

Section 2 - Alternating and Direct Current

Current, Charge and Time

In this section you can use the equation:

$$\text{charge} = \text{current} \times \text{time}$$

also written as

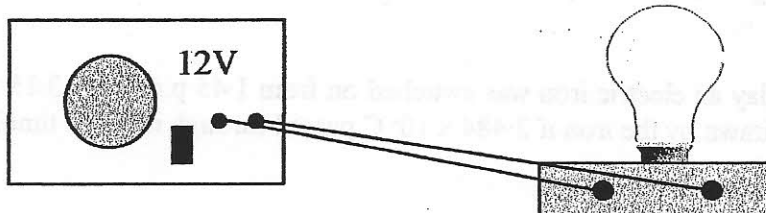
$$Q = It$$

where Q = charge in coulombs (C)
 I = current in amperes (A)
 t = time in seconds (s).

1. Find the missing values in the following table.

	Charge (C)	Current (A)	Time (s)
(a)		5	30
(b)		0.005	3 600
(c)	3	1.5	
(d)	27.6	2.3	
(e)	1 800		60
(f)	94		10

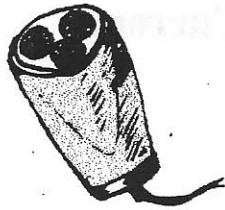
2. A bulb draws a current of 1 A. How much charge flows through it in 60 seconds?



3. 756 C of charge flow through an electric heater in 180 seconds. What is the current in the heater?
4. A hairdryer operates with a current of 5 A. How much time would it take for 6 000 C to pass through the hairdryer?

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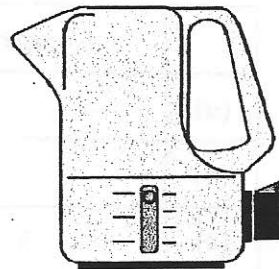
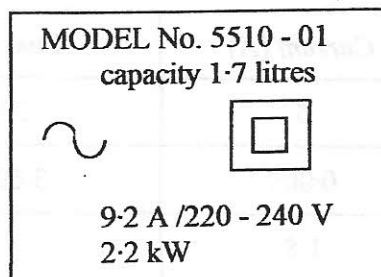


A current of 2.1 A flows through an electric shaver for 5 minutes. How much charge flows in this time?

6. A 60 W bulb is switched on for 30 minutes. If 450 C pass through it in this time, what is the current flowing in the bulb?

7. A 'surround sound' speaker system on a TV draws a current of 0.6 A. In an average day 6 480 C of charge flows through the speaker system. For how long is the TV switched on each day?

8. An electric kettle has a label on it as shown below.



After the kettle is switched on it automatically switches off when the water in it has boiled. On one occasion 1 656 C passed through the kettle before it switched off. Use the information given to work out how long the water took to boil?

9. An electric fire is rated at 2.875 kW, 230 V, 12.5 A. How much charge will flow through this fire in a period of 2 hours 20 minutes?

10. One day an electric iron was switched on from 1.45 p.m. until 3.15 p.m. What current was drawn by the iron if 2.484×10^4 C passed through it in this time?

Section 3 - Resistance

Voltage, Current and Resistance

In this section you can use the equation:

$$\text{voltage} = \text{current} \times \text{resistance}$$

also written as:

$$V = IR$$

where V = voltage in volts (V)
 I = current in amps (A)
 R = resistance in ohms (Ω).

Helpful Hint.

Many appliances run from mains voltage which is 230 V ac.

Useful units for electricity are:

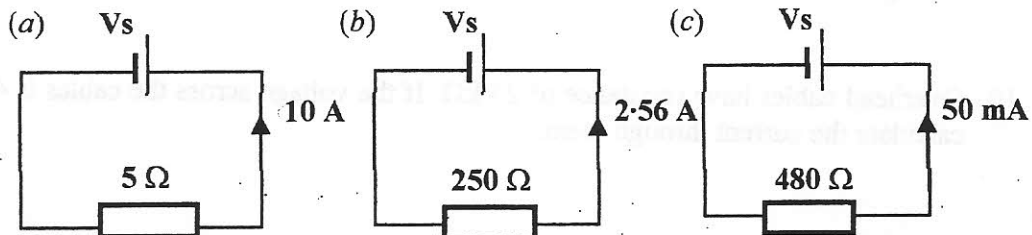
$$1 \mu\text{A} = 0.000\,001 \text{ A} = 1 \times 10^{-6} \text{ A}$$

$$1 \text{ mA} = 0.001 \text{ A} = 1 \times 10^{-3} \text{ A}$$

1. Find the missing values in the following table.

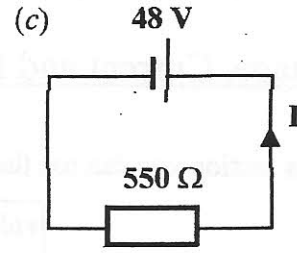
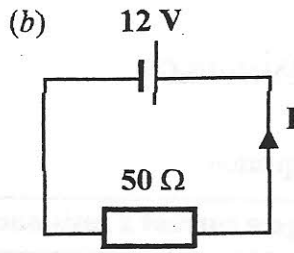
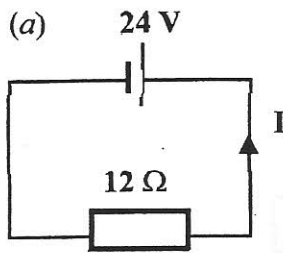
	Voltage (V)	Current (A)	Resistance (Ω)
(a)		15	35
(b)		0.2	1 000
(c)	230		125
(d)	24		550
(e)	120	12	
(f)	6	6.25×10^{-3}	

2. Look at the following circuits and calculate the supply voltage in each case:

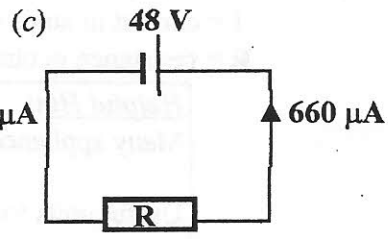
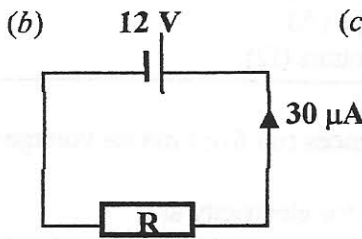
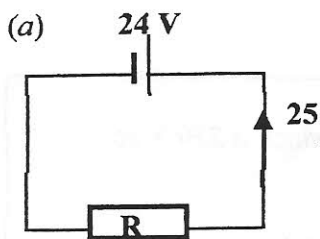


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3. Look at the following circuits and calculate the current in each case:

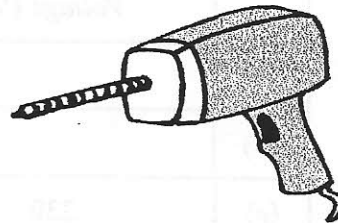


4. Look at the following circuits and calculate the unknown resistance in each case:



5. Calculate the resistance of a lamp if the current through it is 10 mA when operated by a 24 V supply.

6. A power drill is operated at mains voltage and has a resistance of 1.5 kΩ. Calculate the current through the drill.



7. The maximum current an electric motor can safely handle is 10 mA and it has a resistance of 360 Ω. Calculate its safe operating voltage.
8. A cooker draws a maximum current of 28.75 A and has a resistance of 8 Ω. At what voltage should it operate?
9. Hairdryers work from the mains voltage and can have currents of up to 15 mA flowing through them. Calculate the resistance of the hairdryer.
10. Overhead cables have resistance of 25 kΩ. If the voltage across the cables is 4 000 V calculate the current through them.

Power, Energy and Time

In this section you can use the equation:

$$\text{power} = \frac{\text{energy}}{\text{time}}$$

also written as

$$P = \frac{E}{t}$$

where P = power in watts (W)
 E = energy in joules (J)
 t = time in seconds (s).

1. Find the missing values in the following table.

	<i>Power (W)</i>	<i>Energy (J)</i>	<i>Time (s)</i>
(a)		1 500	30
(b)		180 000	36 000
(c)	100		600
(d)	1 200		2
(e)	3 000	120 000	
(f)	2.5	25	

2. How long will it take for a 60 W bulb to use 720 J of electrical energy?
3. A bulb uses 45 000 J of energy in 300 seconds.
What is its power rating?



4. A 50 W immersion heater is switched on for 80 seconds. How much electrical energy passes through it in this time?

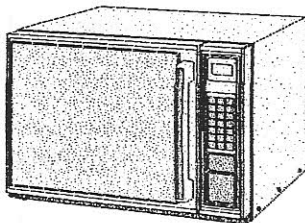
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Calculate the power rating of an electric sewing machine which uses 4 560 J of energy in 8 minutes.

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6. A 1 200 W hairdryer is switched on for 20 minutes. How much electrical energy does it use?
7. For how many minutes must a 600 W shaver be switched on in order to use 540 000 J of electrical energy?
8. An electric fire uses 5.22 MJ of electrical energy in half an hour. Calculate the power rating of the fire. (1 MJ = 1×10^6 J = 1 000 000 J)
9. How long will it take a 1.4 kW paint stripper to use 1.68 MJ of electrical energy?
10. A microwave oven is on for twenty minutes each day. If it uses 7.98 MJ of electrical energy in one week, what is its power rating?



Power, Current and Voltage

In this section you can use the equation:

$$\text{power} = \text{current} \times \text{voltage}$$

also written as

$$P = IV$$

where: **P** = power in watts (W)
I = current in amps (A)
V = voltage in volts (V).

Helpful Hint

The voltage of the **mains** is **230 V ac**.

1. Find the missing values in the following table.

	Power (W)	Current (A)	Voltage (V)
(a)		2.5	12
(b)		0.6	9
(c)	1.5×10^3		230
(d)	36		12
(e)	0.624	2.6×10^{-3}	
(f)	1.5	0.25	

2. A car battery supplies a voltage of 12 V. One headlamp bulb draws a current of 3 A. What is the power rating of this bulb?

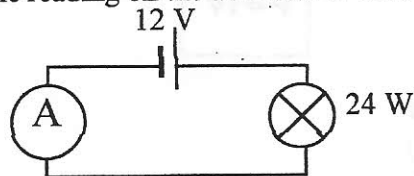
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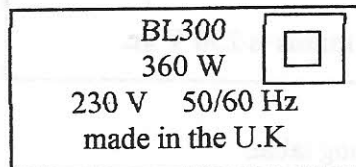
An electric shower has a power rating of 12 W and draws a current of 0.11 A. What voltage is required to operate the shower?

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- What current flows through a 230 V, 60 W household lamp when it is operating at the correct voltage?
- Calculate the power rating of an electric drill which draws a current of 3 A when connected to the mains.
- What would be the reading on the ammeter in the circuit shown?

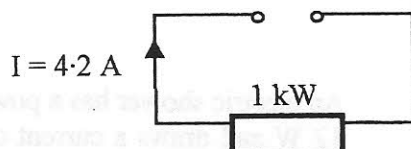


- The following information was found on the rating plate of a food processor:



Calculate the current flowing in the food processor.

- A fridge has a power rating of 160 W. When it is plugged into the mains what current will it draw?
- A radio has a power rating of 6 W and draws a current of 0.5 A when operating normally.
 - What voltage does this radio need?
 - How many 1.5 V batteries would be needed to operate the radio?
- The circuit shows a heating element (resistor) operating correctly.



What is the voltage of the supply?

- A torch bulb draws a current of 500 mA. It has a power rating of 1.75 W. What voltage is required to light the bulb to its correct brightness?

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12. An electric locomotive on the East Coast line gets its electricity from the overhead cables which supply 25 kV a.c. The locomotive has a top speed of 140 mph and it operates at 4.7 MW. Calculate the current flowing to the locomotive.



13. A helium - neon laser emits red light and has many uses in medicine. The laser uses the 230 V mains supply and has a power rating of 5 mW. What current flows in the laser?
14. The current flowing in an electric keyboard is measured as 800 mA. What voltage is required to operate the keyboard if it has a power rating of 7.2 W?
15. An electric fire has three heating elements which can be switched on and off independently. Each element has a power of 1.3 kW and is controlled by a switch on the side of the fire.
- (a) Calculate the current drawn from the socket when one heating element is switched on.
- (b) What is the maximum current that the fire could draw?

