Voltage and circuit

Sunday, 26 January 2025 9:08 AM

- Voltage
- Circuit
- The whole M

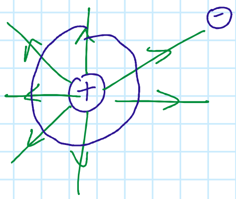
Voltage

Work done

$$W = Fd\cos\theta$$

$$dW = F\,ds\cos\theta$$

Electrical potential energy

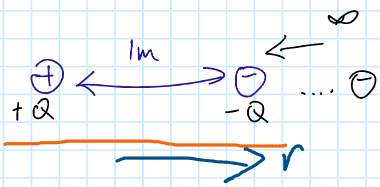


$$W = Fd\cos\theta$$

$$W = Fd$$

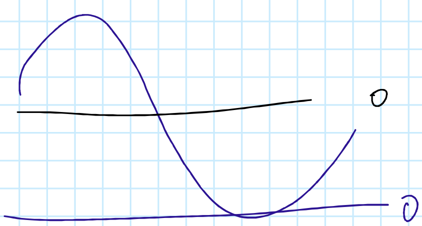
$$dW = F\,ds$$

$$F = \frac{-Q^2}{4\pi\epsilon_0 r^2}$$



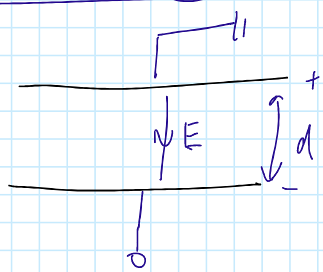
$$U = \left.\frac{Q^2}{4\pi\epsilon_0 r}\right|_{\infty}^{r'}$$

$$U = \frac{Q^2}{4\pi\epsilon_0 r}$$



$$\frac{U\,(J)}{Q\,(C)} = V$$

$$V = \frac{Q}{4\pi\epsilon_0 r} \quad \text{(due to a pt charge)}$$

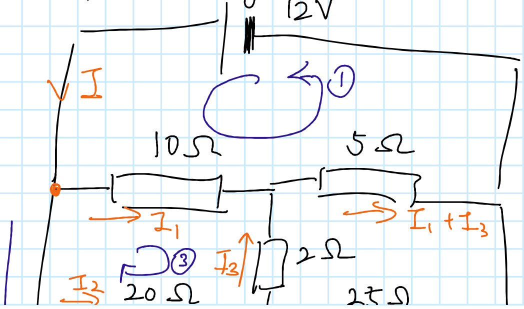


$$V = -\int E\,dl$$

$$V = -Ed$$

$$q\Delta V = \Delta E.$$

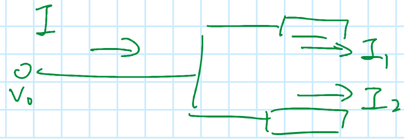
Wheatstone bridge



Circuit

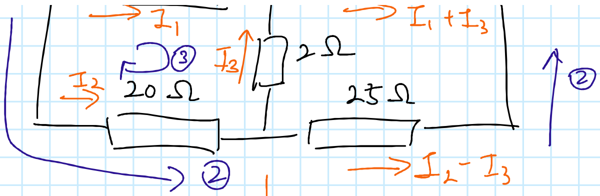
- Kirchoff law.

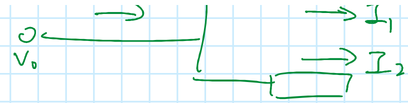
① Current law (conservation of charge)



$$I = I_1 + I_2$$

$$I_{going\ in} = I_{going\ out}$$

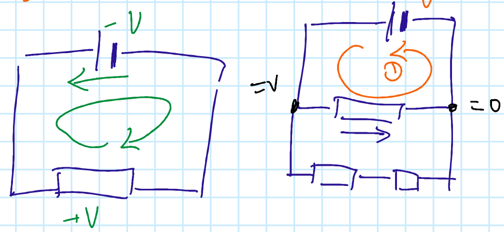




$I = I_1 + I_2$

$I_{going\ in} = I_{going\ out}$

② Loop rule (conservation of energy)



$\Sigma V = 0$

① : $V - IR = 0$

① $12 - 10I_1 - 5(I_1 + I_3) = 0$

$15I_1 + 5I_3 = 12$

② $12 - 20I_2 - 25(I_2 - I_3) = 0$

$45I_2 - 25I_3 = 12$

③ $-10I_1 + 20I_2 + 2I_3 = 0$

$-5I_1 + 10I_2 + I_3 = 0$

$\boxed{I_3 = 5I_1 - 10I_2}$

$15I_1 + 25I_1 - 50I_2 = 12$

$40I_1 - 50I_2 = 12$

$45I_2 - 25(5I_1 - 10I_2) = \cancel{0}\ 12$

$-125I_1 + 295I_2 = 12$

$40I_1 - 50I_2 = -125I_1 + 295I_2$

$165I_1 = 345I_2$

$I_1 = \frac{23}{11} I_2$

$40 \cdot \frac{23}{11} I_2 - 50I_2 = 12$

$I_2 = 0.357\ A \quad \left(\frac{66}{185}\right)$

$I_1 = 0.746\ A \quad \left(\frac{138}{185}\ A\right)$

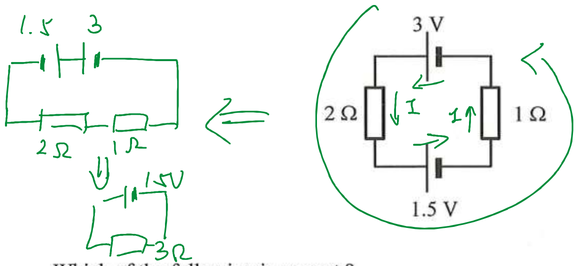
$I_3 = 5I_1 - 10I_2$

$= 0.162\ A \quad \left(\frac{6}{37}\ A\right)$

2 Battery

2 Battery

25. Two cells of negligible internal resistance are connected to two resistors as shown.



$+3-2I-1.5-I=0$

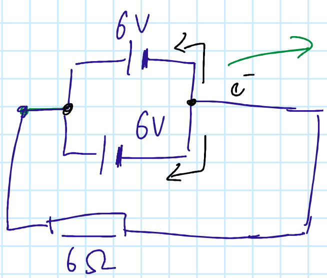
$1.5-3I=0$

$I=0.5A$

Which of the following is correct ?

	direction of current	current in the circuit
A.	anticlockwise	0.5 A
B.	clockwise	0.5 A
C.	anticlockwise	1.5 A
D.	clockwise	1.5 A

Batteries in parallel

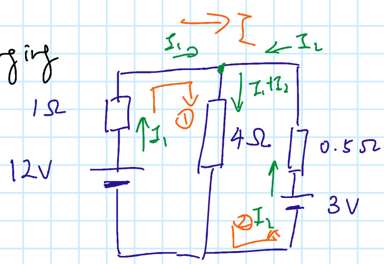


Total voltage = 6V

$(6)I = 6 \ (V)$

$I = 1A$

Charging



① : $I_1 + 4(I_1+I_2) = 12$

② $0.5(I_2) + 4(I_1+I_2) = 3$

③ $5I_1 + 4I_2 = 12$

④ $4I_1 + 4.5I_2 = 3$

③ $- \frac{5}{4} \times$ ④

$-\frac{13}{8} I_2 = \frac{33}{4}$

$I_2 = -\frac{66}{13} A$

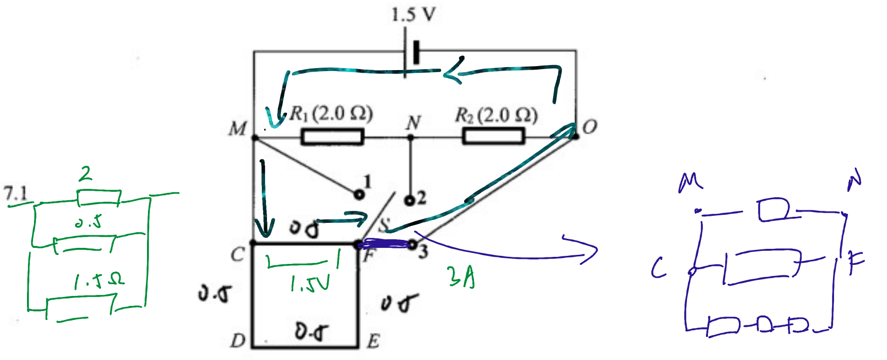
$= -5.08A$

$I_1 = \cancel{3.2A}, \cancel{6.5A}$

$6.46A$

(b) Four such metallic wires in (a) are joined together to form a square coil *CDEF*. The coil is connected to a circuit consisting of a 1.5 V cell of negligible internal resistance and two identical resistors R_1 and R_2, each of 2.0 Ω, as shown in Figure 7.1.

Figure 7.1



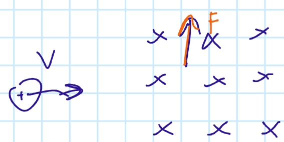
(i) To which terminal (**1**, **2** or **3**) should switch *S* be connected in order to have a maximum current flowing through side *CF* of the coil ? (1 mark)

Terminal 3

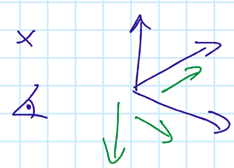
(ii) With *S* connected to terminal 2, find the equivalent resistance across *MN*. (2 marks)

Magnetic forces

① : On a moving charge



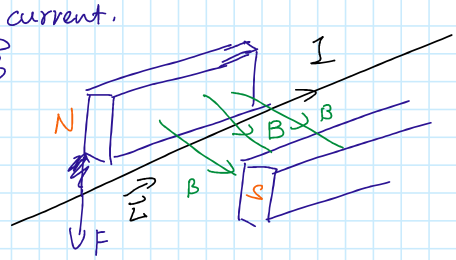
$\vec{F} = q\,\vec{v} \times \vec{B}$



$dW = F \cdot v_{\parallel}\, dt = 0$

② Force on a current.

$\vec{F} = I\,\vec{L} \times \vec{B}$



$\vec{\tau} = \vec{r} \times \vec{F}$