Question 1

A conductor is distinguished from an insulator with the same number of atoms by the number of:

A nearly free atoms

B electrons

C nearly free electrons

D protons

E molecules

C

Question 2

A small object has charge Q. Charge q is removed from it and placed on a second small object. The two objects are placed 1 m apart. For the force that each object exerts on the other to be a maximum, q should be:

A 2Q

B Q

C Q/2

D Q/4

E 0

$$F = \frac{q(Q-q)}{4\pi\varepsilon_0 d^2}$$

$(Q\text{-}q)q$ to be maximum

$$q = \frac{1}{2}Q$$

C

Question 3

Two identical conducting spheres A and B carry equal charge. They are separated by a distance much larger than their diameters. A third identical conducting sphere C is uncharged. Sphere C is first touched to A, then to B, and finally removed. As a result, the electrostatic force between A and B, which was originally F , becomes:

A F/2

B F/4

C 3F/8

D F/16

E 0

	A	B	C
beginning	Q	Q	0
First touch	Q/2	Q	Q/2
Second touch	Q/2	3Q/4	3Q/4

C

Question 4

Experimenter A uses a test charge q_0 and experimenter B uses a test charge $2q_0$ to measure an electric field produced by stationary charges. A finds a field that is:

A the same in both magnitude and direction as the field found by B

B greater in magnitude than the field found by B

C less in magnitude than the field found by B

D opposite in direction to the field found by B

E either greater or less than the field found by B, depending on the accelerations of the test charges

A

Question 5

Two thin spherical shells, one with radius R and the other with radius 2R, surround an isolated charged point particle. The ratio of the number of field lines through the larger sphere to the number through the smaller is:

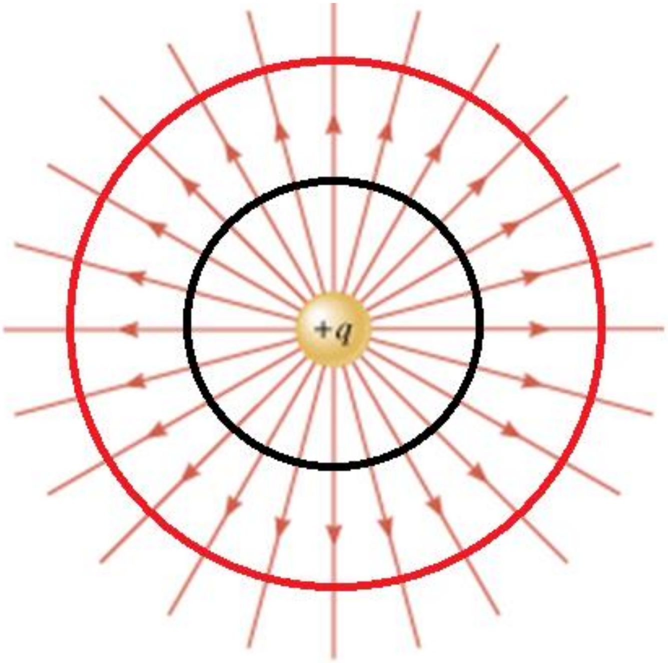
A 1

B 2

C 4

D 1/2

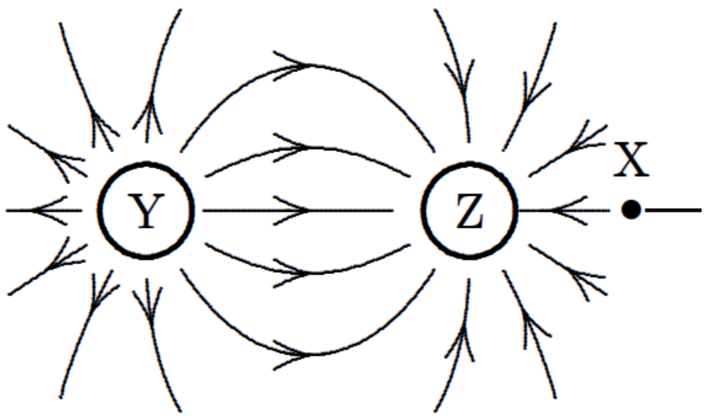
E 1/4



A

Question 6

The diagram shows the electric field lines in a region of space containing two small charged spheres (Y and Z). Then:



A Y is negative and Z is positive

B the magnitude of the electric field is the same everywhere

C the electric field is strongest midway between Y and Z

D the electric field is not zero anywhere (except infinitely far from the spheres)

E Y and Z must have the same sign

D

Question 7

An isolated charged point particle produces an electric field with magnitude E at a point 2 m away from the charge. A point at which the field magnitude is E/4 is:

A 1 m away from the particle

B 0.5 m away from the particle

C 2 m away from the particle

D 4 m away from the particle

E 8 m away from the particle

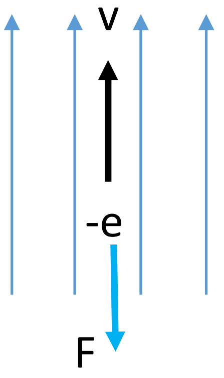
$$E = \frac{Q}{4\pi\varepsilon_0 d^2}$$

$$\frac{E}{4} = \frac{Q}{4\pi\varepsilon_0 (2d)^2}$$

D

Question 8

An electron traveling north enters a region where the electric field is uniform and points north. The electron:



A speeds up

B slows down

C veers east

D veers west

E continues with the same speed in the same direction

B

Question 9

An electric field exerts a torque on a dipole only if:

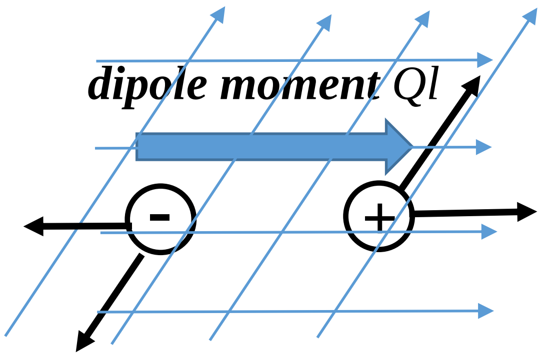
A the field is parallel to the dipole moment

B the field is not parallel to the dipole moment

C the field is perpendicular to the dipole moment

D the field is not perpendicular to the dipole moment

E the field is uniform



B

Question 10

A conducting sphere of radius 0.01m has a charge of 1.0×10^{-9} C deposited on it. The magnitude of the electric field in N/C just inside the surface of the sphere is:

A 0

B 450

C 900

D 4500

E 90, 000

A

Question 11 (beyond what you have learned)

Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2 . A particle with charge q is placed at the center of the cavity. The magnitude of the electric field at a point in the cavity, a distance r from the center, is:

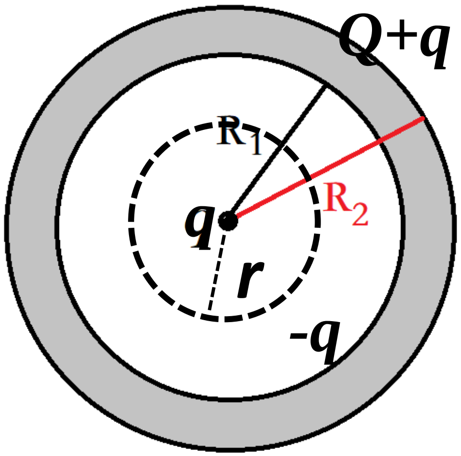
A zero

B $\frac{Q}{4\pi\varepsilon_0 R_1^2}$

C $\frac{q}{4\pi\varepsilon_0 r^2}$

D $\frac{q+Q}{4\pi\varepsilon_0 r^2}$

E $\frac{q+Q}{4\pi\varepsilon_0 \left(R_1^2 - r^2\right)}$



C

Question 12 (beyond what you have learned)

Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2 . A particle with charge q is placed at the center of the cavity. The magnitude of the electric field at a point outside the shell, a distance r from the center, is:

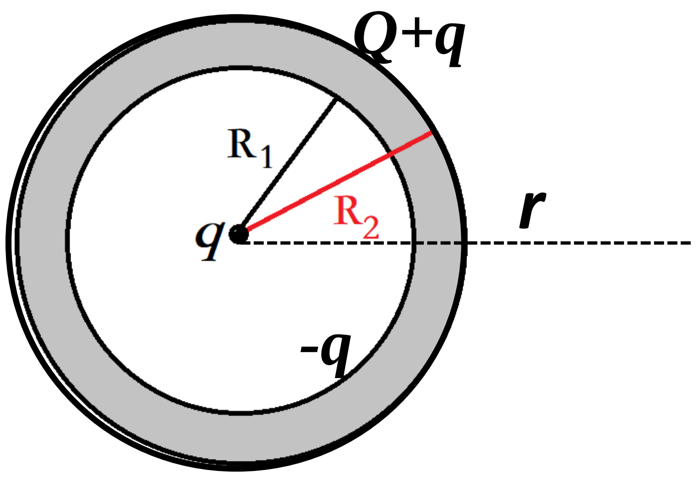
A zero

B $\dfrac{Q}{4\pi\varepsilon_0 R_1^2}$

C $\dfrac{q}{4\pi\varepsilon_0 r^2}$

D $\dfrac{q+Q}{4\pi\varepsilon_0 r^2}$

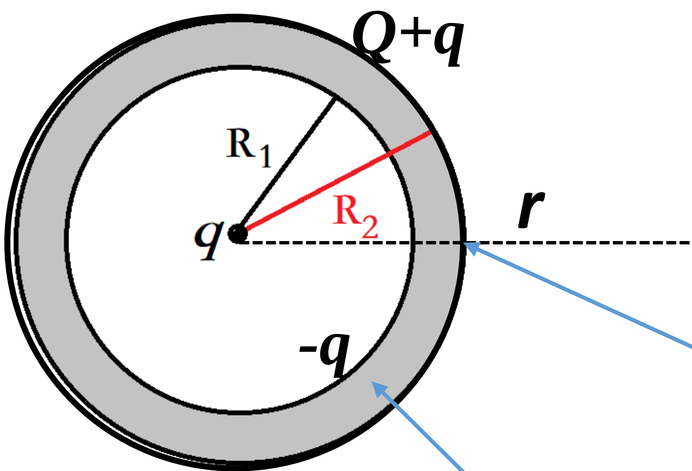
E $\dfrac{q+Q}{4\pi\varepsilon_0 \left(R_1^2 - r^2\right)}$



D

Question 13

Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2. A particle with charge q is placed at the center of the cavity. The electric potential at a point on the shell ($R_1 \leq r \leq R_2$) is:



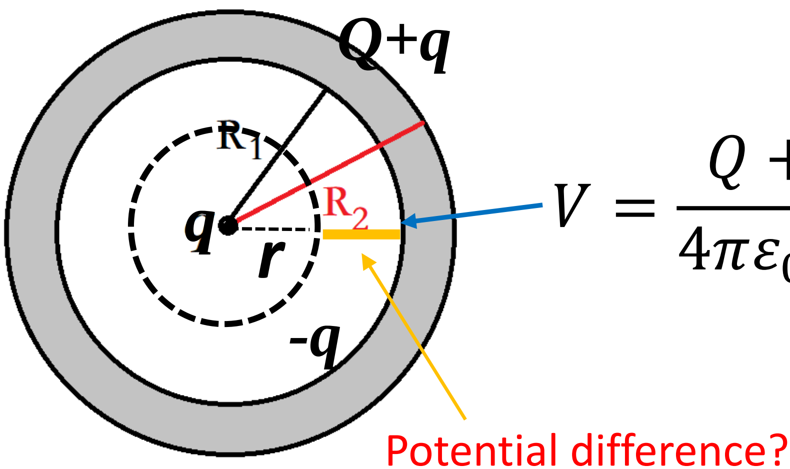
$$V(r) = \frac{Q+q}{4\pi\varepsilon_0 r}$$

$$V(R_2) = \frac{Q+q}{4\pi\varepsilon_0 R_2}$$

$$V(R_1 \leq r \leq R_2) = \frac{Q+q}{4\pi\varepsilon_0 R_2}$$

Question 14

Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2 . A particle with charge q is placed at the center of the cavity. The electric potential at a point in the cavity, a distance r from the center, is:



$$V = \frac{Q+q}{4\pi\varepsilon_0 R_2}$$

$$E = \frac{q}{4\pi\varepsilon_0 r^2}$$

$$E = -\frac{dV}{dr}$$

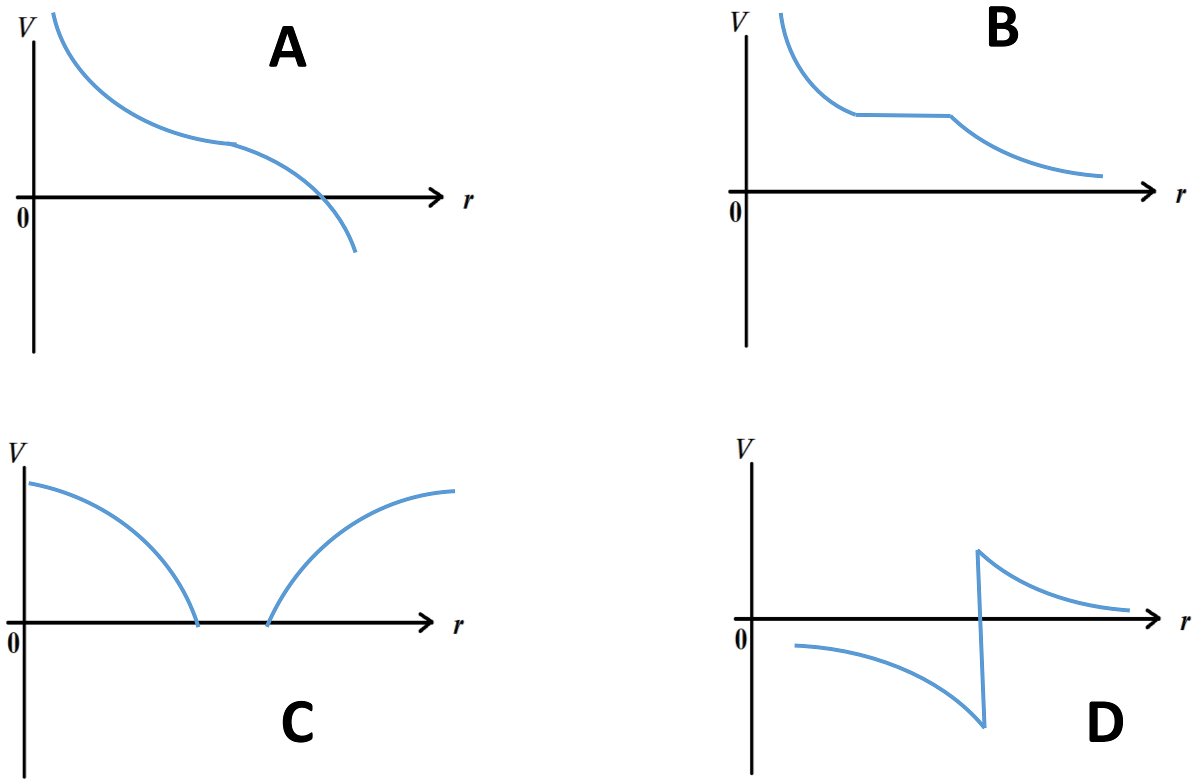
$$\Delta V = -\int_r^{R_1} E dr$$

$$\Delta V = -\frac{q}{4\pi\varepsilon_0}(\frac{1}{r} - \frac{1}{R_1})$$

$$V(r) = V(R_1) - \Delta V = \frac{Q+q}{4\pi\varepsilon_0 R_2} + \frac{q}{4\pi\varepsilon_0}(\frac{1}{r} - \frac{1}{R_1})$$

Question 15

Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2 . A particle with positive charge q is placed at the center of the cavity. The graph of the *electric potential* versus the distance *r* from the center is likely to be:

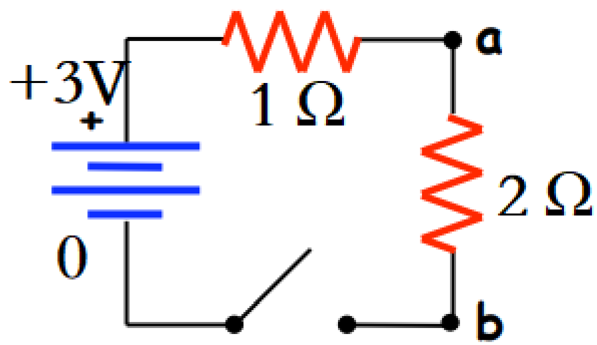


B

Question 16

What are the potentials of point a and b when the switch is open?

And what are the potentials of point a and b after the switch is closed?

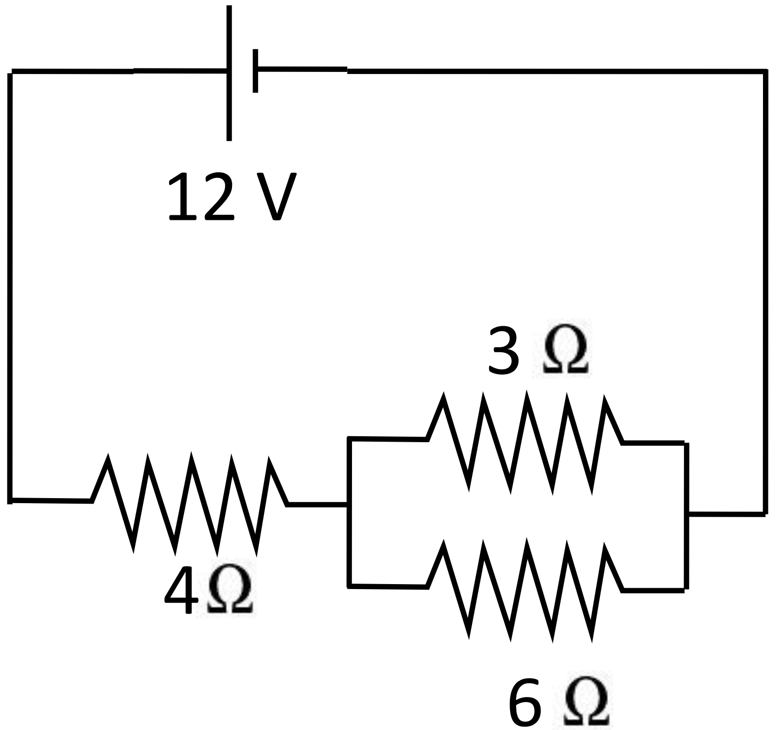


Before: $V_a = +3\text{ V},\ \ V_b = +3\text{ V}$

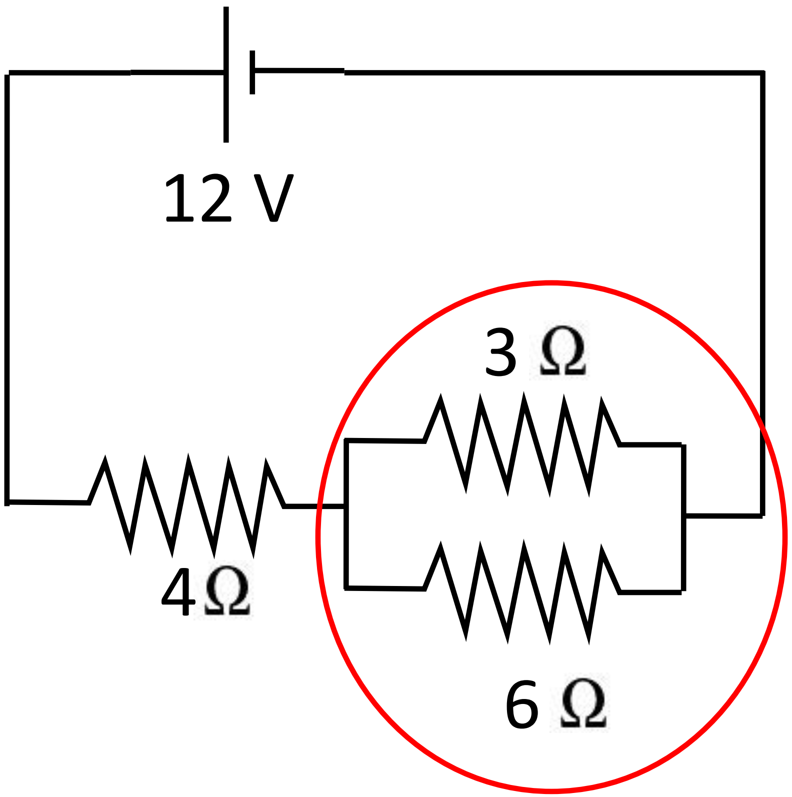
After: $V_a = +2\text{ V},\ \ V_b = 0\text{ V}$

Question 17

Determine the power dissipated in each resistor



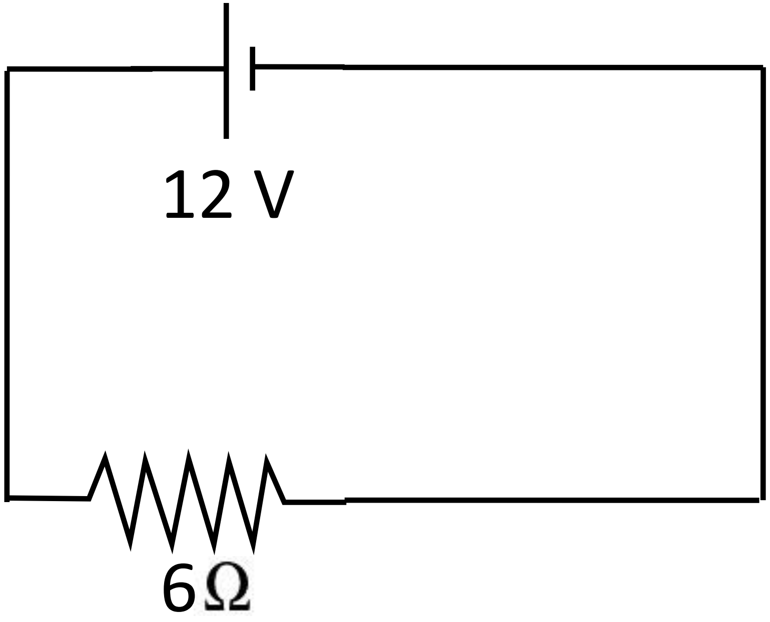
1. What is the equivalent resistance? And the total resistance?



$$\frac{1}{R_{eq}} = \left(\frac{1}{3} + \frac{1}{6}\right) = \frac{1}{2} \qquad R_{eq} = 2\,\Omega$$

$$R_{eq2} = 4\,\Omega + 2\,\Omega = 6\Omega$$

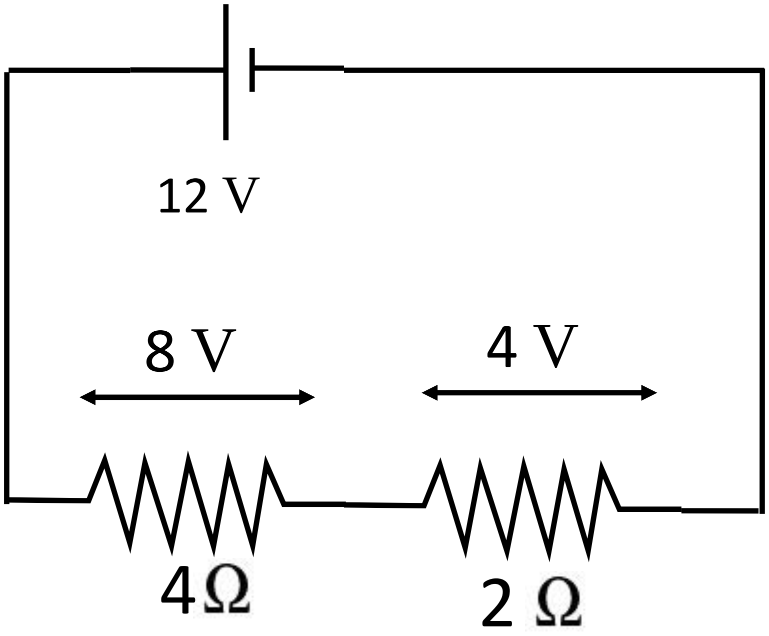
2. Find the total current :



$$I_{tot} = \frac{V}{R_{eq2}} = \frac{12\ \text{V}}{6\ \Omega} = 2\ \text{A}$$

3. Find the total voltage drop in the equivalent series resistances

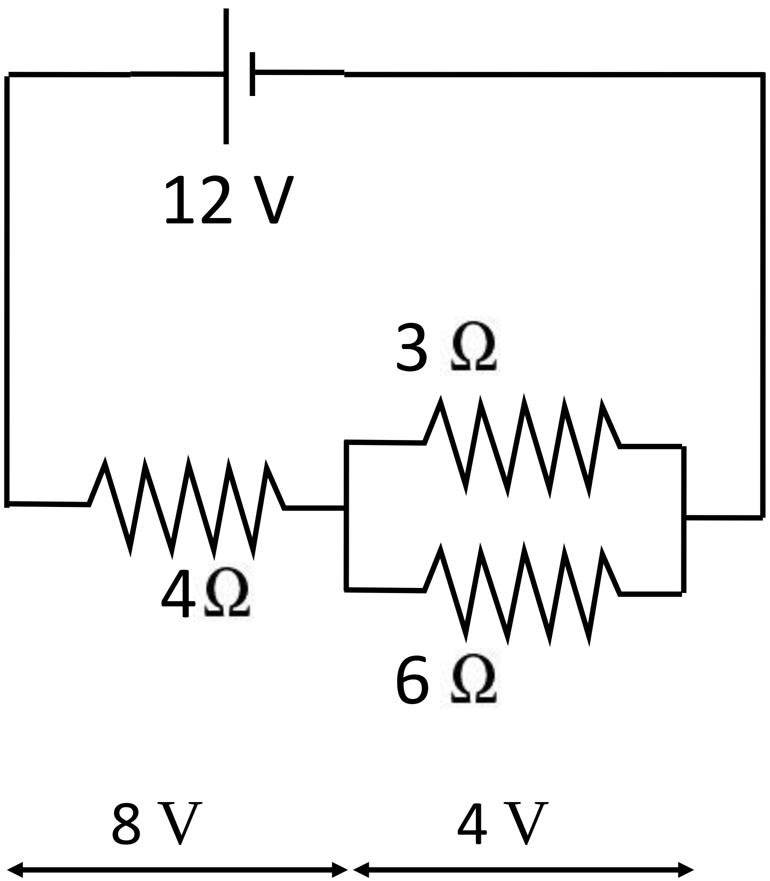
$I_{tot} = 2\,\mathrm{A}$



$$V_1 = RI_{tot} = 4\Omega * 2\,\mathrm{A} = 8\,\mathrm{V}$$

$$V_2 = RI_{tot} = 2\Omega * 2\,\mathrm{A} = 4\,\mathrm{V}$$

4. Find the power in each resistance

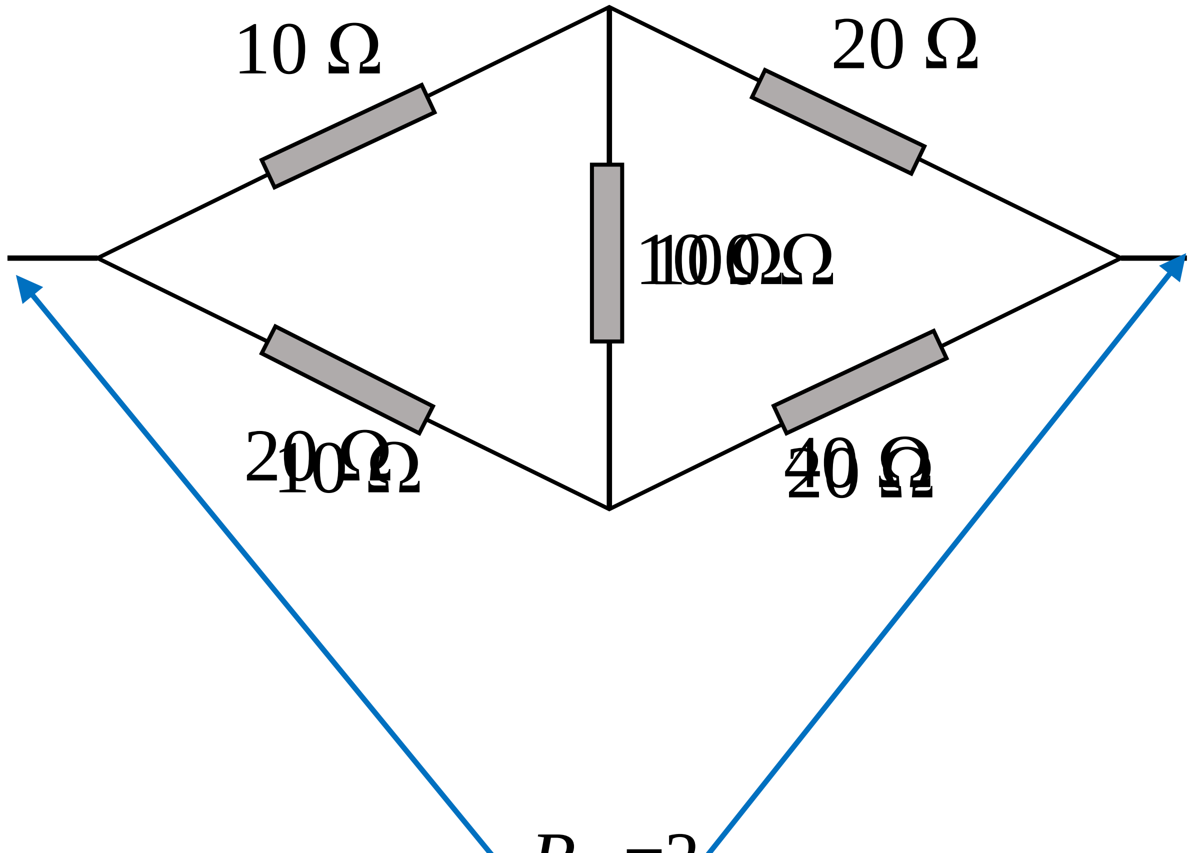


$$P_{4\Omega} = \frac{U^2}{R} = \frac{(8\,V)^2}{4\Omega} = 16\,W$$

$$P_{3\Omega} = \frac{(4\,V)^2}{3\,\Omega} = 5.33\,W$$

$$P_{6\Omega} = \frac{(4\,V)^2}{6\,\Omega} = 2.67\,W$$

A (resistance) bridge circuit – what is the equivalent resistance?



$R_{eq} = ?$

$R_{eq} = 15\ \Omega$

$R_{eq} = 20\ \Omega$