KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES P2

COMMON TEST

JUNE 2024

MARKS: 75

DURATION: 1 ½ hours

This question paper consists of 8 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of 6 questions. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEETS.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions et cetera where required.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four 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 1.6 E.

1.1 Which one of the following statements is CORRECT for the evaporation of water?

A Evaporation occurs only at 100 °C.

B The temperature of the remaining water increases when evaporation takes place.

C The temperature of the remaining water decreases when evaporation takes place.

D The temperature of the remaining water remains constant when evaporation takes place. (2)

1.2 Which ONE of the following elements has atoms that have 7 valence electrons in the third energy level?

A Nitrogen

B Phosphorus

C Chlorine

D Fluorine (2)

1.3 Which of the following is an example of a physical change?

A Condensation of water vapour

B Rusting of iron

C The reaction between sodium hydroxide and hydrochloric acid

D Decomposition of Hydrogen Peroxide (2)

1.4 Which one of the following is an unreactive gas?

A Cl_2

B He

C O_2

D CO_2

(2)

1.5 Which one of the following is the correct number of Hydrogen (H) atoms in 2 moles of $(NH_4)_2SO_4$?

A 8

B $4 \times 6{,}02 \times 10^{23}$

C $8 \times 6{,}02 \times 10^{23}$

D $16 \times 6{,}02 \times 10^{23}$

(2)
[10]

QUESTION 2 (Start on a new page.)

2.1 The table below lists the density for four different substances.

Substance	Density ($g.cm^{-3}$)
Oak wood	0,8
Aluminium	2,7
Lead	11,35
Water	1

An oak chip and a lead pellet are dropped in water.

2.1.1 Which one of the objects will float in water? Provide a reason for the answer. (2)

A block of aluminium and a block of lead of EQUAL MASS is compared.

2.1.2 Which block will have a greater volume? Explain the answer. (3)

2.2 Aluminium reacts with oxygen present in air to form aluminium oxide.

2.2.1 Is aluminium oxide a MIXTURE or a PURE SUBSTANCE? (1)

2.2.2 Write a balanced chemical equation for the reaction described above. (3)

2.3 Industrially, solid aluminium oxide is broken down into aluminium and oxygen in 2 steps:

Step 1: Solid aluminium oxide is heated into a molten (melted) form.
Step 2: The molten aluminium oxide is converted to aluminium and oxygen.

2.3.1 Is the process described in Step 1 a PHYSICAL or a CHEMICAL change? (1)

2.3.2 Is the reaction occurring in Step 2 a SYNTHESIS or a DECOMPOSITION reaction?
Give a reason for the answer. (2)

2.4 Use the balanced chemical equation below to show that mass is conserved in a chemical reaction.

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$ (3)

[15]

QUESTION 3 (Start on a new page.)

A grade 10 learner removes 50 grams of crushed ice from the freezer and records the temperature changes it experiences as the water is left out to warm.

The results obtained is shown on the table below:

Time (minutes)	0	5	10	15	20	25	30	35	40	45	50
Temperature (°C)	- 7	- 3	0	0	3	7	12	16	20	25	25

3.1 Identify the phase change occurring between 10 and 15 minutes. (1)

3.2 What instrument is used to measure the average kinetic energy of the particles? (1)

3.3 Why is it preferable to use crushed ice instead of ice cubes for this investigation? (2)

3.4 Explain in terms of temperature, energy and movement of particles, the changes that occur between 20 and 45 minutes. (3)

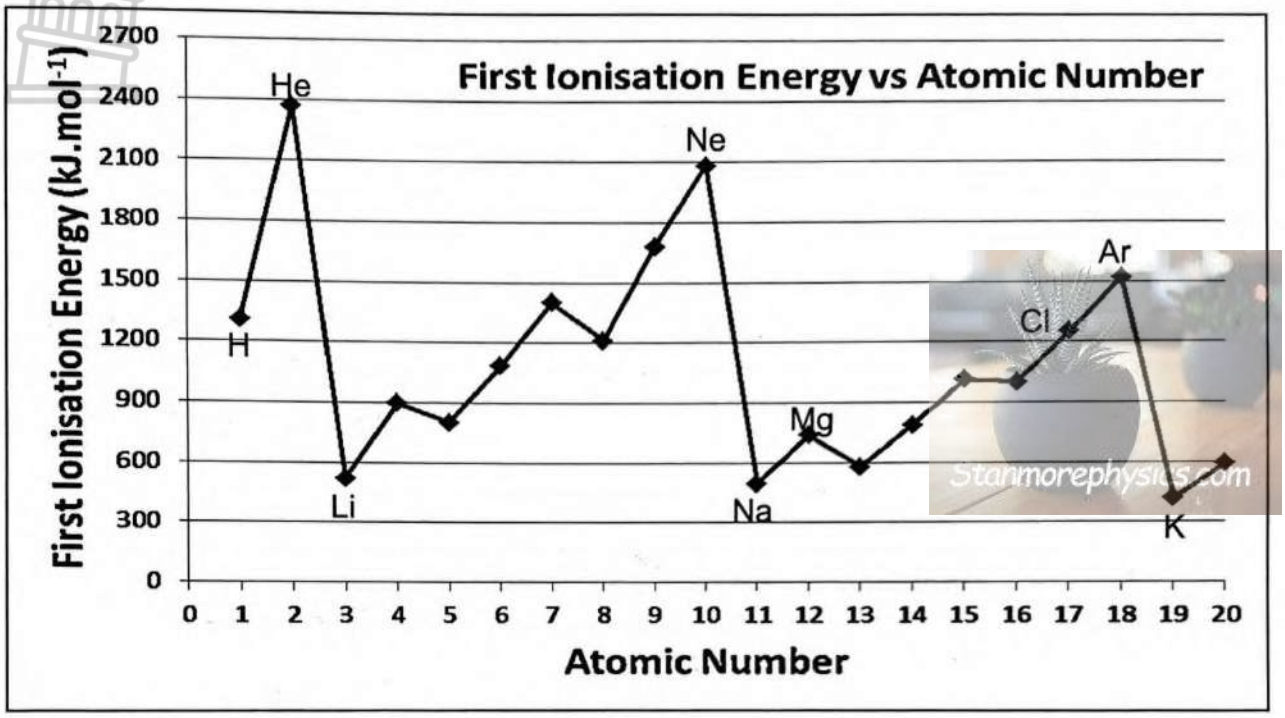
3.5 Why does the temperature remain constant after 45 minutes? (2)

3.6 Write down the phase of water at 50 minutes. (1)

[10]

QUESTION 4 (Start on a new page.)

4.1 The first ionization energy of the first 20 elements in the periodic table is shown in the graph below.



4.1.1 What is the relationship between the first ionisation energy and atomic radius? (1)

4.1.2 Explain why Chlorine (Cl) has higher first ionization energy than Magnesium (Mg). (2)

4.1.3 Does the first ionisation energy INCREASE, DECREASE or REMAIN THE SAME from the top to the bottom in a group? Explain this trend in ionisation energy. (3)

4.1.4 Explain why noble gases have high first ionisation energies. (2)

4.2 Define the term *electron affinity* in words. (2)

4.3 Consider the elements in the same period. Write down the name of the group that has the element with the highest ELECTRON AFFINITY in each period. (1)

[11]

QUESTION 5 (Start on a new page.)

5.1 Calcium (Ca) reacts with Chlorine (Cl) to form Calcium Chloride.

5.1.1 Write down the number of electrons in each Ca^{2+} ion. (1)

5.1.2 Draw the Aufbau diagram and provide the electronic configuration (sp-notation) for chlorine. (3)

5.1.3 Identify the type of bond that forms when calcium and chlorine combine. (1)

5.1.4 Draw the Lewis structure for calcium chloride. (2)

5.2 Copper (Cu) has two stable isotopes. Copper – 65 has a percentage abundance of 25%. The relative atomic mass of copper is 63,5 AMU.
Determine the number of neutrons in the most abundant isotope of copper. (6)

5.3 Write down the chemical formula for:

5.3.1 Magnesium oxide (2)

5.3.2 Ammonium dichromate (2)

5.4 Write down the chemical name of $Cu(NO_3)_2$. (2)
[19]

QUESTION 6 (Start on a new page)

The reaction between calcium carbonate ($CaCO_3$) and hydrochloric acid (HCl) is represented by the balanced chemical equation below:

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(\ell)$$

50 grams calcium carbonate reacts completely to form 0,5 moles of carbon dioxide (CO_2) at STP.

6.1 Determine the:

6.1.1 Molar mass of calcium carbonate (2)

6.1.2 Number of calcium carbonate molecules that reacted. (5)

6.2 Calculate the volume of carbon dioxide formed. (3)

[10]

TOTAL: 75

DATA FOR PHYSICAL SCIENCES GRADE 10

CHEMISTRY

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Standard pressure	p^{θ}	$1{,}013 \times 10^5$ Pa
Molar gas volume at STP	V_m	22,4 $dm^3 \cdot mol^{-1}$
Standard temperature	T^{θ}	273 K
Avogadro's constant	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$

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)
																	2 He 4
2,1 1 H 1												2,0 5 B 11	2,5 6 C 12	3,0 7 N 14	3,5 8 O 16	4,0 9 F 19	10 Ne 20
1,0 3 Li 7	1,5 4 Be 9											1,5 13 Aℓ 27	1,8 14 Si 28	2,1 15 P 31	2,5 16 S 32	3,0 17 Cℓ 35,5	18 Ar 40
0,9 11 Na 23	1,2 12 Mg 24																
0,8 19 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	1,5 25 Mn 55	1,8 26 Fe 56	1,8 27 Co 59	1,8 28 Ni 59	1,9 29 Cu 63,5	1,6 30 Zn 65	1,6 31 Ga 70	1,8 32 Ge 73	2,0 33 As 75	2,4 34 Se 79	2,8 35 Br 80	36 Kr 84
0,8 37 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	1,9 43 Tc	2,2 44 Ru 101	2,2 45 Rh 103	2,2 46 Pd 106	1,9 47 Ag 108	1,7 48 Cd 112	1,7 49 In 115	1,8 50 Sn 119	1,9 51 Sb 122	2,1 52 Te 128	2,5 53 I 127	54 Xe 131
0,7 55 Cs 133	0,9 56 Ba 137	57 La 139	1,6 72 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	1,8 81 Tℓ 204	1,8 82 Pb 207	1,9 83 Bi 209	2,0 84 Po	2,5 85 At	86 Rn
0,7 87 Fr	0,9 88 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

KEY/*SLEUTEL*

Atomic number
Atoomgetal

Electronegativity
Elektronegatiwiteit

29
1,9 Cu
63,5

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

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MARKING GUIDELINE

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MARKS: 75

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This marking guideline consists of 5 pages.

QUESTION 1:

1.1 C ✓✓ (2)
1.2 C ✓✓ (2)
1.3 A ✓✓ (2)
1.4 B ✓✓ (2)
1.5 D ✓✓ (2)
[10]

QUESTION 2

2.1

2.1.1 Oak (chip). ✓
The density of oak is less than the density of water. ✓ (2)

2.1.2 Aluminium. ✓
Aluminium has a lower density than lead. ✓
For a constant mass, the density is inversely proportional to the volume. ✓ (3)

2.2

2.2.1 Pure Substance ✓ (1)

2.2.2 $4Al + 3O_2 \rightarrow 2Al_2O_3$ LHS ✓
RHS ✓
Balancing ✓ (3)

2.3

2.3.1 Physical (change) ✓ (1)

2.3.2 Decomposition ✓
A single reactant is broken down into multiple products. ✓ (2)

2.4 Mass of reactants = $2(14 + 1x3) + 2x1 + 32 + 16x4$ ✓
= 132 $g.mol^{-1}$
Mass of products = $2(14 + 4x1) + 32 + 16x4$ ✓
= 132 $g.mol^{-1}$
Mass of reactants is equal to the mass of products. Therefore mass is conserved. ✓ (3)

[15]

QUESTION 3

3.1 Melting. ✓ (1)

3.2 Thermometer ✓ (1)

3.3 Crushed ice allows for easier transfer of heat energy from one particle to the next. ✓✓

or

Use crushed ice because it is easier for the thermometer to measure the temperature✓✓ (2)

3.4 The temperature of the substance increases. ✓
The average kinetic energy of the particles increases. ✓
Particles move faster. ✓ (3)

3.5 The water has reached room temperature ✓ and there isn't an external heat source. ✓ (2)

3.6 Liquid. ✓ (1)

[10]

QUESTION 4

4.1

4.1.1 A larger atomic radius results in lower first ionisation energy. ✓ (1)

4.1.2 As you move from left to right across a period the effective nuclear charge increase ✓
The force of attraction between the nucleus and the outer orbital increases. ✓

or

Cl has a smaller atomic radius than Mg✓✓ (2)

4.1.3 Decrease ✓
As you move down the group the atomic radius increases. ✓
The force of attraction between the nucleus and valence electrons decreases. ✓ (3)

4.1.4 The outermost energy level is full in noble gases✓ resulting in a stable electronic configuration ✓

or

Noble gases have the smallest atomic radius✓ for the elements in the same period. ✓ (2)

4.2 The energy released when an electron is attached to an atom or molecule to form a negative ion. ✓✓ (2)

4.3 Halogen ✓ (1)

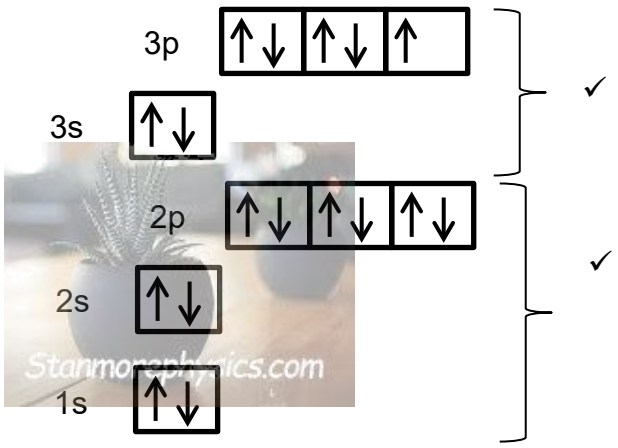
[11]

QUESTION 5

5.1

5.1.1 18 ✓ (1)

5.1.2

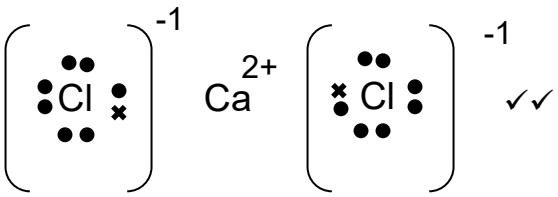


sp-notation: $1s^2 2s^2 2p^6 3s^2 3p^5$ ✓ (3)

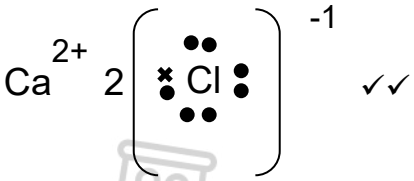
5.1.3 Ionic bonds✓ (1)

5.1.4

OPTION 1



OPTION 2



(2)

5.2 Let the 2nd isotope be Copper – X

% Copper – X = 100 – 25 ✓ = 75%

✓ ✓ ✓

$63,5 = 65 \times \frac{25}{100} + X\left(\frac{75}{100}\right)$

x = 63

number of neutrons = 63 – 29 ✓

= 34 ✓ (6)

5.3

5.3.1 MgO ✓✓ (2)

5.3.2 $(NH_4)_2Cr_2O_7$ ✓✓ (2)

5.4 Copper (II) nitrate ✓✓ **Note:** Copper nitrate ✓ (2)

[19]

QUESTION 6

6.1

6.1.1 $M(CaCO_3) = 40 + 12 + 16 \times 3$ ✓

$= 100\ g.mol^{-1}$ ✓ (2)

Positive marking from 6.1.1

6.1.2 $n(CaCO_3) = \frac{m}{M}$ ✓

$n(CaCO_3) = \frac{50}{100}$ ✓

$n(CaCO_3) = 0,5\ mol$

$n(CaCO_3) = \frac{N}{N_A}$ ✓

$0,5 = \frac{N}{6,02 \times 10^{23}}$ ✓

$N = 3,01 \times 10^{23}$ molecules ✓ (5)

6.2 $n(CO_2) = \frac{V}{V_m}$ ✓

$0,5 = \frac{V}{22,4}$ ✓

$V = 11,2\ dm^3$ ✓ (3)

[10]

TOTAL: 75