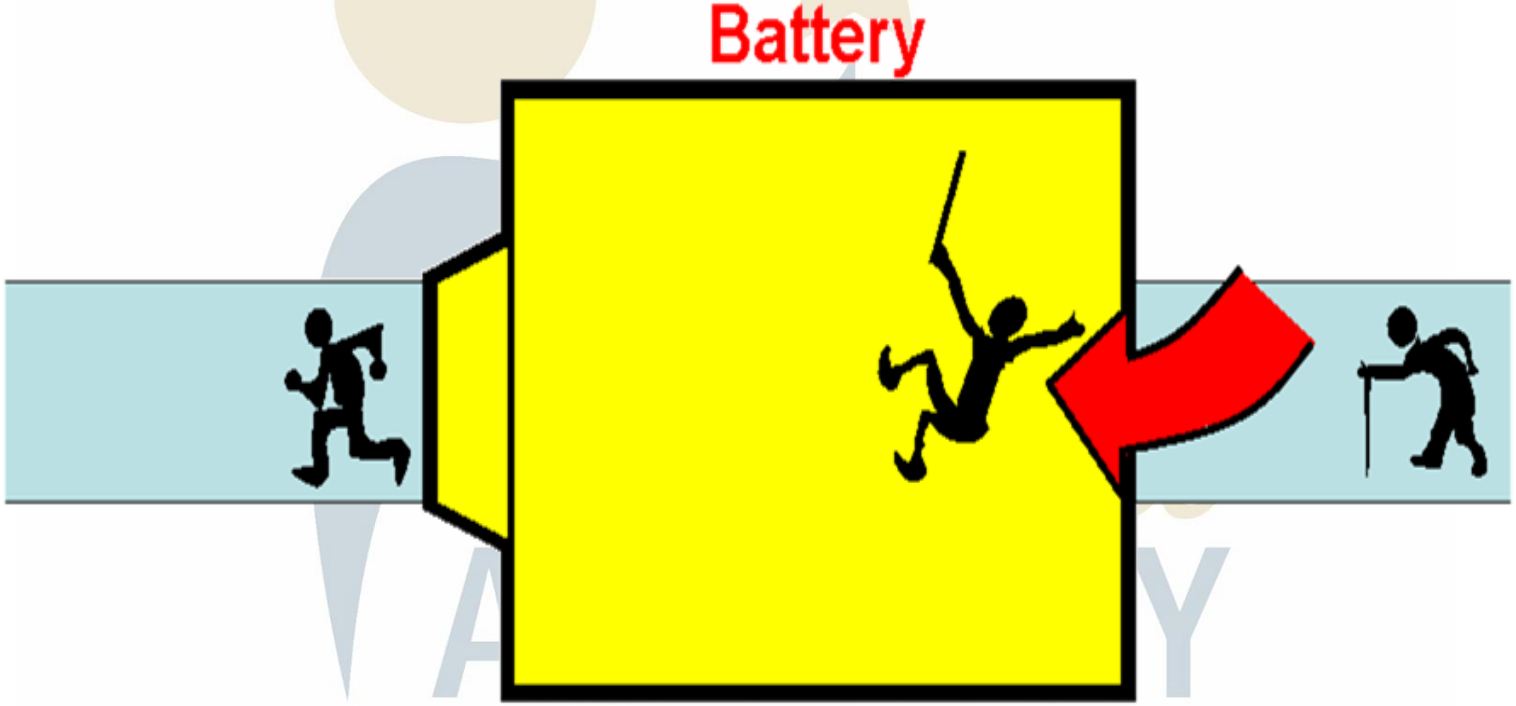
Physics – Grade 10

Unit One – Electricity

Chapter 2 – Potential Difference



Prepared & Presented by: Mr. Mohamad Seif

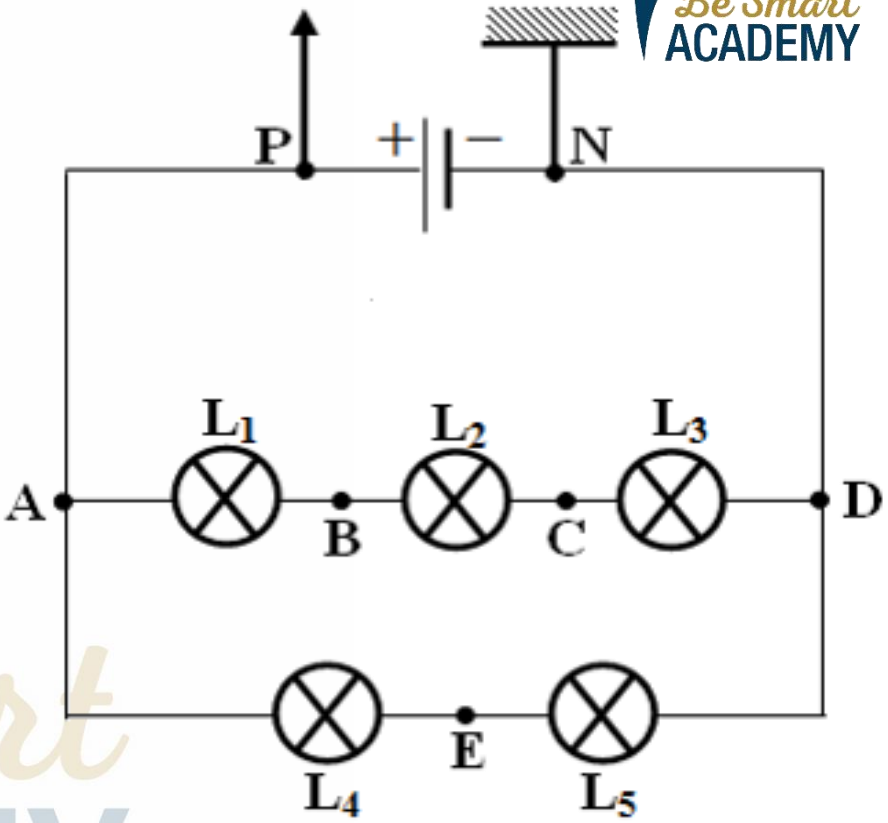
Think then Solve

Exercise 1

Five identical lamps connected to a battery delivering a constant voltage $V_{PN} = 12V$.

An oscilloscope is connected across the terminals of the battery as shown.

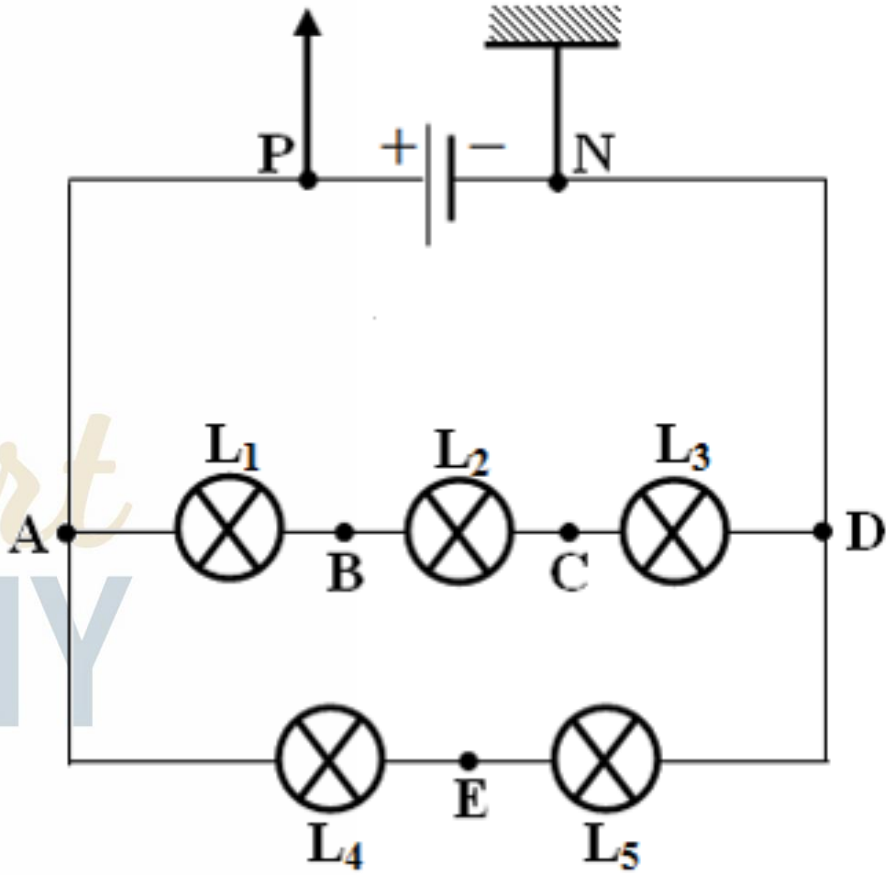
We observe on the screen a luminous line displaced by 4 divisions.



1. Indicate with justification whether this line is displaced upward or downward.
2. What would we observe if the sweeping is off?

Exercise 1

3. Determine the vertical sensitivity adjusted.
4. Calculate the potential difference across each lamp.

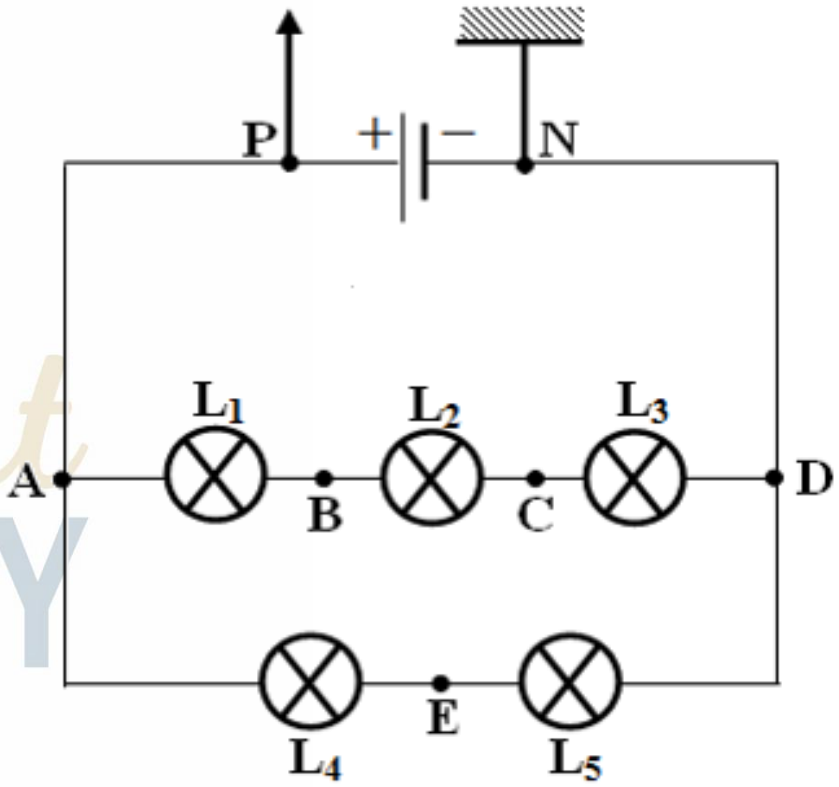


Exercise 1

five identical lamps; $V_{PN} = 12V$; $y = 4div$

1. **Indicate with justification whether this line is displaced upward or downward.**

The luminous line moves upward, because the phase is connected to (+) of the battery and the com is connected to (-) of the battery.

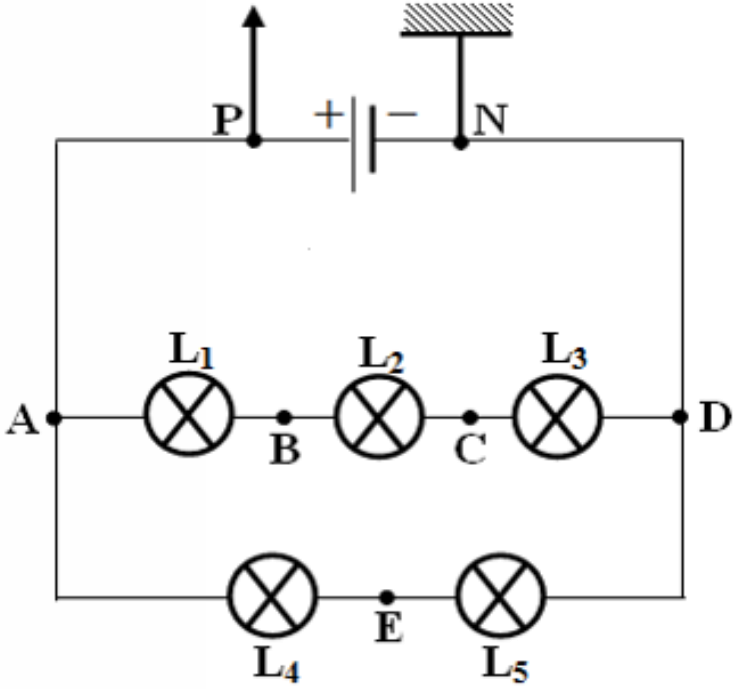


Exercise 1

five identical lamps; $V_{PN} = 12V$; $y = 4div$

2. What would we observe if the sweeping is off?

When we turn off the sweeping, we observe a luminous spot instead of luminous line at the same position.



3. Determine the vertical sensitivity adjusted.

$$V_{PN} = S_V \times y \qquad S_V = \frac{V_{PN}}{y} = \frac{12}{4}$$

$$S_V = 3V/div$$

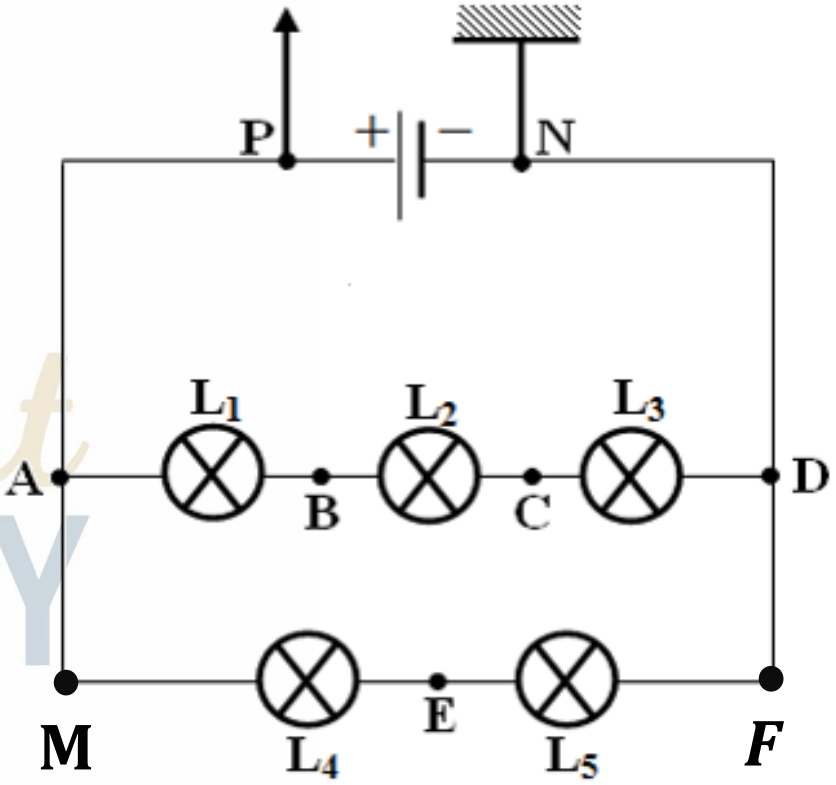
Exercise 1

five identical lamps; $V_{PN} = 12V$; $y = 4div$

4. Calculate the potential difference across each lamp.

$$V_{PN} = V_{AD} = V_{MF} = 12V$$

(law of uniqueness of voltage in parallel)



$$V_{AD} = V_{AB} + V_{BC} + V_{CD}$$

But the lamps are identical & in series then:

$$V_{AB} = V_{BC} = V_{CD}$$

Exercise 1

$$V_{AD} = V_{AB} + V_{BC} + V_{CD}$$

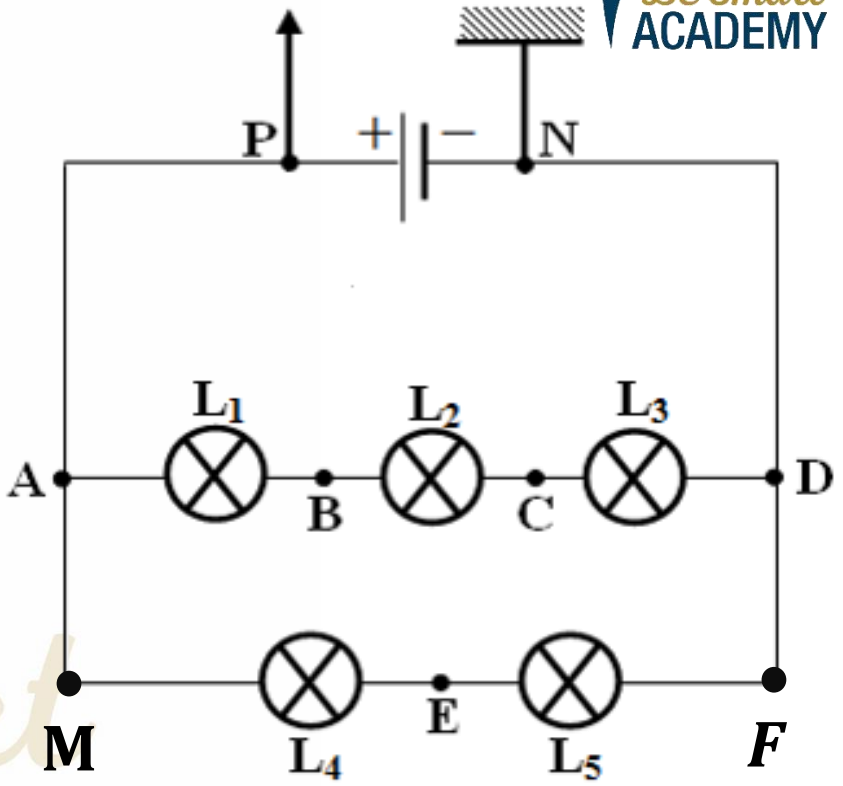
But the lamps are identical then:

$$V_{AB} = V_{BC} = V_{CD}$$

$$V_{AD} = V_{AB} + V_{AB} + V_{AB}$$

$$V_{AD} = 3V_{AB}$$

$$V_{AB} = \frac{V_{AD}}{3} = \frac{12}{3}$$



$$V_{AB} = V_{BC} = V_{CD} = 4V$$

Exercise 1

$$V_{MF} = V_{ME} + V_{EF}$$

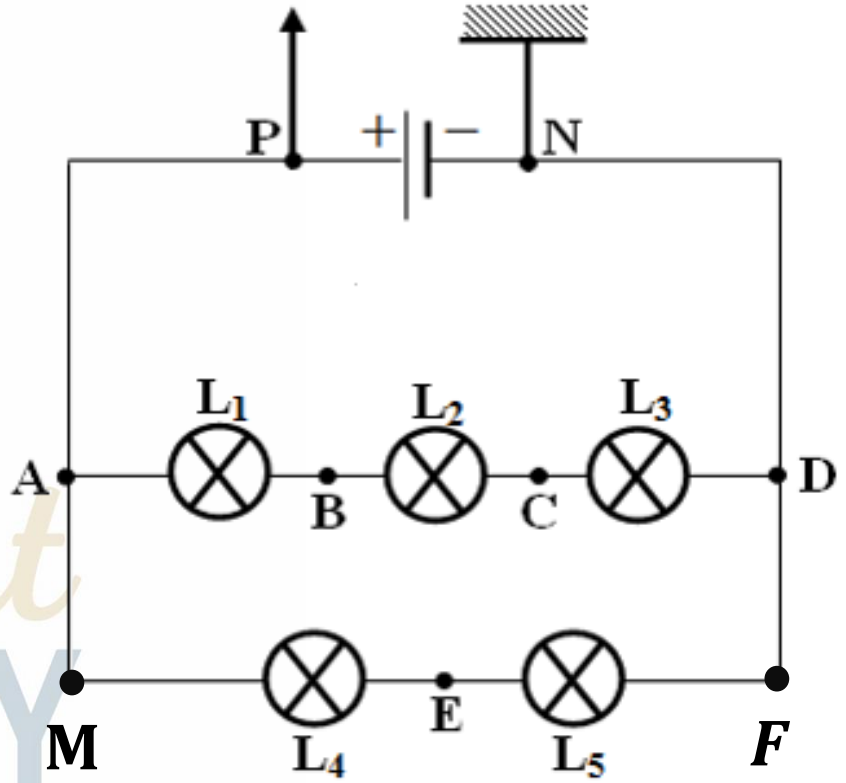
But since L_4 and L_5 are identical then:

$$V_{ME} = V_{EF}$$

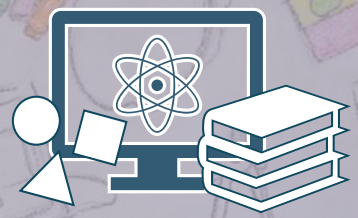
$$V_{MF} = V_{ME} + V_{ME}$$

$$V_{MF} = 2V_{ME} \qquad V_{ME} = \frac{V_{MF}}{2} = \frac{12}{2}$$

$$V_{ME} = V_{EF} = 6V$$



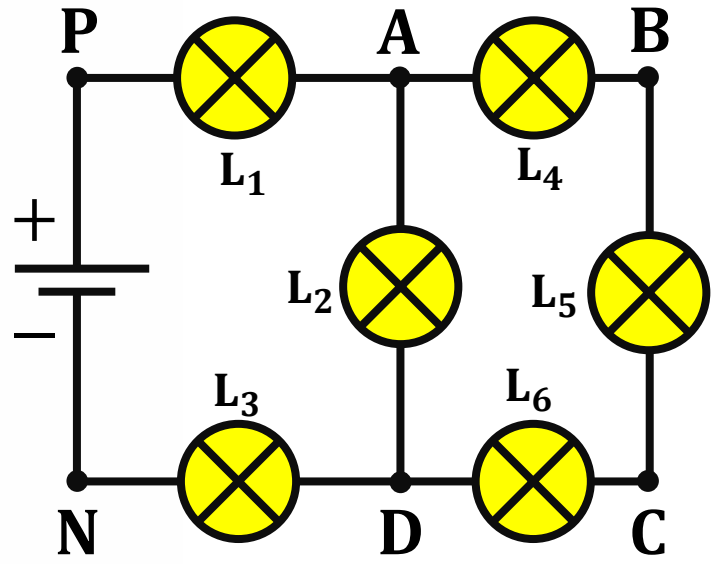
The End



Think then Solve

Exercise 2

Six lamps are connected to across a battery delivers a constant voltage $V_{PN} = 24V$ as shown in the adjacent figure.



Given: $V_{PA} = 8V$; $V_{ND} = -4V$; and $V_{AC} = 6V$.

1. Calculate the electric potential differences: V_{AD} and V_{CD}.
2. C is taken as a reference potential. Determine the electric potentials V_C; V_A and V_P.

Exercise 2

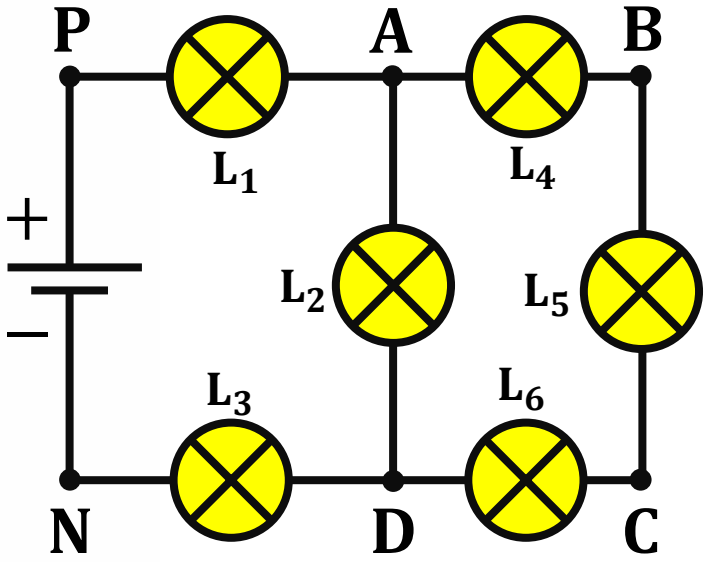
$V_{PN} = 24V$; $V_{PA} = 8V$; $V_{ND} = -4V$; and $V_{AC} = 6V$.

1.Calculate the electric potential differences: V_{AD} and V_{CD}.

$$V_{PN} = V_{PA} + V_{AD} + V_{DN}$$

$$24V = 8V + V_{AD} + 4V$$

$$24V - 12V = V_{AD} \Rightarrow V_{AD} = 12V$$



$$V_{PN} = V_{PA} + V_{AC} + V_{CD} + V_{DN}$$

$$24V = 8V + 6V + V_{CD} + 4V$$

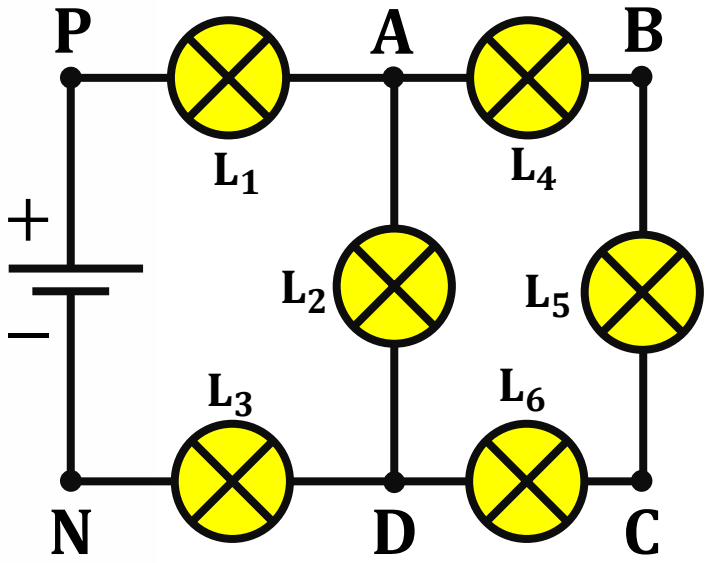
$$24 = 18V + V_{CD}$$

$$V_{CD} = 6V$$

Exercise 2

$V_{PN} = 24V$; $V_{PA} = 8V$; $V_{ND} = -4V$; and $V_{AC} = 6V$.

2. C is taken as a reference potential. Determine the electric potentials V_A and V_P.



C is reference potential, then: $V_C = 0V$

$$V_{AC} = V_A - V_C$$

$$6V = V_A - 0 \Rightarrow V_A = 6V$$

$$V_{PA} = V_P - V_A$$

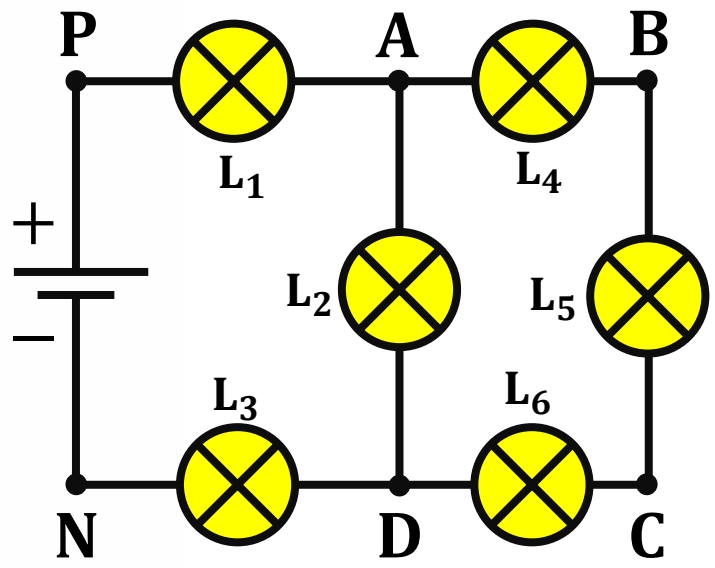
$$8V = V_P - 6V \Rightarrow V_P = 8V + 6V \Rightarrow V_P = 14V$$

Exercise 2

3. An oscilloscope is connected across the two terminals B and C. We observe on the screen a luminous line displaced upward by 3 div. Given: $S_V = 1V/div$.

a) Show on the figure the connection of the oscilloscope.

b) Calculate V_{BC} then deduce V_{AB}.

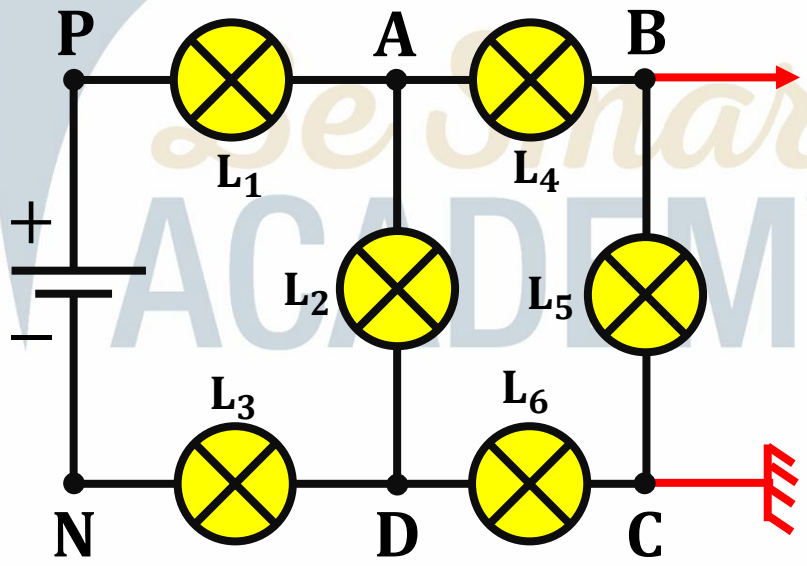


Exercise 2

3. An oscilloscope is connected across the two terminals B and C.

We observe on the screen a luminous line displaced upward by 3 div. Given: $S_V = 1V/div$.

a)Show on the figure the connection of the oscilloscope.



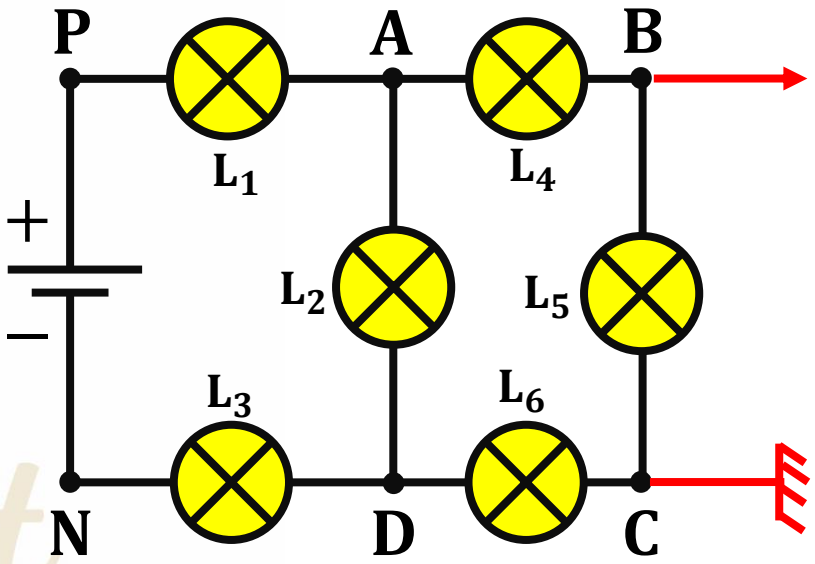
Exercise 2

$y = 3\ div;\ S_V = 1V/div.$

b) Calculate V_{BC} then deduce V_{AB}

$$V_{BC} = S_V \times y \qquad V_{BC} = 1v/div \times 3v$$

$$V_{BC} = 3V$$

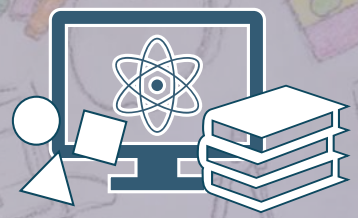


$$V_{PN} = V_{PA} + V_{AB} + V_{BC} + V_{CD} + V_{DN}$$

$$24V = 8V + V_{AB} + 3V + 6V + 4V$$

$$24V = 21 + V_{AB} \Rightarrow V_{AB} = 3V$$

The End



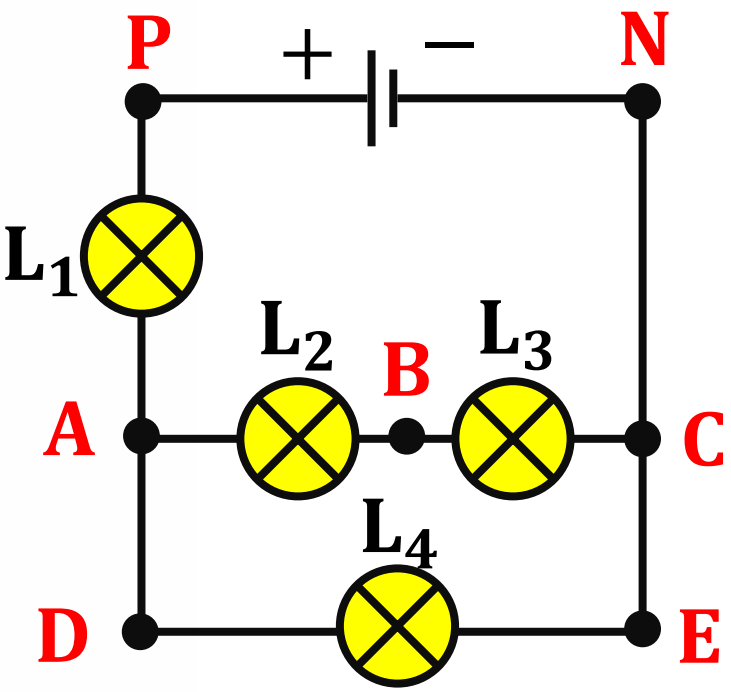
Exercise 3

During a lab session, a group of students wanted to measure the voltage of some electrical components.
For this aim, they used a voltmeter and an oscilloscope.
The electric circuit is represented in the adjacent circuit.

1. A voltmeter is connected across the terminals of the dry cell; it reads 9V.

a) Redraw the circuit showing the connection of the voltmeter.

b) The voltmeter has the ranges [250V, 50V, 20V, 10V; 5V]. Specify the convenient scale.

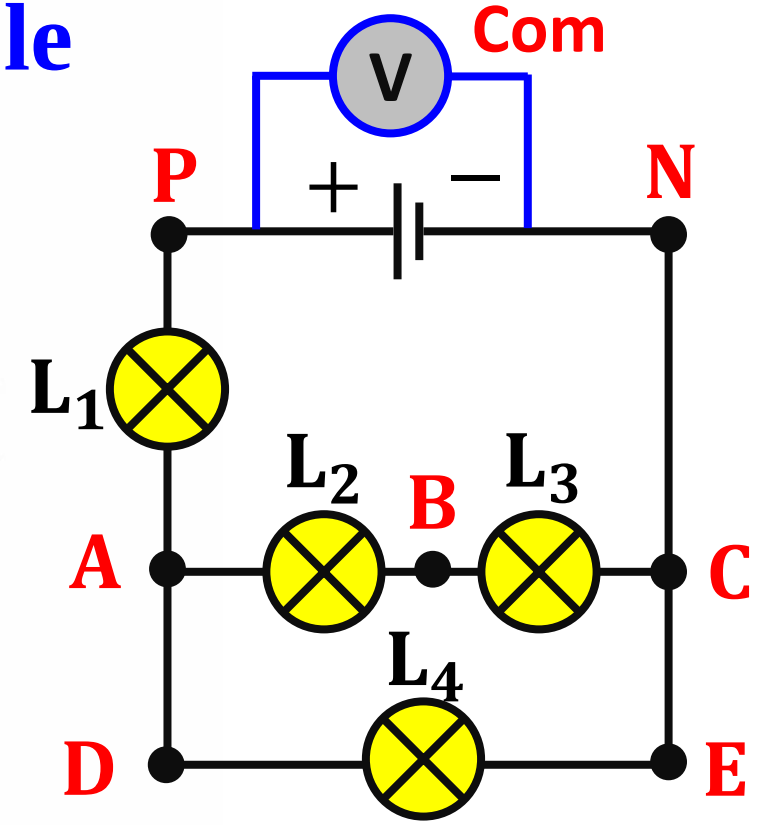


Exercise 3

1. A voltmeter is connected across the terminals of the dry cell; it reads 9V.

a) Redraw the circuit showing the connection of the voltmeter.

The Com must be connected to negative pole of the battery



b) The voltmeter has the ranges [250V, 50V, 20V, 10V; 5V]. Specify the convenient scale.

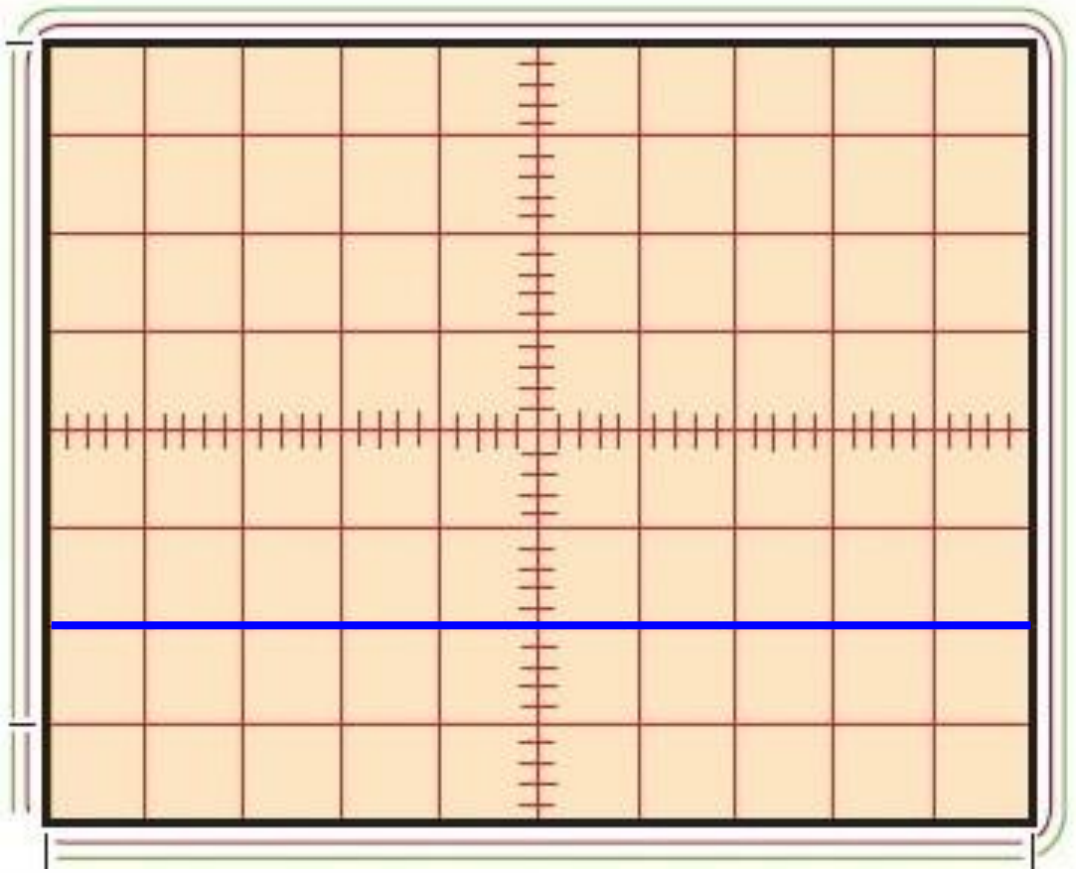
The convenient scale should be slightly greater than the measured voltage.

The chosen scale is 10V

Exercise 3

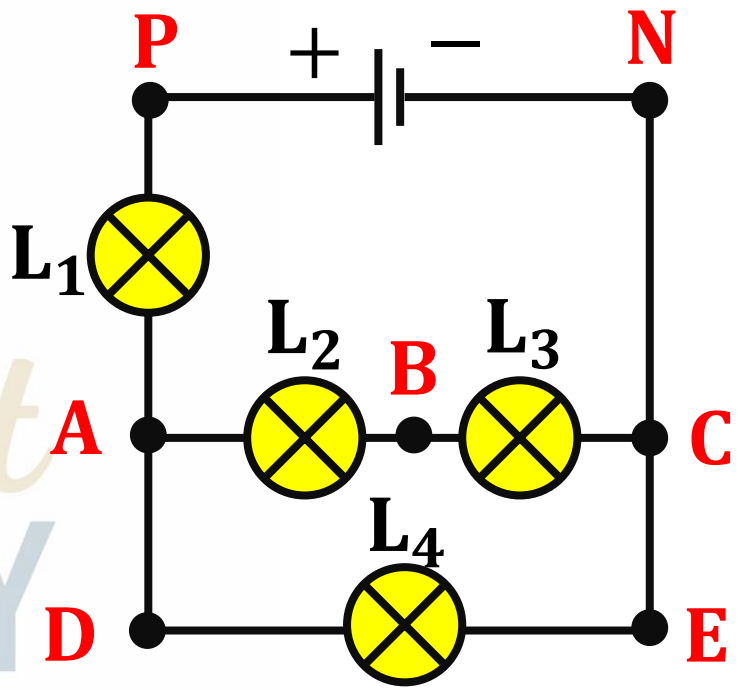
A student connects the oscilloscope to measure the voltage U_{ED}. The following oscillogram is obtained. Given: $S_V = 1v/div$

1. **Calculate the voltage U_{ED}.**
2. **A student regulates the vertical sensitivity such that the straight line displaces down one more division. Calculate the new vertical sensitivity.**



Exercise 3

3. Calculate the voltage U_{PA} across the lamp L_1.
4. Knowing that the lamps L_2 and L_3 are identical, determine U_{AB} and U_{BC}



Exercise 3

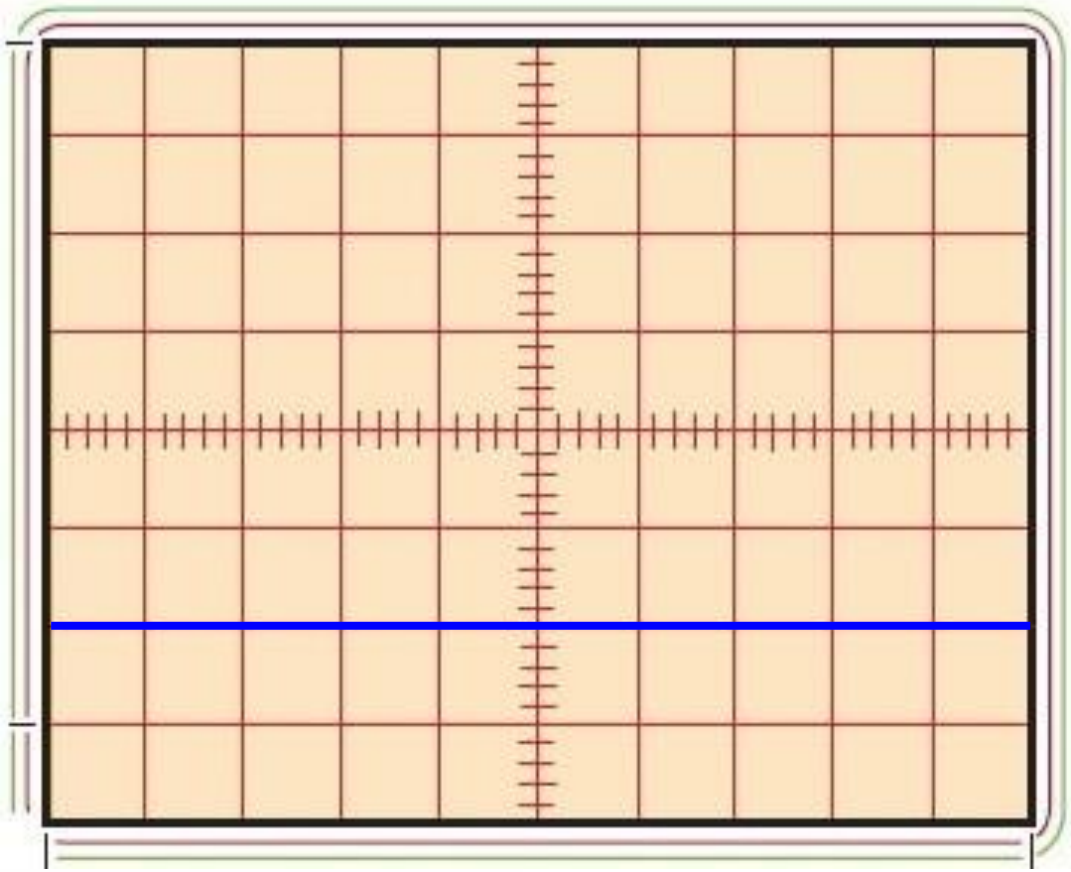
Given: $S_V = 1v/div$

1.Calculate the voltage U_{ED}.

$$U_{ED} = S_V \times y$$

$$U_{ED} = 1v/div \times (-2div)$$

$$U_{ED} = -2v$$



Exercise 3

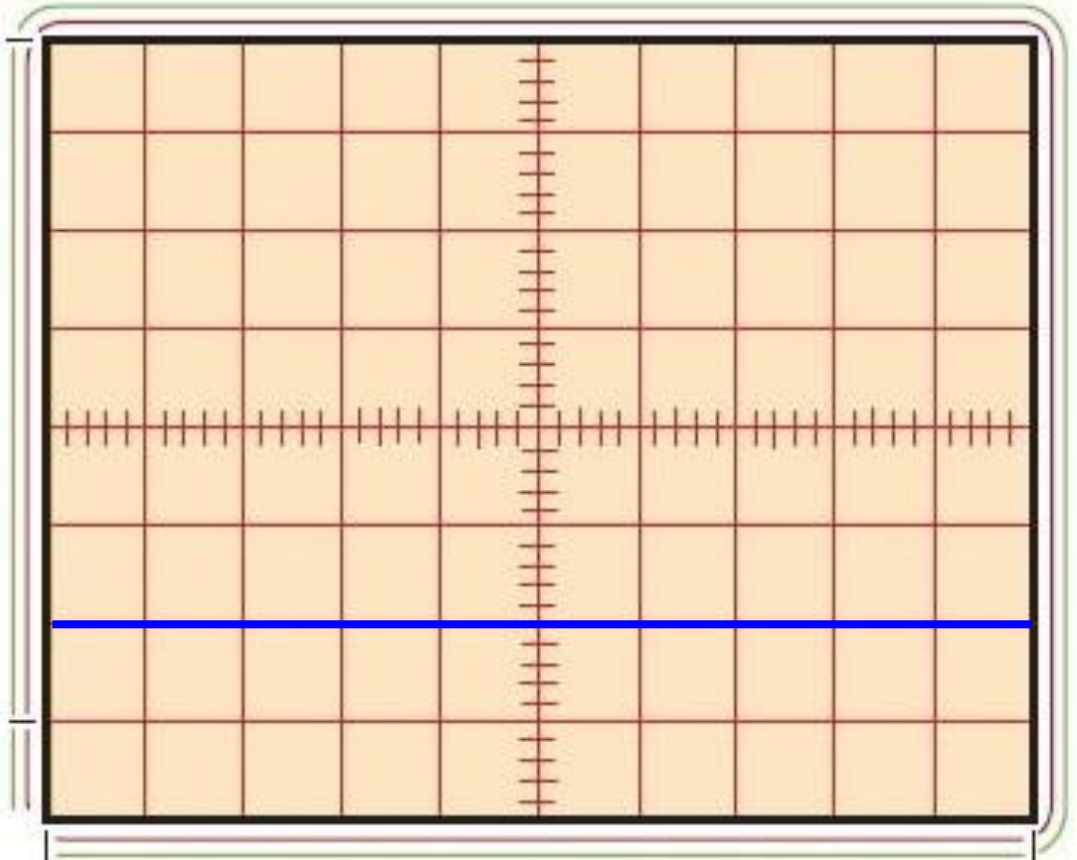
2. A student regulates the vertical sensitivity such that the straight line displaces down one more division. Calculate the new vertical sensitivity.

$$U_{ED} = S'_V \times y$$

$$-2V = S'_V \times (-3)$$

$$S'_V = \frac{-2V}{-3}$$

$$S'_V = 0.67V$$



Exercise 3

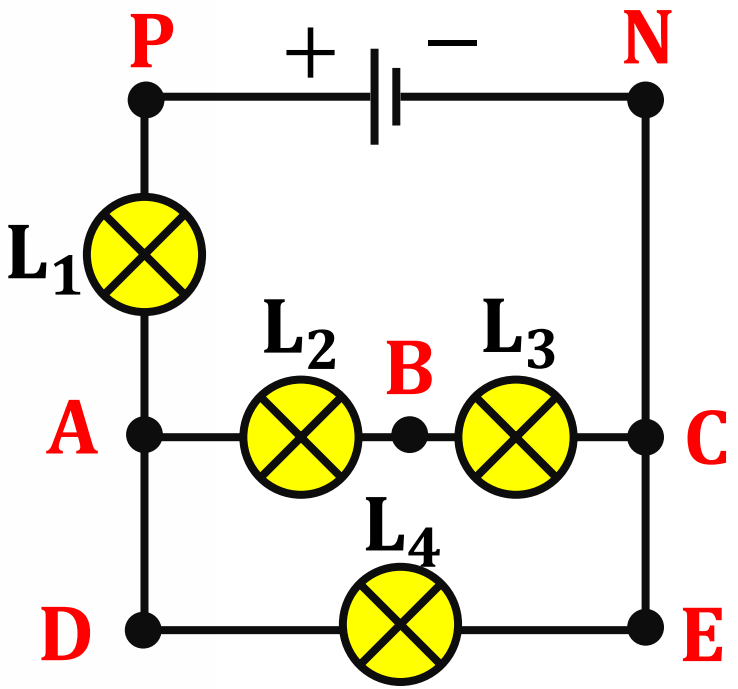
3. Calculate the voltage U_{PA} across the lamp L_1.

$$V_{PN} = V_{PA} + V_{AD} + V_{DE} + V_{EC} + V_{CN}$$

$$9V = V_{PA} + 0 + 2V + 0 + 0$$

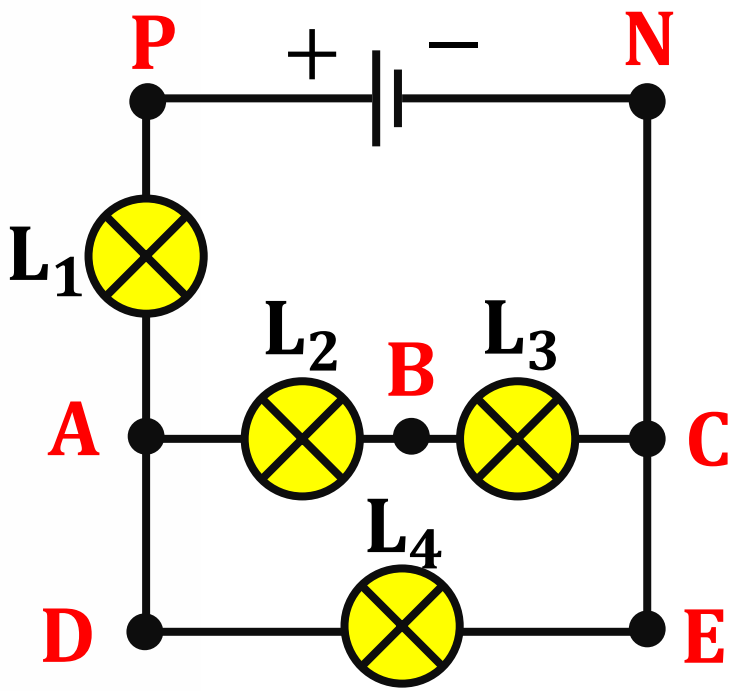
$$9V - 2V = V_{PA}$$

$$V_{PA} = 7V$$



Exercise 3

4. Knowing that the lamps L_2 and L_3 are identical, determine U_{AB} and U_{BC}



$$V_{PN} = V_{PA} + V_{AB} + V_{BC} + V_{CN}$$

But L_2 and L_3 are identical: $V_{AB} = V_{BC}$

$$V_{PN} = V_{PA} + V_{AB} + V_{AB} + V_{CN}$$

$$9V = 7V + 2V_{AB} + 0$$

$$2V = 2V_{AB} \Rightarrow V_{AB} = \frac{2}{2} = 1V \Rightarrow V_{AB} = V_{BC} = 1V$$

The End