education

Department of Education
FREE STATE PROVINCE

CONTROL TEST

GRADE 11

PHYSICAL SCIENCES

SEPTEMBER 2017

MARKS: 100

TIME: 2 HOURS

This paper consists of NINE pages and THREE information sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and other applicable information in the appropriate spaces on the ANSWER BOOK.

2. The question paper consists of EIGHT questions. Answer ALL questions in the ANSWER BOOK.

3. Start EACH question on a NEW page in the ANSWER BOOK.

4. Number the answers correctly according to the numbering system used in this question paper.

5. Leave one line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable pocket calculator.

7. You may use appropriate mathematical instruments.

8. You are advised to use the attached DATA SHEETS.

9. Show ALL formulae and substitutions in ALL calculations.

10. Round off your final numerical answers to a minimum of TWO decimal places where applicable.

11. Give brief motivations, discussions, et cetera where required.

12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and only write down the letter A, B, C or D next to the question number (1.1 – 1.10) in your ANSWER BOOK.

1.1 The magnitude of an electric field is …

A directly proportional to the force exerted on a charge, and inversely proportional to the charge itself.

B directly proportional to the force exerted on a charge, and directly proportional to the charge itself.

C inversely proportional to the force exerted on a charge, and directly proportional to the charge itself.

D inversely proportional to the force exerted on a charge, and inversely proportional to the charge itself. (2)

1.2 One ohm is one …

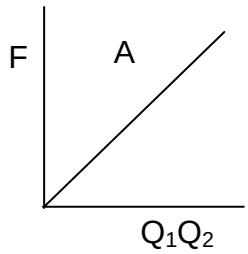
A coulomb of charge per joule.

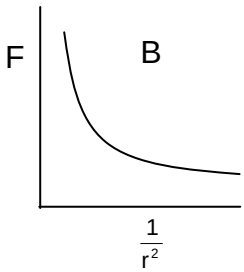
B joule per coulomb of charge.

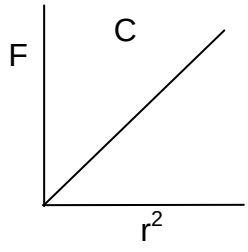
C volt per ampere.

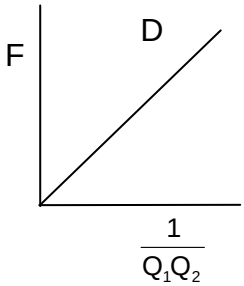
D ampere per second. (2)

1.3 Which one of the following graphs represents Coulomb's law the best?



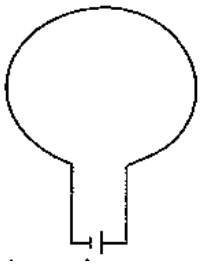






(2)

1.4 The direction of the magnetic field lines at the centre of the coil of wire shown in the sketch, is …



A to the right.

B to the left.

C into the page.

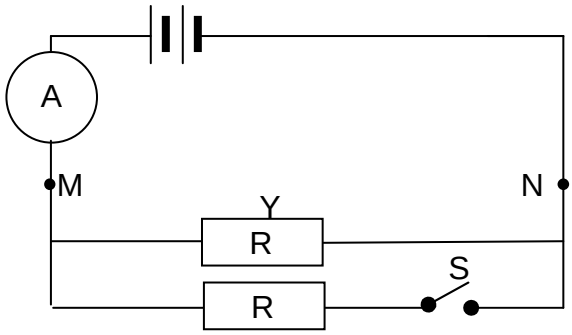
D out of the page. (2)

1.5 What will be the minimum and maximum resistance that can be obtained by connecting two 8 Ω resistors?

	Minimum	Maximum
A	0,25 Ω	4 Ω
B	0,25 Ω	16 Ω
C	4 Ω	4 Ω
D	4 Ω	16 Ω

(2)

1.6 In the given circuit, the battery and the ammeter have negligible resistances. The reading on the ammeter is 1 A. An additional resistor is then connected in parallel with **Y** between **M** and **N** and the switch **S** is closed.



Which one of the following is true?

	CURRENT	**POTENTIAL DIFFERENCE between M and N**
A	Increase	Unchanged
B	Increase	Decrease
C	Decrease	Unchanged
D	Decrease	Decrease

(2)

1.7 An electric heater **X** has a resistance *R*. The power of heater **Y** is twice that of **X** if the potential difference is the same for **X** and **Y**. What is the resistance of **Y** in terms of *R*?

A ¼ R

B ½ R

C R^2

D 2 R (2)

1.8 A sample of a compound containing sulphur and oxygen has a mass of 20 g, of which 10 g is sulphur. What is the relationship of the number of sulphur atoms to oxygen atoms?

A 1:2

B 1:1

C 2:1

D 3:1 (2)

1.9 Which one of the following statements about a chemical reaction is correct? The actual yield of a chemical reaction is usually ...

A equal to the percentage yield.

B greater than the percentage yield.

C less than the theoretical yield.

D greater than the theoretical yield. (2)

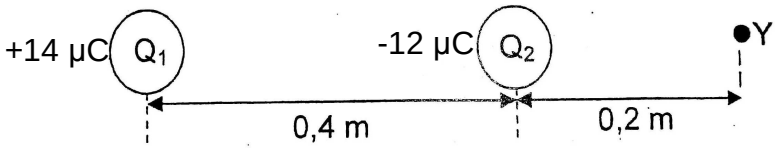
1.10 0,1 mol of Na_2CO_3 is dissolved in 1 dm^3 of water. Which one of the following correctly represents the concentrations of the Na_2CO_3 solution, sodium ions and carbonate ions (in $mol \cdot dm^{-3}$)?

	$[Na_2CO_3]$	**$[Na^+]$**	**$[CO_3^{2-}]$**
A	0,2	0,1	0,1
B	0,1	0,1	0,2
C	0,2	0,2	0,1
D	0,1	0,2	0,1

(2)
[20]

QUESTION 2

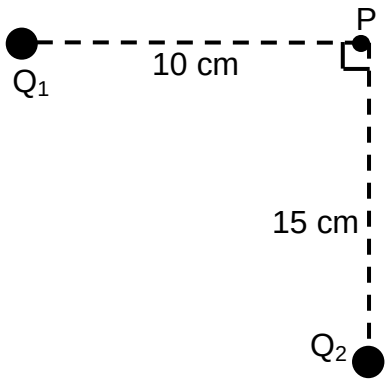
2.1 Two small, identical, metallic spheres, $\mathbf{Q}_1$ and $\mathbf{Q_2}$, on isolated stands, are separated by a distance of 0,4 m as shown below. The charge on $\mathbf{Q_1}$ is +14 µC and the charge on $\mathbf{Q_2}$ is -12 µC.



2.1.1 Draw the resultant electric field pattern of $\mathbf{Q_1}$ and $\mathbf{Q_2}$. (2)

2.1.2 Calculate the magnitude of the electric field at point **Y** as a result of $\mathbf{Q_2}$. (3)

2.2 The same charges $\mathbf{Q_1}$ and $\mathbf{Q_2}$ as in question 2.1 are now placed at an angle of 90° with respect to a third charge **P**. The charge on **P** is +10 µC and the distances are indicated in the diagram.



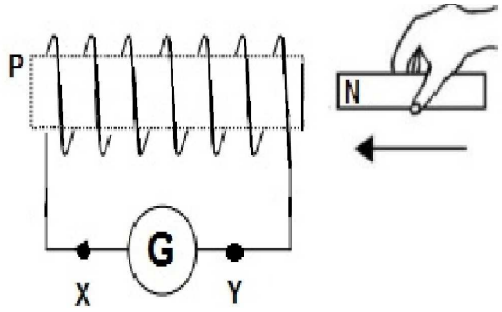
2.2.1 Write down *Coulomb's law* in words. (2)

2.2.2 Calculate the magnitude of the NET ELECTROSTATIC FORCE exerted on **P** by $\mathbf{Q_1}$ and $\mathbf{Q_2}$. (6)

[13]

QUESTION 3

3.1 In the sketch, the north pole of a magnet enters a solenoid.



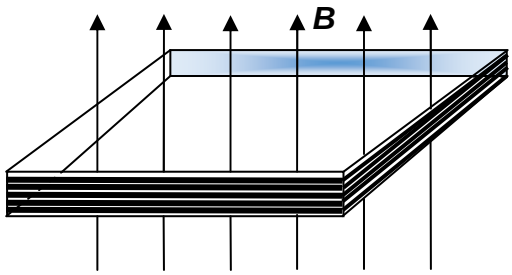
3.1.1 Name the instrument represented by the **G**. (1)

3.1.2 What is the direction of the current? Write only FROM **X** TO **Y** or FROM **Y** TO **X**. (2)

3.1.3 What is the polarity of the magnetic field of the solenoid at **P** while the magnet enters the solenoid? (1)

3.2 Formulate *Faraday's law of electromagnetic induction*. (2)

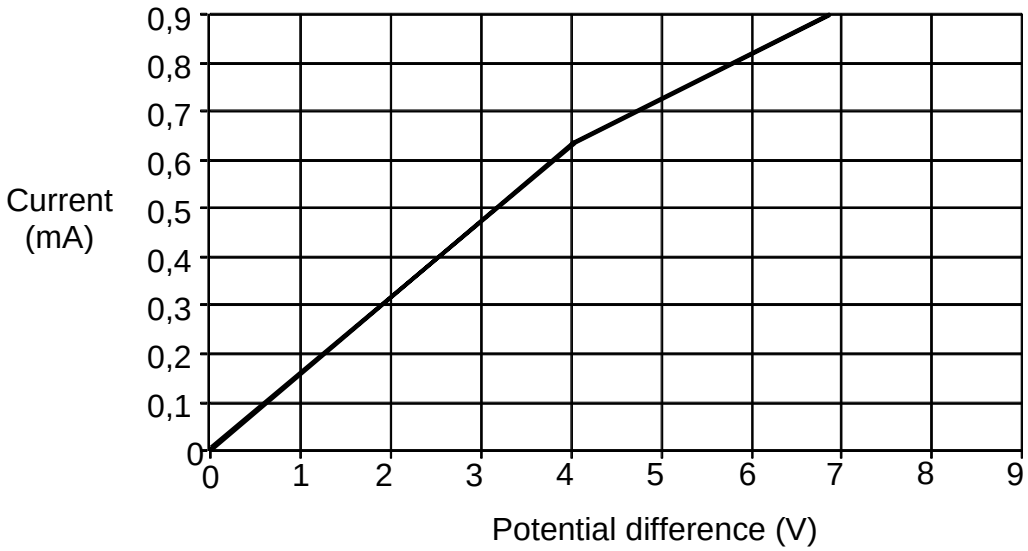
3.3 Consider a flat, square coil with 5 turns. Each of the coil's sides is 0,50 m in length and has a magnetic field of 0,5 T passing through it. The plane of the coil is perpendicular to the magnetic field.



Calculate the magnitude of the induced emf if the magnetic field is increased uniformly from 0,5 T to 1 T in 10 s. (6)
[12]

QUESTION 4

Learners conduct an investigation to prove Ohm's law. They measure the current in a conducting wire while changing the potential difference across its ends. The graph shows the results they have obtained.



4.1 Which one of the measured values is the dependent variable? (1)

4.2 The graph deviates from Ohm's law at some stage.

4.2.1 Write down the co-ordinates for the point on the graph from where Ohm's law is no longer obeyed. (2)

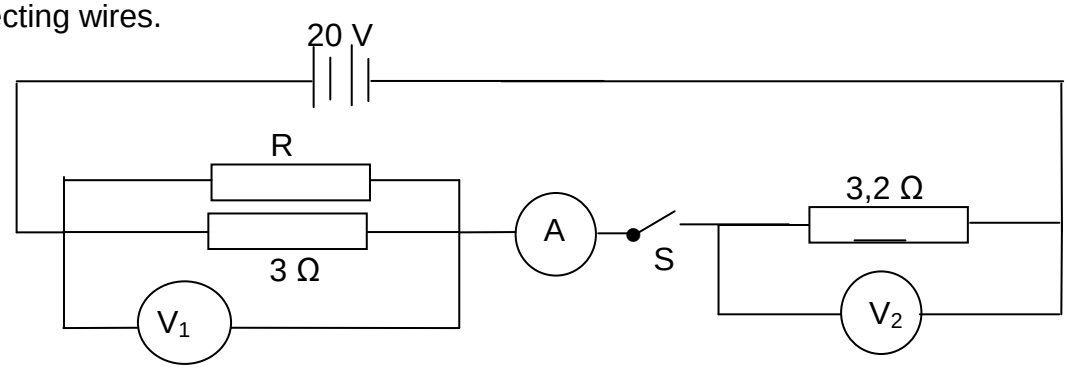
4.2.2 Give a possible reason why the graph deviates from Ohm's law as shown. Assume that all measurements are correct. (2)

4.3 Calculate the gradient of the graph and then use this value to calculate the resistance of the conducting wire. (4)

[9]

QUESTION 5

A battery with an emf of 20 V is connected in a circuit as shown. When the switch is closed, the reading on the ammeter is 4 A. Ignore the resistance of the battery and connecting wires.



Calculate the:

5.1 Effective resistance in the circuit (3)

5.2 Reading on V_1 when switch **S** is closed (4)

5.3 Resistance of resistor **R**. (5)

5.4 Power in the 3 Ω resistor. (3)

5.5 Total cost of the electricity used by the 3 Ω resistor in 10 hours at R2,20 per unit (kWh). (3)
[18]

QUESTION 6

Sodium forms a compound with chromium with the following composition: 17,5% sodium; 39,7% chromium and 42,8% oxygen.

6.1 Define the concept *empirical formula*. (2)

6.2 Determine the empirical formula for this sodium salt. (5)
[7]

QUESTION 7

Magnesium carbonate reacts with hydrochloric acid to form water and carbon dioxide according to the following balanced equation:

$$MgCO_3(s) + 2HC\ell(aq) \rightarrow MgC\ell_2(aq) + H_2O(aq) + CO_2(g)$$

Calculate the:

7.1 Number of moles of $MgCO_3$ in 126 g of $MgCO_3$ (3)

7.2 Mass of $MgC\ell_2$ that can be formed from 3 moles of $MgCO_3$. (3)

7.3 Volume occupied by 6 moles of CO_2 at STP. (3)

7.4 Volume of a 0,5 mol·dm^{-3} hydrochloric acid solution needed to react with 0,2 mol of magnesium carbonate. (4)

[13]

QUESTION 8

About 15% of the world's titanium reserves are found in South Africa. Titanium is a strong, lightweight, corrosion resistant metal. It is used in the construction of rockets, aircraft and jet engines. The titanium is prepared by the reaction of molten magnesium with titanium(IV) chloride at temperatures of approximately 1 000°C. The reaction is represented by the following equation:

$$TiC\ell_4(g) + 2Mg(\ell) \rightarrow Ti(s) + 2MgC\ell_2(\ell)$$

At an industrial plant 3 540 kg of titanium chloride reacted with 1 130 kg of magnesium to produce 894,32 kg of titanium.

8.1 Show by means of calculations that $TiC\ell_4$ was the limiting reactant. (6)

8.2 Calculate the percentage yield of titanium if only 820 kg of titanium was produced in this process. (2)

[8]

GRAND TOTAL: 100

DATA FOR PHYSICAL SCIENCES GRADE 11 (PHYSICS)
CONTROL TEST - TERM 3

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11 (FISIKA)
KONTROLETOETS - KWARTAAL 3

TABLE 1: PHYSICAL CONSTANTS / *TABEL 1: FISIESE KONSTANTES*

NAME / *NAAM*	SYMBOL / *SIMBOOL*	VALUE / *WAARDE*
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^{9}\ N \cdot m^2 \cdot C^{-2}$
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}\ kg$

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

ELECTROSTATICS / *ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9,0 \times 10^{9}\ N \cdot m^2 \cdot C^{-2})$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ $(k = 9,0 \times 10^{9}\ N \cdot m^2 \cdot C^{-2})$	$V = \frac{W}{Q}$

ELECTROMAGNETISM / *ELEKTROMAGNETISME*

$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$	$\Phi = BA\cos\theta$

CURRENT ELECTRICITY / *STROOMELEKTRISITEIT*

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + ...$	$R = r_1 + r_2 + r_3 + ...$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

DATA FOR PHYSICAL SCIENCES GRADE 11 (CHEMISTRY)
CONTROL TEST - TERM 3

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11 (CHEMISTRY)
KONTROLETOETS - KWARTAAL 3

TABLE 1: PHYSICAL CONSTANTS / *TABEL 1: FISIESE KONSTANTES*

NAME / *NAAM*	SYMBOL / *SIMBOOL*	VALUE / *WAARDE*
Avogadro's constant *Avogadrokonstante*	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22{,}4\ dm^3 \cdot mol^{-1}$
Standard pressure *Standaarddruk*	p^θ	$1{,}013 \times 10^5\ Pa$
Standard temperature *Standaardtemperatuur*	T^θ	273 K
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}\ C$
Molar gas constant *Molêre gaskonstante*	R	$8{,}31\ J \cdot K^{-1} \cdot mol^{-1}$

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	$pV = nRT$
$n = \frac{m}{M}$	$c = \frac{n}{V}$
$c = \frac{m}{MV}$	$\frac{n_a}{n_b} = \frac{c_aV_a}{c_bV_b}$ / $\frac{n_s}{n_b} = \frac{c_sV_s}{c_bV_b}$

THE PERIODIC TABLE OF ELEMENTS
DIE PERIODIEKE TABEL VAN ELEMENTE