

JOHANNESBURG EAST DISTRICT

PHYSICAL SCIENCES

GRADE 11

TERM 3 CONTROL TEST 2023

TOTAL : 100 MARKS

TIME : 2 HOURS

This question paper consists of 11 printed pages

Stanmorephysics

INSTRUCTIONS AND INFORMATION

1. Write your NAME and SURNAME on your ANSWER PAPER.
2. Answer ALL questions.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. Number the answers according to the numbering system used in this question paper.
6. An information sheet is attached for your use.
7. Wherever motivation, discussion, et cetera is required, be brief. Start EACH question on a NEW page.
8. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
9. Show the formulae and substitutions used in all calculations.
10. Round all numerical answers off to TWO decimal places.



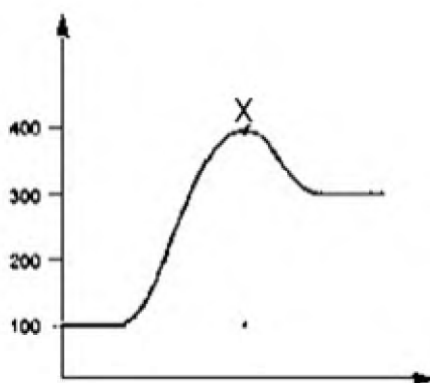
QUESTION 1

1.1 Which ONE of the following statements CORRECTLY describes the characteristics of an endothermic reaction?

- A ΔH is positive and the products have less potential energy than the reactants.
- B ΔH is positive and the products have more potential energy than the reactants.
- C ΔH is negative and the products have less potential energy than the reactants
- D ΔH is negative and the products have more potential energy than the reactants.

(2)

1.2 Study the following graph and match label X from the following choices.



- A Activation Energy
- B Activated Complex
- C Activation Complex
- D Activated Energy

(2)

1.3 According to the kinetic-molecular theory, molecules of different gases at the same temperature always have the same

- A pressure
- B volume
- C kinetic energy
- D average kinetic energy.

(2)

1.4 Which ONE of the following statements is CORRECT about an exothermic reaction?

- A The products have more energy than the reactants
- B The reactants release heat and therefore have less energy than products
- C The heat of reaction is positive as the products have higher energy
- D The reactants absorb heat and therefore the reaction container would feel cold.

(2)

1.5 Which ONE of the following combinations is correct for an endothermic reaction?

	HEAT OF REACTION (ΔH)	THE POTENTIAL ENERGY OF PRODUCTS IS
A	positive	less than that of reactants
B	positive	more than that of reactants
C	negative	less than that of reactants
D	negative	more than that of reactants

(2)

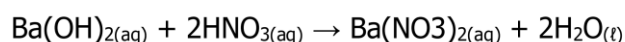
1.6 Which ONE of the following statements about a chemical reaction is CORRECT? The actual yield of a chemical reaction is usually ...

- A equal to the percentage yield.
- B greater than the percentage yield.
- C less than the theoretical yield.
- D greater than the theoretical yield.

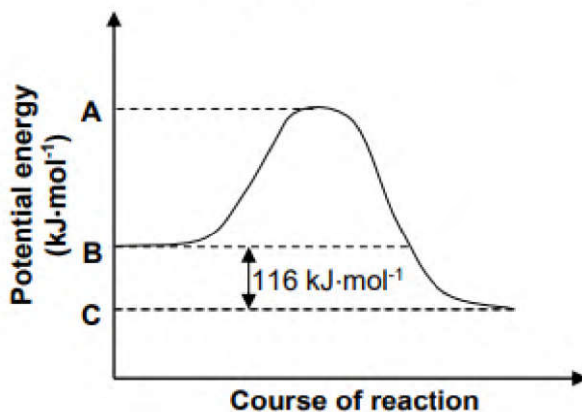
(2)

QUESTION 2 (Start on a new page.)

A barium hydroxide solution, $\text{Ba}(\text{OH})_2(\text{aq})$, reacts with a nitric acid solution, $\text{HNO}_3(\text{aq})$, according to the following balanced equation:



The potential energy graph below shows the change in potential energy for this reaction.



2.1 Is this reaction ENDOTHERMIC or EXOTHERMIC? Give a reason for the answer? (2)

2.2 Use energy values A, B and C indicated on the graph and write down an expression for each of the following:

2.2.1 The energy of the activated complex (1)

2.2.2 The activation energy for the forward reaction (1)

2.2.3 ΔH for the reverse reaction (1)

2.3 Calculate the amount of energy released during the reaction if 0,18 moles of $\text{Ba}(\text{OH})_2(\text{aq})$ reacts completely with the acid. (3)

[8]

QUESTION 3 (Start on a new page.)

Hydrogen gas and oxygen gas react to form water according to the following balanced equation:



The activation energy (EA) for this reaction is $1\,370 \text{ kJ}\cdot\text{mol}^{-1}$.

3.1 Define the term *activation energy*. (2)

3.2 Sketch a potential energy versus reaction coordinate graph for the above reaction. Clearly label the axes and indicate the following on the graph:

- ΔH
- EA for the forward reaction
- Reactants (R) and products (P)
- Activated complex (X) (5)

3.3 Write down the value of the:

3.3.1 Heat of reaction (1)

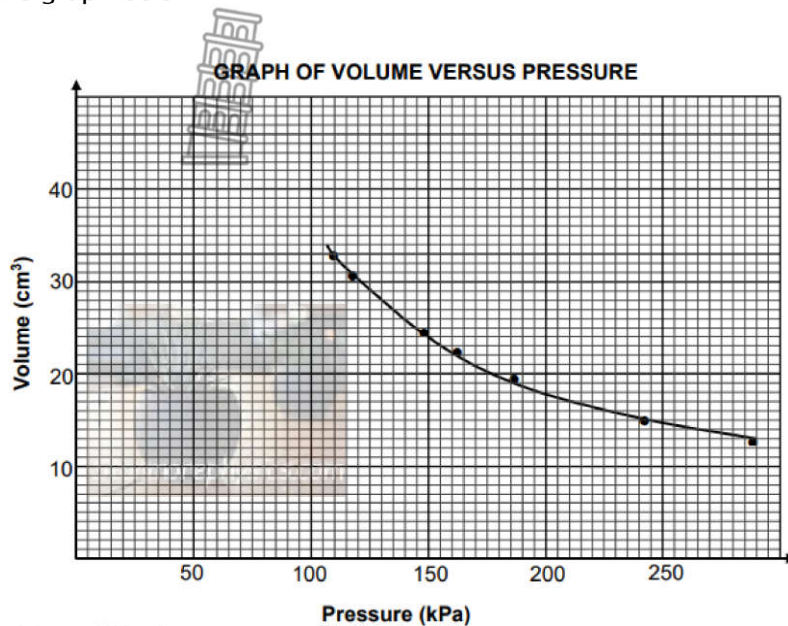
3.3.2 Activation energy for the following reaction:



[10]

QUESTION 4 (Start on a new page)

A fixed mass of oxygen is used to verify one of the gas laws. The results obtained are shown in the graph below



4.1 Write down:

- 4.1.1 A mathematical expression, in symbols, for the relationship between the variables shown in the graph (1)
- 4.1.2 The name of the gas law investigated (1)
- 4.1.3 Explain the relationship in QUESTION 4.1.1 in terms of the kinetic theory of gases. (2)

4.2 Write down TWO variables that must be kept constant during this investigation and briefly describe how this is done. (4)

4.3 From the graph, write down the volume of oxygen, in cm³, when the pressure is 120 kPa. (2)

4.4 Calculate the pressure, in kPa, exerted on the gas when it is compressed to 5 cm³. (4)

4.5 Write down TWO conditions under which oxygen gas will deviate from ideal gas behavior. (2)

[16]

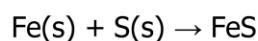
QUESTION 5 (Start on a new page.)

- 5.1 Define the term *molar mass* of a substance. (1)
- 5.2 Calculate the number of moles of water in 100 g of water. (3)
- 5.3 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.
- 5.3.1 Define the term empirical formula. (2)
- 5.3.2 Determine the empirical formula of methyl benzoate. (7)
- 5.3.3 If the molar mass of methyl benzoate is $136 \text{ g}\cdot\text{mol}^{-1}$, what is its molecular formula? (3)

[16]

QUESTION 6 (Start on a new page.)

- 6.1 Iron (Fe) reacts with sulphur (S) to form iron sulphide (FeS) according to the following balanced equation:



- 6.1.1 Calculate which of the two substances will be used up completely if 20 g of Fe and 10 g of S are mixed and heated. (5)
- 6.1.2 How many grams of the other substance are in excess? (2)

[7]



QUESTION 7 (Start on a new page.)

- 7.1 Limestone, or sometimes ash, is used in pit latrines (long drops) to neutralise acidic waste. Limestone reacts with hydrochloric acid according to the following UNBALANCED equation:

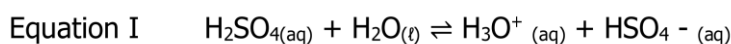


7.1.1 Define an acid in terms of the Arrhenius theory (2)

7.1.2 Is ash acidic or basic? (1)

7.1.3 Rewrite the above equation into your ANSWER BOOK and then balance the equation. (1)

- 7.2 Sulphuric acid reacts with water in two steps as represented by the equations below.



7.2.1 Define the term ampholyte. (2)

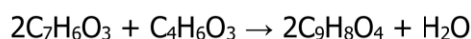
7.2.2 Write down the FORMULA of a species that acts as ampholyte in the above reactions. (1)

7.2.3 Write down the NAME of the conjugate base of the hydrogen sulphate ion. (1)

[8]

QUESTION 8 (Start on a new page)

The chemical reaction for the production of the drug, aspirin, from two compounds, X and Y, is represented by the balanced equation below.



A chemist reacts 14 g of compound X with 10 g of compound Y.

8.1 Define the term limiting reactant in a chemical reaction (2)

8.2 Perform the necessary calculations to determine which one of compound X or compound Y is the limiting reactant. (5)

The actual mass of aspirin obtained is 11,5 g.

8.3 Calculate the percentage yield of the aspirin (5)

[12]

QUESTION 9 (Start on a new page.)

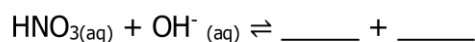
Acids and bases can be defined in terms of the following two theories:

I: Arrhenius theory

II: Lowry-Brønsted theory

9.1 According to the Arrhenius theory, sodium hydroxide is classified as a base. Write down the chemical formula of the ion responsible for the basic properties of sodium hydroxide. (1)

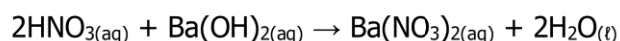
9.2 Consider the reaction represented by the incomplete equation below:



9.2.1 Use your knowledge of the Lowry-Brønsted theory to write a balanced equation for this reaction. (3)

9.2.2 Write down the formulae of ONE conjugate acid-base pair in this reaction. (2)

9.3 In a reaction, 40 cm³ of nitric acid neutralises 25 cm³ of a 0,05 mol·dm⁻³ solution of barium hydroxide according to the following balanced equation:



Calculate the:

9.3.1 Number of moles of base that reacted (2)

9.3.2 Number of moles of acid that reacted (1)

9.3.3 Concentration of the acid (2)

[11]

GRAND TOTAL 100



NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)



GEGEWENS VIR FISIESTE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESTE KONSTANTES

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

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$ or/of	$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$ $K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14}$ at /by 298K
$n = \frac{N}{N_A}$ or/of	$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	
$n = \frac{V}{V_m}$		
$E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}} / E^\theta_{\text{sel}} = E^\theta_{\text{katode}} - E^\theta_{\text{anode}}$		
$E^\theta_{\text{cell}} = E^\theta_{\text{reduction}} - E^\theta_{\text{oxidation}} / E^\theta_{\text{sel}} = E^\theta_{\text{reduksie}} - E^\theta_{\text{oksidasie}}$		
$E^\theta_{\text{cell}} = E^\theta_{\text{oxidising agent}} - E^\theta_{\text{reducing agent}} / E^\theta_{\text{sel}} = E^\theta_{\text{oksideermiddel}} - E^\theta_{\text{reduseermiddel}}$		



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

(I)	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
(II)	(III)	KEY/ SLEUTEL												(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Atomic number																			
1 1 ⁺ H	2 1 ⁺ He	3 2 ⁺ Li	4 2 ⁺ Be	5 2 ⁺ B	6 2 ⁺ C	7 2 ⁺ N	8 2 ⁺ O	9 2 ⁺ F	10 2 ⁺ Ne	11 1 ⁺ Na	12 2 ⁺ Mg	13 2 ⁺ Al	14 2 ⁺ Si	15 2 ⁺ P	16 2 ⁺ S	17 2 ⁺ Cl	18 0 Ar		
19 1 ⁺ K	20 2 ⁺ Ca	21 3 ⁺ Sc	22 4 ⁺ Ti	23 4 ⁺ V	24 4 ⁺ Cr	25 4 ⁺ Mn	26 4 ⁺ Fe	27 4 ⁺ Co	28 4 ⁺ Ni	29 4 ⁺ Cu	30 4 ⁺ Zn	31 3 ⁺ Ga	32 4 ⁺ Ge	33 3 ⁺ As	34 4 ⁺ Se	35 4 ⁺ Br	36 0 Kr		
37 2 ⁺ Rb	38 2 ⁺ Sr	39 3 ⁺ Y	40 4 ⁺ Zr	41 4 ⁺ Nb	42 4 ⁺ Mo	43 4 ⁺ Tc	44 4 ⁺ Ru	45 4 ⁺ Rh	46 4 ⁺ Pd	47 4 ⁺ Ag	48 4 ⁺ Cd	49 3 ⁺ In	50 4 ⁺ Sn	51 3 ⁺ Sb	52 4 ⁺ Te	53 4 ⁺ I	54 0 Xe		
87 1 ⁺ Fr	88 2 ⁺ Ra	89 3 ⁺ Ac	90 3 ⁺ Th	91 3 ⁺ Pa	92 3 ⁺ U	93 3 ⁺ Np	94 3 ⁺ Pu	95 3 ⁺ Am	96 3 ⁺ Cm	97 3 ⁺ Bk	98 3 ⁺ Cf	99 3 ⁺ Es	100 3 ⁺ Fm	101 3 ⁺ Md	102 3 ⁺ No	103 3 ⁺ Lr			
133 1 ⁺ Cs	137 2 ⁺ Ba	139 3 ⁺ La	140 3 ⁺ Ce	141 3 ⁺ Pr	144 3 ⁺ Nd	150 3 ⁺ Pm	152 3 ⁺ Eu	157 3 ⁺ Gd	159 3 ⁺ Tb	163 3 ⁺ Dy	165 3 ⁺ Ho	167 3 ⁺ Er	169 3 ⁺ Tm	173 3 ⁺ Yb	175 3 ⁺ Lu				
179 1 ⁺ Hf	181 2 ⁺ Ta	184 2 ⁺ W	186 2 ⁺ Re	190 2 ⁺ Os	192 2 ⁺ Ir	195 2 ⁺ Pt	197 2 ⁺ Au	201 2 ⁺ Hg	204 2 ⁺ Tl	207 2 ⁺ Pb	209 2 ⁺ Bi	212 2 ⁺ Po	217 2 ⁺ At	226 2 ⁺ Rn					
226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra	226 2 ⁺ Ra		

29 29 63,5 Cu	Elektronnegatiwiteit Electronegativity	Simbool Symbol	Benaderde relatiewe atoommassa Approximate relative atomic mass
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