Resistance & Equivalent Resistance:

name: SOLUTIONS

1) An automobile starter requires 100 Amps of current and a 12 V battery. What is the Resistance of the starter ?

$R = \frac{V}{I}$

$R = \frac{12}{100}$

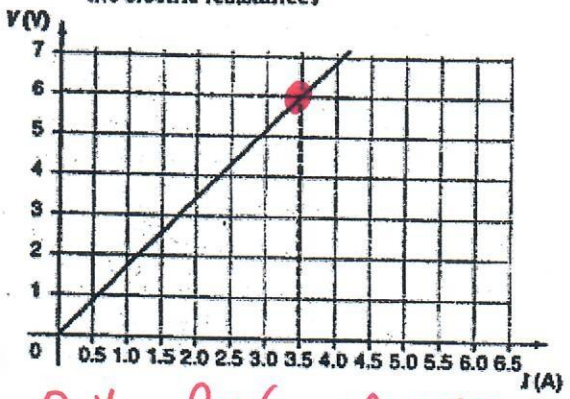
$R = 0.12\ \Omega$

2) What potential difference is required for a 0.05 A current to flow through a 1500 Ω resistor?

$V = IR$

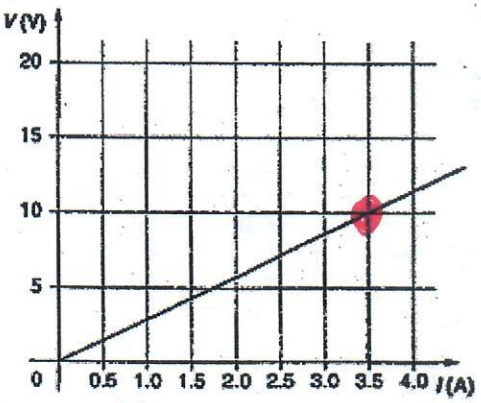
$V = 0.05(1500)$ $V = 75\ V$

3) Using the following V = f(I) graph, determine the electric resistance.



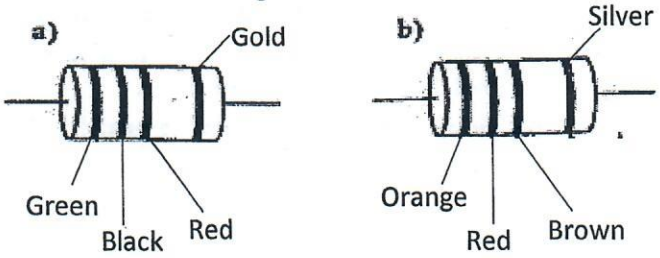
$R = \frac{V}{I}$ $R = \frac{6}{3.5}$ $R = 1.7\ \Omega$

4) Using the following V = f(I) graph, determine the electric resistance.



$R = \frac{V}{I}$ $R = \frac{10}{3.5}$ $R = 2.85\ \Omega$

5) Determine the electric resistance and tolerance of these resistors using the colour code.



a) $50 \times 10^2\ \Omega \pm 5\%$

$5000\ \Omega \pm 5\%$

Range:

$5000\ \Omega \pm 250\ \Omega$

4750 to $5250\ \Omega$

b) $32 \times 10^1\ \Omega \pm 10\%$

$320\ \Omega \pm 10\%$

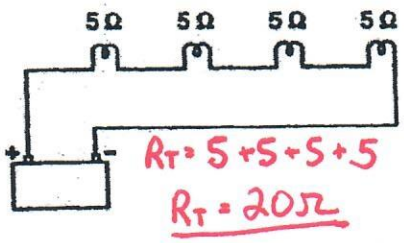
Range:

$320\ \Omega \pm 32\ \Omega$

288 to $352\ \Omega$

6) Determine the equivalent resistance of each of the following circuits:

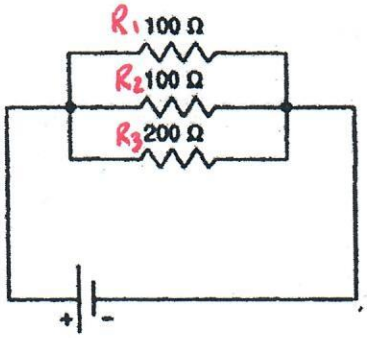
a)



$R_T = 5+5+5+5$

$R_T = 20\ \Omega$

b)



$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$\frac{1}{R_T} = \frac{1}{100} + \frac{1}{100} + \frac{1}{200}$

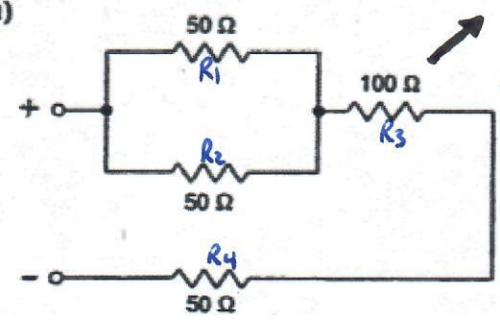
$\frac{1}{R_T} = \frac{2+2+1}{200}$

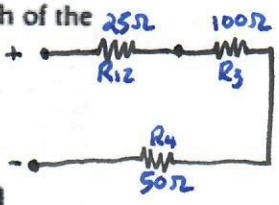
$\frac{1}{R_T} = \frac{5}{200}$

$R_T = 40\ \Omega$

7) Calculate the equivalent resistance of each of the following combination circuits.

a)





① $\frac{1}{R_{12}} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R_{12}} = \frac{1}{50} + \frac{1}{50}$

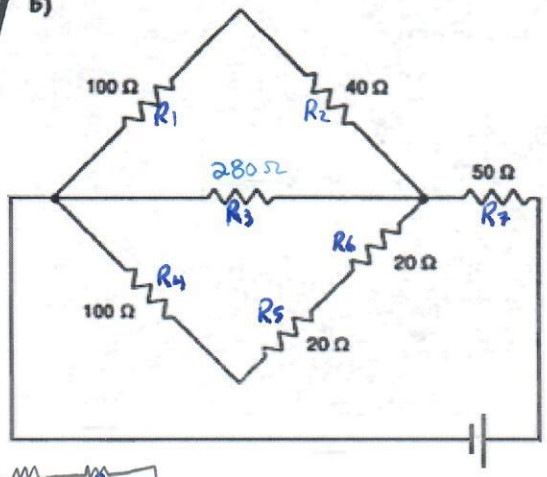
$R_{12} = 25\Omega$

② $R_T = R_{12} + R_3 + R_4$ (series)

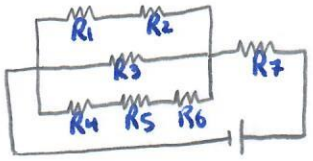
$R_T = 25 + 100 + 50$

$R_T = 175\Omega$

b)



Same



② $R_{12} = R_1 + R_2$

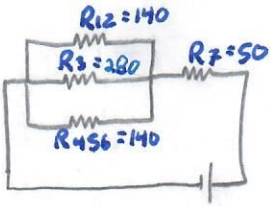
$R_{12} = 100 + 40$

$R_{12} = 140\Omega$

③ $R_{456} = R_4 + R_5 + R_6$

$R_{456} = 100 + 20 + 20$

$R_{456} = 140\Omega$

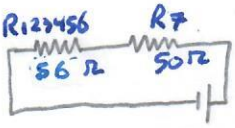


⑤ $\frac{1}{R_{123456}} = \frac{1}{R_{12}} + \frac{1}{R_3} + \frac{1}{R_{456}}$

$\frac{1}{R_{123456}} = \frac{1}{140} + \frac{1}{280} + \frac{1}{140}$

$R_{123456} = 56\Omega$

⑥



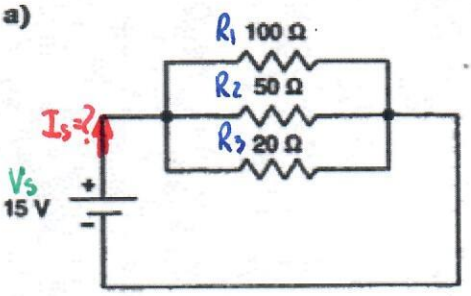
⑦ $R_T = R_{123456} + R_7$

$R_T = 56 + 50$

$R_T = 106\Omega$

8) Calculate the current coming from the batteries in the following circuits.

a)



① $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$\frac{1}{R_T} = \frac{1}{100} + \frac{1}{50} + \frac{1}{20}$

$\frac{1}{R_T} = \frac{1+2+5}{100}$

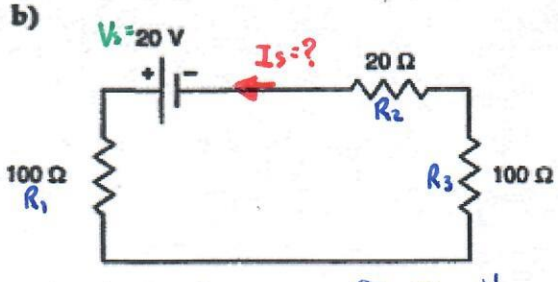
$R_T = 12.5\Omega$

② $I_S = \frac{V_S}{R_T}$

$I_S = \frac{15}{12.5}$

$I_S = 1.2\,A$

b)



① $R_T = R_1 + R_2 + R_3$

$R_T = 100 + 20 + 100$

$R_T = 220\Omega$

② $I_S = \frac{V_S}{R_T}$

$I_S = \frac{20}{220} = 0.09\,A$

9) a) A bulb operating on 110 V is carrying a 0.9 A current. What is the resistance of the bulb?

b) Determine the equivalent resistance of three such bulbs connected in series.

c) Determine the equivalent resistance of three such bulbs connected in parallel.

a) $R = \frac{V}{I}$

$R = \frac{110}{0.9} = 122\Omega$

b) $R_T = 122 + 122 + 122$

$R_T = 366\Omega$

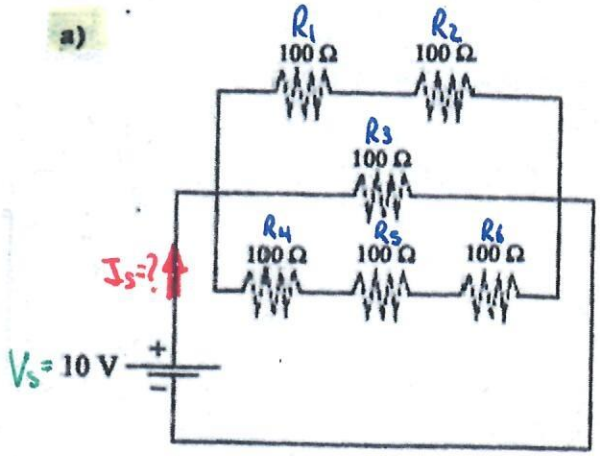
c) $\frac{1}{R_T} = \frac{1}{122} + \frac{1}{122} + \frac{1}{122}$

$\frac{1}{R_T} = \frac{1+1+1}{122}$

$R_T = 40.7\Omega$

10) Determine the current leaving the battery in each of the following circuits.

a)



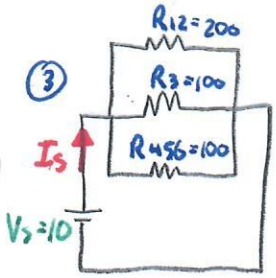
① $R_{12} = R_1 + R_2$

$R_{12} = 200\,\Omega$

② $R_{456} = R_4 + R_5 + R_6$

$R_{456} = 300\,\Omega$

③



④ $\frac{1}{R_T} = \frac{1}{R_{12}} + \frac{1}{R_3} + \frac{1}{R_{456}}$

$\frac{1}{R_T} = \frac{1}{200} + \frac{1}{300} + \frac{1}{100}$

$\frac{1}{R_T} = \frac{3+6+2}{600}$

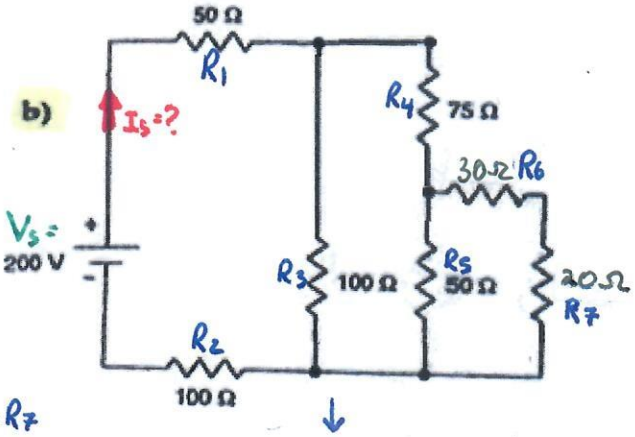
$\frac{1}{R_T} = \frac{11}{600}$

$R_T = 54.5\,\Omega$

⑤ $I_S = \frac{V_S}{R_T}$

$I_S = \frac{10}{54.5}$ $\quad I_S = 0.18\,A$

b)



① $R_{67} = R_6 + R_7$ (series)

$R_{67} = 50\,\Omega$

② $\frac{1}{R_{567}} = \frac{1}{R_5} + \frac{1}{R_{67}}$ (parallel)

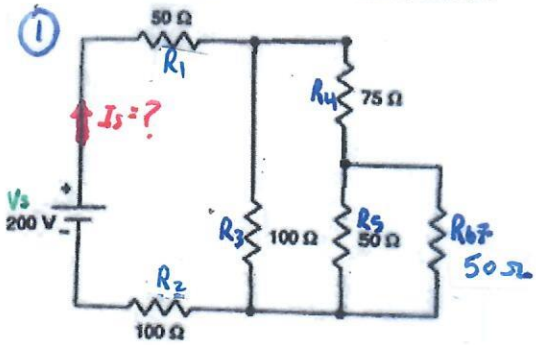
$\frac{1}{R_{567}} = \frac{1}{50} + \frac{1}{50}$

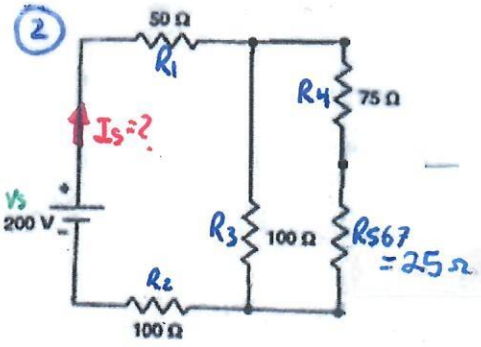
$R_{567} = 25\,\Omega$

③ $R_{4567} = R_4 + R_{567}$ (series)

$R_{4567} = 75 + 25$

$R_{4567} = 100\,\Omega$





⑤ $R_T = R_1 + R_2 + R_{34567}$ (series)

$R_T = 50 + 100 + 50$

$R_T = 200\,\Omega$

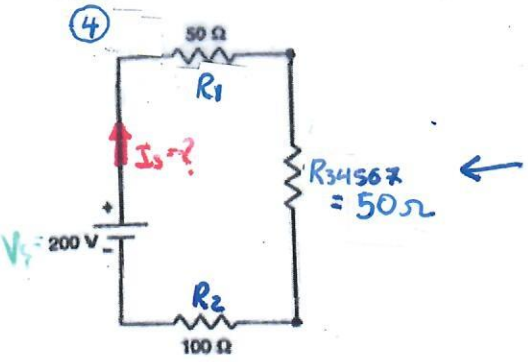
④ $\frac{1}{R_{34567}} = \frac{1}{R_3} + \frac{1}{R_{4567}}$ (Parallel)

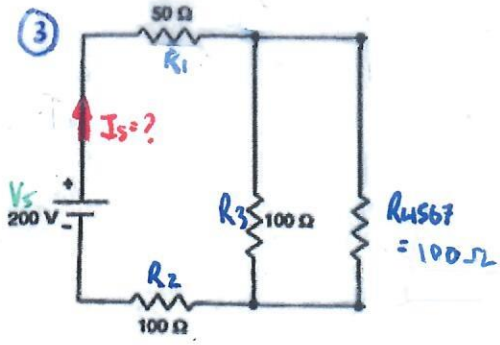
$R_{34567} = 50\,\Omega$

⑥ $I_S = \frac{V_S}{R_T}$

$I_S = \frac{200}{200}$

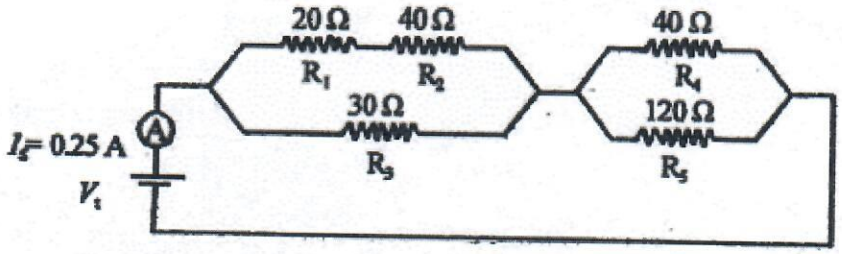
$I_S = 1\,A$





11)

The following electric circuit consists of a power supply, five resistors (R_1, R_2, R_3, R_4 and R_5) and an ammeter (A).

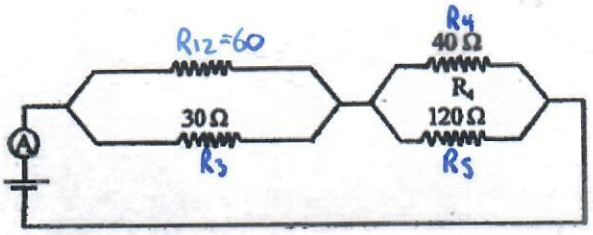


What is the potential difference (voltage), V_s, across the power supply?

① $R_{12} = R_1 + R_2$ (series)

$R_{12} = 20 + 40$

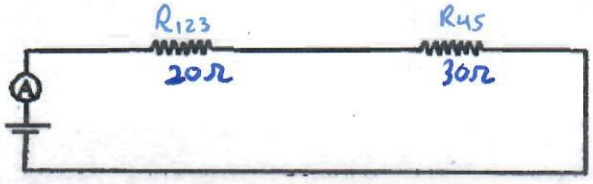
$R_{12} = 60\,\Omega$



② $\frac{1}{R_{123}} = \frac{1}{R_{12}} + \frac{1}{R_3}$ (Parallel)

$\frac{1}{R_{123}} = \frac{1}{60} + \frac{1}{30}$

$R_{123} = 20\,\Omega$



③ $\frac{1}{R_{45}} = \frac{1}{R_4} + \frac{1}{R_5}$ (Parallel)

$\frac{1}{R_{45}} = \frac{1}{40} + \frac{1}{120}$

$R_{45} = 30\,\Omega$

④ $R_T = R_{123} + R_{45}$ series.

$R_T = 20 + 30$

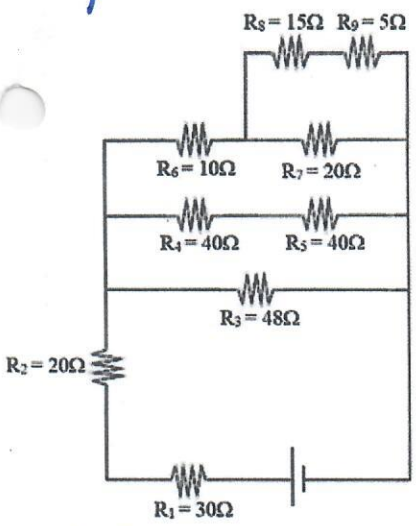
$R_T = 50\,\Omega$

⑤ $V_S = I_S R_T$

$V_S = 0.25(50)$

$V_S = 12.5\,V$

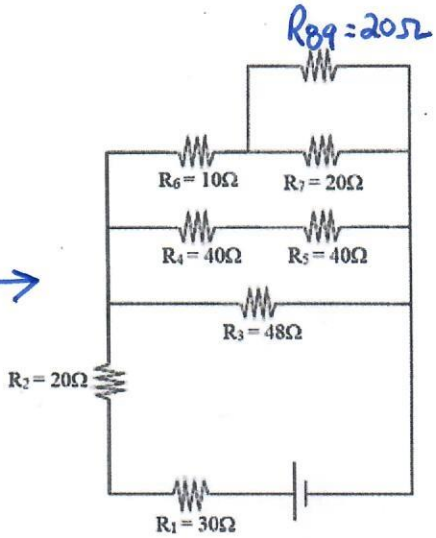
#12) Find R_T



① $R_{89} = R_8 + R_9$

$R_{89} = 15 + 5$

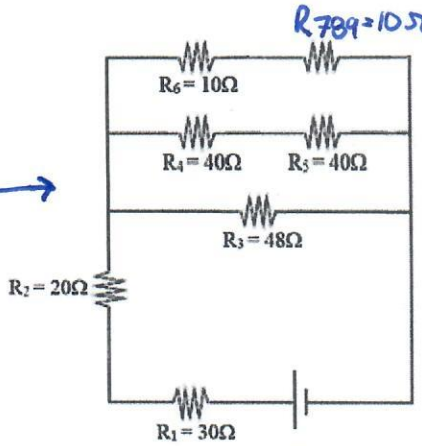
$R_{89} = 20\Omega$



② $\frac{1}{R_{789}} = \frac{1}{R_7} + \frac{1}{R_{89}}$

$\frac{1}{R_{789}} = \frac{1}{20} + \frac{1}{20}$

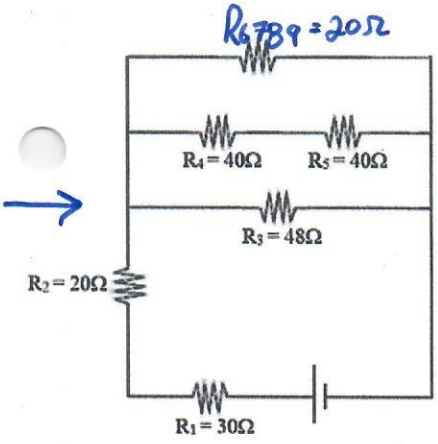
$R_{789} = 10\Omega$



③ $R_{6789} = R_6 + R_{789}$

$R_{6789} = 10 + 10$

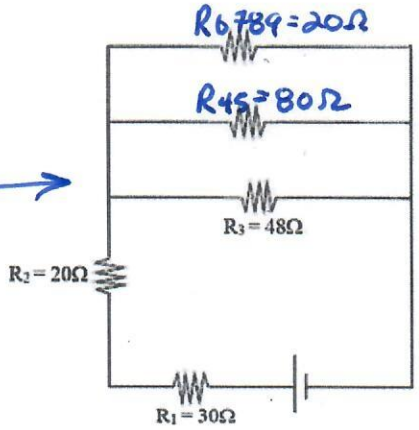
$R_{6789} = 20\Omega$



④ $R_{45} = R_4 + R_5$

$R_{45} = 40 + 40$

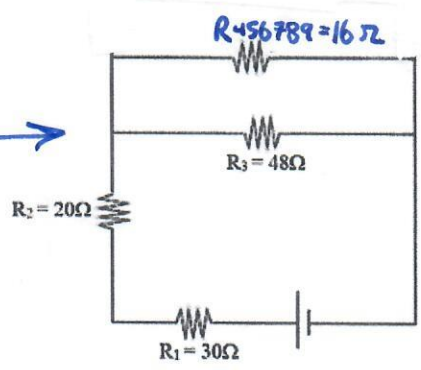
$R_{45} = 80\Omega$



⑤ $\frac{1}{R_{456789}} = \frac{1}{R_{45}} + \frac{1}{R_{6789}}$

$\frac{1}{R_{456789}} = \frac{1}{80} + \frac{1}{20}$

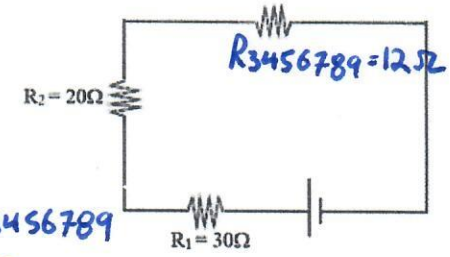
$R_{456789} = 16\Omega$



⑥ $\frac{1}{R_{3456789}} = \frac{1}{R_3} + \frac{1}{R_{456789}}$

$\frac{1}{R_{3456789}} = \frac{1}{48} + \frac{1}{16}$

$R_{3456789} = 12\Omega$



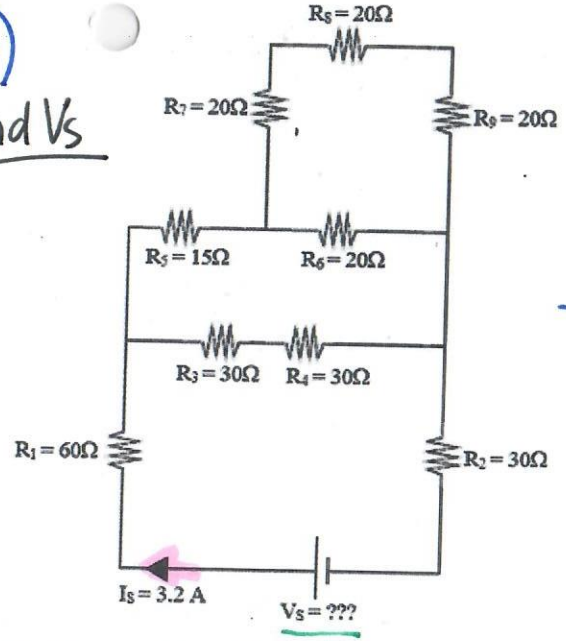
⑦ $R_T = R_1 + R_2 + R_{3456789}$

$R_T = 30 + 20 + 12$

$R_T = 62\Omega$

#13)

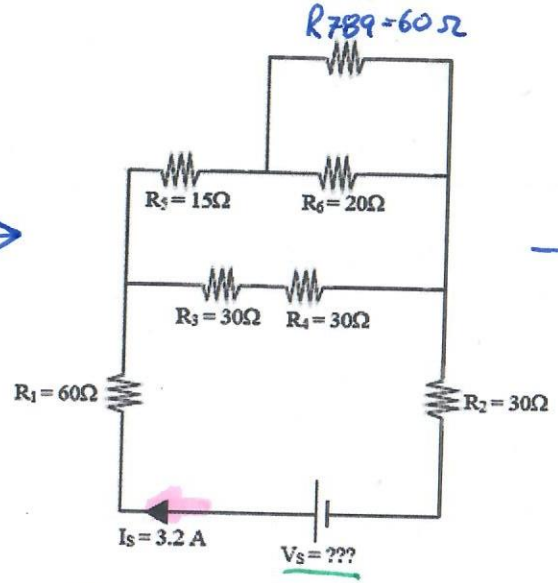
Find Vs



① $R_{789} = R_7 + R_8 + R_9$

$R_{789} = 20 + 20 + 20$

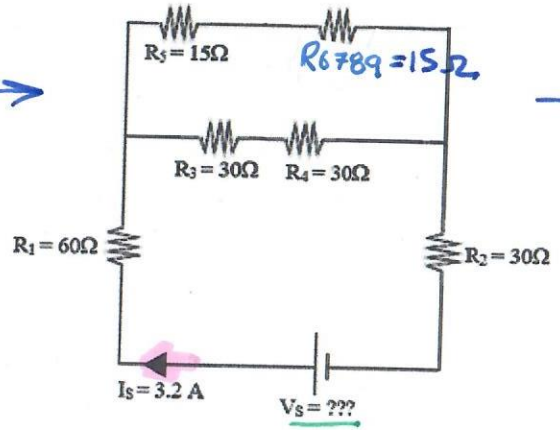
$R_{789} = 60\Omega$



② $\frac{1}{R_{6789}} = \frac{1}{R_6} + \frac{1}{R_{789}}$

$\frac{1}{R_{6789}} = \frac{1}{20} + \frac{1}{60}$

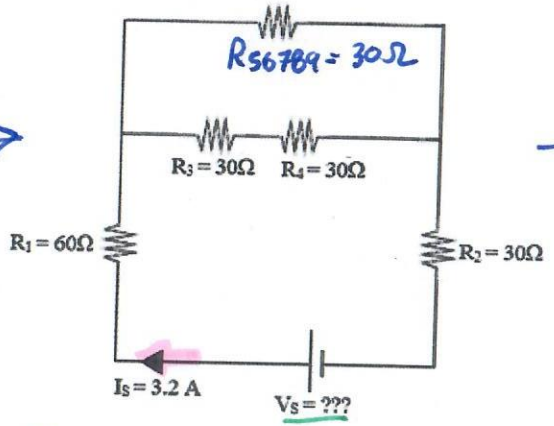
$R_{6789} = 15\Omega$



③ $R_{56789} = R_5 + R_{6789}$

$R_{56789} = 15 + 15$

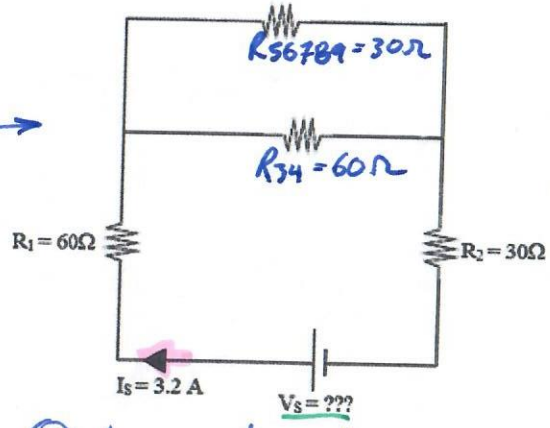
$R_{56789} = 30\Omega$



④ $R_{34} = R_3 + R_4$

$R_{34} = 30 + 30$

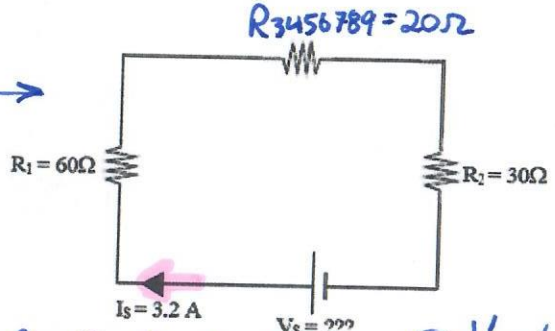
$R_{34} = 60\Omega$



⑤ $\frac{1}{R_{3456789}} = \frac{1}{R_{34}} + \frac{1}{R_{56789}}$

$\frac{1}{R_{3456789}} = \frac{1}{60} + \frac{1}{30}$

$R_{3456789} = 20\Omega$



⑥ $R_T = R_1 + R_2 + R_{3456789}$

$R_T = 60 + 30 + 20$

$R_T = 110\Omega$

⑦ $V_S = I_S R_T$

$V_S = 3.2(110)$

$V_S = 352\,V$