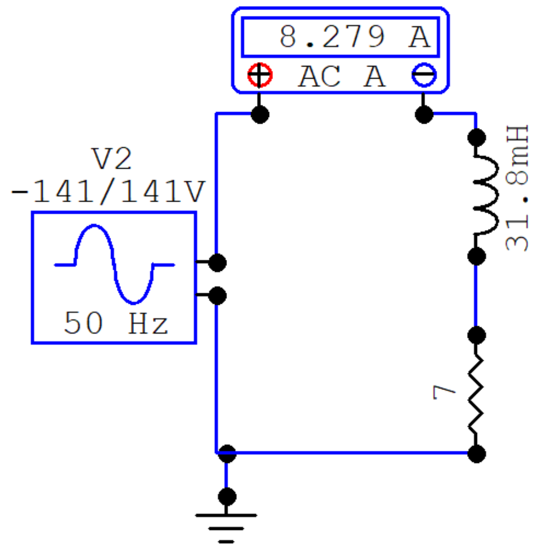
$$Z = \sqrt{\left(7^2 + 10^2\right)} \approx 12.21\,\Omega$$

$$I = \frac{100\,V}{12.21} \approx 8.2\,A$$

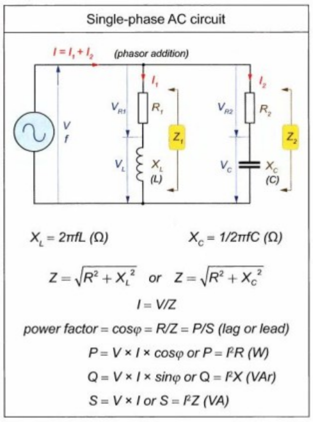
$$p.f.(\cos\phi) = \tan^{-1}\left(\frac{10}{7}\right) \approx 55°$$

$$¿\ \textit{purely inductive loads, this affects the curren} t' \textit{s angle} \therefore \textit{the current lags the voltage.}$$





- AC Circuit Single Phase, Page 3, Hall, Practical Marine Knowledge 3rd Edition.



$$X_L = 2\pi f L = 2\pi \times 60 \times 0.1 \approx 37.7\,\Omega$$

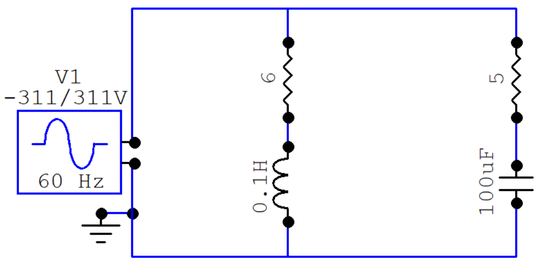
$$X_C = \frac{1}{2\pi f C} = \frac{1}{2\pi \times 60 \times (100 \times 10^{-6})} \approx 26.5\,\Omega$$

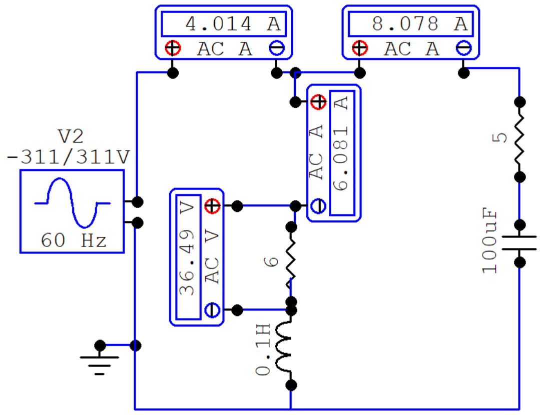
$$Z_{C+R} = \sqrt{26.5^2 + 5^2} \approx 27\,\Omega$$
$$Z_{L+R} = \sqrt{37.7^2 + 6^2} \approx 38.2\,\Omega$$

$$I_C = \frac{220}{27} = 8.14\,A\,\phi - 79.3\,°$$

$$I_L = \frac{220}{38.2} = 5.76\,A\,\phi\,81.1\,°$$

$$I_{total} = 3.331\,A\,\phi - 43.849\,°$$





Outcome 2: **Direct Online Motor Starter. Submit working drawings, photos of your work and Zelio files.**

- Build one Direct-Online starter for a three phase motor incorporating two remote start/stop stations and an emergency stop pushbutton. Test the circuit for operation and then modify it to incorporate one Schneider Electric Zelio relay controller. You will need to write a program, download it to the Zelio relay, and test the operation.

Resources

- CANVAS.
- Hall – Practical Marine Electrical Knowledge.
- Hughes – Electrical and Electronic Technology.
- Lloyds of London Rules and Regulations for the Classification of Ships July 2018.