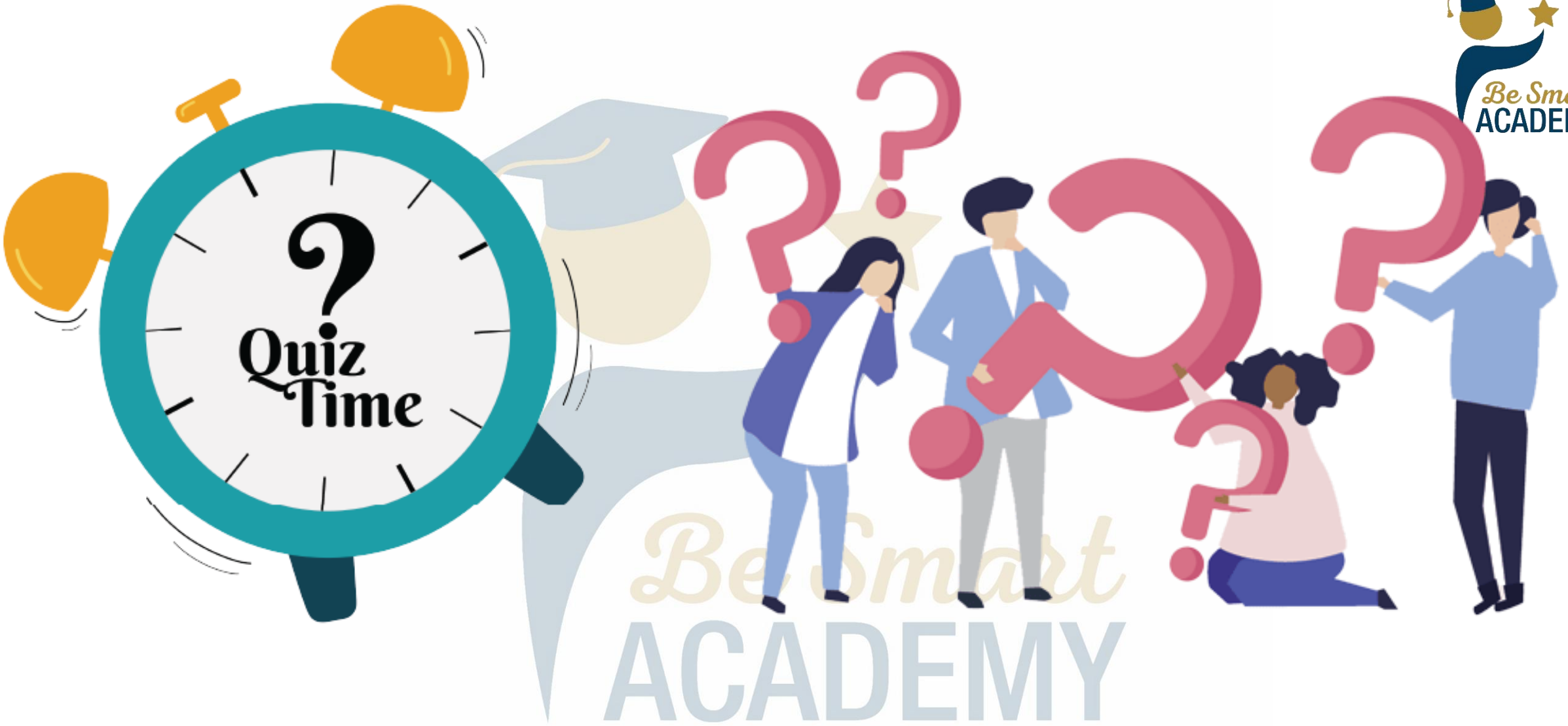
Physics – Grade 10

Unit One – Electricity

Chapter 5
Generator and Receiver

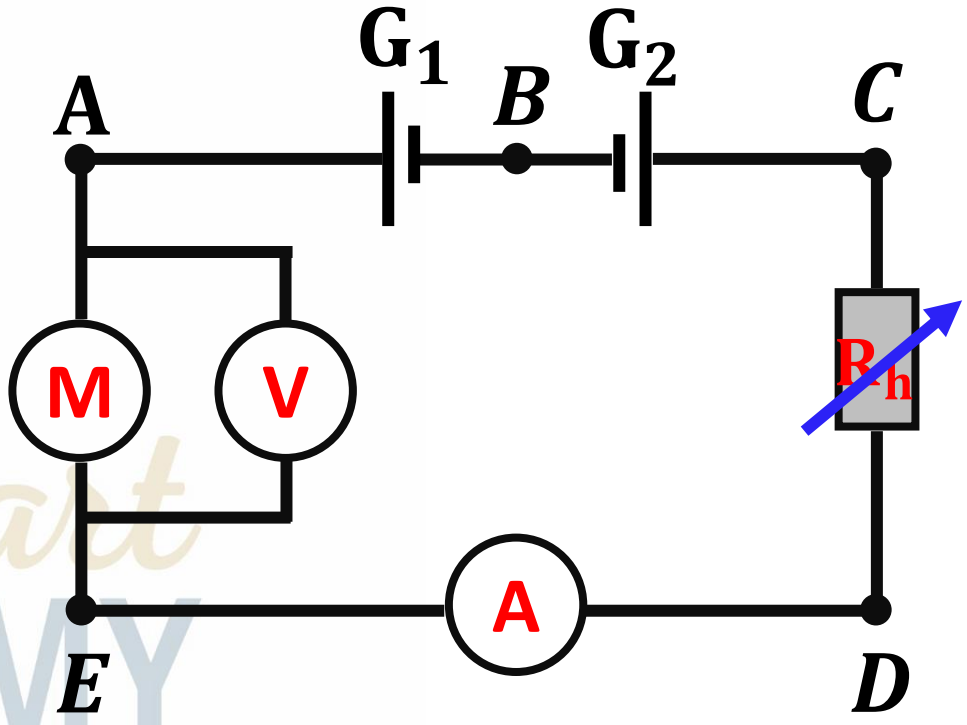
Prepared & Presented by: Mr. Mohamad Seif



Quiz 1 physics Duration: 20 min

Given $G_1(48V;\ 2\Omega)$, $G_2(12V;\ 1\Omega)$, a motor M $(E';\ r')$; and a rheostat R_h, an ammeter and a voltmeter and connected as shown.

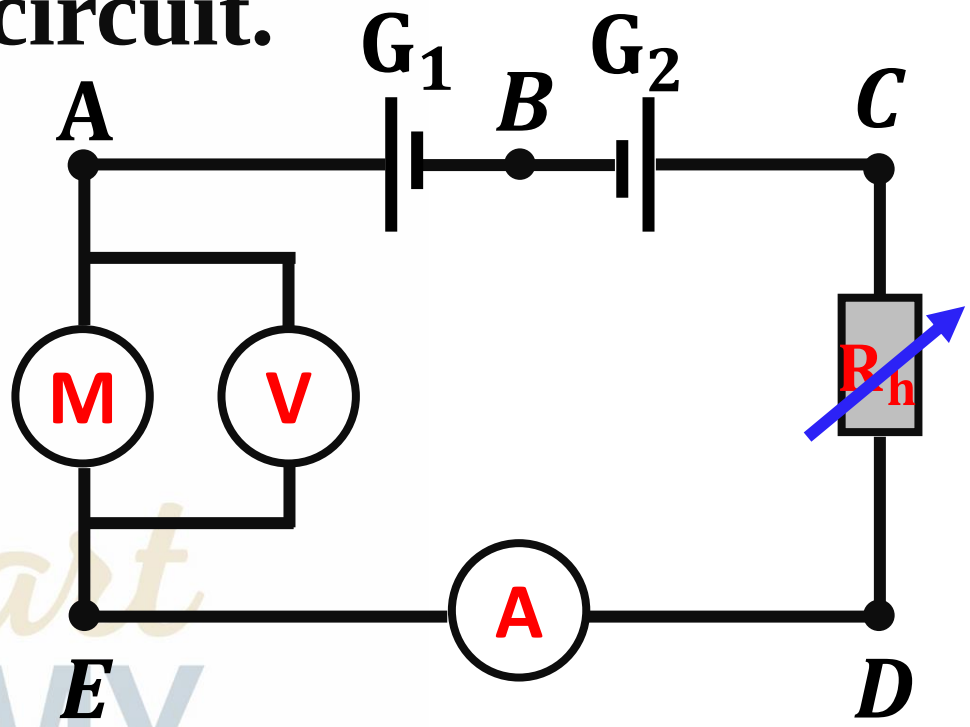
1. Specify the role of G_1 and G_2 in the circuit.
2. For $R_h = 4\Omega$, the ammeter indicates 3 A. Determine the voltages across G_1, G_2 and R_h.
3. Deduce the voltage U_M across the motor.
4. Find a relation between E' and r'.



Quiz 1 physics Duration: 20 min

$G_1(48V; 2\Omega)$; $G_2(12V; 1\Omega)$; M $(E'; r')$; and R_h.

1.Specify the role of G_1 and G_2 in the circuit.



The negative pole of G_1 is connected to negative pole of G_2 (connected in opposition):

G_1 acts as a generator and G_2 acts as receiver.

Quiz 1 physics Duration: 20 min

$G_1(48V; 2\Omega)$; $G_2(12V; 1\Omega)$; M $(E'; r')$; and R_h.

For $R_h = 4\Omega$, the ammeter indicates 3 A.

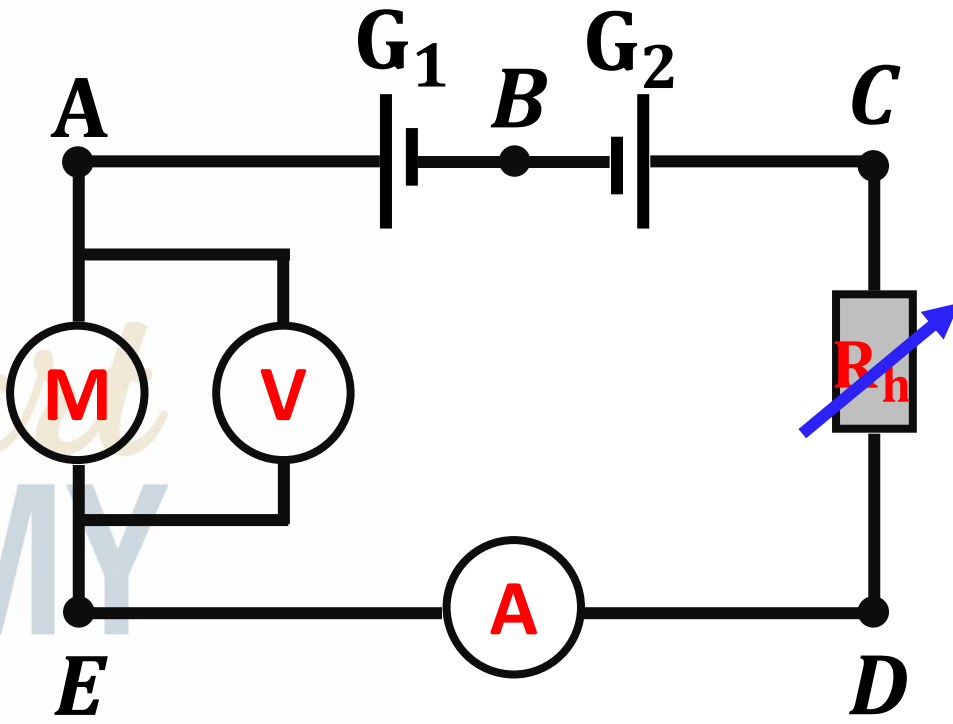
2.Determine the voltages across G_1, G_2 and R_h.

$$U_{G1} = -rI + E$$

$$U_{G1} = -2 \times 3 + 48 \Rightarrow U_{G1} = 42V$$

$$U_{G2} = r'I + E'$$

$$U_{G1} = 1 \times 3 + 12 \Rightarrow U_{G2} = 15V$$

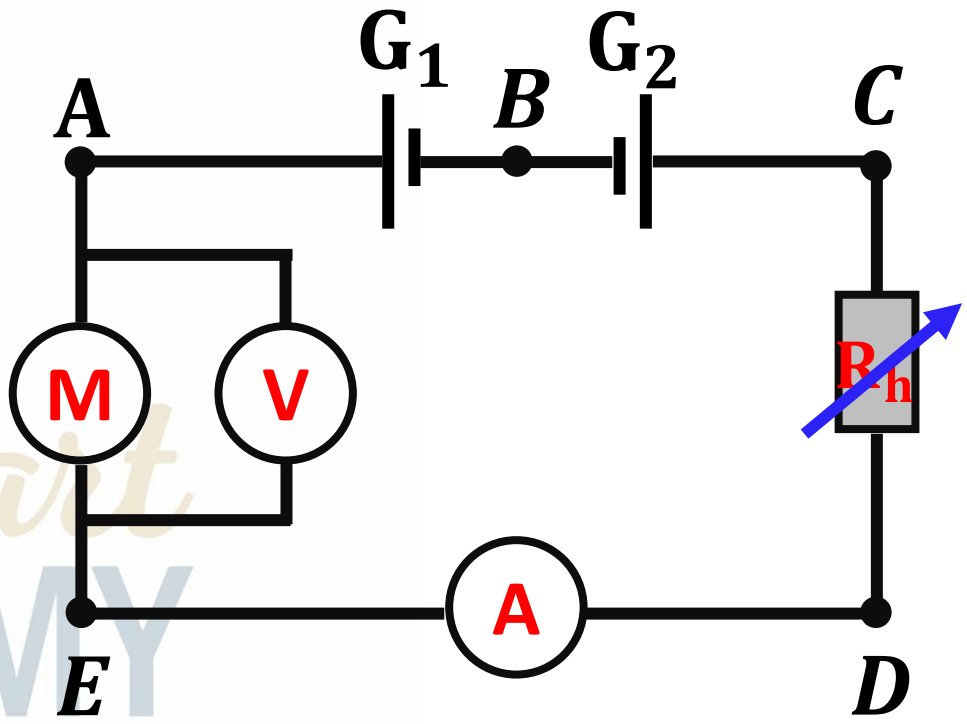


$$U_{Rh} = R_h \times I \Rightarrow U_{Rh} = 4 \times 3 \Rightarrow U_{Rh} = 12V$$

Quiz 1 physics Duration: 20 min

$G_1(48V; 2\Omega)$; $G_2(12V; 1\Omega)$; M $(E'; r')$; and R_h.

3.Deduce the voltage U_M across the motor.



Using law of addition of voltage in series:

$$U_{G1} = U_M + U_{Rh} + U_{G2}$$

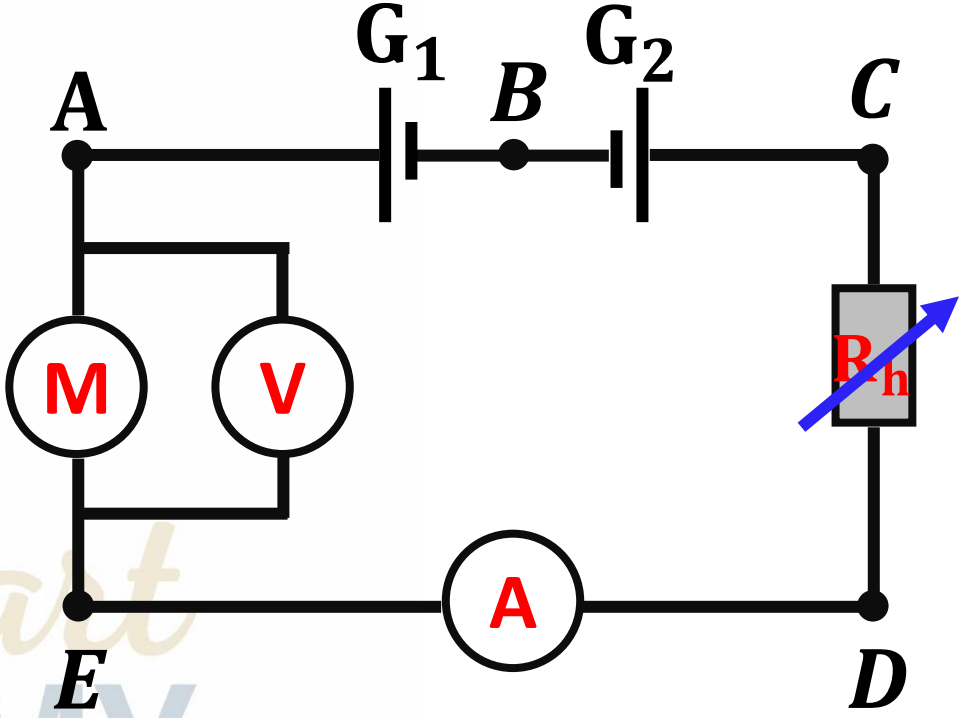
$$42V = U_M + 12V + 15V$$

$$U_M = 15V$$

Quiz 1 physics Duration: 20 min

$G_1(48V; 2\Omega)$; $G_2(12V; 1\Omega)$; M $(E'; r')$; and R_h.

4. Find a relation between E′ and r′.



The motor is a receiver then:

Use ohm's law of receiver:

$$U_M = r'I + E'$$

$$15V = 3 \times r' + E' \dots\dots (1)$$

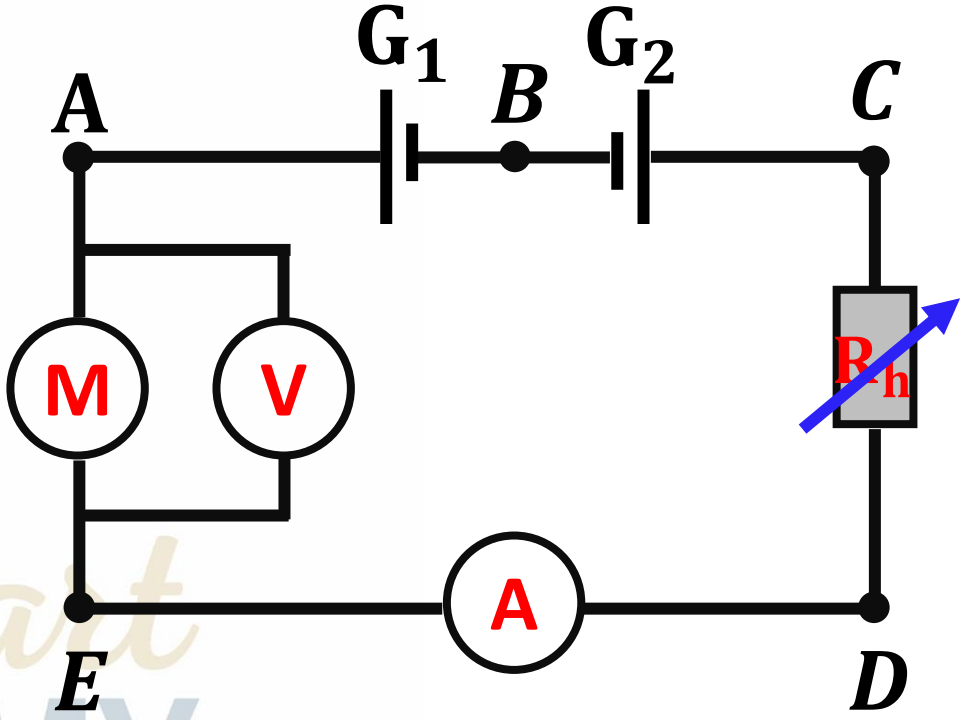
Quiz 1 **physics** **Duration: 20 min**

5. For $R_h = 8\Omega$, the ammeter indicates 2 A, and the voltmeter indicates 14 V.

a) Determine a relation between E' and r'.

b) Determine the back e.m.f. (E') and the internal resistance (r') of the motor.

c) Does the motor functions normally? Justify your answer.

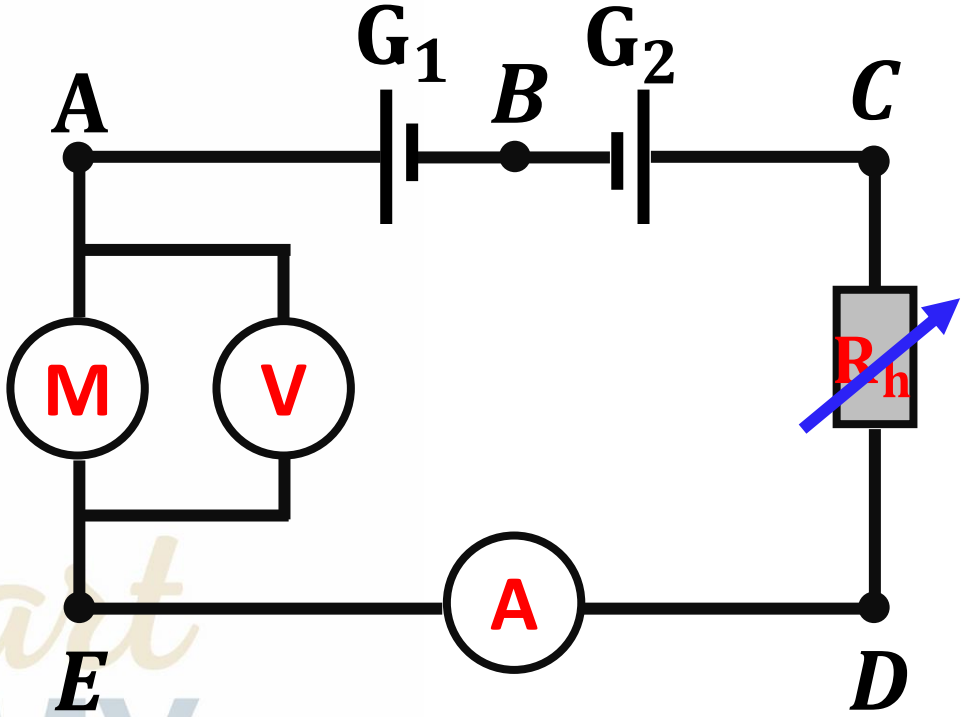


Quiz 1 physics Duration: 20 min

$G_1(48V; 2\Omega)$; $G_2(12V; 1\Omega)$; M $(E'; r')$; and R_h.

5.For $R_h = 8\Omega$, $I = 2$ A, $U_M = 14V$.

a) Determine a relation between E' and r'.



Using ohm's law of receiver:

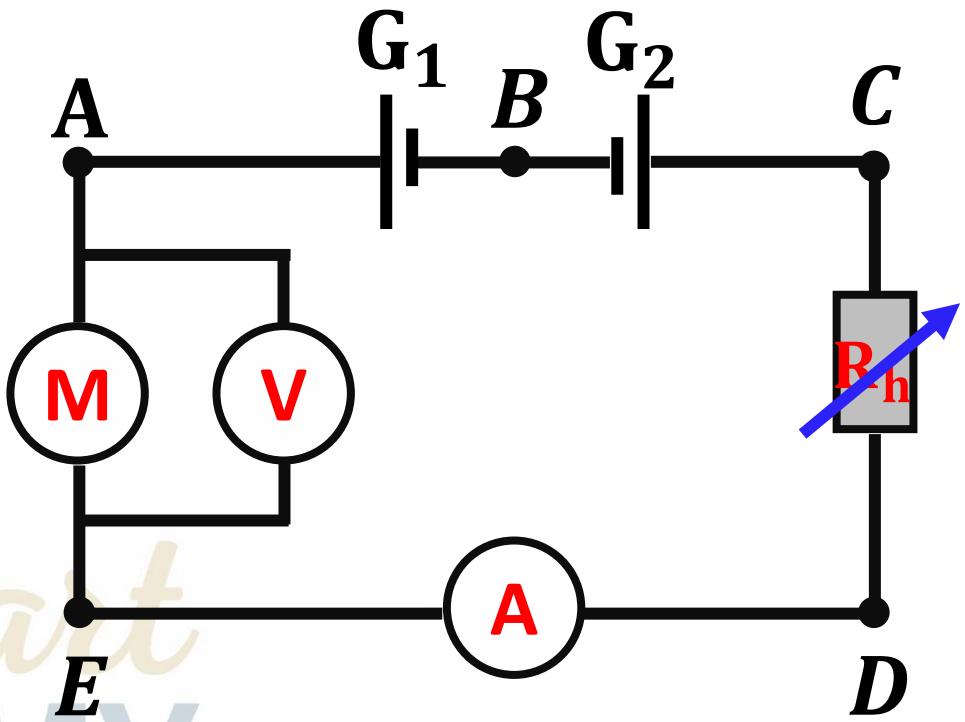
$$U_M = r'I + E'$$

$$14V = 2 \times r' + E' \ldots\ldots (2)$$

Quiz 1 physics Duration: 20 min

$G_1(48V; 2\Omega)$; $G_2(12V; 1\Omega)$; M $(E'; r')$; and R_h.

6.Determine the back e.m.f. (E') and the internal resistance (r') of the motor.



$$\begin{cases} 15V = 3r' + E' \ \ldots\ldots (1) \\ 14V = 2r' + E' \ \ldots\ldots (2) \ \ (-1) \end{cases}$$

$$\begin{cases} 15V = 3 \times r' + E' \\ -14V = -2 \times r' - E' \end{cases}$$

$$\begin{cases} 15V = 3 \times r' + E' \\ -14V = -2 \times r' - E' \end{cases}$$

Add the above two equations:

$$15V - 14V = 3r' + E' - 2r' - E'$$

$$1 = r' \qquad r' = 1\Omega$$

Substitute $r' = 1\Omega$ in any of the above equations:

$$15V = 3 \times r' + E'$$

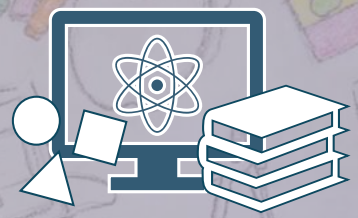
$$15V = 3 \times (1) + E'$$

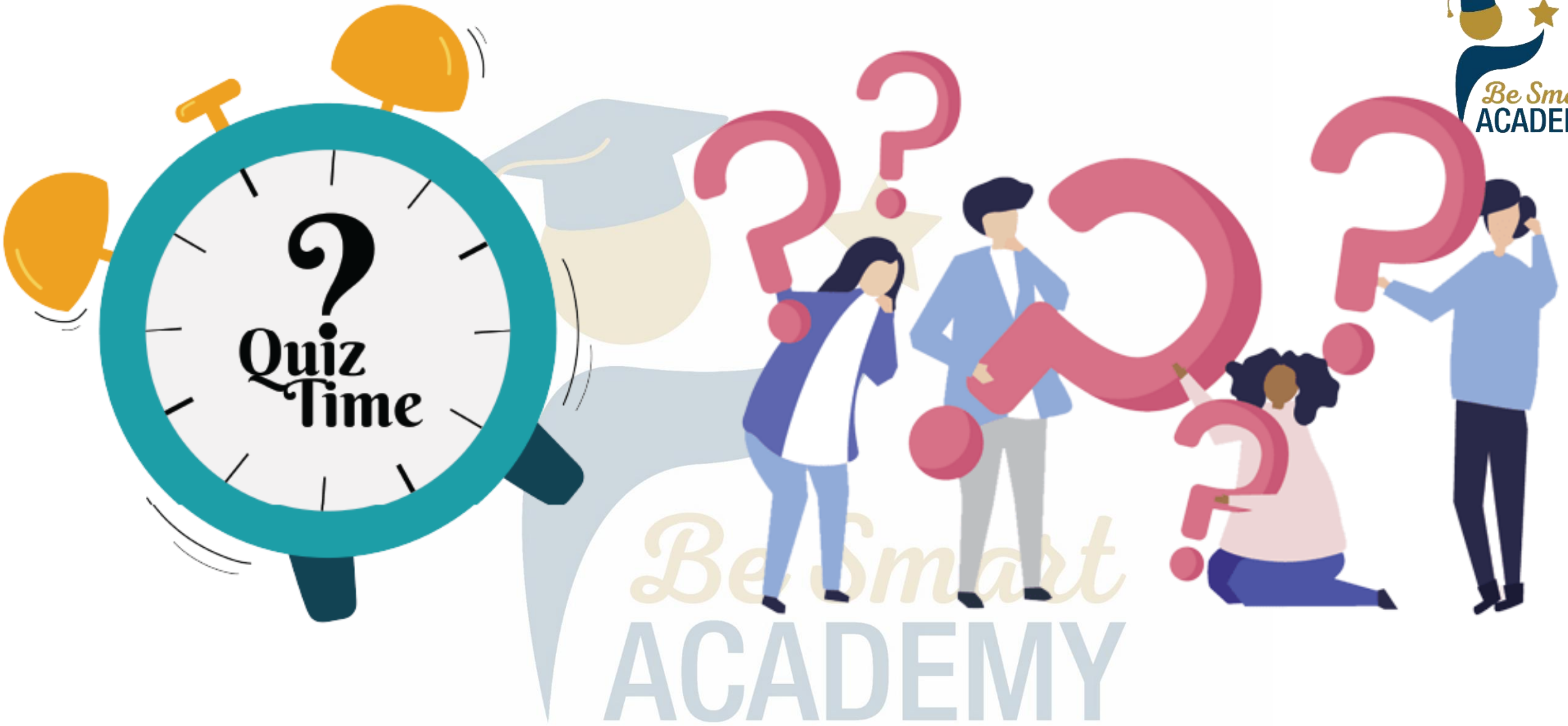
$$15V = 3 + E'$$

$$15 - 3 = E'$$

$$E' = 12V$$

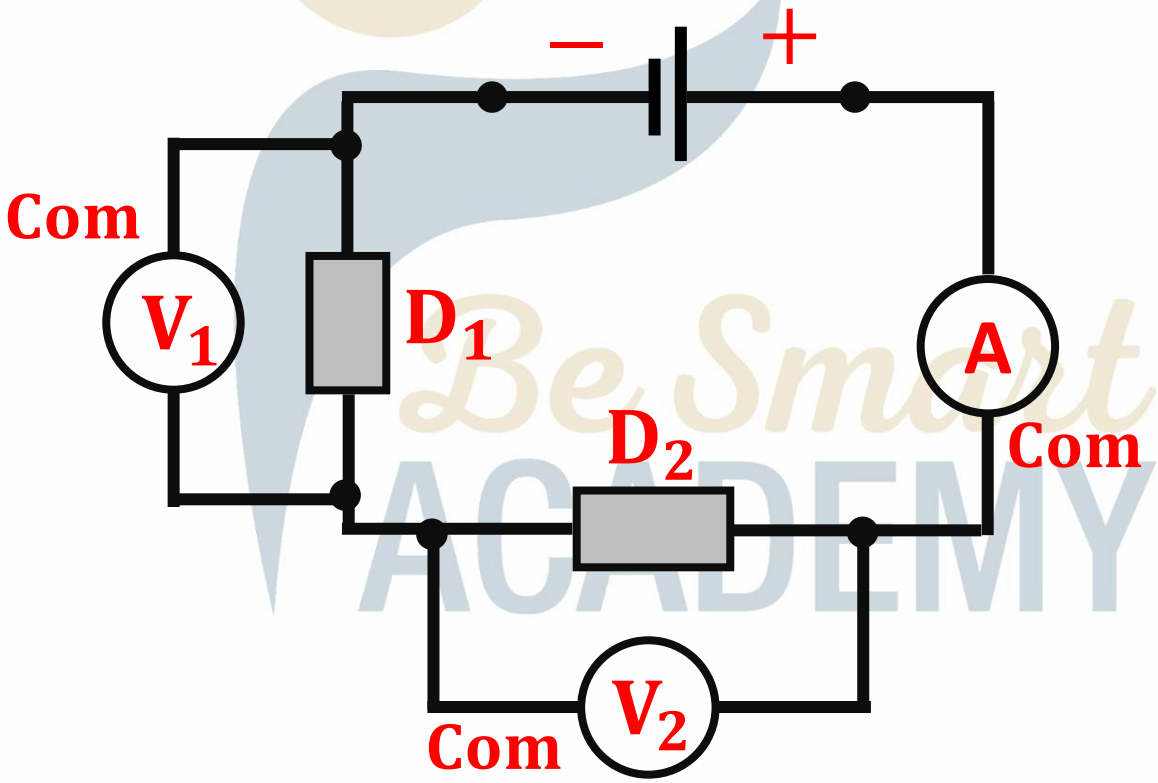
The End





Quiz 2 physics Duration: 15 min

To know the nature of two electric loads D_1 and D_2 we connect them in series with DC generator of electromotive force E and internal resistance $r = 2\Omega$.



Quiz 2 physics Duration: 15 min

Two voltmeters V_1 and V_2 are connected across the terminals of D1 and D2 and an ammeter A is connected as shown in the figure. The table below represents the readings of V_1, V_2 and A.

I (mA)	0	100	200	300	400
V_1 (V)	0	1	2	3	4
V_2 (V)	2.5	3	3.5	4	4.5

Quiz 2 physics Duration: 15 min

1.Trace the I-V characteristic curves of the two electric loads D_1, and D_2.

Scale: x – axis: 1cm→ 0.1A & y – axis: 1cm→ 1V

2.Indicate with justification the nature of the electric loads D_1, and D_2.

3.Find the equations of the two graphs that correspond to D_1, and D_2

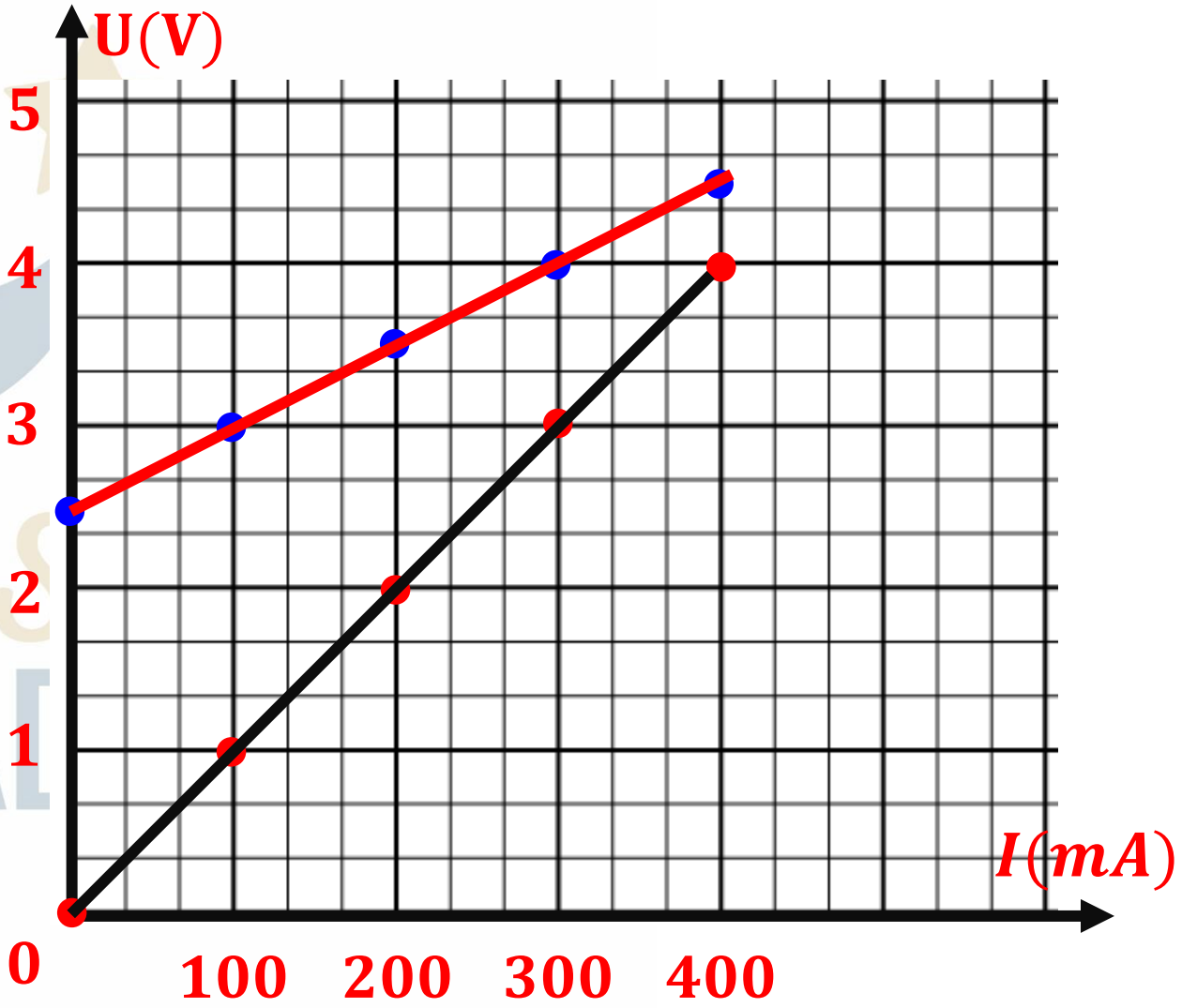
4.Deduce the characteristics of D_1, and D_2.

5.For $I = 0.3A$. Determine, by applying the law of addition of voltages, the value of E of the generator.

Quiz 2 physics Duration: 15 min

1. Trace the I-V characteristic curves of the two electric loads D_1 and D_2

I (mA)	0	100	200	300	400
V_1 (V)	0	1	2	3	4
V_2 (V)	2.5	3	3.5	4	4.5



Quiz 2 physics Duration: 15 min

2. Indicate with justification the nature of the electric loads D_1, and D_2.

D_1 is a resistor, since the shape of its graph is a straight line passing through the origin.

D_2 is a receiver, since the shape of its graph is an increasing straight line and NOT passing by origin.

3. Find the equations of the two graphs that correspond to D_1, and D_2

For D_1: The equation is:

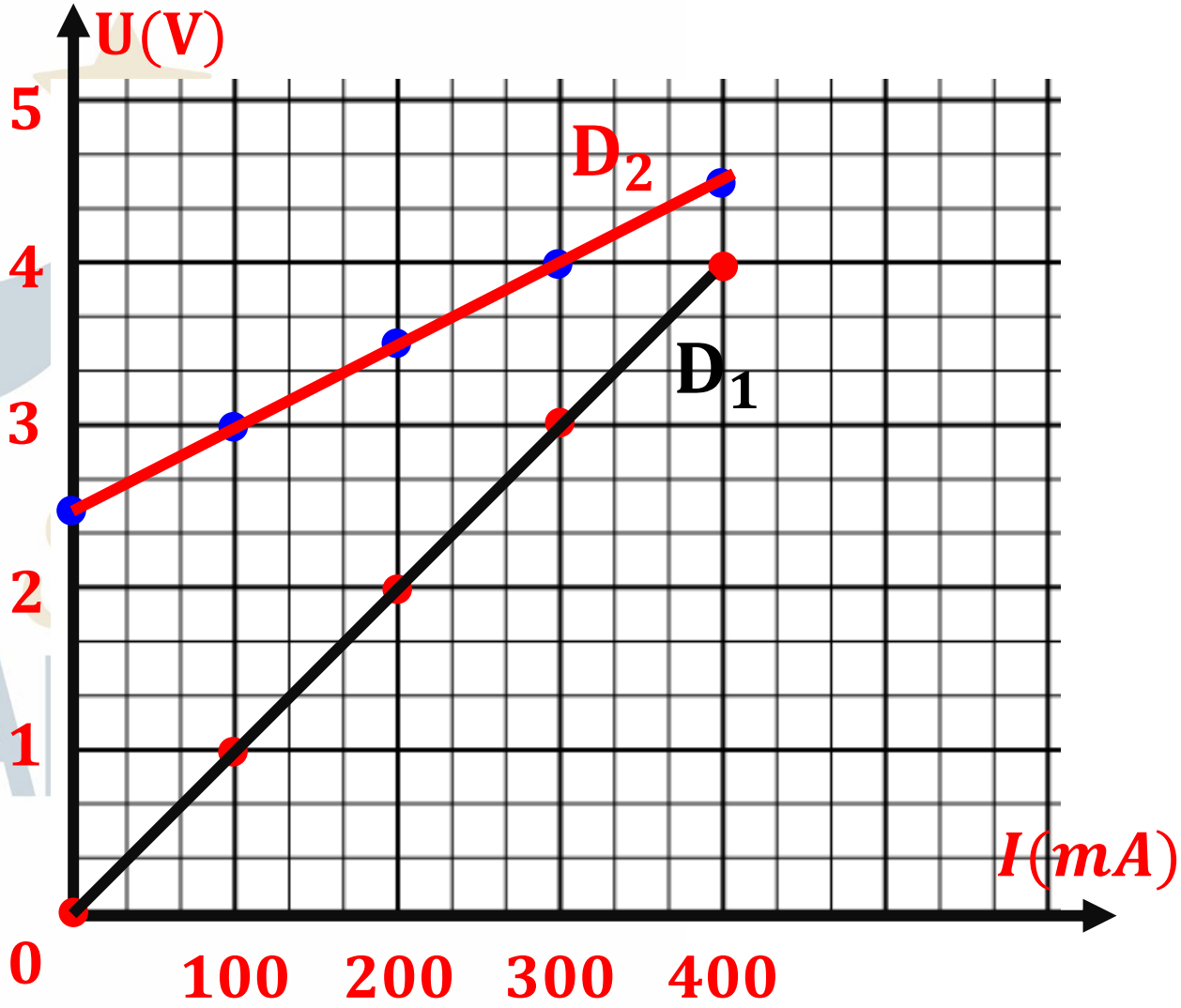
$U = aI$; where a is slope.

$$a = \frac{U_2 - U_1}{I_2 - I_1} = \frac{2 - 1}{0.2 - 0.1}$$

$$a = 10V / A$$

The equation is:

$$U = 10I$$



Quiz 2 physics Duration: 15 min

For D_2: The general equation is $U = a.I + b$; with k is slope

$$a = \frac{U_2 - U_1}{I_2 - I_1} = \frac{4.5 - 4}{0.2 - 0.1}$$

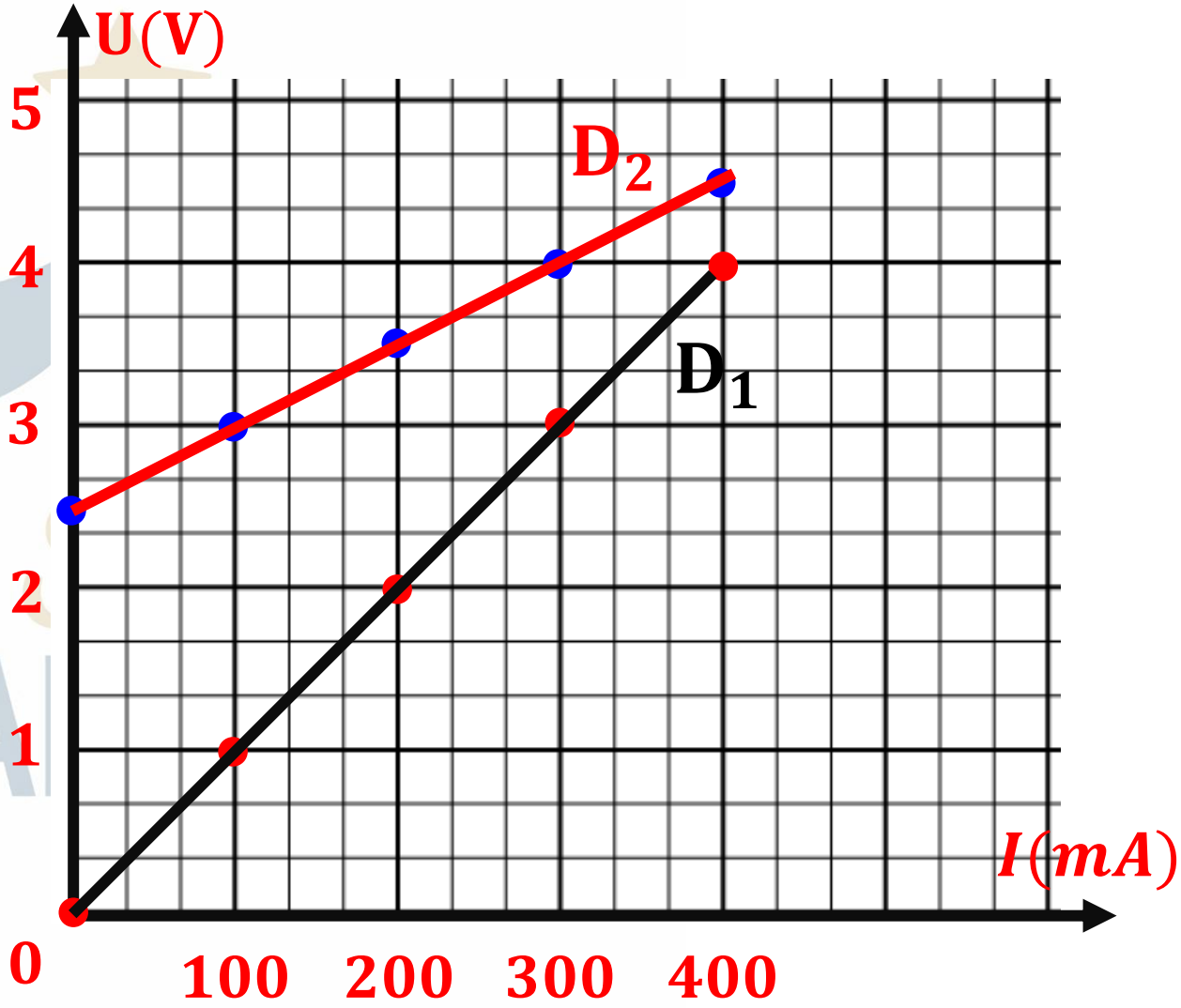
$$a = 5V / A$$

b is y- intercept

$$b = 2.5V$$

The equation is:

$$U = 5.I + 2.5$$



4. Deduce the characteristics values of D_1, and D_2.

D_1 is resistor with equation:

$$U = 10I$$

The ohm's law of resistor is

$$U = R.I$$

Compare the two equations:

$$R = 10\Omega$$

D_2 is a receiver with equation:

$$U = 5.I + 2.5$$

The ohm's law of receiver is

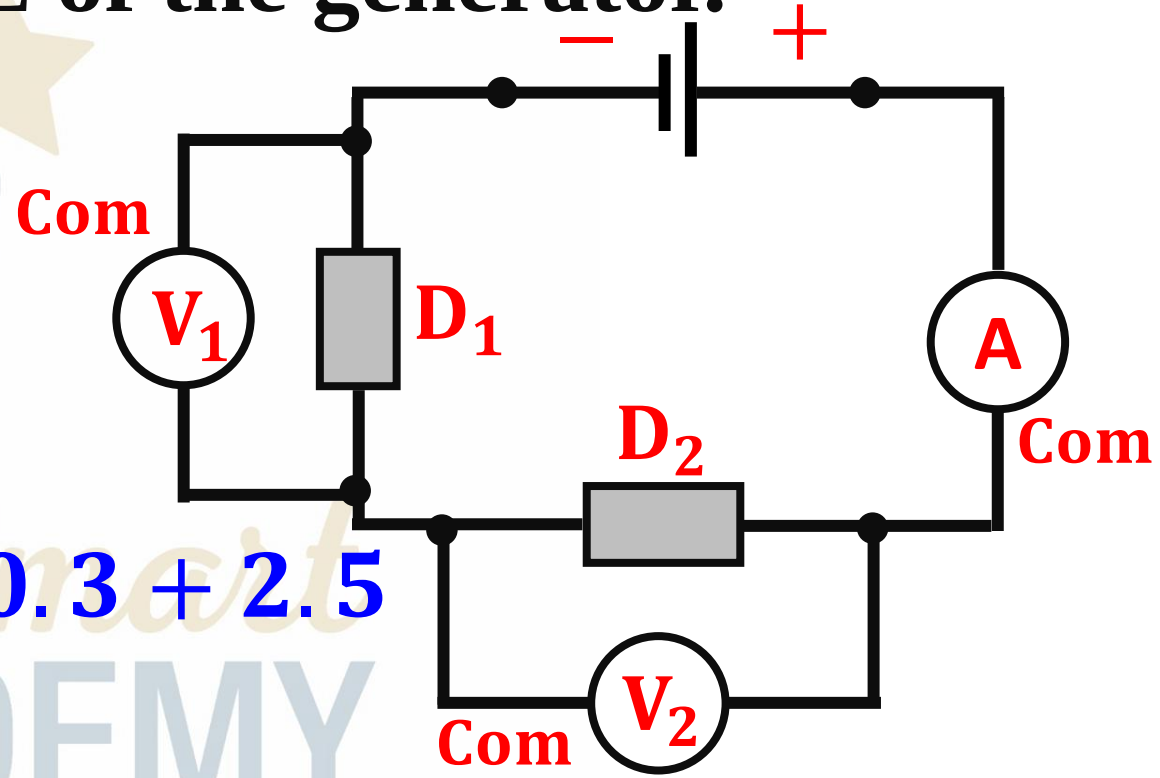
$$U = r'.I + E'$$

Compare the two equations:

$$r' = 5\Omega$$

$$E' = 2.5\Omega$$

5. For I=0.3A. Determine, by applying the law of addition of voltages, the value of E of the generator.



$$U_G = U_R + U_M$$

$$-rI + E = RI + r'I + E'$$

$$-2 \times 0.3 + E = 10 \times 0.3 + 5 \times 0.3 + 2.5$$

$$-0.6 + E = 3 + 1.5 + 2.5$$

$$E = 3 + 1.5 + 2.5 + 0.6$$

$$E = 7.6V$$

The End