ALEXANDER ROAD HIGH SCHOOL

SEPTEMBER 2019 — 1 HOUR

PHYSICAL SCIENCE CONTROL TEST

CO, JA, MH — TOTAL = 60

GRADE 11

Instructions

- The question paper consists of 7 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided AND section B on folio sheets.
- Rule off after each question in Section B.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system.
- Round off to two (2) decimal places where necessary.
- Formulas and a data sheet have been included at the end of the question paper

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SECTION A

- Answer on the answer sheet -

QUESTION 1: Multiple choice

Four possible options are provided as answers to the following questions. Each question has only 1 correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.6) on the answer sheet.

1.1 The definitions for current strength, power and potential difference, respectively, are:

	Current strength	Power	Potential difference
A	Rate of flow of charge	Energy dissipated	Energy transferred per unit time
B	Flow of charge	Flow of energy	Energy per charge transferred
C	Rate of flow of energy	Rate of potential difference	Charge per unit energy
D	Rate of flow of charge	Rate of energy transfer	Energy transferred per unit charge

1.2 If it costs R21,60 to operate a washing machine three days in a week, for 2,5 hours every time, with the unit price of electricity R1,92, the power rating of the machine could be calculated as follows:

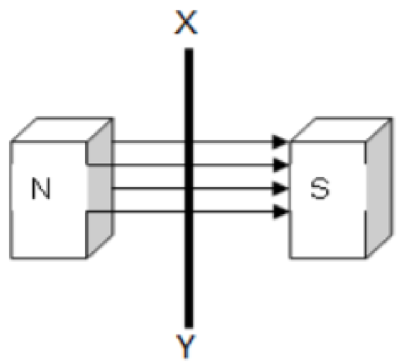
A 21,60 x 2,5 x 3 x 1,92

B 2,5 ÷ 3 ÷ 1,92 x 21,60

C 21,60 ÷ 2,5 ÷ 3 ÷ 1,92

D 21,60 ÷ 2,5 x 3 ÷ 1,92

1.3 A conduction wire, XY, moves between two magnets as shown below.



Which ONE of the following actions can lead to an increased induced current in wire XY?

Move the wire …

A quickly and parallel to the magnetic field.

B slowly and parallel to the magnetic field.

C quickly and perpendicular to the magnetic field.

D slowly and perpendicular to the magnetic field.

1.4 Two charged objects repel each other with a force F when they are separated by a distance *d*. The distance between the charges is reduced to $\frac{1}{3}d$.

The new force, in terms of F, will now be …

A $\frac{1}{9}$F

B 3F

C 6F

D 9F

1.5 In which ONE of the following reactions is HCl oxidised?

A $HCl + H_2O \rightarrow Cl^- + H_3O^+$

B $CaCO_3 + 2\,HCl \rightarrow CaCl_2 + H_2O + CO_2$

C $MnO_2 + 4\,HCl \rightarrow MnCl_2 + H_2O + Cl_2$

D $NH_3 + HCl \rightarrow NH_4Cl$

1.6 Which ONE of the following indicates the correct colour of each indicator in an acid?

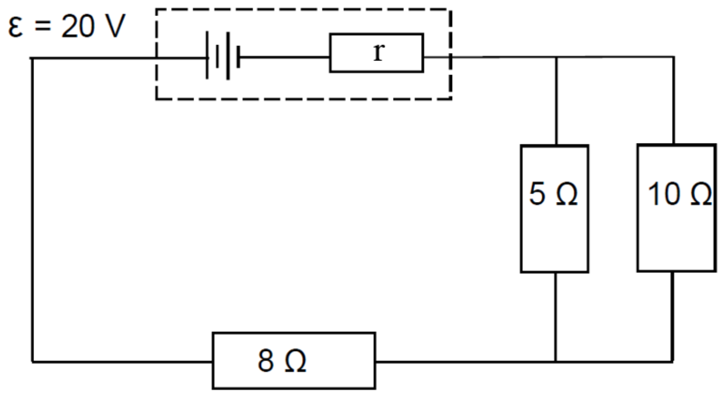
	Methyl Orange	Bromothymol Blue	Phenolphthalein
A	Orange	Pink	Colourless
B	Red	Yellow	Colourless
C	Red	Blue	Pink
D	Orange	Red	Pink

[2 x 6 = 12]

SECTION B

QUESTION 2

A battery with an emf of 20 V and an internal resistance r, is connected to three resistors, as shown in the circuit below.



Initially, consider r = 0 Ω. Then calculate the:

2.1.1 current in the 8 Ω resistor. (4)

2.1.2 potential difference across the 5 Ω resistor. (3)

2.1.3 total power supplied by the battery. (3)

2.1.4 If the internal resistance changes to r = 1Ω, how would the current strength be influenced through the 8 Ω resistor? Only write INCREASE, DECREASE or STAY THE SAME. (1)

2.2 Redraw the graph axes below (rough sketch), and then draw the graph for the results of an ohm's law investigation done when the temperature of the conductor is <u>not</u> kept constant.

(1)

[12]

QUESTION 3

3.1 In the gold mining industry zinc is reacted with a gold solution, to obtain molten gold as the main product. Identify the oxidising and the reducing agent. Only write down A, B, C or D.

	Oxidising agent	Reducing agent
A	Zn	Au
B	Zn^{2+}	Au
C	Au	Zn^{2+}
D	Au^{1+}	Zn

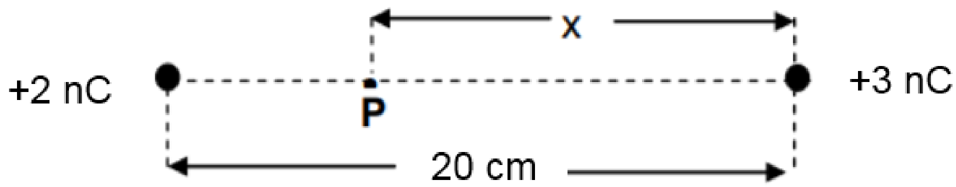
(2)

3.2 What would be an environmental disadvantage of the iron extraction industry? (2)

[4]

QUESTION 4

Two point charges of +2 nC and +3 nC are placed a distance of 20 cm apart. P is a point on the line joining the two charges, a distance of *x* m from the 3 nC charge.



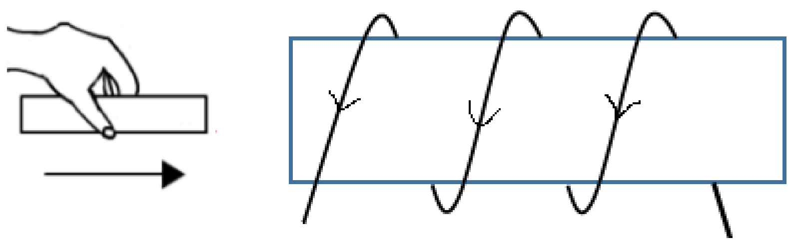
4.1 Define the term ***electric field strength***. (2)

4.2 Calculate the distance *x*, if the net electric field strength at P is zero. (7)

[9]

QUESTION 5

In the diagram below a bar magnet is being pushed into a coil. The current induced in the coil is in the direction indicated.



5.1 Which end of the bar magnet is approaching the coil? Write down only NORTH POLE or SOUTH POLE. (1)

5.2 Write down Faraday's law of electromagnetic induction in words. (2)

A coil of 1000 turns, with a radius of 12 cm, is made from insulated copper wire. The coil is placed in a uniform magnetic field of 0,4 mT in such a way that the angle between the magnetic field and the normal to the plane of the coil is 30˚. The coil is then rotated so that the angle changes to 70˚ in a time interval of 0,2 s.

5.3 Calculate the magnitude of the emf induced in the coil. (5)

[8]

QUESTION 6

Consider what happens when sulphuric acid (H_2SO_4) dissolves in water:

Reaction 1: $H_2SO_4 + H_2O \rightleftharpoons HSO_4^- + H_3O^+$

Reaction 2: $HSO_4^- + H_2O \rightleftharpoons SO_4^{2-} + H_3O^+$

6.1 Define *acid* in terms of Lowry-Brϕnsted theory. (1)

6.2 Identify BOTH conjugate acid-base pairs in reaction 2. (4)

6.3 Which substance acts as an ampholyte? Give a reason for your answer. (2)

6.4 What colour will litmus paper be if placed in the sulphuric acid solution? (1)

[8]

QUESTION 7

Consider the reaction between H_2S and $Cr_2O_7^{2-}$ which took place in acidic medium.

$$H_2S + Cr_2O_7^{2-} \rightleftharpoons Cr^{3+} + S$$

7.1 Define *reduction* in terms of electron transfer. (1)

7.2 Write down the FORMULA of the reducing agent. Explain your answer in terms of oxidation numbers. (2)

7.3. Write down the net balanced ionic equation for the reaction. Show all working. (5)

[8]

TOTAL: 60 MARKS

TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* (↓)

Half-reactions/*Halfreaksies*			E^{θ} (V)
$Li^+ + e^-$	⇌	Li	− 3,05
$K^+ + e^-$	⇌	K	− 2,93
$Cs^+ + e^-$	⇌	Cs	− 2,92
$Ba^{2+} + 2e^-$	⇌	Ba	− 2,90
$Sr^{2+} + 2e^-$	⇌	Sr	− 2,89
$Ca^{2+} + 2e^-$	⇌	Ca	− 2,87
$Na^+ + e^-$	⇌	Na	− 2,71
$Mg^{2+} + 2e^-$	⇌	Mg	− 2,36
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87

Increasing reducing ability/*Toenemende reduserende vermoë* (↑)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m\cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	$6{,}67 \times 10^{-11}\ N\cdot m^2\cdot kg^{-2}$
Radius of Earth *Straal van Aarde*	R_E	$6{,}38 \times 10^6\ m$
Coulomb's constant *Coulomb se konstante*	k	$9{,}0 \times 10^9\ N\cdot m^2\cdot C^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3{,}0 \times 10^8\ m\cdot s^{-1}$
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Mass of the earth *Massa van die Aarde*	M	$5{,}98 \times 10^{24}\ kg$

ELECTROSTATICS/*ELEKTROSTATIKA*

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

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

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

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	$emf\ (\varepsilon) = I(R + r)$
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$