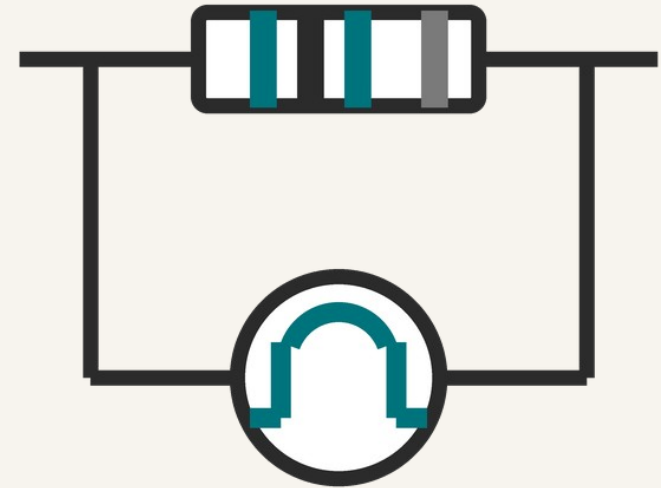


Measuring Resistance

Four coloured bands tell you the value before you measure it.

N5 Physics and Electronics (S3)



Daily Review

Booklet p.4-5 — Current and Voltage

- 1 Define current.
- 2 Define potential difference.
- 3 Where does an ammeter go? Where does a voltmeter go?
- 4 What is the current rule for a series circuit?
- 5 What is the voltage rule for a parallel circuit?

PART 1

Resistors and Colour Coding

Every resistor has its value printed on it — in colour.

By the end of this part...

- 1 I can give the symbol and function of a resistor and a variable resistor
- 2 I can read a resistor's value from its four colour bands
- 3 I can work out the maximum and minimum value from the tolerance

What resistance is

Booklet p.6

The definition

a measure of how difficult it is for charge to flow through a material

Symbol

R

Unit

ohm (Ω)

More resistance means less current for the same voltage.

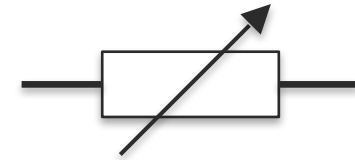
The two resistors

Booklet p.6, Task 1



Resistor

Reduces the current in a circuit
by a fixed amount



Variable resistor

Reduces the current by an
amount you can change

Tasks 1 and 2

Booklet p.6

Task 1: the symbol and function for both resistors.

Task 2: the definition of resistance, its symbol and unit.

Booklet p.6, Tasks 1 and 2

Tasks 1 and 2 – Answers

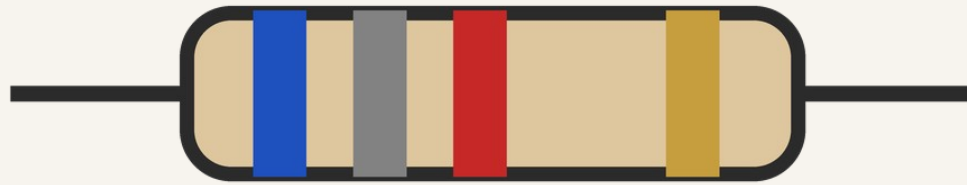
ANSWERS

Booklet p.6

	The answer
Resistor	reduces the current in a circuit by a fixed amount
Variable resistor	reduces the current by an amount you can change
Resistance	a measure of how difficult it is for charge to flow through a material
Symbol and unit	R, measured in ohms (Ω)

Reading the bands

Booklet p.6 – the colour code



Band 1

the first digit

Band 2

the second
digit

Band 3

the noughts

Band 4

the tolerance

The colour key

Booklet p.6

Colour	Digit	Noughts
Black	0	—
Brown	1	0
Red	2	00
Orange	3	000
Yellow	4	0000

Colour	Digit	Noughts
Green	5	00000
Blue	6	000000
Violet	7	—
Grey	8	—
White	9	—

Band 4: gold is $\pm 5 \%$, silver is $\pm 10 \%$.

Worked example

Blue · Grey · Red · Gold



Find the quoted value of this resistor, and its tolerance.

band 1 = blue = 6

band 2 = grey = 8

band 3 = red = 00

band 4 = gold = $\pm 5\%$

$$R = 6800 \, \Omega = 6.8 \, \text{k}\Omega$$

$$\text{tolerance} = 6800 \times 5/100 = 340 \, \Omega$$

$$\underline{6460 \, \Omega \text{ to } 7140 \, \Omega}$$

Task 3 – the seven rows

Booklet p.6

Four rows give the bands – find the value.
Three give the value – find the bands.

Booklet p.6, Task 3

Task 3 – Answers

ANSWERS

Booklet p.6 – rows 1 to 4

Bands	Quoted	Tol.	Max	Min
Orange Orange Brown Silver	330 Ω	$\pm 10 \%$	363 Ω	297 Ω
Green Blue Red Silver	5.6 k Ω	$\pm 10 \%$	6160 Ω	5040 Ω
Brown Green Orange Gold	15 k Ω	$\pm 5 \%$	15 750 Ω	14 250 Ω
Red Black Orange Gold	20 k Ω	$\pm 5 \%$	21 000 Ω	19 000 Ω

Task 3 – Answers

ANSWERS

Booklet p.6 – rows 5 to 7

Quoted	Tol.	Bands	Max	Min
470 Ω	$\pm 5 \%$	Yellow Purple Brown Gold	493.5 Ω	446.5 Ω
820 Ω	$\pm 10 \%$	Grey Red Brown Silver	902 Ω	738 Ω
390 k Ω	$\pm 5 \%$	Orange White Yellow Gold	409.5 k Ω	370.5 k Ω

Show me – the colour code

SHOW ME BOARDS

- 1 Brown Black Red Gold – what is the quoted value?
- 2 What tolerance does a silver band mean?
- 3 Red Red Brown Gold – what is the quoted value?
- 4 A $1000\ \Omega$ resistor: what are its first three bands?
- 5 A $100\ \Omega$ resistor has $\pm 10\%$ tolerance. Find its maximum value.

Show me – the colour code

SHOW ME BOARDS

EXTRA PRACTICE

- 1 Yellow Violet Red Gold – what is the quoted value?
- 2 What tolerance does a gold band mean?
- 3 Green Blue Brown Silver – what is the quoted value?
- 4 A $2200\ \Omega$ resistor: what are its first three bands?
- 5 A $200\ \Omega$ resistor has $\pm 5\%$ tolerance. Find its minimum value.

Daily Review

Booklet p.6 – the colour code

- 1 What does a gold fourth band mean?
- 2 Brown Black Brown Gold – what is the quoted value?
- 3 What does the third band tell you?
- 4 State the definition of resistance.
- 5 What is the unit of resistance?

PART 2

Using an Ohmmeter

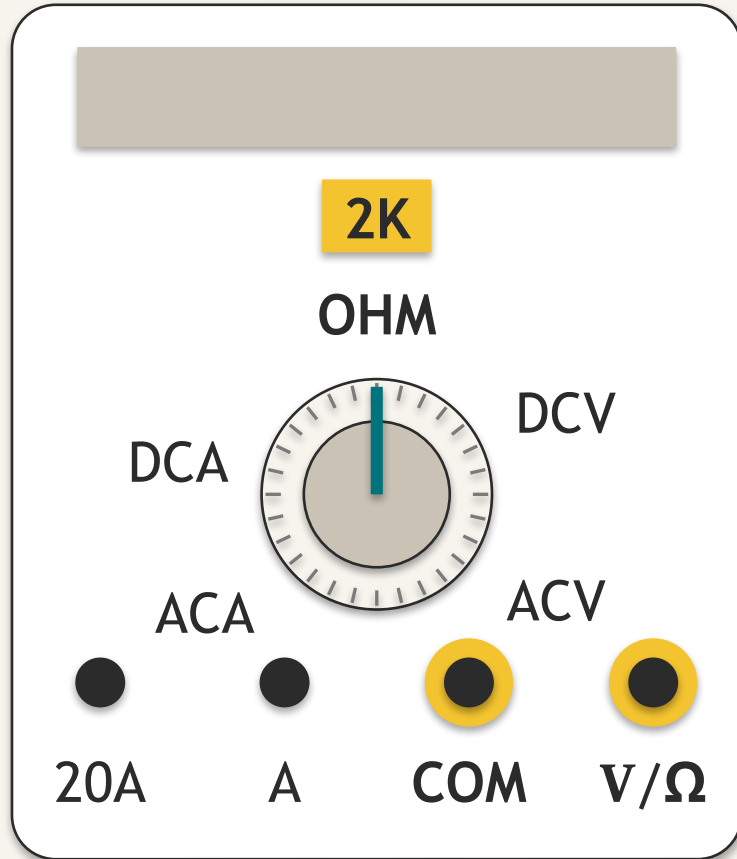
The bands tell you what it should be. The meter tells you what it is.

By the end of this part...

- 1 I can set a multimeter up to measure resistance
- 2 I can connect an ohmmeter across a resistor
- 3 I can say whether a measured value is within tolerance

The meter as an ohmmeter

Booklet p.7 – Task 4



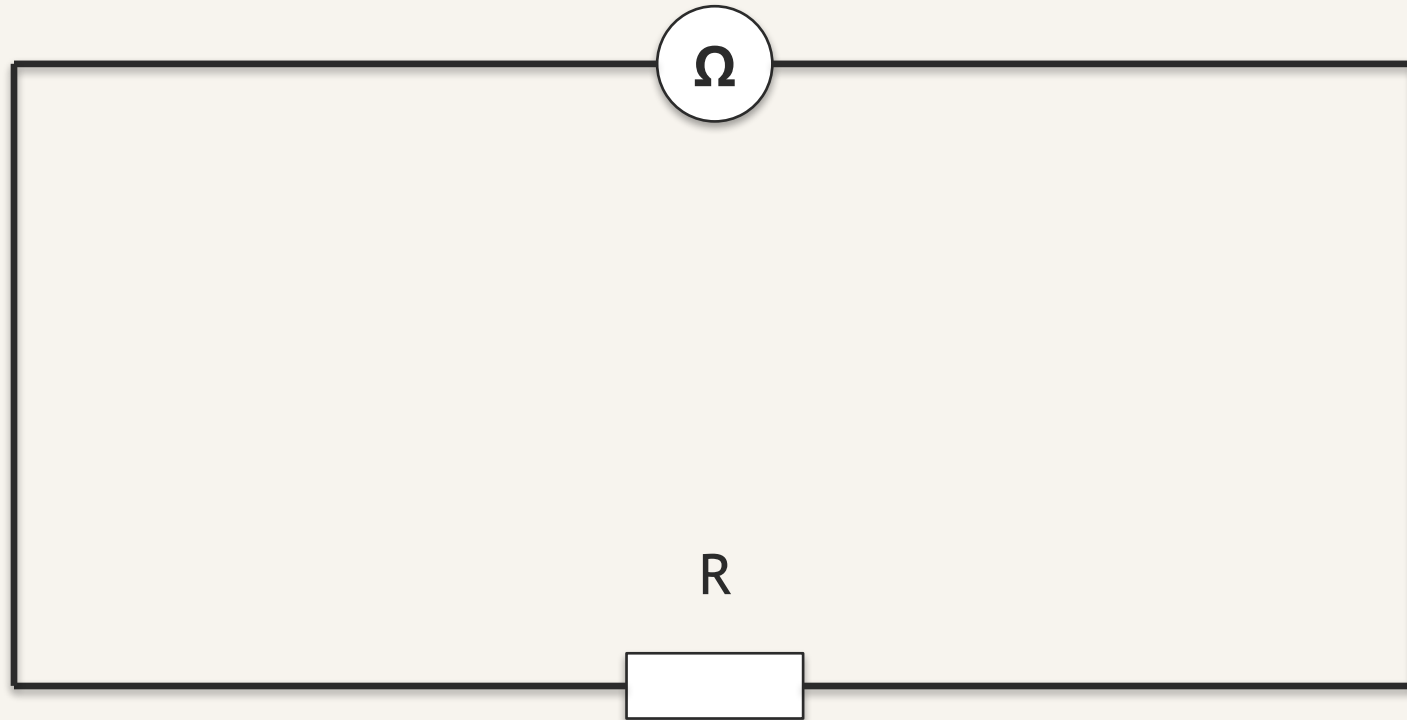
for a 220 Ω resistor

The dial goes on the Ω ranges, and the leads go in COM and V/ Ω .

Pick the smallest range that is bigger than the value you expect.

Connecting it

Booklet p.7



Straight across the resistor – and the resistor out of any circuit.

Task 4 – label the meters

Booklet p.7

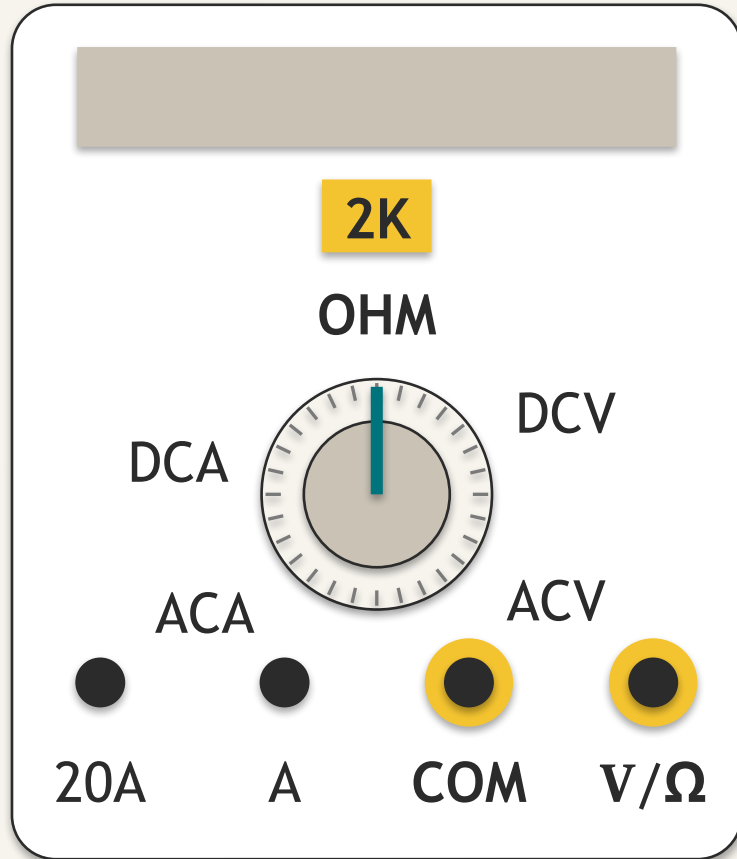
For each value, mark the dial setting
and the two sockets the leads go into.

Booklet p.7, Task 4

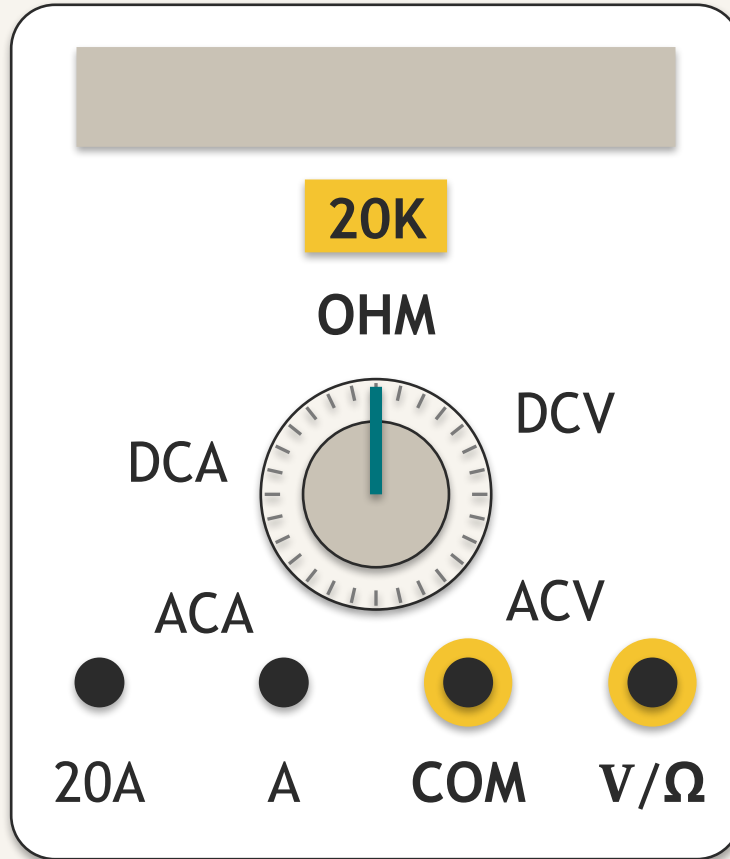
Task 4 – Answers

ANSWERS

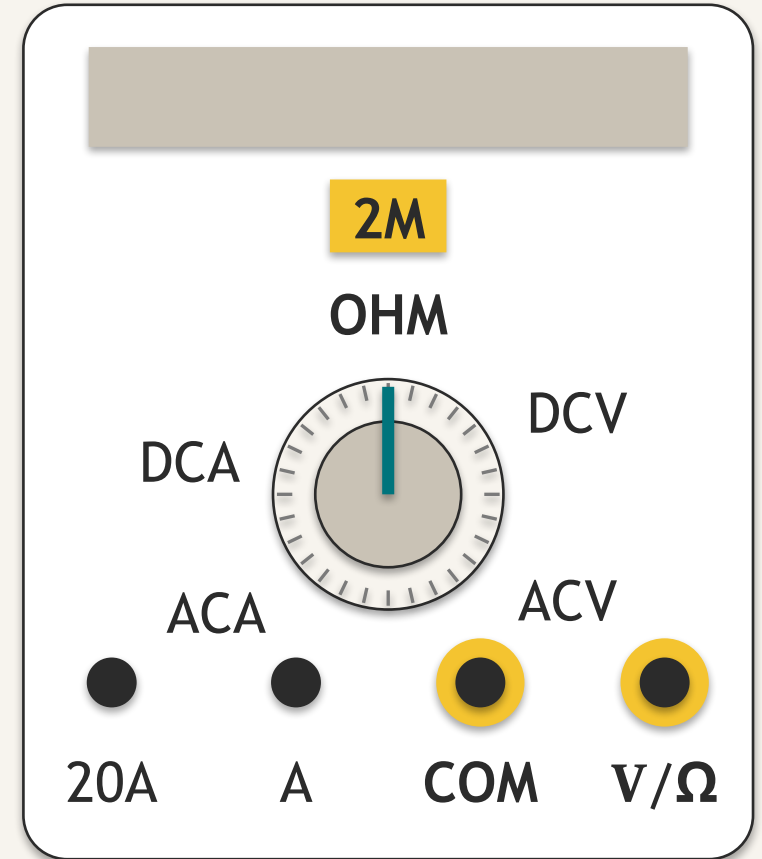
Booklet p.7



220 Ω



3 300 Ω



700 kΩ

Watch out

THE MISTAKE

- Measuring it while it is still in a circuit
- Holding a lead in each hand
- Leaving the dial on the smallest range

THE CORRECT ANSWER

- Take the resistor out first
- You measure yourself as well — hold the plastic
- Start high and work down, or it reads overload

Task 5 – the experiment

Booklet p.7

Fill in quoted, maximum and minimum from
the bands.

Then measure each one and fill in the rest.

Booklet p.7, Task 5 – resistors A to E

Within tolerance

Booklet p.7 – the last column

- The bands promise a range, not one exact number.
- If your measured value sits between the minimum and the maximum, it is within tolerance.
- If it does not, either the resistor is out of spec or the meter is on the wrong range.

Checkpoint

- 1 State the definition of resistance and give its unit.
- 2 Orange Orange Red Gold – find the quoted value and the tolerance.
- 3 Why must a resistor be taken out of the circuit before you measure it?

LOOKING AHEAD

Ohm's Law

One relationship ties voltage, current and resistance together.

Plenary

- 1 What does the first band on a resistor tell you?
- 2 What does the third band tell you?
- 3 Brown Black Orange Gold — find the quoted value.
- 4 Which two sockets does an ohmmeter use?
- 5 What does $\pm 10\%$ tolerance mean for a $100\ \Omega$ resistor?

- 1 What does the fourth band tell you?
- 2 What colour is the digit 5?
- 3 Red Red Red Silver — find the quoted value.
- 4 Where must the dial be set to measure resistance?
- 5 A $470\ \Omega$ resistor measures $500\ \Omega$ on $\pm 5\%$. Is it within tolerance?

Extension

- 1 A resistor measures $6900\ \Omega$. Its bands are Blue Grey Red Gold. Is it within tolerance?
- 2 Why do manufacturers give a tolerance at all?
- 3 Two resistors are both marked $1\ \text{k}\Omega$, one $\pm 5\%$ and one $\pm 10\%$. Which would you choose, and why?

- 1 What is the widest range a $1\text{ k}\Omega \pm 10\%$ resistor could actually be?
- 2 Why is a fourth band with no colour at all worse than gold or silver?
- 3 Design a set of bands for a $47\text{ k}\Omega \pm 5\%$ resistor.

Check your understanding

Booklet p.6-7

Work the resistance questions in the Yellow Book.

Then sit the check test and mark it yourself.

Yellow Books p.42-44
N5 Electricity CT 4 – Practical Circuits