4.1 Combining Resistors PAG Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Equipment: multimeter + 2 leads + 4 (or more) 1kΩ resistors + 5 croc clips

Label each resistor A, B, C or D with a small strip of sticky label.

Measure the combined resistance of the following combinations.

1. Each resistor on its own.

|  |  |  |  |
| --- | --- | --- | --- |
| A | B | C | D |
|  |  |  |  |

2. Pairs of resistor in series

|  |  |  |  |
| --- | --- | --- | --- |
| AB | BA | AC | AD |
|  |  |  |  |

3. Three resistors in series

|  |  |  |  |
| --- | --- | --- | --- |
| ABC | ACB | CAB | BCA |
|  |  |  |  |

4. Four resistors in series

|  |  |  |  |
| --- | --- | --- | --- |
| ABCD | ACBD | DCAB | BDCA |
|  |  |  |  |

Describe any patterns you have found for resistors in series.

5. Two resistors in parallel

|  |  |  |  |
| --- | --- | --- | --- |
| AB | BC | AC | DA |
|  |  |  |  |

6. Three resistors in parallel

|  |  |  |  |
| --- | --- | --- | --- |
| ABC | ABD | ACD | BCD |
|  |  |  |  |

|  |
| --- |
| ABCD |
|  |

7. All four in parallel

What pattern have you found? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

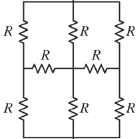
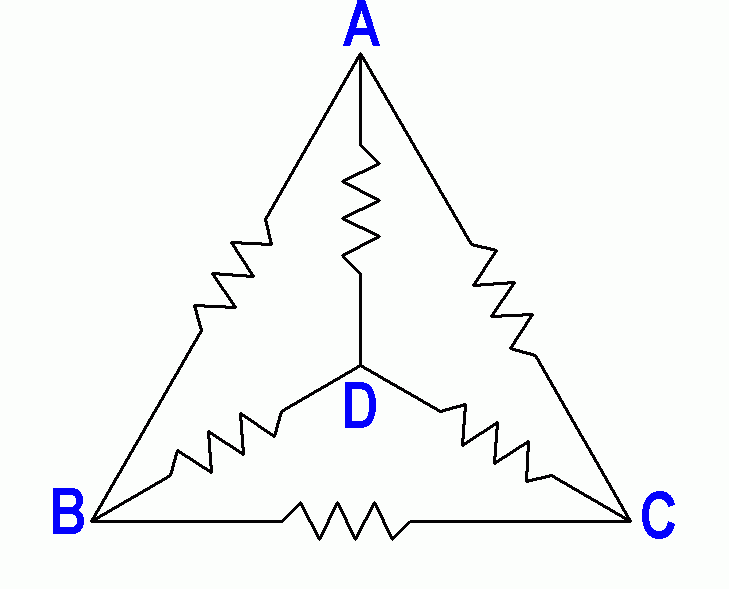
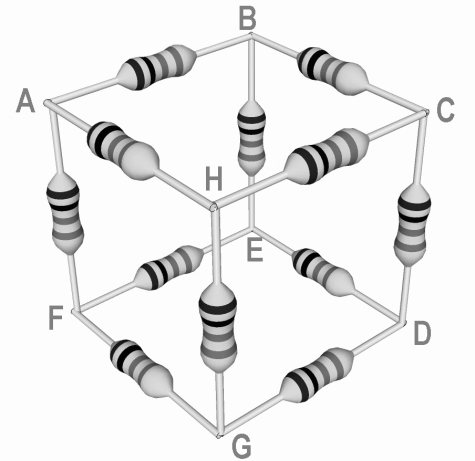
Now predict the resistance of the following combinations and see if you are correct.

Prediction = \_\_\_\_\_\_\_\_\_\_\_\_ Measured Value = \_\_\_\_\_\_\_\_\_\_\_\_

Prediction = \_\_\_\_\_\_\_\_\_\_\_\_ Measured Value = \_\_\_\_\_\_\_\_\_\_\_\_

Prediction = \_\_\_\_\_\_\_\_\_\_\_ Measured Value = \_\_\_\_\_\_\_\_\_\_\_\_

Now investigate the resistances across a 2D or 3D arrangement of resistors such as one of the ones below.



Resistor Arrangement Chosen

|  |
| --- |
|  |

Record your findings below.

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Conclusions**

**Aims and skills covered**

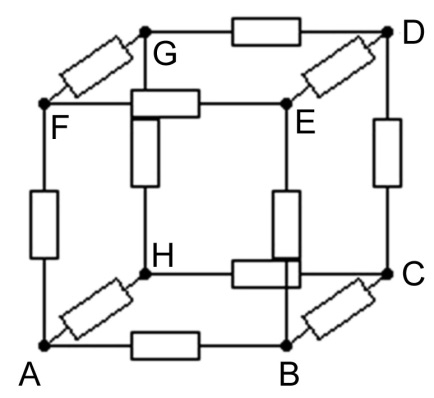
* To determine the combined value of resistor combinations
* To use appropriate digital meters including multimeters to measure resistance

**Practical Skills**

* 1.2.1(a) apply investigative approaches and methods to practical work
* 1.2.1(b) safely and correctly use a range of practical equipment and materials
* 1.2.1(c) follow written instructions
* 1.2.1(d) make and record observations/measurements
* 1.2.1(e) keep appropriate records of experimental activities
* 1.2.1(f) present information and data in a scientific way
* 1.2.1(j) use a wide range of experimental and practical instruments, equipment and techniques appropriate to the knowledge and understanding included in the specification
* 1.2.2(b) use of appropriate digital instruments including electrical multimeters to measure resistance

**CPAC**

* (1) Follows written procedures
* (2) Applies investigative approaches and methods when using instruments and equipment
* (3) Safely uses a range of practical equipment and materials
* (4) Makes and records observations



A to D

A

F

H

B

D

G

E

C

R/3 + R/6 + R/3 = 5/6 R = 83.3Ω

A

H

B

C

F

D

G

E

A to C

Since H,G,E and B are symetrically mid way between A and C they must be at the same potential i.e. midway between A and C therefore we can ignore resistors GH and BE as no current will flow. AHC = 200Ω, ABC = 200Ω so combined that is 100Ω, F to D is 100Ω by the same reasoning. The central paths give 100Ω + 100Ω + 100Ω = 300Ω which is in parallel with the combined outer paths of 100Ω. The total is therefore 75Ω or more generally 3/4 R.

A to B

A

F

H

B

D

G

E

C

Blue = 50+100+50 = 200Ω Yellow = 100/2 = 50Ω Combined = 40Ω

Green = 100/2 = 50Ω so total for shaded routes = 50+40+50=140Ω

So total for whole network = 140Ω in parallel with 100Ω = 58.3Ω

Or more generally 7/12 R