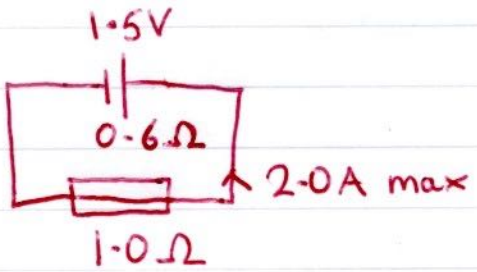
Resistors

① Fuse and resistors in series



1 cell $I = V/R = 1.5/(1.0+0.6) = 0.94\,A$ OK

2 cells $I = V/R = 3.0/(1.0+0.6+0.6) = 1.4\,A$ OK

3 cells $I = V/R = 4.5/(1.0+0.6+0.6+0.6) = 1.6\,A$ OK

4 cells $1.5\times4/1+(0.6\times4) = 1.76\,A$ OK

OK fed up with this method so ....

$$I = \frac{V}{R} = \frac{1.5\times n}{1+0.6n} < 2.0A$$

$\frac{1.5n}{1+0.6n} < 2$ n = number of cells.

6 cells ⇒ 1.95 A
7 cells ⇒ 2.02 A ✓

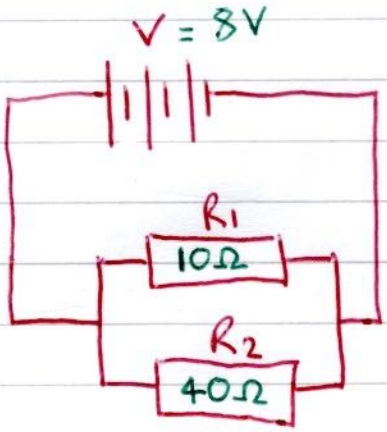
$1.5n < 2 + 1.2n$

$0.3n < 2$

$n < 2/0.3 = 6.66$ cells

∴ 6 cells max.

② Resistors in Parallel



(A) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{10} + \frac{1}{40} = \frac{1}{8}$

$\therefore R_T = 8\,\Omega$

$I = V/R = 8V/8\,\Omega = \underline{1.0\ A}$

(B) $P = IR = V^2/R = 8^2/10 = \underline{6.4\ W}$

(C) <u>Increases</u> as resistance will be lower (or conductance will be higher)

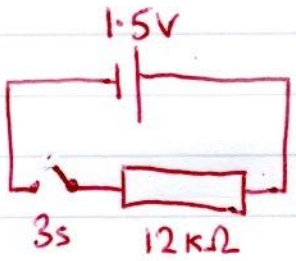
(D) For current to double the total resistance must halve so must now be $4\,\Omega$

$\frac{1}{4} = \frac{1}{10} + \frac{1}{40} + \frac{1}{R_3}$

$\frac{1}{R_3} = \frac{1}{4} - \frac{1}{8} = \frac{1}{8}$

so $\underline{R_3 = 8.0\,\Omega}$

③ Electron Current

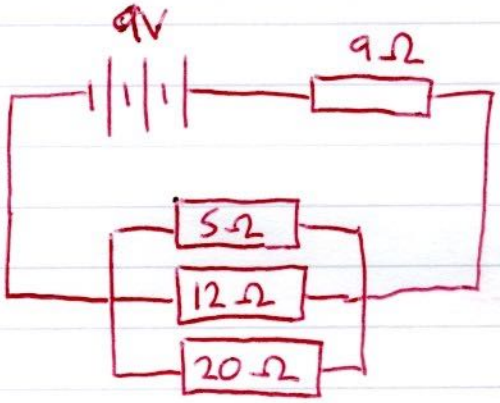


Current = V/R = $1.5/12\times10^{3}$ = 1.25×10^{-4} A

Charge = It = 1.25×10^{-4} A × 3s = 3.75×10^{-4} C

No of electrons = Q/e = $\frac{3.75\times10^{-4}\,C}{1.6\times10^{-19}}$ = $\underline{2.3\times10^{15}}$

④ Resistors in Parallel & Series



Ⓐ $\frac{1}{R_T} = \frac{1}{5} + \frac{1}{12} + \frac{1}{20} = \frac{1}{3}$ $\therefore$ $R_T = \underline{3\,\Omega}$

Ⓑ $I = V/R$ = $9V/9\Omega+3\Omega$ = 0.75 A

= $\underline{0.8\,A}$ 1sf

Ⓒ Voltage across 5Ω resistor = $\frac{3}{9+3}\times 9V$ = 2.25V

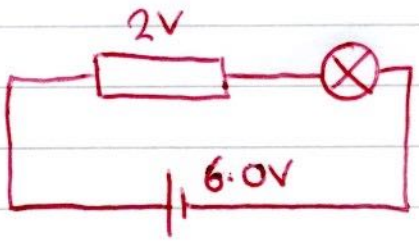
Current = V/R = $2.25V/5\Omega$ = 0.45A = $\underline{0.5A}$

⑤ Power of a light bulb.

Bulb			
	2.0V	→	0.3 A
	4.0V	→	0.5 A
	6.0V	→	0.6 A

(from graph)

Ⓐ



Ⓐ If 2V across resistor 4V must be across lamp. so the current must be 0.5 A

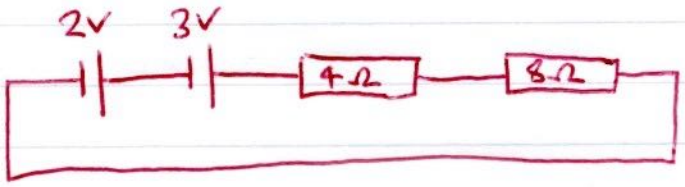
$P = IV = 0.5A \times 4V = 2.0W$

Ⓑ If current is 0.30A then voltage across bulb must be 2.0V so voltage across resistor must be 4.0V.

$R = V/I = 4.0V/0.3A = 13.3\ \Omega$

$\underline{13\ \Omega}$ 2 sf.

⑥ Two cells & two resistors



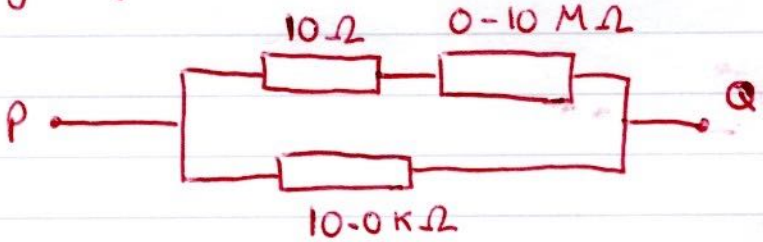
Ⓐ $R_T = 4\Omega + 8\Omega = 12\ \Omega$

Wrong way cell ⇒ 1V ∴ $I = V/R = \frac{1V}{12\Omega} = 0.08\ A$

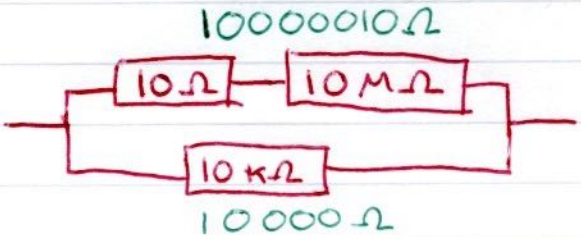
correct way cell ⇒ 5V ∴ $I = V/R = 5V/12\Omega = 0.42\ A$

↓ Ratio = 5.0 ← OR

⑦ Range of related resistors

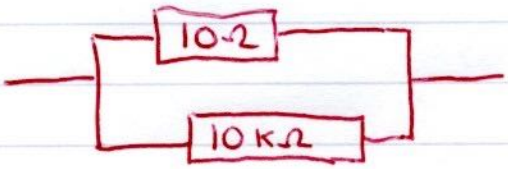


max



= 9990.01 Ω

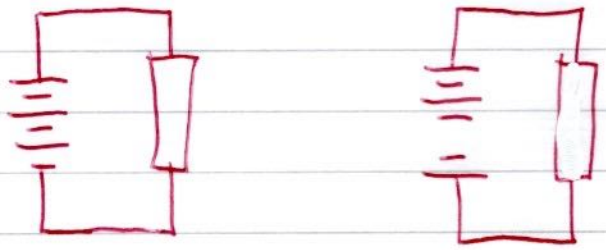
min



= 9.99001 Ω

Difference = 9980 Ω

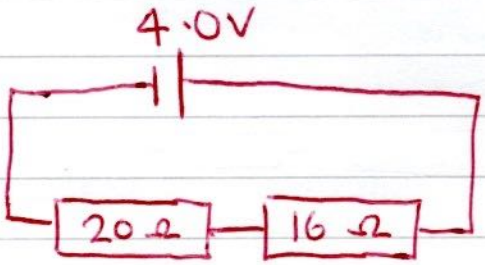
⑧ Cells in Reverse



voltage ratio = 3 : 1 ∴ power ratio = 9 : 1

as $P = IV = I^2R = V^2/R$ and R is constant so $P \propto V^2 = 3^2 = 9$

⑨ Series resistors



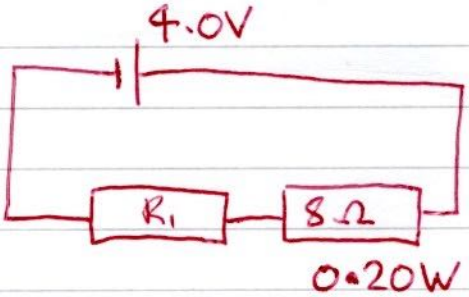
Ⓐ $R_T = 20\Omega + 16\Omega = 36\Omega$

$I = V/R = 4.0V/36\Omega = 0.11\ A$

$P = I^2R = 0.11^2 \times 16 = 0.198\ W$

$= 0.20\ W$ 2 sf

Ⓑ



$P = I^2R$ ∴ $I = \sqrt{P/R} = \sqrt{\frac{0.20}{8}}$

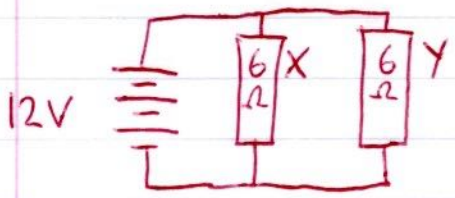
$= 0.158\ A$

TOTAL $R = V/I = 4/0.158 = 25.3\Omega$

∴ $R_1 = 25.3 - 8 = 17.3\Omega$

17Ω ←

(10) Current in parallel Resistors



$x, y = 6\ \Omega$

Combined resistance $= \frac{1}{R_T} = \frac{1}{6} + \frac{1}{6} = \frac{1}{3}$

$\therefore R_T = 3\ \Omega$

$I_{TOTAL} = 12V/R = 12/3 = 4.0A$

$\therefore$ current through each $= 4.0A/2 =$ <u>2.0A</u>

or Just $I = V/R = 12/6 =$ <u>2.0 A</u>

↑ ie much more simply!