



Education and Sports Development

Department of Education and Sports Development
Department van Onderwys en Sport Ontwikkeling
Lefapha la Thuto le Tlhabololo ya Metshameko
NORTH WEST PROVINCE

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

TECHNICAL SCIENCES PAPER 2

JUNE EXAMINATION

2018

MARKS: 150

TIME : 3 hours

This question paper consists of 11 pages including this cover sheet and data/information sheets.



NW/JUNE/TEC-SCNE/ EMIS/6*****

INSTRUCTIONS AND INFORMATION

1. This question paper consists of EIGHT questions.
2. Answer ALL the sections and questions in the question paper.
3. Start EACH question on a NEW page on the ANSWER SHEETS.
4. Number the answers correctly according to the numbering system used in the 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 calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEET.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions etcetera where required.
12. Write neatly and legibly.

SECTION A**QUESTION 1: MULTIPLE CHOICE QUESTIONS**

Four options are provided as possible answers to the following questions. Each question has ONE correct answer. Choose the answer and write only the letter (A-D) next to the question number (1.1-1.8) in the answer book for example 1.1 E.

- 1.1 A quantum of energy is also called....
A. A photon of light
B. The speed that light moves
C. The frequency of a light wave
D. The wavelength of light
(2)
- 1.2 Which one of the following statements concerning an endoscope is **not** true?
A. Images are transferred by optical fibers
B. Refraction is used to see the image
C. Light is reflected back to the eye piece
D. Total internal reflection takes place
(2)
- 1.3 Which one of the following compounds is an aldehyde?
A. CH_3COCH_3
B. $\text{CH}_3\text{CH}_2\text{COH}$
C. $\text{CH}_3\text{CH}_2\text{COOH}$
D. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
(2)
- 1.4 Which one of the following pairs of compounds are FUNCTIONAL isomers?
A. Methanol and methanal
B. Butane and 2-methylpropane
C. Propan-1-ol and propan-2-ol
D. Propanoic acid and methylethanoate
(2)
- 1.5 What is the FUNCTION of a catalyst in a reaction?
A. To increase the product quantity.
B. To add the flavor to the product.
C. To speed up the reaction process.
D. To add the coloring in the reaction.
(2)



1.6 Frequency

- A. Indicates the length of a wave
- B. How long it takes to complete one full vibration
- C. Is measured in Hz
- D. Indicates the speed at which a wave moves (2)

1.7 Which one of the following IUPAC names represents $\text{CH}_3\text{CBr}(\text{CH}_3)\text{CH}_2\text{CH}_3$?

- A. 2,2-bromo-methylbutane
- B. 2-bromo-2-methylbutane
- C. 2-bromo-2-methylpentane
- D. 2-bromo-2-methylpent-2-ene (2)

1.8 Which one of the following combinations is responsible for the formation of an ester?

- A. Ketone and carboxylic acid
- B. Ketone and alcohol
- C. Aldehyde and ketone
- D. Alcohol and carboxylic acid (2)

[16]**SECTION B****QUESTION 2**

Four compounds of comparable molecular mass, are used to investigate the effect of a functional group on vapor pressure. The results are as shown in the table below.

COMPOUND		VAPOR PRESSURE (KPa at 20 °C)
A	Butane	204
B	Propan-2-one	24.6
C	Propan-1-ol	2
D	Ethanoic acid	1.6

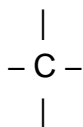
- 2.1 Define the term "functional group" of an organic compound. (2)
- 2.2 Which one of the compounds (A,B,C or D) in the table has the:
- 2.2.1 Highest boiling point? (Refer to the vapor pressure in the table and give the reason for your answer) (2)
- 2.2.2 Weakest intermolecular force? (1)
- 2.3 Refer to the different types of intermolecular forces to explain the difference between the vapor pressure of compound A and compound B. (3)
- 2.4 The vapor pressures of compound C and D are very low compared to the vapor pressure of compound A and B. Name the type of intermolecular forces in C and D that are responsible for this difference. (1)
- 2.5 Briefly explain the difference in vapor pressure between compound C and compound D. (2)
- 2.6 Is compound B a gas or a liquid at room temperature? (1)

[12]

QUESTION 3

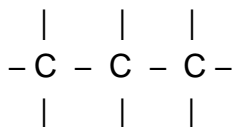
3.1 Use IUPAC prefixes to name the following alkanes:

3.1.1



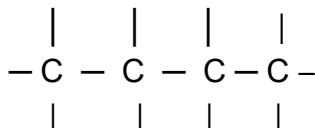
(2)

3.1.2



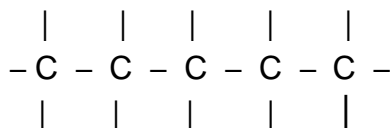
(2)

3.1.3



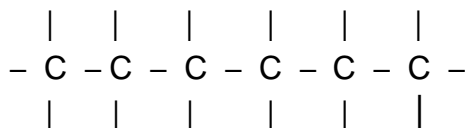
(2)

3.1.4



(2)

3.1.5



(2)

3.2 Define the following terms:

3.2.1 Homologous series.

(2)

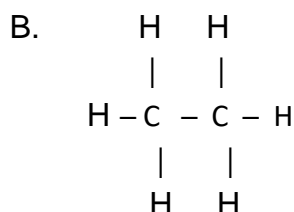
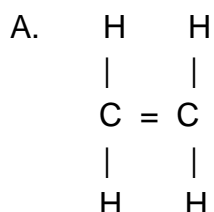
3.2.2 Organic molecules.

(2)

3.2.3 Structural isomer.

(2)

3.3 Consider the following molecules



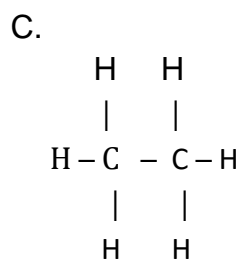
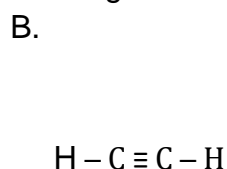
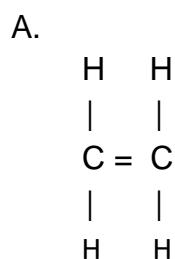
3.3.1 Which one of the above is a saturated hydrocarbon? (Write only A or B)

(2)

3.3.2 Give a reason for your answer in question 3.3.1.

(2)

3.4 Consider the molecules A, B and C given below.



3.4.1 For each one of the structures above write down:

- The name of the structure.
- The name of the homologous series to which the molecule belongs. (6)

3.5 Ethyne is used in industry in blow torches and for the welding and cutting of different metals. The ethyne is burnt in the presence of oxygen during this process.

Complete and balance the following reaction that takes place during the combustion of ethyne.



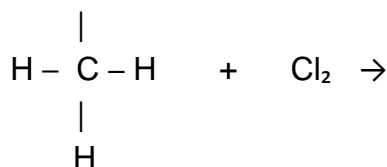
[30]

QUESTION 4

4.1 What is a halo-alkane? (2)

4.2 Explain what is meant by “a halogenation reaction”. (2)

4.3 H



4.3.1 Complete the reaction above by drawing the structural formula of the products. (3)

4.3.2 What is the IUPAC name of the molecule that forms? (2)

[9]

QUESTION 5

Match column A with column B. Write down the question number and ONLY the LETTER of the correct answer next to the question number. E.g. (5.2 F)

Column A	Column B
5.1 The use of optical fiber.	A. Used by ships as sonar to transmit and receive signals.
5.2 When white light is dispersed it forms.	B. Spectrum.
5.3 Microwaves are used for...	C. The speed of light.
5.4 When a light ray leaves a denser medium and enters a less dense medium the ray...	D. Angle of incidence is always equal to the angle of reflection.
5.5 In the same medium the speed of electromagnetic radiation is equal to the speed of...	E. Endoscope.
5.6 needs a medium to travel through.	F. Bends towards the normal
5.7 Ultra sound	G. Is equal to the speed of sound in water.
	H. Bends away from the normal.
	I. Cooking of food
	J. Sound
	K. Is used to correct the vision of short-sighted people.

[14]



QUESTION 6

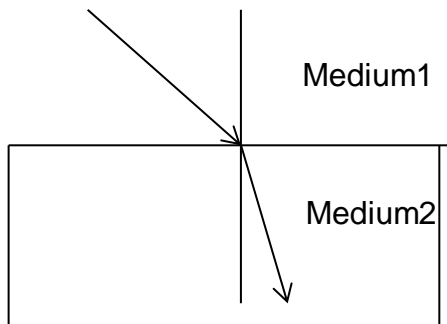
In our day-to-day activities there are two types of lenses that are being used. These are concave lenses and convex lenses.

- 6.1 Give the name of the lens that is also known as a converging lens. (1)
- 6.2 Converging lenses are also used to correct the vision of people with sight problems, by developing glasses for them.
 - 6.2.1 What is the problem with the eyes of people who use converging lenses in their glasses? (2)
 - 6.2.2 Draw and label a ray diagram when light passes through a converging lens. Include the following labels in your diagram: Lens, focal length and focal point. (3)
 - 6.2.3 Name three uses of concave lenses. (6)

[12]

QUESTION 7

- 7.1 Redraw and label the diagram below. Include the following labels in your diagram: normal, incident ray, angle of incidence, refracted ray and angle of refraction. (5)



- 7.2 Define refraction. (2)
- 7.3 State the law of reflection. (4)
- 7.4 What can happen to a light ray when it falls on an object? Name three things. (3)
- 7.5 Define the angle of refraction. (2)
- 7.6 Define dispersion. (2)
- 7.7 Which light can be refracted the most? Choose your answer from the following and write only the alphabet and the number of the correct answer, e.g. (7.7 B)
 - A. Red
 - B. Violet
 - C. Green
 (1)
- 7.8 State the two conditions for total internal reflection to take place. (4)

[23]



QUESTION 8

The table below indicates different electro-magnetic waves.

EM waves
Ultraviolet wave
Gamma
Radio waves
Visible light
Microwave
x-ray
Infrared

- 8.1 Rearrange the table in order of the increasing wavelength. (7)
- 8.2 Explain what happens to frequency as wavelength increases. (2)
- 8.3 Briefly explain how electromagnetic waves propagate. (3)
- 8.4 Name any two properties of electromagnetic radiation. (4)
- 8.5 Name two uses of an X-ray. (2)
- 8.6 Give one disadvantage of too much exposure of x-rays to the skin. (2)
- 8.7 Name two advantages of ultraviolet light and two disadvantages of its use. (4)
-
- 8.8 An ultraviolet light has a frequency of 3.2×10^{15} Hz.
- 8.8.1 Calculate its wavelength. (5)
- 8.8.2 Calculate the energy of its photon. (5)

[34]

TOTAL: 150



**DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 2**

**GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
VRAESTEL 2**

TABLE 1/TABEL 1

PHYSICAL CONSTANTS/FISIESE KONSTANTES		
CONSTANT/KONSTANTE	SYMBOL/SIMBOOL	VALUE/WAARDE
Planck's constant <i>Planck se konstante</i>	h	$6,63 \times 10^{-34} \text{ J.s}$
Speed of light <i>Spoed van lig</i>	c	$3 \times 10^8 \text{ m.s}^{-1}$

TABLE 2/TABEL 2

WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG	
Speed/ <i>Spoed</i>	$c = f \lambda$
Energy/ <i>Energie</i>	$E = hf$ or/of $E = \frac{hc}{\lambda}$

TABLE 3/TABEL 3

ELECTROCHEMISTRY/ELEKTROCHEMIE	
Emf/ <i>Emk</i>	$E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta} / E_{\text{sel}}^{\theta} = E_{\text{katode}}^{\theta} - E_{\text{anode}}^{\theta}$ or/of $E_{\text{cell}}^{\theta} = E_{\text{reduction}}^{\theta} - E_{\text{oxidation}}^{\theta} / E_{\text{sel}}^{\theta} = E_{\text{reduksie}}^{\theta} - E_{\text{oksidasie}}^{\theta}$ or/of $E_{\text{cell}}^{\theta} = E_{\text{oxidisingagent}}^{\theta} - E_{\text{reducingagent}}^{\theta} / E_{\text{sel}}^{\theta} = E_{\text{oksideermiddel}}^{\theta} - E_{\text{reduseeermiddel}}^{\theta}$



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

	Half-reactions/ <i>Halfreaksies</i>	E^θ (V)
↑ Increasing oxidising ability/ <i>Toenemende oksiderende vermoë</i>	$F_2(g) + 2e^- \rightleftharpoons 2F^-$	+ 2,87
	$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+ 1,81
	$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+1,77
	$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 1,51
	$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 1,36
	$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+ 1,33
	$O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+ 1,23
	$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+ 1,23
	$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+ 1,20
	$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
	$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
	$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 0,85
	$Ag^+ + e^- \rightleftharpoons Ag$	+ 0,80
	$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+ 0,80
	$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 0,77
	$O_2(g) + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+ 0,68
	$I_2 + 2e^- \rightleftharpoons 2I^-$	+ 0,54
	$Cu^+ + e^- \rightleftharpoons Cu$	+ 0,52
	$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+ 0,45
	$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+ 0,40
	$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+ 0,34
	$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+ 0,17
	$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+ 0,16
	$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+ 0,15
	$S + 2H^+ + 2e^- \rightleftharpoons H_2S(g)$	+ 0,14
	$2H^+ + 2e^- \rightleftharpoons H_2(g)$	0,00
	$Fe^{3+} + 3e^- \rightleftharpoons Fe$	- 0,06
	$Pb^{2+} + 2e^- \rightleftharpoons Pb$	- 0,13
	$Sn^{2+} + 2e^- \rightleftharpoons Sn$	- 0,14
	$Ni^{2+} + 2e^- \rightleftharpoons Ni$	- 0,27
	$Co^{2+} + 2e^- \rightleftharpoons Co$	- 0,28
	$Cd^{2+} + 2e^- \rightleftharpoons Cd$	- 0,40
	$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	- 0,41
	$Fe^{2+} + 2e^- \rightleftharpoons Fe$	- 0,44
	$Cr^{3+} + 3e^- \rightleftharpoons Cr$	- 0,74
	$Zn^{2+} + 2e^- \rightleftharpoons Zn$	- 0,76
	$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-$	- 0,83
	$Cr^{2+} + 2e^- \rightleftharpoons Cr$	- 0,91
	$Mn^{2+} + 2e^- \rightleftharpoons Mn$	- 1,18
	$Al^{3+} + 3e^- \rightleftharpoons Al$	- 1,66
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	- 2,36	
$Na^+ + e^- \rightleftharpoons Na$	- 2,71	
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	- 2,87	
$Sr^{2+} + 2e^- \rightleftharpoons Sr$	- 2,89	
$Ba^{2+} + 2e^- \rightleftharpoons Ba$	- 2,90	
$Cs^+ + e^- \rightleftharpoons Cs$	- 2,92	
$K^+ + e^- \rightleftharpoons K$	- 2,93	
$Li^+ + e^- \rightleftharpoons Li$	- 3,05	



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

Half-reactions/ <i>Halfreaksies</i>	E^θ (V)
$\text{Li}^+ + e^- \rightleftharpoons \text{Li}$	- 3,05
$\text{K}^+ + e^- \rightleftharpoons \text{K}$	- 2,93
$\text{Cs}^+ + e^- \rightleftharpoons \text{Cs}$	- 2,92
$\text{Ba}^{2+} + 2e^- \rightleftharpoons \text{Ba}$	- 2,90
$\text{Sr}^{2+} + 2e^- \rightleftharpoons \text{Sr}$	- 2,89
$\text{Ca}^{2+} + 2e^- \rightleftharpoons \text{Ca}$	- 2,87
$\text{Na}^+ + e^- \rightleftharpoons \text{Na}$	- 2,71
$\text{Mg}^{2+} + 2e^- \rightleftharpoons \text{Mg}$	- 2,36
$\text{Al}^{3+} + 3e^- \rightleftharpoons \text{Al}$	- 1,66
$\text{Mn}^{2+} + 2e^- \rightleftharpoons \text{Mn}$	- 1,18
$\text{Cr}^{2+} + 2e^- \rightleftharpoons \text{Cr}$	- 0,91
$2\text{H}_2\text{O} + 2e^- \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^-$	- 0,83
$\text{Zn}^{2+} + 2e^- \rightleftharpoons \text{Zn}$	- 0,76
$\text{Cr}^{3+} + 3e^- \rightleftharpoons \text{Cr}$	- 0,74
$\text{Fe}^{2+} + 2e^- \rightleftharpoons \text{Fe}$	- 0,44
$\text{Cr}^{3+} + e^- \rightleftharpoons \text{Cr}^{2+}$	- 0,41
$\text{Cd}^{2+} + 2e^- \rightleftharpoons \text{Cd}$	- 0,40
$\text{Co}^{2+} + 2e^- \rightleftharpoons \text{Co}$	- 0,28
$\text{Ni}^{2+} + 2e^- \rightleftharpoons \text{Ni}$	- 0,27
$\text{Sn}^{2+} + 2e^- \rightleftharpoons \text{Sn}$	- 0,14
$\text{Pb}^{2+} + 2e^- \rightleftharpoons \text{Pb}$	- 0,13
$\text{Fe}^{3+} + 3e^- \rightleftharpoons \text{Fe}$	- 0,06
$2\text{H}^+ + 2e^- \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^+ + 2e^- \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+ 0,14
$\text{Sn}^{4+} + 2e^- \rightleftharpoons \text{Sn}^{2+}$	+ 0,15
$\text{Cu}^{2+} + e^- \rightleftharpoons \text{Cu}^+$	+ 0,16
$\text{SO}_4^{2-} + 4\text{H}^+ + 2e^- \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+ 0,17
$\text{Cu}^{2+} + 2e^- \rightleftharpoons \text{Cu}$	+ 0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4e^- \rightleftharpoons 4\text{OH}^-$	+ 0,40
$\text{SO}_2 + 4\text{H}^+ + 4e^- \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+ 0,45
$\text{Cu}^+ + e^- \rightleftharpoons \text{Cu}$	+ 0,52
$\text{I}_2 + 2e^- \rightleftharpoons 2\text{I}^-$	+ 0,54
$\text{O}_2(\text{g}) + 2\text{H}^+ + 2e^- \rightleftharpoons \text{H}_2\text{O}_2$	+ 0,68
$\text{Fe}^{3+} + e^- \rightleftharpoons \text{Fe}^{2+}$	+ 0,77
$\text{NO}_3^- + 2\text{H}^+ + e^- \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+ 0,80
$\text{Ag}^+ + e^- \rightleftharpoons \text{Ag}$	+ 0,80
$\text{Hg}^{2+} + 2e^- \rightleftharpoons \text{Hg}(\ell)$	+ 0,85
$\text{NO}_3^- + 4\text{H}^+ + 3e^- \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+ 0,96
$\text{Br}_2(\ell) + 2e^- \rightleftharpoons 2\text{Br}^-$	+ 1,07
$\text{Pt}^{2+} + 2e^- \rightleftharpoons \text{Pt}$	+ 1,20
$\text{MnO}_2 + 4\text{H}^+ + 2e^- \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+ 1,23
$\text{O}_2(\text{g}) + 4\text{H}^+ + 4e^- \rightleftharpoons 2\text{H}_2\text{O}$	+ 1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 6e^- \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+ 1,33
$\text{Cl}_2(\text{g}) + 2e^- \rightleftharpoons 2\text{Cl}^-$	+ 1,36
$\text{MnO}_4^- + 8\text{H}^+ + 5e^- \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+ 1,51
$\text{H}_2\text{O}_2 + 2\text{H}^+ + 2e^- \rightleftharpoons 2\text{H}_2\text{O}$	+ 1,77
$\text{Co}^{3+} + e^- \rightleftharpoons \text{Co}^{2+}$	+ 1,81
$\text{F}_2(\text{g}) + 2e^- \rightleftharpoons 2\text{F}^-$	+ 2,87

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Increasing reducing ability/*Toenemende reduserende vermoë*