EM1 Magnetism

1. Consider the following statements concerning magnetic fields:

   (i) The direction of magnetic field lines is from north to south.
   (ii) The strength of the magnetic field is indicated by the closeness of the field lines.
   (iii) The magnetic field of a bar magnet is weakest near its poles.

   Which of the above statements is CORRECT?

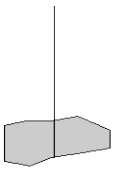
   A (i), (ii) and (iii) B (i) and (ii) only
   C (i) and (iii) only D (ii) and (iii) only

2. The best material needed to make a permanent magnet would be:

   A Copper B Steel C Iron D Graphite

3. Sketch the magnetic field around a bar magnet.

4. The compass is one of our oldest inventions, after fire and the wheel. The first compass, called a lodestone, was a piece of magnetite. Magnetite is magnetised iron oxide.



   4.1 Which element in the lodestone is responsible for its magnetic properties?

   4.2 Use domain theory to explain why the lodestone is permanently magnetised.

   4.3 In the diagram, the lodestone is suspended from a string. Copy the diagram and show the direction of the Earth's magnetic field lines in the space around the lodestone. Also show the direction that a compass would point to geographic North.

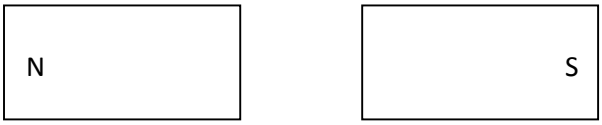
   4.4 The lodestone is cut into two unequal sized pieces. Which piece will be magnetised? Answer NEITHER PIECE, THE SMALLER PIECE, THE LARGER PIECE or BOTH PIECES.

5. We know that the opposite poles of magnets are attracted to each other. The red needle of a compass always points to:

   A Magnetic north, although this is actually the south pole of the Earth's magnetic field.
   B Magnetic south because the north pole of the compass must point to south.
   C Geographic north because magnetic north would repel the north pole of the compass.
   D Both magnetic and geographic north as the one is essentially right next to the other.

6. Erik, a clumsy grade 10 student, makes a magnet by magnetising a bar of ferromagnetic material.

Unfortunately, just as he is celebrating his own brilliance, he drops the magnet onto the ground, and it breaks in half.



"Oh no! I've broken the magnet" he wails.
"Not at all" his friend Charles says." Now you have two magnets, each with their own north and south poles"

6.1 Explain the term *ferromagnetic*

6.2 With the help of diagrams, help Charles explain to Eric why he now has two magnets

6.3 Sketch the electric field around the two pieces arranged as shown above

EM2 Electrostatics

1. A neutral piece of Perspex is rubbed with a cloth until it has a charge of +50 nC.

1.1 In which direction did the charge flow; from the cloth to the Perspex, or from the Perspex to the cloth?

1.2 Explain your answer to QUESTION 6.2.1

1.3 Calculate the number of electrons that moved between the objects

2. Two identical conducting spheres **A** and **B** have charges of ***Q*** and -2***Q*** respectively. The spheres are allowed to touch and are then separated again. Which of the following options correctly describes the force between **A** and **B** before and after they touch?

	Force before touching	**Force after touching**
A	Repulsion	Attraction
B	No force	Repulsion
C	Attraction	Repulsion
D	Repulsion	No force

3. Two objects P and Q, carrying charges of +3 nC and -2 nC respectively.

Sphere P was electrically neutral before it was charged.

3.1 Were electrons removed from P or supplied to P in order to charge it?

3.2 Calculate the number of electrons transferred when P was charged.

The two objects are allowed to touch and then separated out again.

3.3 Calculate the new charge on each sphere.

3.4 Calculate the charge transferred from sphere P to sphere Q.

3.5 Calculate the number of electrons transferred from sphere P to sphere Q.

4. While driving along the road, friction between the tyres and the tar causes a static charge of +24 μC to build up on the plastic bumper of the hybrid.

4.1 Explain why a neutral dust particle will still be attracted to the positively charged bumper of the car.

4.2 The bumper of the neutral petrol car touches the bumper of the hybrid car and charges flow from one bumper to the other. When the charges have stopped flowing, what will be the charge on the petrol car's bumper?

5. Older television sets have an electron gun that fires electrons at the screen to create the picture we see. Immediately after the television has been switched off, a charge is left on the glass screen.

5.1 What type of charge is left on the screen? Answer POSITIVE or NEGATIVE.

5.2 If your arm is close to the screen but not touching it, the hair on your arm stands up.

5.2.1 Is your arm hair charged or polarised?

5.2.2 Explain how this effect happens.

5.3 A glass rod carrying a charge of $+6{,}45 \times 10^{-16}$ C touches the screen.

5.3.1 How has this glass rod been charged?

5.3.2 If 4200 electrons transfer onto the glass rod, calculate the new charge on the rod.

6. An oil drop carries a charge of -24×10^{-19} C. A second drop, carrying a charge of $+32 \times 10^{-19}$ C sticks to the first drop and forms a **new drop**.

   6.1 Calculate the charge on the **new drop**.

   6.2 Calculate the number of excess electrons on the **new drop**.

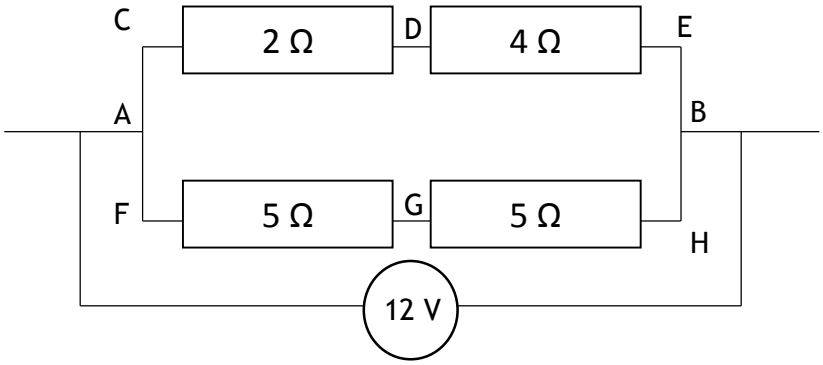
7. Two graphite spheres carry charges of -6×10^{-8} C and $+8 \times 10^{-8}$ C respectively. The balls are brought together, are allowed to touch and are then separated again. State whether the force between the balloons will a**ttractive or repulsive:**

   7.1.1 before they touch

   7.1.2 after they touch

EM3 Potential Difference and Voltage

1. Define the term *emf*
2. Fill in the correct term: A voltmeter must always be correct in _____. This is because it has a very _____ resistance so that no _____ passes through it.
3. In a series circuit with 2 resistors of 2 ohms and a battery providing 12 V what will the voltage be across each resistor?
4. Four resistors are connected as part of the greater circuit as shown in the diagram. Calculate the reading on a voltmeter connected between:
   a. *AB*
   b. *CD*
   c. *DE*
   d. *CE*
   e. *FH*
   f. *FG*
   g. *GH*

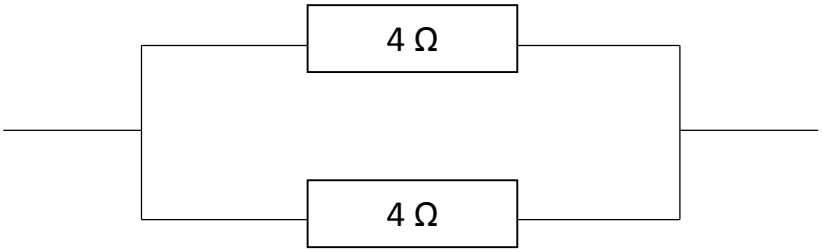


5. The potential difference across a resistor is 8 V. How much energy will be delivered to the resistor when 62 C of charge passes through it?

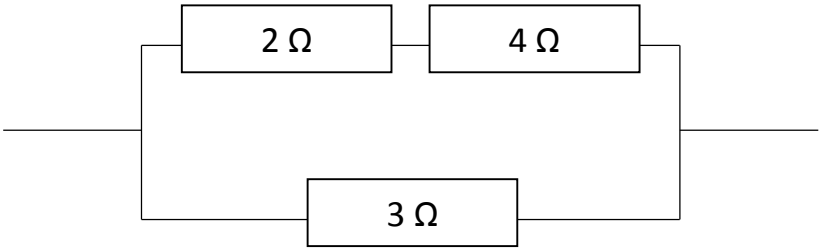
EM4 Resistance

1. Calculate the effective resistance of the following configurations of resistors.

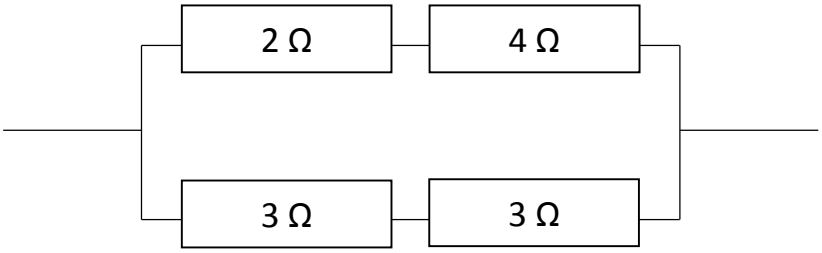
1.1.



1.2.



1.3.



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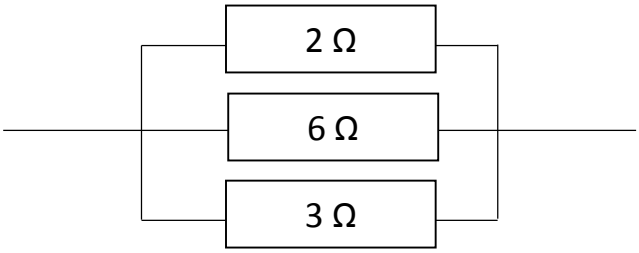

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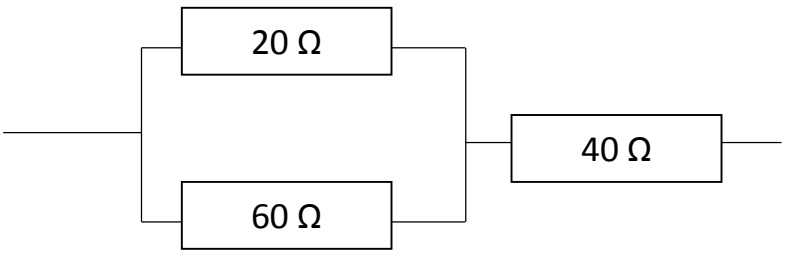

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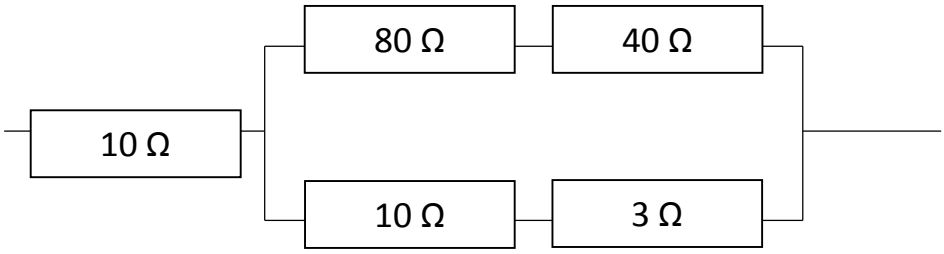
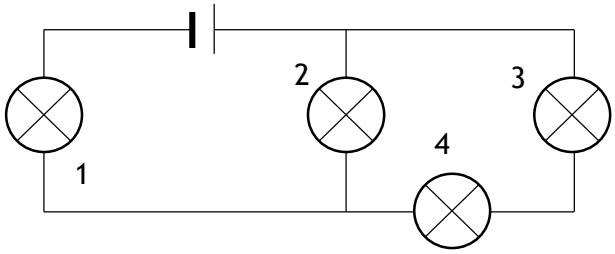


EM5 Current

1. Define the term *current*

2. Calculate the amount of charge that flows through a point in a circuit in 3minutes if the current is 0,5 A.

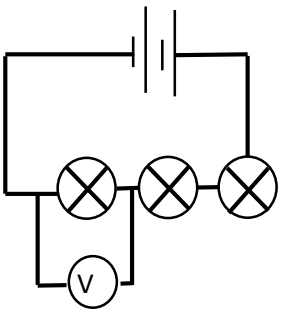
3. In the following circuit, all bulbs are identical. Which bulbs will glow with the same intensity?



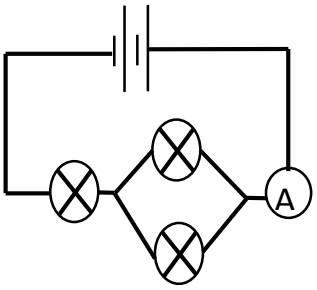
A 1, 2 **B** 1, 2, 3 **C** 2, 3 **D** 3, 4

4. Consider the electrical circuits shown below:

A)



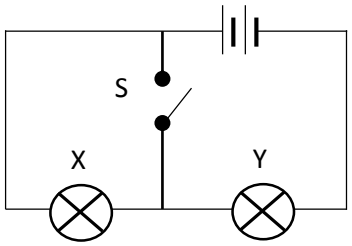
B)



All the bulbs are identical and are 3 Ω each. Each cell is 9V.

4.1 What is the voltage of the battery?
4.2 Determine the voltmeter reading.
4.3 Determine the ammeter reading.
4.4 Which battery is likely to run out first? Briefly explain

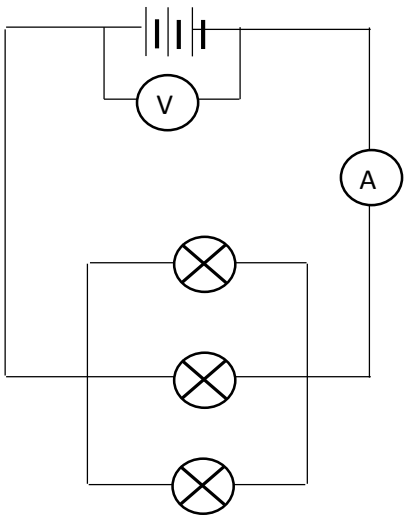
5. The following circuit is set-up.



Two identical light bulbs, X and Y, are connected in series as shown in the diagram. How will the brightness of the bulbs change if switch S is closed?

	X	Y
A	brighter	brighter
B	dimmer	dimmer
C	brighter	not lit up
D	not lit up	brighter

6. Consider the circuit shown below. All bulbs are identical. The resistance of the battery, ammeter and connecting wires can be ignored.



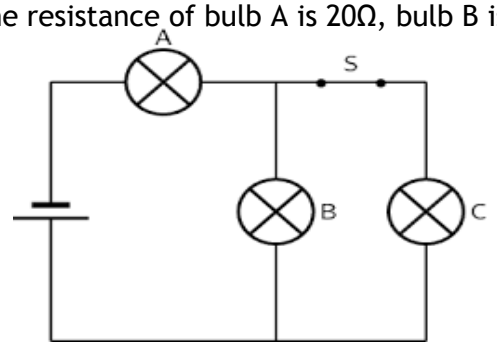
6.1 Show that the voltage across the battery is 4,5 V if it transfers 90 J of energy to 20 C of charge.

6.2 What will be the potential difference of each cell?

6.3 A charge of 30 C passes through the ammeter in 40 seconds. Calculate the strength of the current passing through the main circuit.

6.4 Calculate the resistance of each bulb

7. A circuit is set up with a battery and two light bulbs (B and C) connected in parallel. This combination is then connected in series with light bulb A. Switch S is closed. The resistance of bulb A is 20Ω, bulb B is 15Ω and bulb C is 30Ω.



7.1 Calculate the total resistance of the circuit.

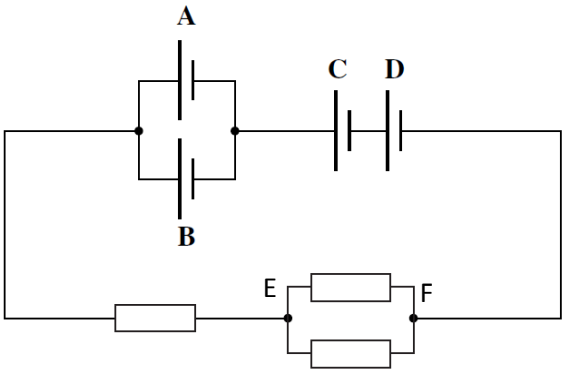
7.2 If switch S is opened, how would this affect the total resistance of the circuit? Use a calculation to substantiate your answer.

7.3 If the current through bulb A is 9A, calculate the current through bulb C.

7.4 Choose the correct answer. Write only the correct word.

Resistors in series are (CURRENT/POTENTIAL DIFFERENCE) dividers.

8 The circuit below contains four identical new cells, **A**, **B**, **C** and **D**, each of emf 1.5V and negligible internal resistance.



The resistance of each resistor is 4Ω.

8.1 Calculate the total resistance of the circuit.

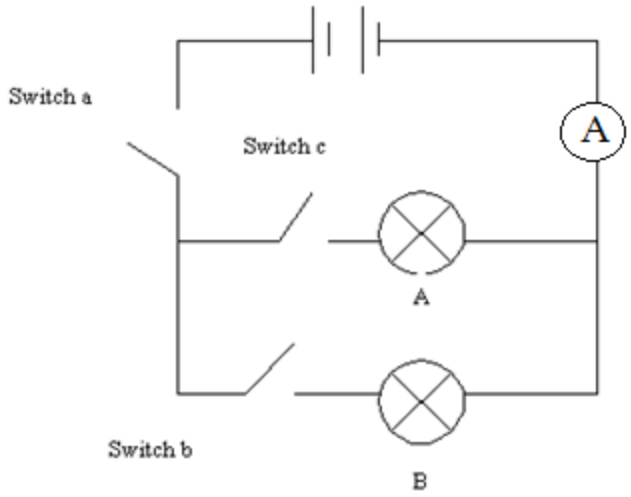
8.2 Calculate the total emf of the combination of cells.

8.3 Calculate the current passing through cell **A**.

8.4 Calculate the charge passing through cell **A** in five minutes.

8.5 Calculate the potential difference between points E and F in the circuit.

9. A 9V battery with negligible internal resistance is connected to two identical bulbs in series. Each bulb has a resistance of 4.5 Ω. Three switches are placed in the circuit as seen in the diagram below.



An ammeter is connected to the circuit.

9.1 What is the reading on the ammeter? Explain your answer.

Switch *a* and *b* are now closed. The ammeter reads 2A

9.2 Calculate the amount of charge which passes through bulb B in one minute.

9.3 Calculate the amount of energy dissipated at bulb B during one minute

Switch *c* is now closed so that all three switches are now closed.

9.4 What effect does closing switch c have on the external circuit?

9.5 Calculate the equivalent resistance of the external circuit.

9.6 Redraw the diagram and indicate how you would connect an ammeter and a voltmeter to measure the current flowing through bulb A and the potential difference across bulb B.

9.7 Calculate the expected reading on the ammeter connected in QUESTION 9.6

9.8 Give the reading on the voltmeter in QUESTION 9.6