



education

Department:
Education
PROVINCE OF KWAZULU-NATAL

**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

PHYSICAL SCIENCE: CHEMISTRY (P2)

COMMON TEST

MARCH 2020

MARKS: 50

TIME: 1 hour

**This question paper consists of 5 pages and
2 data sheets.**

INSTRUCTIONS AND INFORMATION

1. Write your name on the **ANSWER BOOK**.
2. Answer **ALL** the questions in the ANSWER BOOK.
3. This question paper consists of FOUR questions.
4. You may use a non-programmable calculator.
5. Number the answers correctly according to the numbering system used in this question paper.
6. You are advised to use the attached DATA SHEETS.
7. Give brief motivations, discussions et cetera where required.

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 number (1.1 - 1.10) in the ANSWER BOOK, for example 1.5 D.

1.1 Which ONE of the following is a molecule with a multiple bond?

- A N₂
- B NH₃
- C OF₂
- D HOCl

(2)

1.2 The molecular formula of ethyne is C₂H₂.

The shape of the ethyne molecule as predicted by the VSEPR theory is:

- A Trigonal planar.
- B Octahedral.
- C Linear.
- D Bent.

(2)

1.3 The table below indicates the boiling points of four liquids.

SUBSTANCE	BOILING POINT (°C)
Water	100
Methylated spirits	78,5
Ethanol	78,37
Acetone	56

Which ONE of the above liquids has the lowest surface tension?

- A Water.
- B Methylated spirits.
- C Ethanol.
- D Acetone.

(2)

1.4 The predominant forces between the molecules in an ice crystal are called . . .

- A London forces.
- B Hydrogen bonding.
- C Induced dipole forces.
- D Polar covalent bonding.

(2)
[8]

QUESTION 2 (Start on a new page.)

The water molecule has the formula: H₂O.

- 2.1 Water forms a dative covalent bond with the hydrogen ion.
- 2.1.1 What is a dative covalent bond? (2)
- 2.1.2 State ONE requirement for the formation of a dative covalent bond. (1)
- 2.1.3 Draw the Lewis structure to show the bonding that takes place when the above dative covalent bond is formed. (2)
- 2.1.4 Name the ion that is formed from the above dative covalent bond. (1)
- 2.2 The water molecular is angular in shape. Explain this shape in terms of the VSEPR theory. (3)
- 2.3 The density of ice is less than the density of the liquid.
- 2.3.1 Explain the significance of the above for life on EARTH. (3)
- 2.3.2 Calculate the number of water molecules present in 1 dm³ of water if the mass of 1 cm³ of water is 1 g. (3)
- [15]**

QUESTION 3 (Start on a new page.)

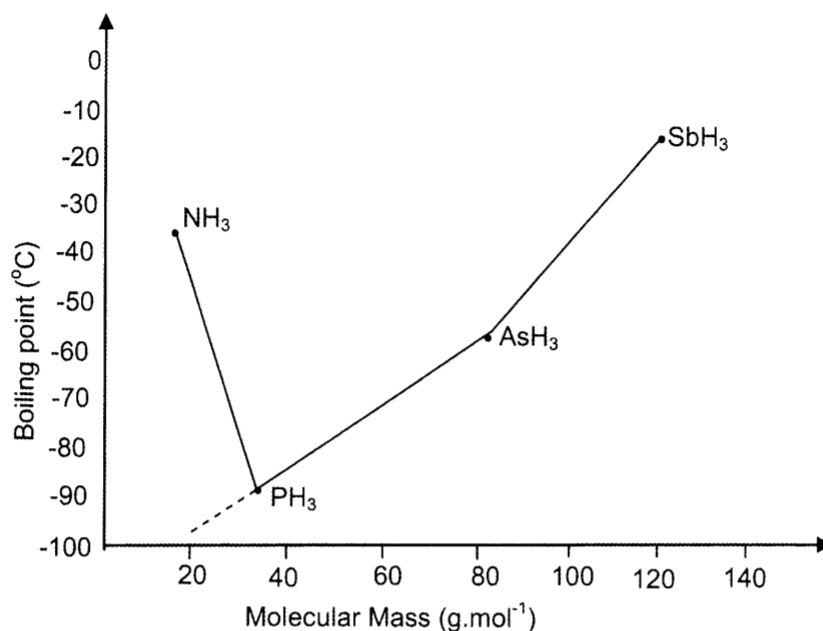
The bond length of the H – Br bond is 60 pm.

350 kJ.mol⁻¹ of energy is required to break the H – Br bond.

- 3.1 Define the term *bond length*. (2)
- 3.2 Draw a sketch graph (not to scale) in your answer book to show how potential energy changes as the distance between the nuclei changes when a hydrogen (H) atom approaches a bromine (Br) atom.
- Indicate the following values on the graph:
- (i) Bond length.
- (ii) Bond energy. (5)
- 3.3 How will the bond length of an H - Cl bond compare to that of the H – Br bond? Write down LONGER THAN, EQUAL TO or SHORTER THAN. (1)
- 3.4 Give a reason for the answer to question 3.3. (1)
- [9]**

QUESTION 4 (Start on a new page.)

The graph below shows the results obtained during an investigation to determine the boiling points of substances formed when hydrogen is bonded to atoms from group V of the periodic table.



- 4.1 Define *boiling point*. (2)
- 4.2 Write down an investigative question for this investigation. (2)
- 4.3 Consider PH₃, AsH₃ and SbH₃.
- 4.3.1 Name the type of van der Waals forces that exist between molecules of PH₃. Explain the answer by referring to the shape and polarity of the molecule. (3)
- 4.3.2 Which of the three substances has the highest vapour pressure? Give a reason for the answer. (2)
- 4.3.3 Fully explain why SbH₃ has a higher boiling point than AsH₃. (3)
- 4.4 It is expected that from the trend shown in the above graph, the boiling point of NH₃ should fall along the dotted line. Explain, with reference to the TYPE OF INTERMOLECULAR FORCES AND ENERGY, why the boiling point of NH₃ does not fall along the dotted line. (4)
- 4.5 The SAME INVESTIGATION is now conducted when the atmospheric pressure is LOWERED. What effect will this have on:
- 4.5.1 The vapour pressure of NH₃? (1)
- 4.5.2 The boiling point of NH₃? (1)
- (Choose from INCREASES, DECREASES or REMAINS THE SAME in each case):

[18]**TOTAL MARKS: 50**

**DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIESTE WETENSAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)**

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Avogadro's constant <i>Avogadro-konstante</i>	N_A	$6,02 \times 10^{23} \text{ mol}^{-1}$
Molar gas constant <i>Molêre gaskonstante</i>	R	$8,31 \text{ J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$
Standard pressure <i>Standaarddruk</i>	p^\ominus	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V_m	$22,4 \text{ dm}^3\cdot\text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	T^\ominus	273 K

TABLE 2: FORMULAE/TABEL 2: FORMULES

$\frac{p_1 V_1}{T_1} = \frac{p_2 V_2}{T_2}$	$pV = nRT$
$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$n = \frac{V}{V_m}$	$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$

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

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18				
		(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)	(IX)	(X)	(XI)	(XII)	(XIII)	(XIV)	(XV)	(XVI)	(XVII)	(XVIII)				
KEY/SLEUTEL																							
	Electronegativity Elektronegatiwiteit																						
	Atomic number Atoomgetal																						
	Symbol Simbool																						
	Approximate relative atomic mass Benaderde relatiewe atoommassa																						
		1 1 H	2 4 Be	3 7 Li	4 9 B	5 11 Na	6 12 Mg	7 14 N	8 16 O	9 17 F	10 18 Ne	11 20 Ca	12 24 Mg	13 28 Si	14 32 S	15 35,5 Cl	16 35,5 Ar	17 40 K	18 40 Ca	19 39 K	20 40 Ca		
		21 39 Sc	20 38 Sr	21 39 Y	22 40 Zr	23 41 Nb	24 42 Mo	25 51 V	26 52 Cr	27 55 Mn	28 56 Fe	29 59 Cu	30 63,5 Zn	31 70 Ga	32 73 Ge	33 75 As	34 79 Se	35 80 Br	36 84 Kr	37 86 Rb	38 88 Sr		
		39 89 La	37 86 Rb	38 88 Sr	39 89 Y	40 91 Zr	41 92 Nb	42 96 Mo	43 96 Tc	44 101 Ru	45 103 Rh	46 106 Pd	47 108 Ag	48 112 Cd	49 115 In	50 119 Sn	51 122 Sb	52 128 Te	53 127 I	54 131 Xe	55 133 Cs	56 137 Ba	
		89 Ac	87 Fr	88 Ra	89 Ac	90 232 Th	91 238 Pa	92 238 U	93 238 Np	94 238 Pu	95 238 Am	96 238 Cm	97 238 Bk	98 238 Cf	99 238 Es	100 238 Fm	101 238 Md	102 238 No	103 238 Lr	104 238 Rf	105 238 Db	106 238 Sg	
		107 254 Boh	105 254 Db	106 254 Sg	107 254 Boh	108 254 Hs	109 254 Mt	110 254 Ds	111 254 Rg	112 254 Cn	113 254 Nh	114 254 Fl	115 254 Mc	116 254 Lv	117 254 Ts	118 254 Og	119 254 Uu	120 254 Uub	121 254 Uut	122 254 Uuq	123 254 Uuq	124 254 Uuq	125 254 Uuq
		129 288 Ubn	127 288 Ubn	128 288 Ubn	129 288 Ubn	130 288 Ubn	131 288 Ubn	132 288 Ubn	133 288 Ubn	134 288 Ubn	135 288 Ubn	136 288 Ubn	137 288 Ubn	138 288 Ubn	139 288 Ubn	140 288 Ubn	141 288 Ubn	142 288 Ubn	143 288 Ubn	144 288 Ubn	145 288 Ubn	146 288 Ubn	147 288 Ubn
		153 304 Ubn	151 304 Ubn	152 304 Ubn	153 304 Ubn	154 304 Ubn	155 304 Ubn	156 304 Ubn	157 304 Ubn	158 304 Ubn	159 304 Ubn	160 304 Ubn	161 304 Ubn	162 304 Ubn	163 304 Ubn	164 304 Ubn	165 304 Ubn	166 304 Ubn	167 304 Ubn	168 304 Ubn	169 304 Ubn	170 304 Ubn	171 304 Ubn
		173 348 Ubn	171 348 Ubn	172 348 Ubn	173 348 Ubn	174 348 Ubn	175 348 Ubn	176 348 Ubn	177 348 Ubn	178 348 Ubn	179 348 Ubn	180 348 Ubn	181 348 Ubn	182 348 Ubn	183 348 Ubn	184 348 Ubn	185 348 Ubn	186 348 Ubn	187 348 Ubn	188 348 Ubn	189 348 Ubn	190 348 Ubn	191 348 Ubn
		183 392 Ubn	181 392 Ubn	182 392 Ubn	183 392 Ubn	184 392 Ubn	185 392 Ubn	186 392 Ubn	187 392 Ubn	188 392 Ubn	189 392 Ubn	190 392 Ubn	191 392 Ubn	192 392 Ubn	193 392 Ubn	194 392 Ubn	195 392 Ubn	196 392 Ubn	197 392 Ubn	198 392 Ubn	199 392 Ubn	200 392 Ubn	201 392 Ubn
		193 436 Ubn	191 436 Ubn	192 436 Ubn	193 436 Ubn	194 436 Ubn	195 436 Ubn	196 436 Ubn	197 436 Ubn	198 436 Ubn	199 436 Ubn	200 436 Ubn	201 436 Ubn	202 436 Ubn	203 436 Ubn	204 436 Ubn	205 436 Ubn	206 436 Ubn	207 436 Ubn	208 436 Ubn	209 436 Ubn	210 436 Ubn	211 436 Ubn
		203 480 Ubn	201 480 Ubn	202 480 Ubn	203 480 Ubn	204 480 Ubn	205 480 Ubn	206 480 Ubn	207 480 Ubn	208 480 Ubn	209 480 Ubn	210 480 Ubn	211 480 Ubn	212 480 Ubn	213 480 Ubn	214 480 Ubn	215 480 Ubn	216 480 Ubn	217 480 Ubn	218 480 Ubn	219 480 Ubn	220 480 Ubn	221 480 Ubn
		213 524 Ubn	211 524 Ubn	212 524 Ubn	213 524 Ubn	214 524 Ubn	215 524 Ubn	216 524 Ubn	217 524 Ubn	218 524 Ubn	219 524 Ubn	220 524 Ubn	221 524 Ubn	222 524 Ubn	223 524 Ubn	224 524 Ubn	225 524 Ubn	226 524 Ubn	227 524 Ubn	228 524 Ubn	229 524 Ubn	230 524 Ubn	231 524 Ubn
		223 568 Ubn	221 568 Ubn	222 568 Ubn	223 568 Ubn	224 568 Ubn	225 568 Ubn	226 568 Ubn	227 568 Ubn	228 568 Ubn	229 568 Ubn	230 568 Ubn	231 568 Ubn	232 568 Ubn	233 568 Ubn	234 568 Ubn	235 568 Ubn	236 568 Ubn	237 568 Ubn	238 568 Ubn	239 568 Ubn	240 568 Ubn	241 568 Ubn
		233 612 Ubn	231 612 Ubn	232 612 Ubn	233 612 Ubn	234 612 Ubn	235 612 Ubn	236 612 Ubn	237 612 Ubn	238 612 Ubn	239 612 Ubn	240 612 Ubn	241 612 Ubn	242 612 Ubn	243 612 Ubn	244 612 Ubn	245 612 Ubn	246 612 Ubn	247 612 Ubn	248 612 Ubn	249 612 Ubn	250 612 Ubn	251 612 Ubn
		243 656 Ubn	241 656 Ubn	242 656 Ubn	243 656 Ubn	244 656 Ubn	245 656 Ubn	246 656 Ubn	247 656 Ubn	248 656 Ubn	249 656 Ubn	250 656 Ubn	251 656 Ubn	252 656 Ubn	253 656 Ubn	254 656 Ubn	255 656 Ubn	256 656 Ubn	257 656 Ubn	258 656 Ubn	259 656 Ubn	260 656 Ubn	261 656 Ubn
		253 700 Ubn	251 700 Ubn	252 700 Ubn	253 700 Ubn	254 700 Ubn	255 700 Ubn	256 700 Ubn	257 700 Ubn	258 700 Ubn	259 700 Ubn	260 700 Ubn	261 700 Ubn	262 700 Ubn	263 700 Ubn	264 700 Ubn	265 700 Ubn	266 700 Ubn	267 700 Ubn	268 700 Ubn	269 700 Ubn	270 700 Ubn	271 700 Ubn
		263 744 Ubn	261 744 Ubn	262 744 Ubn	263 744 Ubn	264 744 Ubn	265 744 Ubn	266 744 Ubn	267 744 Ubn	268 744 Ubn	269 744 Ubn	270 744 Ubn	271 744 Ubn	272 744 Ubn	273 744 Ubn	274 744 Ubn	275 744 Ubn	276 744 Ubn	277 744 Ubn	278 744 Ubn	279 744 Ubn	280 744 Ubn	281 744 Ubn
		273 788 Ubn	271 788 Ubn	272 788 Ubn	273 788 Ubn	274 788 Ubn	275 788 Ubn	276 788 Ubn	277 788 Ubn	278 788 Ubn	279 788 Ubn	280 788 Ubn	281 788 Ubn	282 788 Ubn	283 788 Ubn	284 788 Ubn	285 788 Ubn	286 788 Ubn	287 788 Ubn	288 788 Ubn	289 788 Ubn	290 788 Ubn	291 788 Ubn
		283 832 Ubn	281 832 Ubn	282 832 Ubn	283 832 Ubn	284 832 Ubn	285 832 Ubn	286 832 Ubn	287 832 Ubn	288 832 Ubn	289 832 Ubn	290 832 Ubn	291 832 Ubn	292 832 Ubn	293 832 Ubn	294 832 Ubn	295 832 Ubn	296 832 Ubn	297 832 Ubn	298 832 Ubn	299 832 Ubn	300 832 Ubn	301 832 Ubn
		293 876 Ubn	291 876 Ubn	292 876 Ubn	293 876 Ubn	294 876 Ubn	295 876 Ubn	296 876 Ubn	297 876 Ubn	298 876 Ubn	299 876 Ubn	300 876 Ubn	301 876 Ubn	302 876 Ubn	303 876 Ubn	304 876 Ubn	305 876 Ubn	306 876 Ubn	307 876 Ubn	308 876 Ubn	309 876 Ubn	310 876 Ubn	311 876 Ubn
		303 920 Ubn	301 920 Ubn	302 920 Ubn	303 920 Ubn	304 920 Ubn	305 920 Ubn	306 920 Ubn	307 920 Ubn	308 920 Ubn	309 920 Ubn	310 920 Ubn	311 920 Ubn	312 920 Ubn	313 920 Ubn	314 920 Ubn	315 920 Ubn	316 920 Ubn	317 920 Ubn	318 920 Ubn	319 920 Ubn	320 920 Ubn	321 920 Ubn
		313 964 Ubn	311 964 Ubn	312 964 Ubn	313 964 Ubn	314 964 Ubn	315 964 Ubn	316 964 Ubn	317 964 Ubn	318 964 Ubn	319 964 Ubn	320 964 Ubn	321 964 Ubn	322 964 Ubn	323 964 Ubn	324 964 Ubn	325 964 Ubn	326 964 Ubn	327 964 Ubn	328 964 Ubn	329 964 Ubn	330 964 Ubn	331 964 Ubn
		323 1008 Ubn	321 1008 Ubn	322 1008 Ubn	323 1008 Ubn	324 1008 Ubn	325 1008 Ubn	326 1008 Ubn	327 1008 Ubn	328 1008 Ubn	329 1008 Ubn	330 1008 Ubn	331 1008 Ubn	332 1008 Ubn	333 1008 Ubn	334 1008 Ubn	335 1008 Ubn	336 1008 Ubn	337 1008 Ubn	338 1008 Ubn	339 1008 Ubn	340 1008 Ubn	341 1008 Ubn
		333 1052 Ubn	331 1052 Ubn	332 1052																			



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**PHYSICAL SCIENCES P2
(CHEMISTRY)**

MARKING GUIDELINE

COMMON TEST

MARCH 2020

**NATIONAL
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GRADE 11

MARKS: 50

TIME: 1 hour

N.B: This marking guideline consists of 3 pages.

QUESTION 1

- 1.1 A ✓✓ (2)
- 1.2 C ✓✓ (2)
- 1.3 D ✓✓ (2)
- 1.4 B ✓✓ (2)
- [8]**

QUESTION 2

2.1 2.1.1 the bond formed when an empty valence shell shares a lone pair of electrons from another atom. ✓ (2)

2.1.2 one atom must have a lone pair of electrons while the other atom must have an empty valence shell. (1)

2.1.3 $\left(\begin{array}{c} \text{H} \\ \cdot \\ \cdot \\ \cdot \\ \text{H}:\ddot{\text{O}}:\text{H} \end{array} \right)^+$

- 2 lone pairs and 2 shared pairs ✓
- positively charged ✓
 (2)

2.1.4 hydronium ion/oxonium ion ✓ (1)

2.2 the central atom has 2 lone pairs and 2 bonded pairs ✓
lone pairs repel each other and the bonded pairs more strongly than the bond pairs repel each other ✓
decreasing the bond angle ✓ (3)

2.3 2.3.1 Ice will float on water. ✓
Bottom layer will not freeze. ✓
Thus sustaining the aquatic life. ✓ (3)

2.3.2 1000 g = 1 dm³

$$n = \frac{m}{RM}$$

$$= \frac{1000\text{g}}{18}$$

$$= 55,55 \text{ mol.}$$

$$\text{No. of molecules} = 55,55 \times N_A \checkmark$$

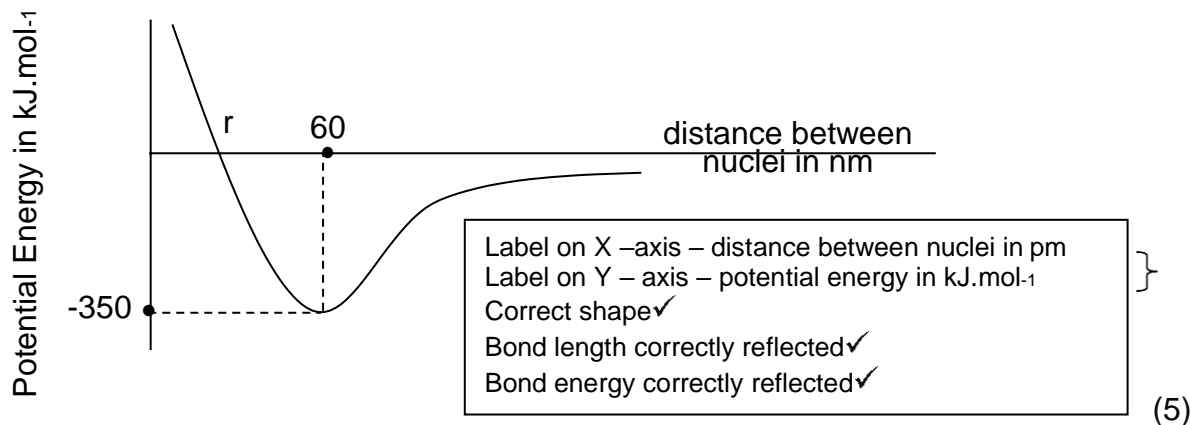
$$= 3,34 \times 10^{25} \checkmark$$

[15]

QUESTION 3

3.1 the average distance between the nuclei of two bonded atoms. ✓✓ (2 or 0) (2)

3.2



3.3 SHORTER THAN ✓ (1)

3.4 chlorine atoms are smaller than bromine atoms. ✓ (1)

[9]

QUESTION 4

4.1 the temperature at which the vapour pressure of a substance equals the atmospheric pressure. ✓✓ (2 or 0) (2)

4.2 What is the relationship between molecular mass and boiling point? ✓✓ (of the hydrides of the group V elements) (2)

4.3.1 Dipole-dipole forces. ✓
Molecular shape is trigonal pyramidal ✓ (one lone pair).
Molecule is polar. ✓ (3)

4.3.2 PH₃ ✓ has the lowest boiling point ✓ (2)

4.3.3 As the relative molecular mass increases, the size of the atom increases forming stronger dipoles. ✓
Strength of the intermolecular forces increases. ✓
More energy required to overcome the intermolecular forces ✓ (3)

4.4 Hydrogen bonding between molecules of NH₃. ✓
Dipole-dipole forces between molecules of PH₃, ASH₃ and SbH₃. ✓
Intermolecular forces therefore unusually stronger between NH₃ molecules. ✓
More energy required to overcome the intermolecular forces in NH₃. ✓ (4)

4.5.1 Remains the same ✓ (1)

4.5.2 Increases ✓ (1)

TOTAL MARKS: 50