education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL
SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES P2 (CHEMISTRY)

COMMON TEST

SEPTEMBER 2019

MARKS: 150

TIME: 3 hours

This question paper consists of 11 pages, 3 data sheets AND a special answer sheet.

INSTRUCTIONS AND INFORMATION TO CANDIDATES

1. Write your name on the **ANSWER BOOK**.

2. Answer **ALL** the questions in the answer book.

3. You may use a non-programmable calculator.

4. You may use appropriate mathematical instruments.

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.

8. Show the formulae and substitutions in ALL calculations.

9. Round off FINAL answers to a minimum of TWO decimal places

QUESTION 1: MULTIPLE- CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK. E.g. 1.11 A

1.1 The measure of the tendency of an atom in a molecule to attract shared electrons is called …

A electronegativity
B ionisation
C mutual attraction
D electronegativity difference (2)

1.2 HI has a higher boiling point than $HC\ell$.
Which statement is INCORRECT for this observation?

A The iodide ion is a larger ion than the chloride ion.
B The molar mass of HI is greater than the molar mass of $HC\ell$.
C There are more electrons in HI than $HC\ell$.
D Hydrogen bonding is present in HI. (2)

1.3 Solid X has a low melting point and dissolves easily in a non-polar solvent.
Solid Y has a high melting point and dissolves easily in a polar solvent.
Solids X and Y are …

	Solid X	**Solid Y**
A	H_2O	I_2
B	I_2	$KC\ell$
C	$NaC\ell$	KBr
D	I_2	C

(2)

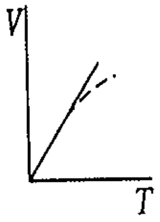
1.4 Which ONE of the following solutions contains the GREATEST number of dissolved ions?

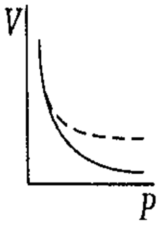
A 50 cm^3 of a 0,10 $mol{\cdot}dm^{-3}$ LiF
B 100 cm^3 of a 0,20 $mol{\cdot}dm^{-3}$ $KC\ell$
C 100 cm^3 of a 0,10 $mol{\cdot}dm^{-3}$ $MgC\ell_2$
D 50 cm^3 of a 0,20 $mol{\cdot}dm^{-3}$ Na_2O (2)

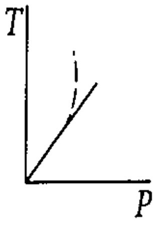
1.5 When the VOLUME of a given mass of gas is DOUBLED at constant temperature, the PRESSURE is HALVED. Which ONE of the following statements BEST explains this observation?

A The force of attraction between the gas molecules is halved.
B The kinetic energy of the gas molecules is halved.
C The number of collisions per unit time between the gas molecules and the walls of the container is halved.
D The speed of the gas molecules is halved. (2)

1.6 Which graph correctly shows how a real gas will deviate from ideal gas behaviour?

A


B


C


D


(2)

1.7 Activation energy can be BEST described as ...

A energy of the reactants before a reaction takes place.
B kinetic energy needed for a reaction to take place.
C difference in energy between reactants and products.
D heat of a reaction. (2)

1.8 Consider the following acid base reactions:

$NH_3 (g) + H_2O(\ell) \rightarrow NH_4^+(aq) + OH^- (aq)$

$SO_4^{2-}(aq) + HNO_3(aq) \rightarrow HSO_4^- (aq) + NO_3^- (aq)$

Two substances acting as PROTON DONORS in the above reactions are:

A H_2O and SO_4^{2-}
B NH_3 and SO_4^{2-}
C NH_3 and HNO_3
D H_2O and HNO_3 (2)

1.9 Which ONE of the statements concerning a REDOX reaction is CORRECT?

A The oxidising agent loses electrons.
B The number of electrons lost must equal the number of electrons gained.
C There is no change in the oxidation states of the substances.
D It involves a change in a mass of the system. (2)

1.10 In which ONE of the following pairs of substances is the oxidation number of sulphur the same?

A SO_2 and SO_3
B SO_3 and H_2SO_4
C H_2S and S
D SO_3 and H_2SO_3 (2)
[20]

QUESTION 2

2.1 State the definition of a *covalent bond.* (2)

Consider the following list of substances and answer the questions that follow.

HF **$BC\ell_3$** **CF_4** **NH_3** **CO_2** **$SC\ell_6$**

2.2 From the list write down the formula/e of:

2.2.1 the molecule that has an octahedral shape (1)

2.2.2 a substance that can sublime at room temperature (1)

2.2.3 the compound that is MOST POLAR (1)

2.2.4 TWO substances that have hydrogen bonds between their molecules (2)

2.3 $BC\ell_3$ can form a dative covalent bond with NH_3.

2.3.1 Draw the Lewis structure for the $BC\ell_3$ molecule. (2)

2.3.2 What is the shape of the $BC\ell_3$ molecule? (1)

2.3.3 Explain why NH_3 is able to form a dative covalent bond with $BC\ell_3$. (2)

2.4 Explain why the bonds in CF_4 are polar, but the molecule is non-polar. (3)

[15]

QUESTION 3

The table below shows the relative molecular masses, melting points and boiling points of a few substances.

Substance	**Formula**	**Relative molecular mass (g·mol^{-1})**	**Melting point (°C)**	**Boiling point (°C)**
Propane	C_3H_8	44	–188	–42
Butane	C_4H_{10}	58	–138	–1
Pentane	C_5H_{12}	72	–130	36
Heptane	C_7H_{16}	100	–90,5	98,4

3.1 Define *melting point*. (2)

3.2 From the substances in the table, write down the NAME or FORMULA of:

3.2.1 TWO substances that are LIQUIDS at room temperature. (2)

3.2.2 The substance with the HIGHEST vapour pressure. (1)

3.2.3 ONE substance that is a GAS at room temperature. (1)

3.3 Propane, butane, pentane and heptane are non-polar molecules.

3.3.1 Name the type of Van der Waals forces present between these molecules. (1)

3.3.2 State the trend with respect to the boiling points of these compounds as shown in the table. (2)

3.3.3 Explain the answer to question 3.3.2 by referring to the strengths of the forces and the energies involved. (2)

[11]

QUESTION 4

4.1 Consider the following table of bond length and bond energies.

Bond	Bond length (pm)	Bond Energy ($kJ\cdot mol^{-1}$)
C = C	134	614
C - C	154	347
Cℓ - Cℓ	199	242
I - I	266	151

4.1.1 State the definition of *bond length.* (2)

Use the information in the table to answer the following questions.

4.1.2 What is the relationship between bond energy and bond length in a stable molecule? (1)

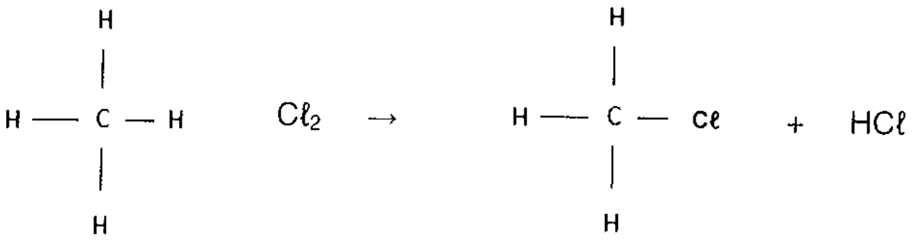
4.1.3 Explain the relationship referred to in question 4.1.2. (2)

4.1.4 Consider the C ≡ C bond.
How will the bond energy of C ≡ C compare to that of C = C?
Choose from GREATER THAN, LESS THAN or EQUAL TO.
Give a reason for the answer. (2)

4.2 Use the table of bond energies below to answer the questions that follow.

Bond	**Bond energy ($kJ \cdot mol^{-1}$)**
H - H	436
C - H	413
Cℓ - Cℓ	242
C - Cℓ	327
H - Cℓ	431

Methane reacts with chlorine according to the following balanced equation:



$$\begin{array}{c} H \\ | \\ H - C - H \\ | \\ H \end{array} \quad C\ell_2 \quad \rightarrow \quad \begin{array}{c} H \\ | \\ H - C - C\ell \\ | \\ H \end{array} \quad + \quad HC\ell$$

4.2.1 Calculate the heat of reaction (ΔH) for the above reaction. (4)

4.2.2 Is the reaction EXOTHERMIC or ENDOTHERMIC?
Give a reason for the answer. (2)

4.2.3 Sketch a potential energy vs course of reaction graph for this reaction.
On the graph indicate the:

- Energy of the reactants
- Energy of the products
- Heat of reaction, and
- Activation energy.

(5)

[18]

QUESTION 5

5.1 Nitrogen and oxygen form a series of oxides with the general formula N_xO_y. One of these compounds contains 36,80% nitrogen and 63,20% oxygen. Determine the empirical formula of this compound. (5)

5.2 Calculate the mass (in grams) of nitrogen present in 10 g of ammonium nitrate (NH_4NO_3). (3)

[8]

QUESTION 6

An investigation is carried out to determine the relationship between the pressure and temperature of an enclosed gas. The following results were obtained from the investigation.

Pressure (kPa)	Temperature (°C)
100	-151
200	-29
300	93
400	X

6.1 Name the gas law being investigated. (1)

6.2 Name TWO variables that need to be controlled in this investigation. (2)

6.3 State the definition of *temperature.* (2)

6.4 Use the graph sheet provided (at the back of this question paper) to draw the graph of Pressure (in kPa) versus Temperature (in °C). The values indicated on the axes have been measured to scale. (2)

(HAND IN THE GRAPH SHEET TOGETHER WITH YOUR ANSWER BOOKLET).

6.5 Extrapolate (extend) the graph until it cuts the x axis.

6.5.1 What is the value of the Kelvin temperature when the pressure is zero? (1)

6.5.2 What is this temperature called? (1)

6.6 Use the graph to write a conclusion for the above investigation. (2)

6.7 Determine the value of X in the table. (4)

6.8 How will the gradient of the graph be affected if a GREATER MASS of the gas is used? Choose from: INCREASE, DECREASE or REMAIN THE SAME. Explain the answer. (4)
[19]

QUESTION 7

A sample of chalk containing 95% calcium carbonate ($CaCO_3$) was reacted with excess dilute hydrochloric acid and 2,128 dm^3 of carbon dioxide was collected at STP according to the following balanced reaction.

$$\mathbf{CaCO_3\ (s) + 2HC\ell\ (aq) \rightarrow CaC\ell_2\ (aq) + H_2O\ (\ell) + CO_2\ (g)}$$

7.1 Define an *acid* according to the Arrhenius Theory. (2)

7.2 Why is $HC\ell$ considered a strong acid? (2)

7.3 Write down the ionisation reaction of $HC\ell$ in water. (2)

7.4 Calculate the mass of the sample of chalk used. (6)

7.5 The excess hydrochloric acid is neutralised by adding sodium carbonate. Write a balance equation for the reaction between hydrochloric acid and sodium carbonate. (3)

[15]

QUESTION 8

Candle wax burns in oxygen to form carbon dioxide and water according to the following balanced equation:

$$\mathbf{C_{23}H_{48} + 35\ O_2 \rightarrow 23\ CO_2 + 24\ H_2O}$$

In one such reaction 4,816 x 10^{22} molecules of candlewax reacts with 3 moles of oxygen.

8.1 Define LIMITING REAGENT. (2)

8.2 Determine which of candle wax or oxygen is the limiting reagent. (4)

8.3 Calculate the MAXIMUM mass of water that can be produced. (4)

8.4 It is found that the percentage yield of carbon dioxide is 90%.

8.4.1 Calculate the ACTUAL volume of CO_2 collected if the molar volume of the gas is 23,2 dm^3 at 27°C. (4)

8.4.2 Calculate the pressure that this gas will exert at a temperature of 27°C. (4)

[18]

QUESTION 9

Grade 11 learners want to prepare a standard solution of oxalic acid ($H_2C_2O_4$). They use 15,75 g of hydrated oxalic acid crystals ($H_2C_2O_4 \cdot 2H_2O$) in order to make a solution of concentration 0,5 mol.dm^{-3}. They prepare the solution in a volumetric flask. They have 250 cm^3, 500 cm^3 and 1 dm^3 volumetric flasks available.

9.1 Define concentration. (2)

9.2 Which volumetric flask should they use?
(Show by calculation how you arrived at the answer) (4)

9.3 The learners wish to change the concentration of a small amount of this acid to 0,2 mol.dm^{-3}. To do this they place 25 cm^3 of the acid in a beaker and add water to it.
How much water must be added to the acid to give the required concentration of 0,2 mol.dm^{-3}? (4)

9.4 The standard oxalic acid solution is used to titrate a solution of sodium hydroxide.

9.4.1 Write a balanced equation for the reaction taking place here. (3)

9.4.2 Which indicator should they use for this titration?
Choose from BROMOTHYMOL BLUE, PHENOLPTHALIEN or METHYL ORANGE. Explain the answer. (3)
[16]

QUESTION 10

Study the reaction below:

$$\mathbf{Mg\,(s) + I_2(s) \rightarrow Mg^{2+}\,(aq) + I^-\,(aq)}$$

10.1 Define REDUCING AGENT in terms of oxidation numbers. (2)

10.2 Identify the reducing agent in the above reaction. (1)

10.3 Write down the FORMULA of the substance that is reduced. (1)

10.4 Write down the balanced for:

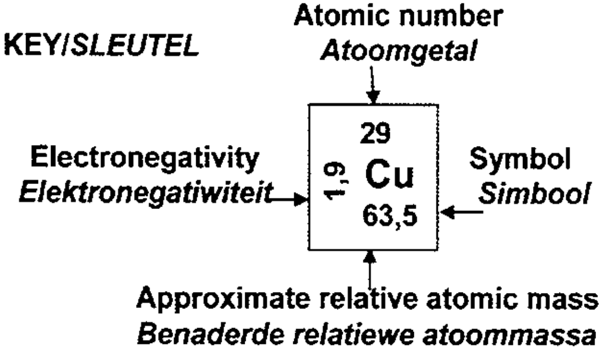
10.4.1 the oxidation half reaction. (2)

10.4.2 the reduction half reaction. (2)

10.4.3 the overall reaction. (2)
[10]

TOTAL: 150

TABLE 3: THE PERIODIC TABLE OF ELEMENTS



1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											13 1,5 Aℓ 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cℓ 35,5	18 Ar 40
19 0,8 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84
37 0,8 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131
55 0,7 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 1,8 Tℓ 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn
87 0,7 Fr	88 0,9 Ra 226	89 Ac															
				58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
				90 Th 232	91 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

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)

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

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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$\frac{p_1V_1}{T_1}=\frac{p_2V_2}{T_2}$	$pV=nRT$
$n=\frac{m}{M}$	$n=\frac{N}{N_A}$
$n=\frac{V}{V_m}$	$c=\frac{n}{V}$ OR/*OF* $c=\frac{m}{MV}$

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

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↓

Increasing reducing ability/*Toenemende reduserende vermoë* ↑

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

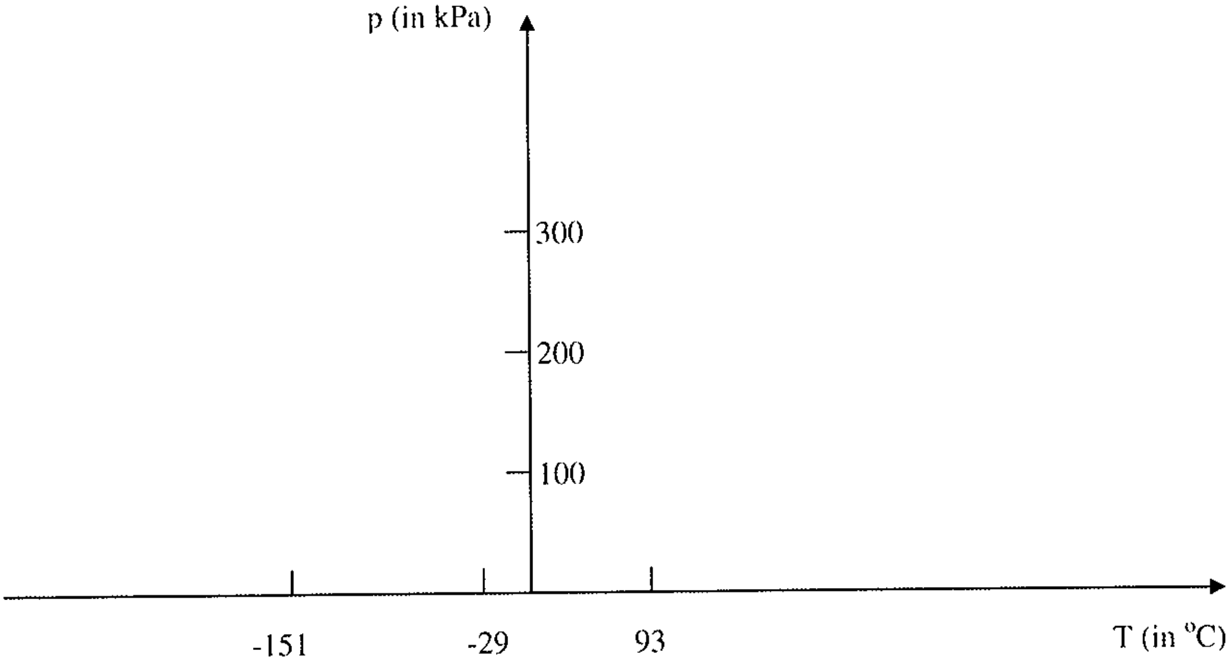
NAME: ________________________________

GRADE: 11 ________

GRAPH SHEET FOR QUERSTION 6.4

(HAND IN THIS SHEET TOGETHER WITH YOUR ANSWER BOOKLET).

GRAPH OF PRESSURE VERSUS TEMPERATURE



PHSCs - P2 Grades 10 + 11

education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL
SENIOR CERTIFICATE

GRADE 11

PHYSICAL SCIENCES P2 (CHEMISTRY)

MARKING GUIDELINE

COMMON TEST

SEPTEMBER 2019

MARKS: 150

This marking guideline consist of 10 pages.

QUESTION 1

1.1 A ✓✓
1.2 D ✓✓
1.3 B ✓✓
1.4 B ✓✓
1.5 C ✓✓
1.6 B ✓✓
1.7 B ✓✓
1.8 D ✓✓
1.9 B ✓✓
1.10 B ✓✓ [20]

QUESTION 2

2.1 Sharing of electrons between atoms to form a molecule.✓✓ (2)

2.2
- 2.2.1 SCl_6 ✓ (1)
- 2.2.2 CO_2 ✓ (1)
- 2.2.3 HF ✓ (1)
- 2.2.4 HF ✓and NH_3✓ (2)

2.3

2.3.1

✓✓ (2)

2.3.2 Trigonal planar ✓ (1)

2.3.3 NH_3 has a lone pair of electrons✓ and BCl_3 has an empty orbital. ✓ (2)

2.4 The electronegativity difference between carbon and flourine is 1,5 which makes the bond polar covalent. ✓ The molecule is symmetrical ✓ with even distribution of charge/no net dipole moment.✓ (3)

[15]

QUESTION 7

7.1 An acid is a substance that produces hydrogen/hydronium ions (H_3O^+) when dissolved in water. ✓✓ (2)

7.2 It ionises completely in water ✓✓ (2)

7.3 $HC\ell + H_2O$ ✓ $\rightarrow Cl^- + H_3O^+$ ✓ (2)

7.4

$n = V/V_m$ ✓

$= \underline{2,128/22,4}$✓

$= 0,095$ mol.

$CaCO_3 : CO_2$

1 : 1 ✓

$n_{CaCO_3} = 0,095$mol

$n = m/M$

$\underline{0,095 = m/100}$✓

$m = 9,50$g

% Purity = pure mass/sample mass x100

$\underline{95 = 9,5 / m_{sample} \times 100}$✓

Mass of sample = 10g ✓

(6)

7.5 $2HC\ell + Na_2CO_3 \rightarrow 2NaC\ell + H_2O + CO_2$ reactants✓ products✓ balancing✓ (3)

[15]

QUESTION 8

8.1 The substance that is used up completely in a reaction ✓✓ (2)

8.2

No of moles	$C_{23}H_{48}$	O_2	CO_2	H_2O
Ratio	1	35	23	24
Start	0,08✓	3	0	0
Change	0,08✓	2,80✓	1,84	1,92
End	0	0,20	1,84	1,92

Candle wax is the limiting reagent. ✓

OR

Candlewax:

$n = N/N_A$

$= 4,816 \times 10^{22} / 6,022 \times 10^{23}$ ✓

$= 0,08$mol ✓

$C_{23}H_{48} : O_2$

1: 35

n_{O_2} needed is 2,80mol ✓

Limiting reagent is candlewax ✓ (4)

8.3 **POSITIVE MARKING FROM 8.2**

From table: n_{H_2O} formed = 1,92 mol ✓✓

$n = m/M$

$\underline{1,92 = m/18}$✓

$m = 34,56$g✓

OR

$C_{23}H_{48} : H_2O$

1: 24 ✓

$n_{H_2O} = 0.08 \times 24 = 1.92$mol✓

$n = m/M$

$\underline{1,92 = m/18}$✓

$m = 34,56$g✓ (4)

8.4

8.4.1

POSITIVE MARKING FROM 8.2

n_{CO_2} formed = 1,84 mol

$V_{CO_2} = n \times V_m$

= 1,84 x 23,2 ✓

= 42,688 dm^3

Actual Volume = 90/100 x 42,688 ✓

= 38,42 dm^3 ✓ (4)

8.4.2 **POSITIVE MARKING FROM 8.4.1**

pV = nRT ✓

p38,42 ✓ = $\underline{1,84 \times 8,31 \times 300}$ ✓

p = 119,39 kPa ✓ (4)

[18]

QUESTION 9

9.1 Amount of substance dissolved per dm^3 of solution / per unit volume of solution. ✓✓ (2)

9.2

$c = \frac{m}{M \times V}$ ✓

✓ $0,5 = \frac{15.75}{126x\ V}$ ✓

V = 0,25dm^3

= 250 cm^3. They should use the 250 ml volumetric flask✓ (4)

9.3 $C_1V_1 = C_2V_2$ ✓

0,5 x 25 = 0,2 V_2 ✓

V_2 = 62,5 cm^3

Volume of water to be added: 62,5 – 25 ✓ = 37,5 cm^3 ✓ (4)

9.4

9.4.1 $2NaOH + H_2C_2O_4 \rightarrow Na_2C_2O_4 + 2H_2O$ reactants✓ products ✓ balancing✓ (3)

9.4.2 Phenolphthalein ✓

Reaction is between a strong base and a weak acid. ✓ Indicator shows colour change in the pH range where neutralisation takes place. ✓ (3)

[16]

QUESTION 10

10.1 Substance whose oxidation number increases ✓ ✓ (2)

10.2 Mg / Magnesium✓ (1)

10.3 I_2 ✓ (1)

10.4

10.4.1 $Mg \rightarrow Mg^{2+} + 2e^-$ ✓✓ (2)

10.4.2 $I_2 + 2e^- \rightarrow 2I^-$ ✓✓ (2)

10.4.3 $Mg + I_2 \rightarrow Mg^{-2+} + 2I^-$ ✓✓ (2)

[10]

TOTAL: 150

QUESTION 5

5.1

N	36,80	36,80/14 = 2,629 ✓	2,629/2,629 = 1	2 ✓
0	63,20 ✓	63,20/16 = 3,95	3,95/2,629 = 1,5 ✓	3

Empirical formula: N_2O_3 ✓ (5)

5.2 % N in NH_4NO_3 = 28/80 x 100✓

= 35%

Mass of N in 10g = 35/100 x10 ✓

= 3.50 g ✓

OR In 80g $NH_4NO_3 \rightarrow$ 28 g of N ✓

In 10g $NH_4NO_3 \rightarrow$ x g ✓

x = 3.50g✓ (3)

[8]

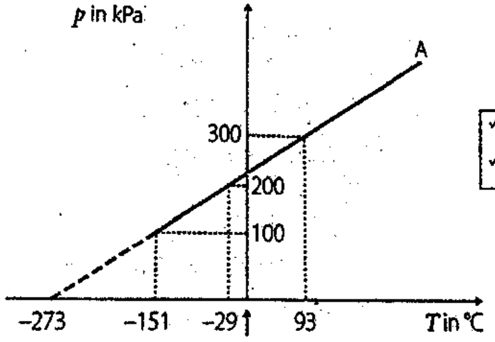
QUESTION 6

6.1 Gay – Lussac Law ✓ (1)

6.2 Volume of gas ✓ and mass / moles of gas. ✓ (2)

6.3 Measure of the average kinetic energy of the particles✓✓ (2)

6.4 **GRAPH OF PRESSURE VERSUS TEMPERATURE IN °C**



✓ plotting all points correctly
✓ straight line joining points

(2)

6.5

6.5.1 0 K✓ (1)

6.5.2 Absolute zero of temperature ✓ (1)

6.6 <u>The pressure of the fixed mass of gas is directly proportional to the temperature of the gas at constant volume.</u> ✓✓ (2)

6.7 $\frac{p1}{T1} = \frac{p2}{T2}$ ✓

$\frac{300}{366}$ ✓ = $\frac{400}{T2}$ ✓

T_2 = 488 K = 215°C✓ (4)

6.8 Increase ✓ – Gradient (p/T) is given by nR/V✓ (from pV = nRT).
Gradient ∝ the amount of gas used.✓ (R and V constant) ✓

OR

At a given temperature ✓, if the mass of the gas increases ✓, the pressure will increase ✓ since more particles will be present in the container. ✓ (4)

[19]

QUESTION 3

3.1 The temperature at which the solid and liquid phases of a substance are at equilibrium✓✓ (2)

3.2

3.2.1 Heptane (C_7H_{16}) ✓ Pentane(C_5H_{12}) ✓ (2)

3.2.2 Propane (C_3H_8) ✓ (1)

3.2.3 Propane (C_3H_8) or Butane (C_4H_{10}) ✓ (1)

3.3

3.3.1 London Forces / Induced dipole ✓ (1)

3.3.2 As the molecular mass of the substance increases ✓, the boiling point increases. ✓ (2)

3.3.3

- With increase in molecular mass there is an increase in strength of the forces ✓
- More energy needed to separate molecules ✓ (2)

[11]

QUESTION 4

4.1

4.1.1 The average distance between the nuclei of bonded atoms. ✓✓ (2)

4.1.2 The shorter the bond length, the greater the bond energy.✓ (1)

4.1.3 Bonds with a shorter bond length have greater forces of attraction✓ and require more energy to break the bond.✓ (2)

4.1.4 GREATER THAN. ✓ C ≡ C has triple bond, ✓ more energy needed to break the bonds. (2)

4.2

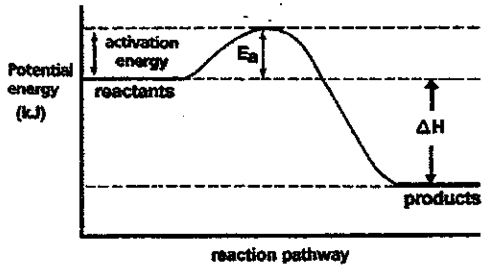
4.2.1

Energy absorbed = $\underline{4(413) + 242}$✓
= 1894 kJ
Energy released = $\underline{3(413) + 327 + 431}$✓
= 1997kJ
ΔH = 1894 – 1997✓
= -103 kJ.mol^{-1}✓

(4)

4.2.2 Exothermic ✓ ΔH < 0 / More energy is released than absorbed.✓ (2)

4.2.3



✓ Shape
✓ energy of reactants correctly indicated
✓energy of products correctly indicated
✓ ΔH indicated correctly
✓ activation energy correctly indicated

(5)

[18]