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NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2022

TECHNICAL SCIENCES P2

MARKS: 75

TIME: 1¹/₂ hours

This question paper consists of 12 pages, including 1 data sheet.

INSTRUCTIONS AND INFORMATION

- 1. This question paper consists of SIX questions. Answer ALL the questions in the ANSWER BOOK.
- 2. Start EACH question on a NEW page in the ANSWER BOOK.
- 3. You may use a non-programmable calculator.
- 4. You may use appropriate mathematical instruments.
- 5. You are advised to use the attached PERIODIC TABLE.
- 6. Number the answers according to the numbering system used in this question paper.
- 7. Show ALL formulae and substitutions in ALL calculations.
- 8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
- 9. Give brief motivations, discussions etc where required.
- 10. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.5) in the ANSWER BOOK, for example 1.6 D.

	STRUCTURE OF THE FUNCTIONAL GROUP	NAME OF THE FUNCTIONAL GROUP
A	О - С – Н	Formyl group
В		Carbonyl group
С	О ॥ - С – О – Н	Carboxyl group
D	– C – O – H	Hydroxyl group

1.1 Which ONE of the following combinations about ketones is correct?

1.2 Consider the structural formula of the compound below and identify the type of intermolecular forces that exist between molecules.

- A Only London forces and Dispersion forces
- B Only Dispersion forces and Dipole-dipole forces
- C Only Hydrogen bonds and Dispersion forces
- D Only Dispersion forces and induced-dipole forces (2)

(2)

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1.3 Consider the organic reaction below. What is represented by X and Y?

 $X + Y \rightarrow CO_2 + H_2O$

- А Hydrocarbon and Oxygen
- В Haloalkane and Oxygen
- С Hydrocarbon and Haloalkane
- D Oxygen and Esters
- 1.4 Which of the following are examples of intrinsic and extrinsic semiconductors?

	Intrinsic semiconductor	Extrinsic semiconductor
А	Silicon	Germanium
В	Phosphorous	Arsenic
С	Silicon	Arsenic
D	Phosphorous	Germanium

- (2)
- 1.5 Which ONE of the following combinations of statements concerning n-type and p-type semiconductors is true?
 - n-type semiconductors have negative charge carriers whereas p-type has (i) positive charge.
 - n-type semiconductors have negative charge carriers whereas p-type has (ii) positive charge carriers
 - n-type is formed when an extrinsic semiconductor is doped with a (iii) pentavalent impurity whereas p-type is formed when an extrinsic semiconductor is doped with a trivalent impurity.
 - (iv) n-type is formed when an intrinsic semiconductor is doped with a pentavalent impurity whereas p-type is formed when an intrinsic semiconductor is doped with a trivalent impurity.
 - А (i) and (iii)
 - В (ii) and (iii)
 - С (i) and (iv)
 - D (ii) and (iv)

(2)[10]

4

(2)

QUESTION 2 (Start on a new page.)

Consider the organic compounds represented by the letters ${\bf A}$ to ${\bf F}$ below and answer the questions that follow.



2.1 Define the term *functional* group.

(2)

2.2 Write down the letter(s) that represents the follo	wing:
--	-------

2.2.1	A tertiary alcohol	(1)
2.2.2	An unsaturated hydrocarbon	(1)
2.2.3	An ester	(1)
2.2.4	A Carbonyl group	(1)
2.2.5	Hydrocarbons	(1)
2.2.6	Chain isomers	(1)
Write d	lown the IUPAC name of:	
2.3.1	C	(1)
2.3.2	E	(1)

2.3.3 **F** (1)

5

2.3

(2)

(1)

(1)

(1) **[16]**

2.4	Write c	down the:
	2.4.1	STRUCTURAL formula of compound D
	2.4.2	STRUCTURAL formula for the positional isomer of compound ${\bf C}$ such that it is a minor product
	2.4.3	Molecular formula of compound A
	2.4.4	STRUCTURAL formula for the functional group of compound ${f B}$

QUESTION 3 (Start on a new page.)

Students were observing the boiling points of carboxylic acids, alcohols and ketones with the same number of carbon atoms. The results are randomly recorded as follows:

	Compound	Boiling point (°C)
А	Carboxylic Acid	222
В	Alcohol	118
С	Ketone	56

3.1 Which compound will have the ...

lowest vapour pressure?	((1)
	lowest vapour pressure?	lowest vapour pressure? (lowest vapour pressure? (1

3.1.2 lowest viscosity?

- 3.2 Compounds listed above differ in boiling points owing to the strength of intermolecular forces they possess. Name the common type of intermolecular force found in all 3 groups of organic compounds in the table above.
- 3.3 Name the type of intermolecular forces that are dominant in carboxylic acids and alcohols.
- 3.4 Use the data in the table above and your answer in QUESTION 3.3 to explain why carboxylic acids have a higher boiling point than alcohols.

7

(1)

(1)

(1)

(3) [**7**]

QUESTION 4 (Start on a new page.)

Curves **A**, **B** and **C** are obtained in an investigation for a relationship between boiling points and a number of carbon atoms in straight chains of <u>different homologous series</u>, namely alkanes, aldehydes and alcohols.



QUESTION 5 (Start on a new page.)

The table below represents the products that were obtained in various organic reactions that were conducted. Consider the table and answer the questions that follow.

	PRODUCT: HOMOLOGOUS SERIES	PRODUCT: STRUCTURAL FORMULA
REACTION 1	Alcohol	т тс
REACTION 2	Alkane	л н 1
REACTION 3	Haloalkane	I — 0 — I I

Product for **REACTION 1** was obtained when an alkene reacted with water. Product for **REACTION 2** was obtained when an alkene reacted with hydrogen. Product for **REACTION 3** was obtained when an alkane reacted with a halogen.

5.1 For **REACTION 1**, write down the:

5.1.1	IUPAC name of the alkene used	(2)
5.1.2	Name of this reaction	(1)
5.1.3	ONE reaction condition for this reaction	(1)
5.1.4	Type of alcohol that this product is	(1)
5.1.5	Type of product formed: Write only MINOR PRODUCT or MAJOR PRODUCT	(1)

<u>10</u>		TECHNICAL SCIENCES P2	(EC/JUNE 2022)					
5.2	For REACTION 2 , write down the:							
	5.2.1	5.2.1 Balanced chemical equation using STRUCTURAL FORMULAE						
	5.2.2	Name of the addition reaction represented here	(1)					
	5.2.3	(1)						
5.3	State,	State, with reasons, why the alkane formed is a saturated hydrocarbon.						
5.4	For RE							
	5.4.1	Name of the halogen used	(1)					
	5.4.2	Structural formula for the positional isomer of the product formed	(2)					
	5.4.3 IUPAC name of the positional isomer given in QUESTION 5.4.2 above		(1)					
5.5	Define	a polymer.	(2)					
5.6	Give ONE use of polythene.							

6.2

6.3

QUESTION 6 (Start on a new page.)

A semiconductor is a material which has an electrical conductivity between that of a conductor and an insulator.

- 6.1 Define the following terms:
 - 6.1.1 An intrinsic semiconductor (2)
 - 6.1.2 Doping

Semiconductor 1 Semiconductor 2 ** Si ** Si * Α Si ** Si ×× В B· * Si ** Si * * Si * Si Si × Identify the: (1) 6.2.1 p-type semiconductor 6.2.2 n-type semiconductor (1) 6.2.3 With reference to parts marked A and B, explain the answers to QUESTION 6.2.1 and QUESTION 6.2.2. (2) Briefly explain how the p-n junction is formed. (3) [11] TOTAL: 75

(2)

TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

1 (I)		2 (II)		3	4	4	KE	5		6 :11TE	7	8 Atoom	9 Igetal	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 1 5,1 1			-				Γ	_ / 、	SLL	.072			, , 									2 He 4
0, Li 7	1,5	4 Be 9						<i>Ele</i> Ele	<i>ktrol</i> ectro	negat onega	<i>tiwiteit</i>	لم في أرك 63	u €u 3,5	Simbo Symb	ool ol		5 0.2 11	6 C 12 5:2	7 0. N ແ 14	8 0 16 3.2	9 0. F 19	10 Ne 20
م 11 Na 23	1,2	12 Mg 24									Bena Appro	derde re oximate r	<i>latiewe</i> elative	atoomn atomic	nassa mass		13 5. Al 27	∞ 14	15 N P 31	16 5.7 S 32	0. 17 ຕິ Cl 35,5	18 Ar 40
8, 19 6 K 39	1,0	20 Ca 40	1,3	21 Sc 45	1,5	22 Ti 48	1,6	23 V 51	1,6	24 Cr 52	25 S [.] Mn 55	26 ^{®:} Fe 56	27 8. Co 59	28 0. 1 59	29 6. Cu 63,5	9 [.] 9 [.] 65	9. 9. 70	∞.	33 0: As 75	34 ₹ ₹ 79	35 87 80	36 Kr 84
37 0 Rb 86	1,0	38 Sr 88	1,2	39 Y 89	1,4	40 Zr 91		41 Nb 92	1,8	42 Mo 96	43 م: Tc	44 7 Ru 101	45 २ Rh 103	46 7 Pd 106	47 6. Ag 108	48 1- Cd 112	49 2.1 115	50 0 50 50 50 50 50 50 50 50 119	51 6. Sb 122	52 57 Te 128	53 57 127	54 Xe 131
55 ^{ト,} Cs 133	0,9	56 Ba 137		57 La 139	1,6	72 Hf 179	1	73 Ta 81		74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 ••• Te 204	82 ••• Pb 207	83 م: Bi 209	84 0. Po 5. 0	85 At 5'2	86 Rn
87 ℃, Fr	0,9	88 Ra		89 Ac			5	8	5	9	60	61	62	63	64	65	66	67	68	69	70	71
L		220	<u> </u>		J		C 14	e 40	F 14	Pr 41	Nd 144	Pm	Sm 150	Eu 152	Gd 157	Tb 159	Dy 163	Ho 165	Er 167	Tm 169	Yb 173	Lu 175
							9 T 2:	0 h 32	9 F	1 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr