

Exercise walk-through

11.6

Kirchhoff's Loop Rule

AP Physics 2

You must be able to

- state **Kirchhoff's loop rule** : the sum of potential differences around any closed loop is zero
- explain the loop rule as a statement of **conservation of energy**
- apply the loop rule to write equations for a circuit

1

The method

Method — The loop rule

Around any closed loop, $\sum V = 0$: the potential rises across the battery equal the drops across the resistors.

Exercises 2.1·2.2

2.1 State Kirchhoff's loop rule.

[1]

2.2 State the conservation law that 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 that the loop rule expresses.

[1]

2.2

- conservation of energy

Exercises 2.3-3.1

2.3 A single loop has a 9.0 V battery and resistors $2.0\ \Omega$ and $1.0\ \Omega$ in series. Write the loop equation and find the current. [2]

3.1 Kirchhoff's loop rule states that around a closed loop the sum of the potential differences is [1]

☐

A a maximum

B zero

C equal to the emf only

D always negative

Exercises 2.3-3.1

2.3 A single loop has a 9.0 V battery and resistors $2.0\ \Omega$ and $1.0\ \Omega$ in series. Write the loop equation and find the current. [2]

2.3

- going round the loop, the emf equals the sum of the potential drops:

$$\varepsilon - IR_1 - IR_2 = 0 \Rightarrow I = \frac{\varepsilon}{R_1 + R_2} = \frac{9.0\text{ V}}{2.0\ \Omega + 1.0\ \Omega}$$

- $I = 3.0\text{ A}$

3.1 Kirchhoff's loop rule states that around a closed loop the sum of the potential differences is [1]

☐

A a maximum

B zero

C equal to the emf only

D always negative

3.1 B

- zero.

Exercise 3.2

3.2 The loop rule is a statement of conservation of

[1]

☐

A charge

B energy

C momentum

D mass

Exercise 3.2

3.2 The loop rule is a statement of 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 6.0 V battery and resistors of $4.0\ \Omega$ and $2.0\ \Omega$ in series.

(a) Write the loop equation.

[2]

Exercise 3.3 (a)

3.3 A single loop contains a 6.0 V battery and resistors of $4.0\ \Omega$ and $2.0\ \Omega$ in series.

(a) Write the loop equation.

[2]

(a)

- the gain across the battery equals the drops across the resistors:

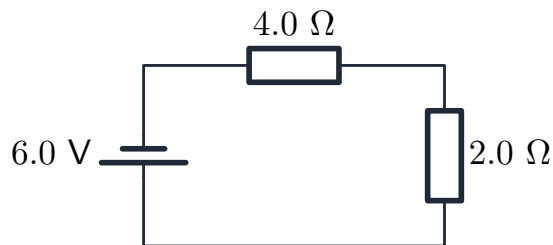
$$\varepsilon - IR_1 - IR_2 = 0, \quad \text{i.e.} \quad 6.0\text{ V} - I(4.0\ \Omega) - I(2.0\ \Omega) = 0$$

Exercise 3.3 (b)

3.3 A single loop contains a 6.0 V battery and resistors of $4.0\ \Omega$ and $2.0\ \Omega$ in series.

(b) Find the current.

[1]

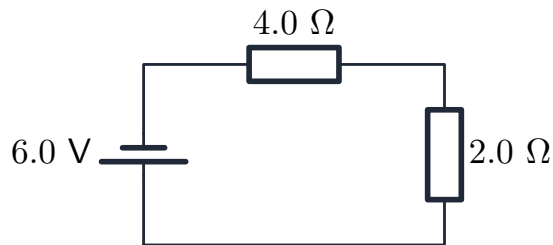


Exercise 3.3 (b)

3.3 A single loop contains a 6.0 V battery and resistors of $4.0\ \Omega$ and $2.0\ \Omega$ in series.

(b) Find the current.

[1]



(b)

$$I = \frac{\varepsilon}{R_1 + R_2} = \frac{6.0\ \text{V}}{6.0\ \Omega} = \mathbf{1.0\ A}$$