EASTERN CAPE DEPARTMENT OF EDUCATION

GRADE 11

PHYSICAL SCIENCES CONTROLLED TEST

TERM 2

2022

MARKS: 100

TIME : 2 Hours

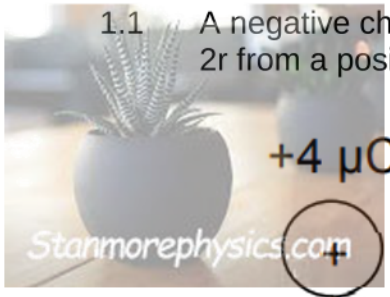
This question papers consists of 15 pages including cover page

INSTRUCTIONS AND INFORMATION

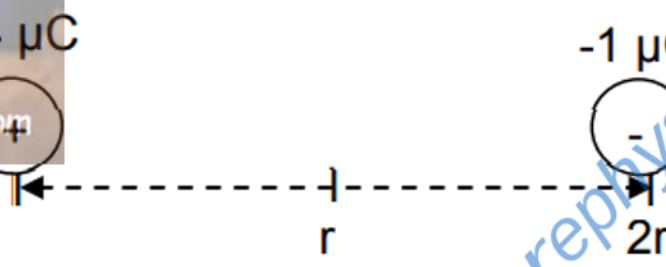
1. Write your NAME and SURNAME in the appropriate spaces on the ANSWER BOOK.
2. Answer ALL the questions in the ANSWER BOOK.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. Number the answers correctly according to the numbering system used in this question paper.
6. You are advised to use the attached DATA SHEETS.
7. The formulae and substitutions must be shown in ALL calculations.
8. Give brief motivations, discussions, et cetera where required.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Start EACH question on a NEW page.
11. All diagrams are not necessarily drawn according to scale.
12. Write neatly and legibly.

Question 1

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



1.1 A negative charge of 1 µC, which is free to move, is placed at a distance 2r from a positive charge of 4 µC.



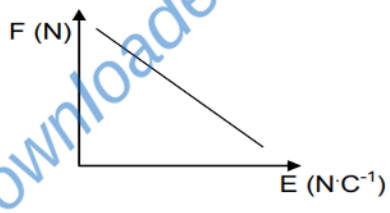
Which ONE of the following statements regarding the -1 µC charge, when it is at distance r, is CORRECT?

The electrostatic force experienced by the -1 µC charge will …

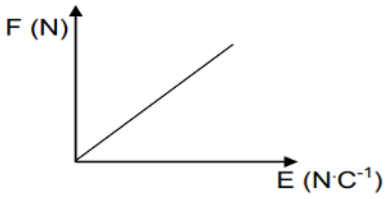
A remain the same.
B be halved.
C be doubled.
D increase four times.

1.2 Which ONE of the graphs below represents the correct relationship between force F on a charge and the electric field E?

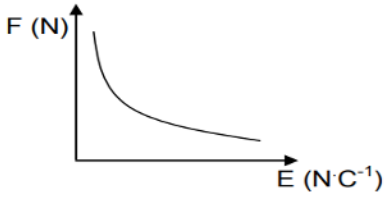
A



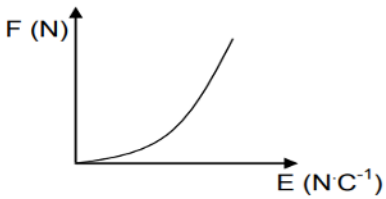
B



C

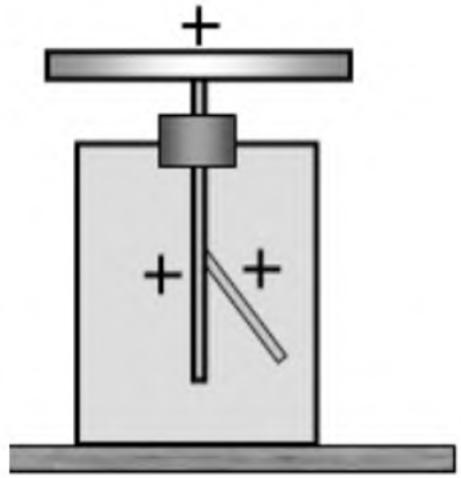


D



(2)

1.3 The leaves of the electroscope in the diagram below are positively charged.



When an object is brought close to the plate, the leaves diverge more. It can therefore conclude that the object …

A is positively charged.
B is negatively charged.
C is not charged at all.
D releases positive charges. (2)

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 1/3 d. The new force, in terms of F, will now be ..

A F
B 3F
C 6F
D 9F

(2)

1.5 Which ONE of the following has the strongest forces between its molecules?

A F_2
B $C\ell_2$
C Br_2
D I_2

(2)

1.6 Sodium chloride (NaCℓ) is a solid which is soluble in water. Which one of the following describes the intermolecular forces that exist between sodium chloride and water in solution?

A Ion-dipole
B Dipole-dipole
C Ion-induced dipole
D Induced dipole-dipole (2)

1.7 Two moles of H_2 gas at STP occupy a volume of ...

A 2 dm^3
B 11,2 dm^3
C 22,4 dm^3
D 44,8 dm^3 (2)

1.8 How many moles of $KBrO_3$ are required to prepare 0.0700 moles of Br_2 according to the reaction:

$KBrO_3 + 5KBr + 6HNO_3 \longrightarrow 6KNO_3 + 3Br_2 + 3H_2O$

A 0.0233
B 0.0732
C 0.0704
D 0.0220 (2)

1.9 The limiting reagent in a chemical reaction is one that:

A has the largest molar mass (formula weight).
B has the smallest molar mass (formula weight).
C is in excess.
D is consumed completely. (2)

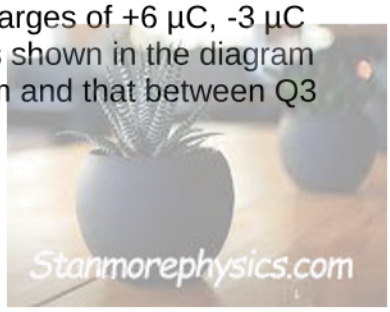
1.10 What is the mass percent of each element in dichloromethane, CH_2Cl_2?

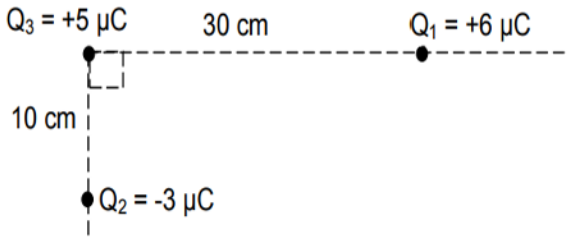
A 10.06% C, 60.24% H, 29.70% Cl
B 14.11% C, 2.35% H, 83.53% Cl
C 24.10% C, 3.11% H, 72.79% Cl
D 33.87% C, 0.22% H, 65.91% Cl (2)

[20]

Question 2

Three point charges, Q1, Q2 and Q3, carrying charges of +6 µC, -3 µC and +5 µC respectively, are arranged in space as shown in the diagram below. The distance between Q3 and Q1 is 30 cm and that between Q3 and Q2 is 10 cm.



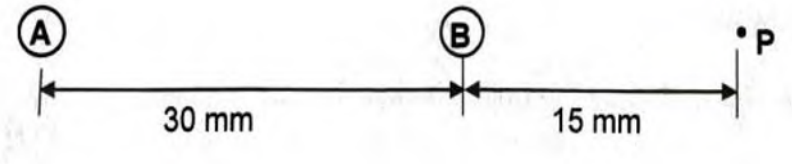


2.1 State Coulombs law in words (2)

2.2 Draw a force diagram showing the electrostatic forces exerted on Q_3 by Q_1 and Q_2 respectively. (2)

2.3 Calculate the net force exerted on Q_3 by Q_1 and Q_3 respectively. (8)

2.4 Two identical spheres, A and B, carrying charges +5 nC and -10 nC respectively, are separated by a distance of 30 mm. P is a point located at a distance of 15 mm from sphere B as shown below.



The spheres A and B are allowed to touch each other and then return to their original positions.

2.4.1 Define the electric field strength at a point in words (2)

2.4.2 Draw an electric field pattern between spheres A and B, after touching. (3)

2.4.3 Which sphere has an excess of protons before their contact? (1)

2.4.4 Calculate a new charge (3)

2.4.5 Calculate the magnitude of the net electric field at point P due to A and B (6)

2.4.6 If electron is placed at point P, calculate the magnitude of the force experienced by an electron. (3)

[30]

Question 3

The reaction below is used in the Haber process to manufacture ammonia.

$2H_2(g) + 2O_2(g) \rightarrow 2H_2O(g)$

The boiling points of the substances in the reaction are as follows:

Formula of Substance	Boiling point (°C)	Melting point (°C)
H_2	-252.9	-259.2
O_2	-183	-218.8
H_2O	100	0

3.1 Define the term vapour pressure. (2)

3.2 Write down the NAME of the substance in the table that will have the lowest vapour. (1)

3.3 Name the type of intermolecular force present in H_2O and H_2 (2)

3.4 Which substance is a liquid at room temperature? (1)

3.5 Which substance will have strongest intermolecular forces? Explain in terms strength of intermolecular forces and boiling point. (3)

3.8 How does the strength of intermolecular of compound H_2 compare to the vapour pressure of compound O_2? Write down only HIGHER THAN, LOWER THAN or EQUAL TO. Explain the answer referring to the MOLECULAR SIZE and INTERMOLECULAR FORCES. (3)

[12]

Question 4

Methyl benzoate is a compound used in the manufacture of perfumes. It is found that a 5,325 g sample of methyl benzoate contains 3,758 g of carbon, 0,316 g of hydrogen and 1,251 g of oxygen.

4.1.1 Describe the term mole (2)

4.1.2 Determine the empirical formula of methyl benzoate. (5)

4.1.2 If the molar mass of methyl benzoate is 136 $g \cdot mol^{-1}$, what is its molecular formula? (2)

4.2 A sample of sodium carbonate was reacted with dilute hydrochloric acid in a closed container according to the following equation:
Na_2CO_3 (s) + 2HCl (aq) → 2NaCl (aq) + CO_2 (g) + H_2 O(l)

The carbon dioxide gas produced was collected at STP and occupied a volume of 0,336 dm^3.

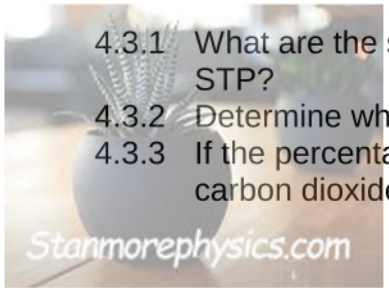
4.2.1	State Avogadro's Law	(2)
4.2.2	Calculate the number of moles of carbon dioxide produced.	(3)
4.2.3	Calculate the number of carbon dioxide molecules in the sample collected.	(2)
4.2.4	Calculate the mass of sodium chloride formed in this reaction.	(4)
4.2.5	Define concentration in words.	(2)
4.2.6	If the concentration of the hydrochloric acid is 0,10 $mol.dm^{-3}$ what is the minimum volume of hydrochloric acid needed for the reaction to run to completion?	(4)

4.3 50 g of magnesium carbonate is added to 500 cm3 of hydrochloric acid with a concentration of 0,75 $mol.dm^{-3}$. The equation for the reaction is given below:
$MgCO_3$ + 2HCl → $MgCl_2$ + CO_2 + H_2O

The carbon dioxide gas is collected at STP.

4.3.1	What are the standard conditions used when conducting an experiment at STP?	(2)
4.3.2	Determine which reactant is the limiting reactant	(6)
4.3.3	If the percentage yield of the experiment is 85%, calculate the volume of carbon dioxide collected at the end of the experiment at STP	(5)

[38]



DATA FOR PHYSICAL SCIENCES GRADE 11

PAPER 1 (PHYSICS)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1:*

NAME/*NAAM*	SYMBOL/ *SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity / *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant / *Universelegravitasiekonstant*	G	$6,67 \times 10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$
Speed of light in a vacuum / *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^8$ $m \cdot s^{-1}$
Planck's constant / *Planck se konstante*	h	$6,63 \times 10^{-34}$ J•s
Coulomb's constant / *Coulomb se konstante*	k	$9,0 \times 10^9$ $N \cdot m^2 \cdot C^{-2}$
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 earth / *Massa op aarde*	M	$5,98 \times 10^{24}$ kg
Radius of earth / *Radius van aarde*	R_E	$6,38 \times 10^3$ km

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/*of* $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{d^2}$	$\mu_s = \frac{f_s^{max}}{N}$
$\mu_k = \frac{f_k}{N}$	

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$	$T = \frac{1}{f}$
$n_i \sin\theta_i = n_r \sin\theta_r$	$n = \frac{c}{v}$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$ (k = 9,0 x 10^9 N.m^2.C^{-1})	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ (k = 9,0 x 10^9 N.m^2.C^{-1})	$n = \frac{Q}{q_e}$

ELECTROMAGNETISM/ *ELEKTROMAGNETISME*

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

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$R_s = R_1 + R_2 + \ldots$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

NATIONAL SENIOR CERTIFICATE

NASIONALE SENIOR SERTIFIKAAT

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*

NAAM/*NAME*	**SIMBOOL/*SYMBOL***	**WAARDE/*VALUE***
Standard pressure *Standaarddruk*	p^{θ}	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume teen STD*	V_m	$22{,}4\ dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron Lading op elektron	e	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant Avogadro se konstante	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$

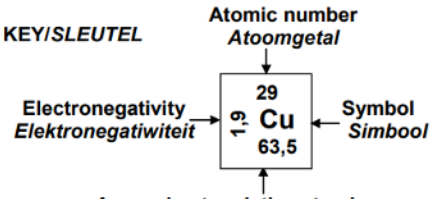
TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$ or/of $n = \frac{N}{N_A}$ or/of $n = \frac{V}{V_m}$	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$ $\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	

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

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)
2,1 **H** 1																	**He** 4
1,0 **Li** 7	1,5 **Be** 9											2,0 **B** 11	2,5 **C** 12	3,0 **N** 14	3,5 **O** 16	4,0 **F** 19	**Ne** 20
0,9 **Na** 23	1,2 **Mg** 24											1,5 **Aℓ** 27	1,8 **Si** 28	2,1 **P** 31	2,5 **S** 32	3,0 **Cℓ** 35,5	**Ar** 40
0,8 **K** 39	1,0 **Ca** 40	1,3 **Sc** 45	1,5 **Ti** 48	1,6 **V** 51	1,6 **Cr** 52	1,5 **Mn** 55	1,8 **Fe** 56	1,8 **Co** 59	1,8 **Ni** 59	1,9 **Cu** 63,5	1,6 **Zn** 65	1,6 **Ga** 70	1,8 **Ge** 73	2,0 **As** 75	2,4 **Se** 79	2,8 **Br** 80	**Kr** 84
0,8 **Rb** 86	1,0 **Sr** 88	1,2 **Y** 89	1,4 **Zr** 91	**Nb** 92	1,8 **Mo** 96	1,9 **Tc**	2,2 **Ru** 101	2,2 **Rh** 103	2,2 **Pd** 106	1,9 **Ag** 108	1,7 **Cd** 112	1,7 **In** 115	1,8 **Sn** 119	1,9 **Sb** 122	2,1 **Te** 128	2,5 **I** 127	**Xe** 131
0,7 **Cs** 133	0,9 **Ba** 137	**La** 139	1,6 **Hf** 179	**Ta** 181	**W** 184	**Re** 186	**Os** 190	**Ir** 192	**Pt** 195	**Au** 197	**Hg** 201	1,8 **Tℓ** 204	1,8 **Pb** 207	1,9 **Bi** 209	2,0 **Po**	2,5 **At**	**Rn**
0,7 **Fr**	0,9 **Ra** 226	**Ac**															

KEY/*SLEUTEL*



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**

EASTERN CAPE DEPARTMENT OF EDUCATION

GRADE 11

PHYSICAL SCIENCES CONTROLLED TEST

MEMORUNDUM

TERM 2

INSTRUCTIONS AND INFORMATION

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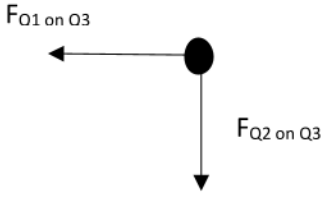
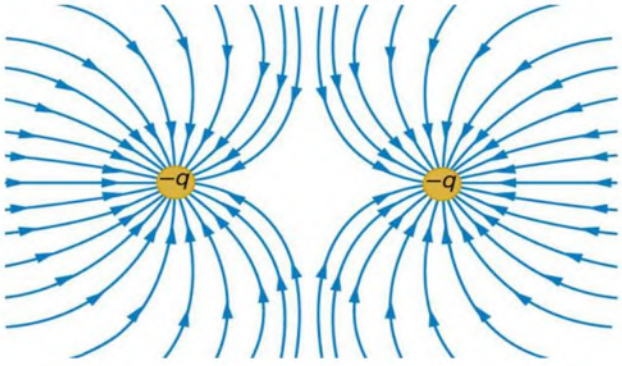
	Question 1	
1.1	D✓✓	
1.2	B✓✓	
1.3	A✓✓	
1.4	D✓✓	
1.5	D✓✓	
1.6	A✓✓	
1.7	D✓✓	
1.8	A✓✓	
1.9	D✓✓	
1.10	B✓✓	
	Question 2	
2.1	The magnitude of the electrostatic force exerted by two point charges on each other is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance between them.	
2.2		Marking guide $F_{Q2 \text{ on } Q3}$ ✓ $F_{Q1 \text{ on } Q3}$ ✓

2.3	$F_{Q2\ on\ Q3} = \frac{kQ_2Q_3}{r^2}$ ✓ $F_{Q2\ on\ Q3} = \frac{(9\times10^9)(3\times10^{-6})(5\times10^{-6})}{0.1^2}$ ✓✓ $F_{Q2\ on\ Q3} = 13.5\ N\ downwards$ $F_{Q1\ on\ Q3} = \frac{(9\times10^9)(6\times10^{-6})(5\times10^{-6})}{0.3^2}$ ✓✓ $F_{Q1\ on\ Q3} = 3\ N\ left$ $F_{net} = F_{Q2\ on\ Q3} + F_{Q1\ on\ Q3}$ $F_{net} = \sqrt{13.5^2 + 3^2}$ ✓ $F_{net} = 13.83\ N$ $\theta = \tan^{-1}\frac{3}{13.5}$ ✓ $\theta = 77.47°$ $F_{net} = 13.83\ N\ in\ the\ direction\ \theta = 77.47°$ ✓	(8)
2.4.1	The electric field strength at a point is the electrostatic force experienced per unit positive charge placed at that point. ✓ ✓	(2)
2.4.2		

Marking guidelines	
Correct shape	✓
Correct direction of field lines	✓
No field lines crossing	✓

2.4.3	A ✓  			(1)
2.4.4	$Q_{new} = \frac{Q_1 + Q_2}{2}$ ✓ $Q_{new} = \frac{(5\times10^{-9})+(-10\times10^{-9})}{2}$ ✓ $Q_{new} = -2.5 \times 10^{-9}$ C✓			(3)
2.4.5	$E_A = \frac{kQ_1}{r^2}$ ✓ $E_A = \frac{(9\times10^9)(2.5\times10^{-9}}{(45\times10^{-3})^2}$ ✓✓ = 11 111.11 N.C^{-1} right $E_B = \frac{(9\times10^9)(2.5\times10^{-9}}{(15\times10^{-3})^2}$ ✓ = 100 000 N.C^{-1} left E_{net} = 11 111.11 + (-100 000)✓ = - 88 888.89 = 88 888.89 N.C^{-1} left✓			(6)
2.4.6	$E = \frac{F}{q}$ ✓ F = Eq = (-88 888.89) x(-1.6x10^{-19}) ✓ F = 1.42 x 10^{-14} N✓			(3)
				[30]

	Question 3	
3.1	The pressure exerted by a vapour at equilibrium with its liquid in a closed system.✓ ✓	(2)
3.2	Water/H_2O ✓	(1)
3.3	H_2O: Hydrogen bond✓ H_2: London force/ Mutually induced dipole forces✓	(2)
3.4	Water/H_2O	
3.5	H_2O/water ✓ The stronger the intermolecular forces, the higher the boiling point. ✓✓	(3)
3.6	LOWER THAN✓	
	Molecular size of H_2 is lesser that the molecular size of O_2. ✓ The lesser the molecular size, the weaker the London forces✓	(3)
		[12]
	Question 4	
4.1.1	Mole is the SI unit for amount of substance. ✓✓	(2)
4.1.2	$n_C = \frac{3.758}{12} = 0.3131\ mol$✓ $n_H = \frac{0.316}{1} = 0.316\ mol$✓ $n_O = \frac{1.251}{16} = 0.078\ mol$✓ $\frac{0.3131}{0.078} : \frac{0.316}{0.078} : \frac{0.078}{0.078}$ ✓ 4 : 4 : 1 C_4H_4O✓	(5)
4.1.3	$n = \frac{136}{68}$ ✓ = 2 C_8H_8O✓	

		(2)
4.2.1	One mole of any gas occupies the same volume at the same temperature and pressure. ✓✓	(2)
4.2.2	$n = \frac{v}{v_m}$ ✓ $n = \frac{0.336}{22.4}$ ✓ $n = 0.015\ mol$ ✓	(3)
4.2.3	N = nN_A = (0.015) (6.02 x10^{23}) ✓ =9.0 x1023 molecules✓	(2)
4.2.4	Mole ratio n(NaCl) : n(CO_2) 2 : 1 n(NaCl) = 0.03 mol ✓ m = nM ✓ = 0.03x58.5✓ = 1.76 g✓ 	(4)
4.2.5	Concentration is the amount of solute per litre of solution. ✓✓	(2)
4.2.6	n(HCl):n(CO_2) 2 : 1 n(HCl) = 0.03 mol✓ $V = \frac{n}{c}$ ✓ $V = \frac{0.03}{0.1}$ ✓ = 0.3 dm^3✓	(4)
4.3.1	Temperature of 0 °C (273 K) ✓ Pressure of 101.3 kPa/ 1atm✓	(2)

4.3.2	$n = \frac{m}{M}$ ✓ $n = \frac{50}{84}$ ✓ n = 0.593 mol ($MgCO_3$) ✓ n = cV = 0.75x0.5✓ = 0.375 mol (HCl) ✓ HCl is the limiting reagent✓	(6)
4.3.3	N(HCl) = 0.375 mol Ratio n(HCl):n(CO_2) 2:1 V(CO_2) = 0.1875 x 22.4✓ = 4.2 dm^3✓ V = 4.2 x 0.85 ✓= 3.57 dm^3✓	(4)
		[38]
	TOTAL :100