Combining equations

PHYSICS EQUATION PRACTICE

USEFUL Equations

VOLTAGE = CURRENT X RESISTANCE

CHARGE = CURRENT X TIME

ENERGY = VOLTAGE X CHARGE

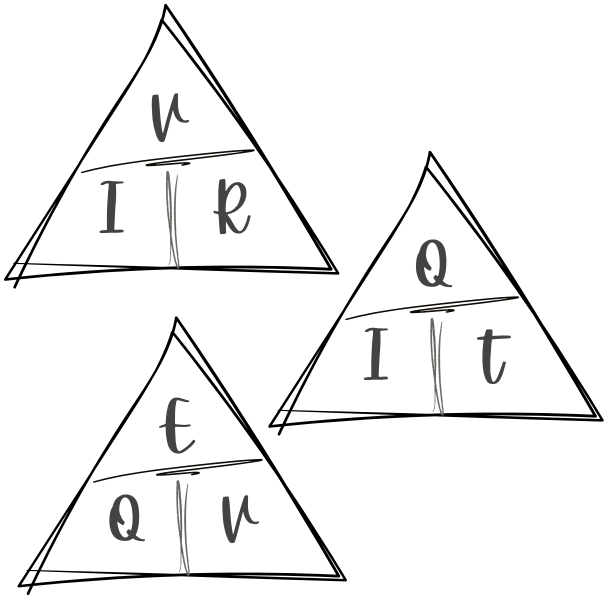
Understand

UNDERSTAND, DON'T MEMORISE

These questions involve two equations. You'll need to identify which are involved to answer the question.

Make a list of variables you have on the left of the answer space, so you can figure out which equations you need.

Equation TRIANGLES



Example QUESTION

QUESTION:

R V t

A smart irrigation valve with a resistance of 100 Ω runs on a 5 V supply for 2.5 minutes. How much charge flows?

Q

ANSWER:

List

$R = 100\ \Omega$

$V = 5\ v$

$t = 2.5\ mins = 2.5 \times 60\ s$

$Q = ?$

$V = I \times R$

$I = V / R$

$I = 5\ V / 100\ \Omega$

$I = 0.05\ A.$

Equations

$Q = I \times t$

$Q = 0.05\ A \times 150\ s$

$Q = 7.50\ C.$

Answer & unit

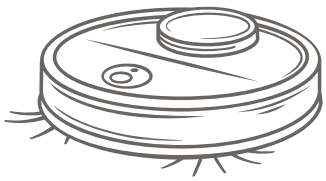
Challenge QUESTIONS

1. A mini Mars rover operates at 12 V and has a resistance of 48 Ω. How much charge flows if it runs for 2 minutes?

2. A space probe sensor draws 20 μA for 5 hours. How much energy does it consume if its operating voltage is 3.3 V?

3. A lighthouse beacon has a resistance of 8 Ω and is connected to a 24 V supply. How much charge passes in 30 seconds?

4. A robotic vacuum is charged with 1.5 A for 40 minutes. If the charger voltage is 5 V, how much energy is delivered?



5. A camping fan with a resistance of 15 Ω is powered by a 9 V battery. If it transfers 600 C of charge, how much energy is used?

Challenge QUESTIONS

6. A weather sensor has a resistance of 2 kΩ and runs on a 10 V supply for 1.5 minutes. Find the total charge passing through it.

7. A delivery drone draws 3 A for 12 minutes. At a voltage of 11.1 V, how much energy does it use during the flight?

8. A high-voltage heater with a resistance of 50 Ω is connected to a 230 V supply. If 4,000 C of charge flows, find the energy transferred as heat.

9. A solar charging station outputs 5 V and has an internal resistance of 250 mΩ. If it delivers 12 kC of charge, find the energy output.

10. An LED parade sign operates at 12 V and has a resistance of 48 Ω. If 1.2 kC of charge flows, how much energy is used?

Working SPACE

Combining Equations - V, Q, E

Challenge QUESTIONS

Worked Answers

1. A mini Mars rover operates at 12 V and has a resistance of 48 Ω. How much charge flows if it runs for 2 minutes?

$V = 12\ v$
$R = 48\ \Omega$
$Q = ?$
$t = 2\ mins = 2 \times 60\ s$

$I = V / R = 12\ V / 48\ \Omega = 0.250\ A.$

$Q = I \cdot t = 0.250\ A \times 120\ s = 30.0\ C.$

2. A space probe sensor draws 20 μA for 5 hours. How much energy does it consume if its operating voltage is 3.3 V?

$I = 20\ \mu A$
$t = 5\ hrs$
$= 5 \times 60 \times 60\ s$
$E = ?$
$V = 3.3\ v$

$\Delta Q = I \cdot t = 20 \times 10^{-6}\ A \times 18{,}000\ s = 0.360\ C.$

$E = Q \cdot V = 0.360\ C \times 3.3\ V = 1.188\ J.$

3. A lighthouse beacon has a resistance of 8 Ω and is connected to a 24 V supply. How much charge passes in 30 seconds?

$R = 8\ \Omega$
$V = 24\ v$
$Q = ?$
$t = 30\ s$

$I = V / R = 24\ V / 8\ \Omega = 3.00\ A.$

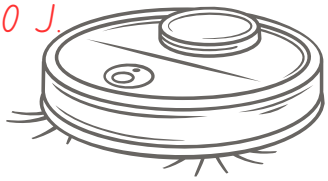
$Q = I \cdot t = 3.00\ A \times 30\ s = 90.0\ C.$

4. A robotic vacuum is charged with 1.5 A for 40 minutes. If the charger voltage is 5 V, how much energy is delivered?

$I = 1.5\ A$
$t = 40\ mins$
$= 40 \times 60\ s$
$V = 5\ v$
$E = ?$

$Q = I \cdot t = 1.50\ A \times 2{,}400\ s = 3{,}600\ C.$

$E = Q \cdot V = 3{,}600\ C \times 5\ V = 18{,}000\ J.$



5. A camping fan with a resistance of 15 Ω is powered by a 9 V battery. If it transfers 600 C of charge, how much energy is used?

$R = 15\ \Omega$
$V = 9\ v$
$Q = 600\ C$
$E = ?$

$E = Q \cdot V = 600\ C \times 9\ V = 5{,}400\ J.$

Challenge QUESTIONS

Worked Answers

6. A weather sensor has a resistance of 2 kΩ and runs on a 10 V supply for 1.5 minutes. Find the total charge passing through it.

R = 2 kΩ
V = 10 v
t = 1.5 mins
  = 1.5 x 60 s
Q = ?

I = V / R = 10 V / 2,000 Ω = 0.00500 A.

Q = I · t = 0.00500 A × 90 s = 0.450 C.

7. A delivery drone draws 3 A for 12 minutes. At a voltage of 11.1 V, how much energy does it use during the flight?

I = 3 A
t = 12 mins
  12 x 60 s
V = 11.1 v
E = ?

Q = I · t = 3.00 A × 720 s = 2,160 C.

E = Q · V = 2,160 C × 11.1 V = 23,976 J.

8. A high-voltage heater with a resistance of 50 Ω is connected to a 230 V supply. If 4,000 C of charge flows, find the energy transferred as heat.

R = 50 Ω
V = 230 v
Q = 4000 C
E = ?

I = V / R = 230 V / 50 Ω = 4.60 A.

E = Q · V = 4,000 C × 230 V = 920,000 J.

9. A solar charging station outputs 5 V and has an internal resistance of 250 mΩ. If it delivers 12 kC of charge, find the energy output.

V = 5 v
R = 250 mΩ
  = 250 / 1000 Ω
Q = 12 kC
  = 12 x 1000 C
E = ?

I = V / R = 5 V / 0.250 Ω = 20.0 A.

E = Q · V = 12,000 C × 5 V = 60,000 J.

10. An LED parade sign operates at 12 V and has a resistance of 48 Ω. If 1.2 kC of charge flows, how much energy is used?

V = 12 v
R = 48 Ω
Q = 1.2 kC
  = 1.2 x 1000 C
E = ?

E = Q · V = 1,200 C × 12 V = 14,400 J.