



# Wynberg Boys High School

## Physical Sciences

Grade 10 Test

### Electricity and Magnetism

20 July 2016

Total marks: 30

Time: 30 minutes

#### Instructions:

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1. All working must be clearly shown.
2. Standard scientific calculators may be used.
3. Give all answers to 2 decimal places, unless otherwise stated.
4. Relevant formulae and data are provided on the back of this cover sheet. In some cases, data booklets may be provided.
5. Once you have finished the test, write in your estimated mark at the top right corner of your answers script. Accurate estimations may result in rewards.

### ELECTROSTATICS

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{F}{q}$	$V = \frac{W}{q}$
$n = \frac{Q}{q_e}$	

### ELECTRIC CIRCUITS

$R = \frac{V}{I}$	emf ( $\mathcal{E}$ ) = I(R + r)
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$q = I \Delta t$

### PHYSICAL CONSTANTS

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Charge on electron	$q_e/e$	$-1,6 \times 10^{-19} \text{ C}$
Electron mass	$m_e$	$9,11 \times 10^{-31} \text{ kg}$

**Question 1 Multiple Choice (5 marks)**

1.1 A rod acquires a negative charge after it has been rubbed with wool. Which ONE of the following best explains why this happens?

- A Positive charges are transferred from the rod to the wool.
- B Negative charges are transferred from the rod to the wool.
- C Positive charges are transferred from the wool to the rod.
- D Negative charges are transferred from the wool to the rod. (1)

1.2 For which ONE of the quantities below is the CORRECT unit of measurement given?

	Quantity	Unit
A	Current	$A \cdot s^{-1}$
B	Energy	kW
C	Potential difference	V
D	Resistance	$V \cdot s$

(1)

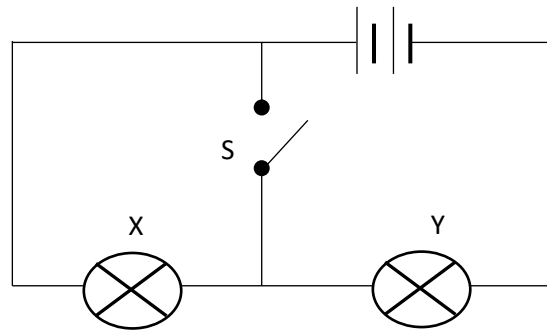
1.3 Consider the following statements concerning magnetic fields:

- (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 (1)

1.4 The following circuit is set-up.

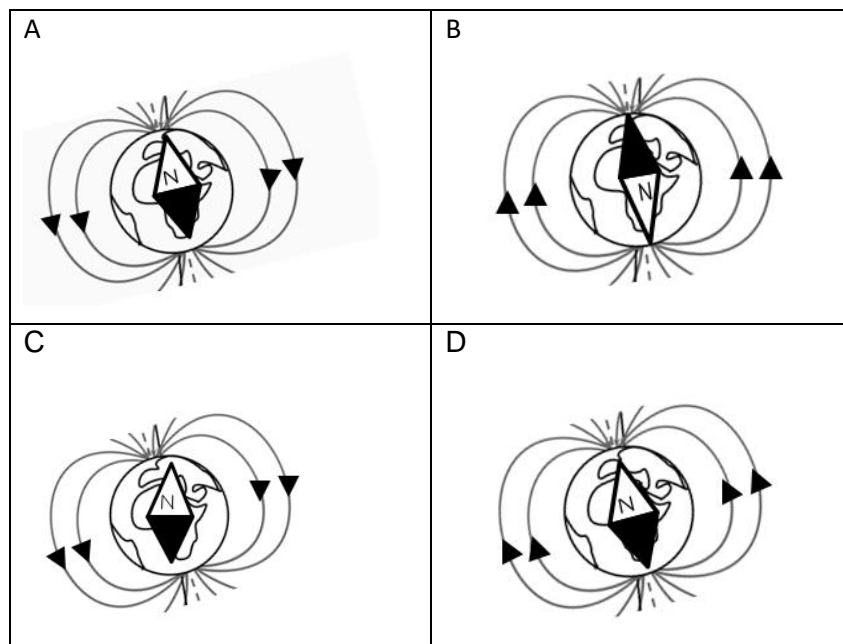


Two identical light bulbs, X and Y, are connected in series as shown in the diagram. How will the brightness of the bulbs change if switch S is closed?

	X	Y
<b>A</b>	brighter	brighter
<b>B</b>	dimmer	dimmer
<b>C</b>	brighter	not lit up
<b>D</b>	not lit up	brighter

(1)

1.5 Which of the following diagrams correctly shows how a compass aligns itself to the Earth's magnetic field?

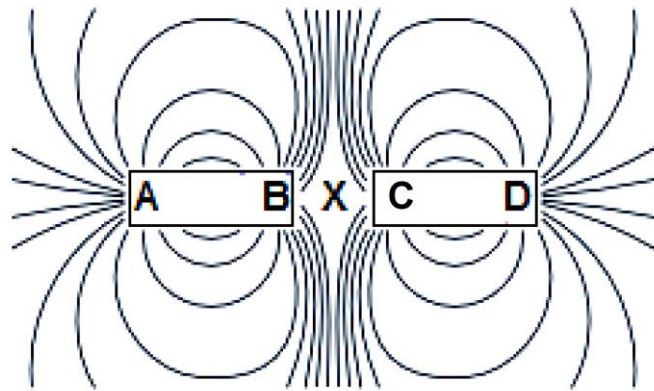


(1)

[5]

**Question 2 Magnetism (6 marks)**

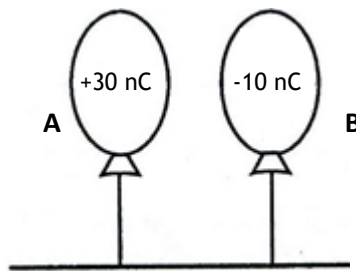
Two magnets of unknown polarity are placed near each other and the resultant field is as shown in the diagram below.



- 2.1 Define the term *magnetic field* (2)
- 2.2 Give the term for metals that can be permanently magnetized. (1)
- 2.3 If A is a north pole, redraw the diagram showing the correct labels for the poles of the magnets, and the direction of the magnetic field. (3)
- [6]

**Question 3 Electrostatics (8 marks)**

Two insulated metal spheres are placed a certain distance apart. The spheres A and B have charges of +30 nC and -10 nC respectively.



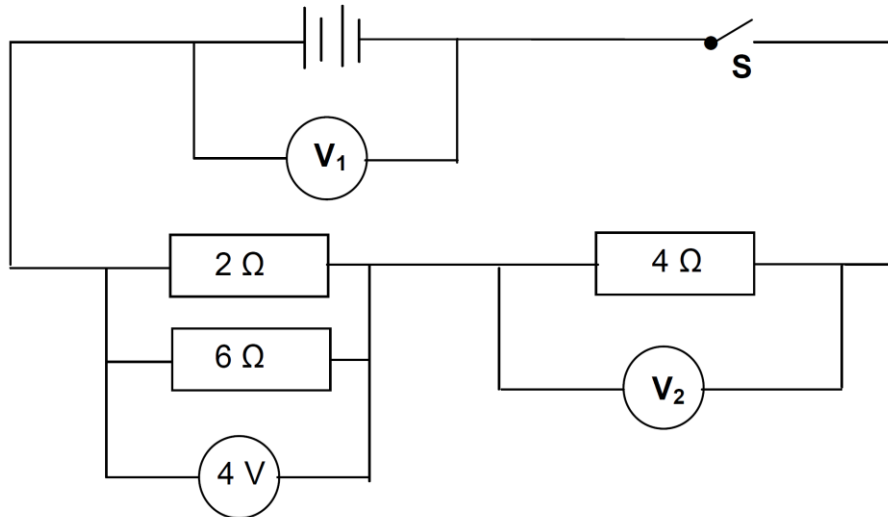
The two sphere move together and touch, and then are separated again.

- 3.1 Calculate the new charge on each sphere. (3)
- 3.2 Calculate the charge transferred from A to B. (2)
- 3.3 Determine the number of electrons which are transferred from one sphere to the other. (3)

[8]

**Question 4 Electric circuits (11 marks)**

In the circuit below, the potential difference,  $V_1$ , across the battery and potential difference  $V_2$ , across the  $4\ \Omega$  resistor are unknown.



When switch  $S$  is closed, the potential difference across the parallel combination is  $4\ \text{V}$ .

4.1 Define the term *electric current* (2)

Calculate the:

4.2 Effective resistance of the  $2\ \Omega$  and the  $6\ \Omega$  resistors. (3)

4.3 Current through the battery. (3)

4.4 Reading on  $V_1$  (3)

[11]

**Total: 30 marks**

## Memo:

### Question 1:

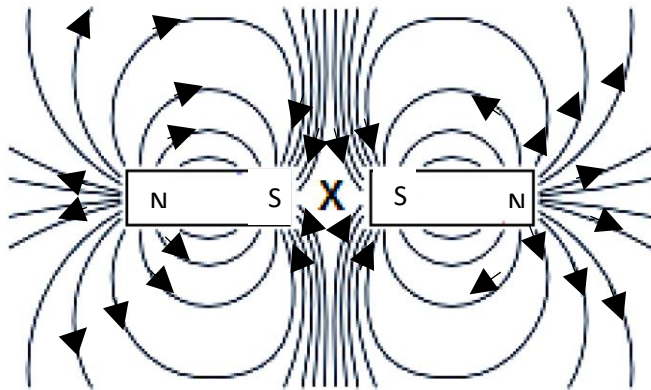
- 1.1 D ✓  
1.2 C ✓  
1.3 B ✓  
1.4 D ✓  
1.5 D ✓

### Question 2:

2.1 A region in which a magnet will experience a force ✓✓

2.2 Ferromagnetic ✓

2.3



✓✓ arrows

✓ poles correct

### Question 3:

3.1  $Q_{\text{sphere}} = \frac{Q_1 + Q_2}{2}$  ✓  
 $= \frac{((30 \text{ nC}) + (-10 \text{ nC}))}{2}$  ✓  
 $= 10 \text{ nC}$  ✓

3.2  $Q_{\text{transferred}} = (10) - (-10)$  ✓  
 $= 20 \text{ nC}$  ✓

3.3  $n_e = \frac{Q}{q_e}$  ✓  
 $= \frac{20 \times 10^{-9}}{1,6 \times 10^{-19}}$  ✓  
 $= 1,25 \times 10^{11}$  ✓

Question 4:

4.1 Electric current is the rate of flow of charge ✓✓

$$4.2 \quad \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \quad \checkmark$$

$$= \frac{1}{2} + \frac{1}{6} \quad \checkmark$$

$$= \frac{3+1}{6}$$

$$= \frac{2}{3}$$

$$R_p = \frac{3}{2}$$

$$= 1,5 \Omega \quad \checkmark$$

$$4.3 \quad I = \frac{V}{R} \quad \checkmark$$

$$= \frac{4}{1,5} \quad \checkmark$$

$$= 2,67 \text{ A} \quad \checkmark$$

$$4.4 \quad V = IR \quad \checkmark$$

$$= (2,67)(1,5 + 4) \quad \checkmark$$

$$= 14,67 \Omega \quad \checkmark$$