

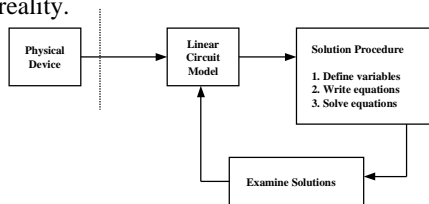
Basic Quantities

Lecture 6

1

Models and Reality

- Linear circuit theory is used to model reality.



Lecture 6

2

Summary of Basic Quantities

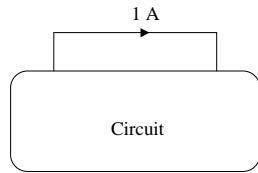
- Basic quantities are **voltage**, **current**, and **power**.
- The **sign convention** is important in computing power supplied by or dissipated by a circuit element.
- Circuit elements** can be active or passive; active elements are called sources.

Lecture 6

3

Current

- Current is moving electrical charge.
- Measured in Amperes (A) = 1 Coulomb/s



Lecture 6

4

More Current

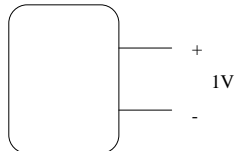
- Current is represented by I or i
- Constant current is called DC
- Sinusoidally varying current is called AC

Lecture 6

5

Voltage

- Electromotive force or potential- V or v
- 1 J of energy is needed to move 1 C of charge through a 1 V potential difference.



Lecture 6

6

What does it mean if you have a negative current?

What does it mean if you have a negative voltage?

Lecture 6

7

Power

- $P = IV$ or $p = i v$ (check the units here)
- The sign convention:
 - Positive power is produced by positive current flowing from high to low voltage.
 - Negative power is produced by positive current flowing from low to high voltage.

Lecture 6

8

Positive Power

+ 8 V -



7A

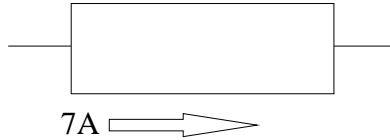
This circuit element is **dissipating** power:

- Resistor (light bulb, heating element)-converts electrical energy to heat energy.
- Motor-converts electrical energy to motion.

9

Negative Power

- 8 V +



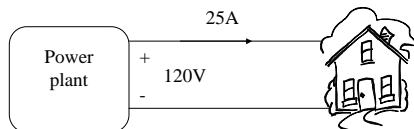
This circuit element is **supplying** power:

- Battery-converts chemical energy to electrical.
- Generator-converts mechanical energy to electrical.

Lecture 6

10

Example



- Which circuit element is supplying power?
- Which is dissipating power?
- How much is supplied/dissipated?

Lecture 6

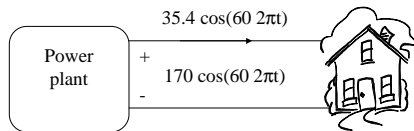
11

What is inaccurate about this example?

Lecture 6

12

Example



- How much power is supplied/dissipated?

Lecture 6

13

Let's Use MATLAB!

Start MATLAB

```
t=0:0.0005:0.1;  
v=170*cos(2*pi*60*t);  
plot(t,v)  
i=35.4*cos(2*pi*60*t);  
plot(t,i)
```

Lecture 6

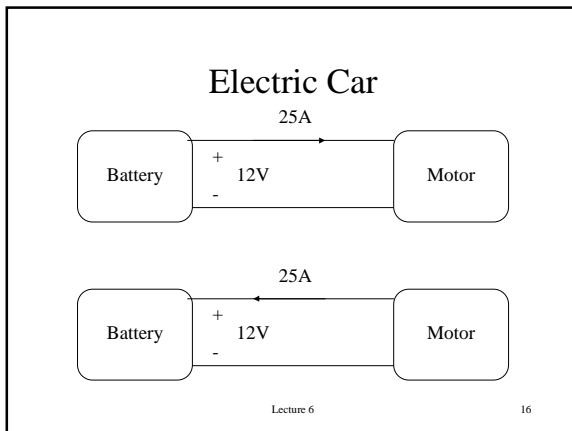
14

More MATLAB

```
p=v.*i;  
plot(t,p)  
sum(p)/201
```

Lecture 6

15



Electric Car

Which circuit represents accelerating?
Which circuit represents braking?

Lecture 6 17

Active vs. Passive Elements

- Active elements can generate energy.
- Passive elements cannot generate energy.

Lecture 6 18

Independent vs. Dependent Sources

An independent source (voltage or current) may be DC (constant) or time-varying, but does not depend on other voltages or currents in the circuit.

A dependent source's value depends on another voltage or current in the circuit.

Lecture 6

19

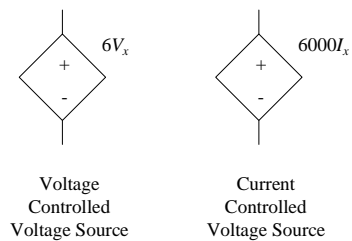
Independent and Dependent Sources

Any examples?

Lecture 6

20

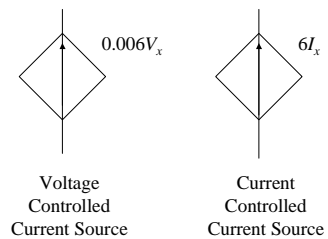
Types of Dependent Sources



Lecture 6

21

Types of Dependent Sources



Lecture 6

22

What are the units for each of the dependent source constants?

Lecture 6

23
