Exercise walk-through

11.6
Kirchhoff's Loop Rule

AP Physics C: Electricity and Magnetism

You must be able to

- state **Kirchhoff's loop rule** , $\sum \Delta V = 0$ around any closed loop
- explain it as a consequence of **conservation of energy**
- assign consistent **sign conventions** for emf sources and resistors
- write and solve **loop equations**

1 The method

Method — The loop rule

Around any closed loop, $\sum \Delta V = 0$ – the rises across the emf sources balance the drops across the resistors.

Exercises 2.1·2.2

2.1 State Kirchhoff's loop rule. [1]

2.2 State the conservation law the loop rule expresses. [1]

Exercises 2.1–2.2

2.1 State Kirchhoff's loop rule. [1]

2.1

- the sum of the potential differences around any closed loop is zero

---

2.2 State the conservation law the loop rule expresses. [1]

2.2

- conservation of energy

Exercises 2.3·3.1

2.3 A single loop has a 10 V battery and resistors 2.0 Ω and 3.0 Ω in series. Find the current. [2]

3.1 Kirchhoff's loop rule sums the potential differences around a closed loop to [1]

- **A** the emf
- **B** zero
- **C** a maximum
- **D** infinity

Exercises 2.3·3.1

2.3 A single loop has a 10 V battery and resistors 2.0 Ω and 3.0 Ω in series. Find the current. [2]

2.3

- loop rule: the emf equals the sum of the drops:

$$\varepsilon = IR_1 + IR_2 \quad \Rightarrow \quad I = \frac{10\ \text{V}}{2.0\ \Omega + 3.0\ \Omega}$$

- $I = \mathbf{2.0}$ A

3.1 Kirchhoff's loop rule sums the potential differences around a closed loop to [1]

- ☐ **A** the emf
- **B** zero
- **C** a maximum
- **D** infinity

3.1 B

- zero.

Exercise 3.2

3.2 The loop rule expresses conservation of [1]

- [ ] **A** charge
- [ ] **B** energy
- [ ] **C** momentum
- [ ] **D** mass

Exercise 3.2

3.2 The loop rule expresses conservation of [1]

- ☐ **A** charge
- **B** energy
- **C** momentum
- **D** mass

3.2 B

- energy.

Exercise 3.3 (a)

3.3 A single loop contains a 12 V battery and resistors of 3.0 Ω and 1.0 Ω in series.

(a) Write the loop equation. [2]

Exercise 3.3 (a)

3.3 A single loop contains a 12 V battery and resistors of 3.0 Ω and 1.0 Ω in series.

(a) Write the loop equation. [2]

(a)

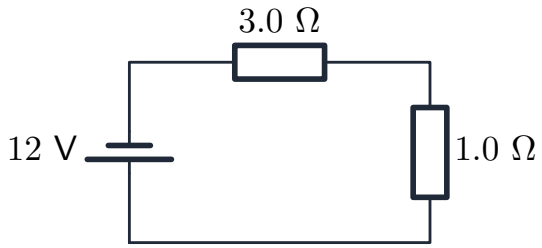
- going round the loop, the emf rise equals the two drops:

$$12\ \text{V} - I(3.0\ \Omega) - I(1.0\ \Omega) = 0$$

Exercise 3.3 (b)

3.3 A single loop contains a 12 V battery and resistors of 3.0 Ω and 1.0 Ω in series.

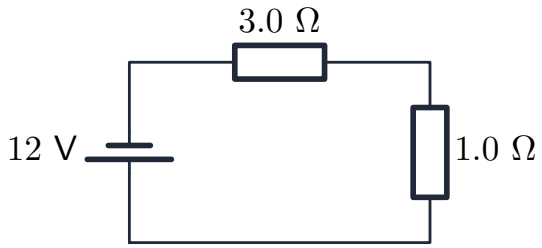
(b) Find the current. [1]



Exercise 3.3 (b)

3.3 A single loop contains a 12 V battery and resistors of 3.0 Ω and 1.0 Ω in series.

(b) Find the current. [1]



(b)

- $I = \dfrac{12\ \text{V}}{4.0\ \Omega} = \mathbf{3.0}\ \text{A}$