Hoërskool Johan Jurgens

Physical Science Gr. 10

8 September 2025

Term 3 cycle test

Marks: 100

Time: 2 hours

Examiner: S Stoltz

Moderator: N Gertenbach

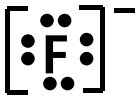
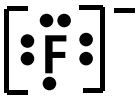
INSTRUCTIONS AND INFORMATION

1. The question paper consists of seven questions and eight pages. Answer all questions.
2. Start EACH question on a NEW page.
3. Number your answers correctly according to the numbering system used in this question paper.
4. Leave ONE line between two sub-questions, e.g., between QUESTION 2.1 and QUESTION 2.2.
5. A non-programmable calculator may be used.
6. Appropriate mathematical instruments may be used.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, etc. where required.
10. You are advised to use the attached data sheets.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four 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), for example 1.10 E.

1.1 Which Lewis diagram represents a fluoride ion?

A. 	B. 
C. 	D. 

(2)

1.2 Which of the following is not a physical change?

A. Combustion

B. Cutting

C. Boiling

D. Sanding (2)

1.3 If atoms of the same or different elements share electrons, which of the following is formed?

A Precipitation.

B Neutral atoms.

C Electrolyte.

D Chemical bond. (2)

1.4 Choose the CORRECT formula for iron(III)oxide:

A FeO

B Fe_2O

C FeO_2

D Fe_2O_3 (2)

1.5 "A physical quantity with magnitude and direction." Is referring to a:

A. Scalar

B. Vector

C. Physical change

D. Motion (2)

1.6 120 $km.h^{-1}$ = ... $m.s^{-1}$

A. 3,33

B. 33,33

C. 4320

D. 432 (2)

1.7 Choose the correct combination that represents a SCALAR and a VECTOR.

	SCALAR	***VECTOR***
A.	Time	Temperature
B.	Distance	Speed
C.	Mass	Force
D.	Acceleration	Velocity

(2)

[14]

QUESTION 2

Consider the chemical equation below:

$$NH_3(g) + O_2(g) \rightarrow NO(g) + H_2O(\ell)$$

2.1 State the *Law of Conservation of Mass* in words. (2)

2.2 Rewrite the above equation and balance it. (4)

2.3 By doing calculations prove that mass is conserved during this chemical reaction. (6)

2.4 Is the number of atoms of each element also conserved? Motivate your answer by showing how many atoms of each element there is on either side of the equation. (6)

[18]

QUESTION 3

If 0.5 mole of sodium burns in oxygen and hydrogen, sodium hydroxide is formed.

3.1 Define the term *mole* in words. (2)

3.2 Write down a balanced chemical equation for the reaction. (4)

3.3 Calculate the mass of sodium that reacts. (3)

3.4 Determine the number of moles of sodium ions formed. (4)

[13]

QUESTION 4

In science, the amount of a substance, such as a salt, that is in a certain amount of tissue or liquid, such as blood, is called concentration.
A substance becomes more concentrated when less water is present.
For example, the salt in urine may become more concentrated when a person doesn't drink enough water.

4.1 Define *concentration*. (2)

Urea is a major organic component found in human urine.
A urine sample contains 250 cm^3 urea with a concentration of 0,45 $mol.dm^{-3}$.

4.2 Calculate the mass of urea present in this sample. (4)

Urea is 20,0% C; 6,7% H; 46,7% N; and *x*% oxygen.
The molar mass of urea is 60 $g.mol^{-1}$.

4.3 Calculate the % oxygen in urea. (2)

4.4 Define the term empirical formula. (2)

4.5 Use the above information to determine the:

4.5.1 empirical formula of urea.
Show ALL calculations. (5)

4.5.2 molecular formula of urea. (2)

[17]

QUESTION 5

The reaction between 2 g of zinc and an excess of hydrochloric acid takes place in a conical flask at STP according to the following balanced equation.

$$Zn(s) + 2HCl(aq) \rightarrow ZnCl_2(aq) + H_2(g)$$

5.1 Give another name for a conical *flask*, as it is mostly referred to in a laboratory. (1)

5.2 What is the name of the salt that forms when zinc reacts with hydrochloric acid? (2)

5.3 Calculate the:

5.3.1 volume of hydrogen gas produced at STP (in dm^3). (4)

5.3.2 theoretical yield (in gram) of $ZnCl_2$. (3)

5.3.3 percentage yield of $ZnCl_2$, if the actual mass of $ZnCl_2$ which was formed is 3 g. (3)

[13]

QUESTION 6

Some salts contain water trapped in the crystal structure. We refer to this water as crystal water and we say the salt is hydrated.

5,72 g fresh crystalline washing soda ($Na_2CO_3 \cdot xH_2O$) is heated to expel the crystal water and then weighed again. The mass is now 2,12 g.

6.1 What was the mass of the water in the original sample of sodium carbonate? (2)

6.2 In the original sample of washing soda (mass = 5.72 g), calculate the number of moles:

6.2.1 water. (3)

6.2.2 sodium carbonate. (3)

6.3 Determine *x* in the formula of hydrated sodium carbonate. (2)

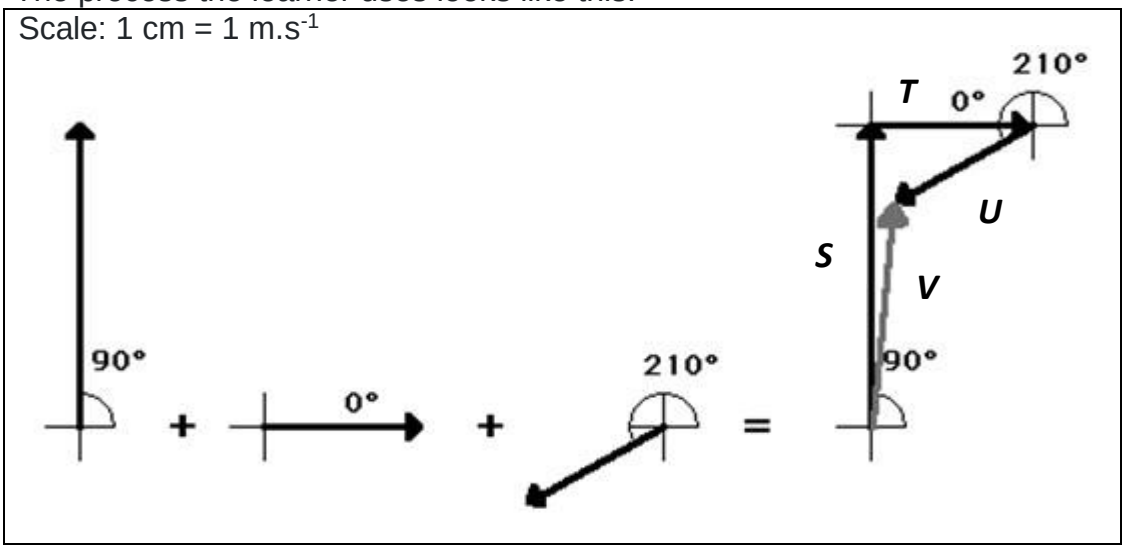
[10]

QUESTION 7

7.1 A grade 10 learner is asked to graphically add the following three vectors and to calculate the resultant.

- 4 m.s^{-1}, 90°
- 2 m.s^{-1}, 0°
- 2 m.s^{-1}, 210°

The process the learner uses looks like this:



7.1.1 Define the term *resultant*. (2)

7.1.2 Give the NAME of the method that the learner used to graphically determine the resultant. (1)

7.1.3 Which ONE of the vectors represents the resultant.
Write only **S** or **T** or **U** or **V**. (1)

7.1.4 A teacher marks the learner's answer, but does not award full marks for the answer. The teacher's comment is: "Direction!!!"
Explain what the teacher means by this. (2)

7.2 A jogger starts at position ***A*** and runs 100 m due west to position ***B***. He then turns around and runs 80 m due east to position ***C***. This motion is described as <u>one dimensional motion</u>.

7.2.1 Define *one dimensional motion*. (2)

7.2.2 Draw a vector diagram (according to scale) for this one-dimensional motion. (4)

7.2.3 Determine his final displacement when using position ***A*** as a reference point. (2)

[14]

TOTAL: 100

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10
(CHEMIE)
DATA FOR PHYSICAL SCIENCES GRADE 10
(CHEMISTRY)

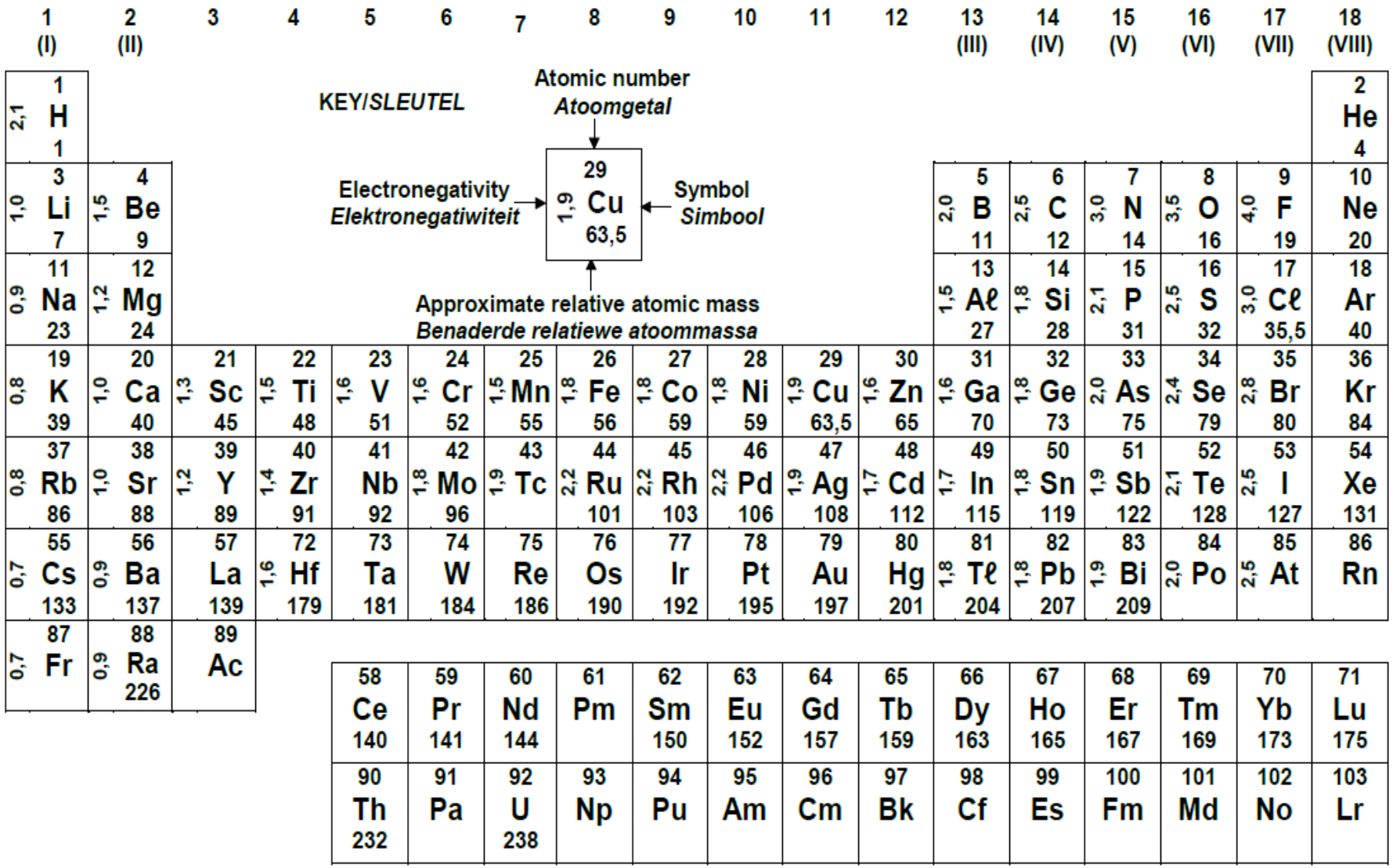
TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES

NAME/*NAAM*	**SYMBOL/*SIMBOOL***	**VALUE/*WAARDE***
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}\ mol^{-1}$
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22{,}4\ dm^3 \cdot mol^{-1}$
Standard pressure *Standaarddruk*	$p^\ominus$	$1{,}013 \times 10^5\ Pa$

TABLE 2: FORMULAE/TABEL 2: FORMULES

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

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



8 SEPTEMBER 2025 GRADE 10 CYCLE TEST
MEMO

QUESTION 1

1.1 A (2)
1.2 A (2)
1.3 D (2)
1.4 D (2)
1.5 B (2)
1.6 B (2)
1.7 C (2)

[14]

QUESTION 2

2.1 The total mass of reactants is equal to the total mass of the products. ✓✓ (2)

2.2 $4NH_3(g)$ ✓ + $5O_2(g)$ ✓ → $4NO(g)$ ✓ + $6H_2O(l)$ ✓ (4)

2.3 Calculation of mass:

Reactants	
NH_3	O_2
4(14 + 1 x 3) = 68 ✓	5(2 x 16) = 160 ✓
Total = 228 ✓	
Products	
NO	H_2O
4(14 + 16) = 120 ✓	6(2 x 1 + 16) = 108 ✓
Total = 228 ✓	

Hence mass is conserved. (6)

2.4 Calculation of atoms:

Reactants	
NH_3	O_2
(4x1) x N & (4x3) x H ✓	(5x2) x O ✓
4 x N, 12 x H, 10 x O ✓	
Products	
NO	H_2O
4 x N & 4 x O ✓	12 x H & 6 x O ✓
4 x N, 12 x H, 10 x O ✓	

Hence atoms are conserved. (6)

[18]

QUESTION 3

3.1 The amount of a substance that has the same number of particles as is in 12g of carbon-12. ✓✓ (2)

3.2 2Na ✓+ O_2 ✓ + H_2 ✓→ 2NaOH✓ Balanced ✓ (4)

3.3 $\mathrm{n} = \frac{\mathrm{m}}{\mathrm{M}}$ ✓

$0{,}5 = \frac{\mathrm{m}}{23}$ ✓

$\mathrm{m} = 11{,}5$ g Na ✓ (3)

3.4 Ratio is 2 : 2 ✓
0,5 : n ✓
n = 0,5 mole ✓
Sodium ion = 0,5 mole ✓ (4)

[13]

QUESTION 4

4.1 Concentration as the number of moles of solute per cubic decimetre of solution. ✓✓ (2)

4.2 $m = cMV$✓
= 0,45(60) ✓ (0,25) ✓
= 6,75 g ✓ (4)

4.3 %O = 100 – 20 – 6,7 – 46,7 ✓
= 26,6 % ✓ (2)

4.4 An empirical formula is the simplest whole-number ratio of atoms in a compound. ✓✓ (2)

4.5.1 $n(C) = \frac{m}{M} = \frac{20}{12} = 1{,}67\ mol$
$n(H) = \frac{6{,}7}{1} = 6{,}7\ mol$
$n(N) = \frac{46{,}7}{14} = 3{,}34\ mol$
$n(O) = \frac{26{,}6}{16} = 1{,}66\ mol$ ✓✓

C	:	H	:	N	:	O
$\frac{1{,}67}{1{,}67}$	:	$\frac{6{,}7}{1{,}66}$	:	$\frac{3{,}34}{1{,}66}$	:	$\frac{1{,}66}{1{,}66}$ ✓✓
1	:	4	:	2	:	1

CH_4N_2O ✓ (5)

4.5.2 $(CH_4N_2O)_n$

$n = \frac{M(empiricasl\ mass)}{M(molecular\ mass)} = \frac{60}{60} = 1\ \therefore molecular\ formula = empirical\ formula$ ✓✓ (2)

[17]

QUESTION 5

5.1 Erlenmeyer flask✓ / titration flask (1)

5.2 zinc chloride✓✓ (2)

5.3.1 $n(Zn) = \frac{m}{M}$
$= \frac{2}{65}$✓
$= 0{,}03\ mol$

$n(H_2) = n(Zn) \ = \ 1:1$ ✓

$V = nV_m$ ✓
$= 0{,}03(22{,}4)$
$= 0{,}67\ dm^3$ ✓ (4)

5.3.2 $m = nM$
$= 0{,}03$✓$((65) + 2(35{,}5))$✓
$= 4{,}08\ g$✓ (3)

5.3.3 $\%yield = \frac{actual\ practical\ yield}{theoretical\ yield} \times 100$
$= \frac{2}{4{,}08}$✓✓ $\times 100$
$= 73{,}53\%$ ✓ (3)

[13]

QUESTION 6

6.1 $m_{crystal\ water}$ = 5,72 – 2,12 ✓ = 3,6 g ✓ (2)

6.2.1 $n = \frac{m}{M}$✓ $= \frac{3{,}6}{18}$✓ $= 0{,}2\ mol$✓ (3)

6.2.2 $n = \frac{m}{M} = \frac{2{,}12✓}{2(23)+12+3(16)✓} = 0{,}02\ mol$✓ (3)

6.3 $n(Na_2CO_3) : n(H_2O)$
$0{,}02 : 0{,}2$
$\frac{0{,}02}{0{,}02} : \frac{0{,}2}{0{,}02}$ ✓
1 : 10 ✓

Therefore, the formula is: $Na_2CO_3 \cdot 10H_2O$✓ (3)

[11]

QUESTION 7

7.1.1 The single vector having the same effect as two or more vectors together. ✓✓ (2)

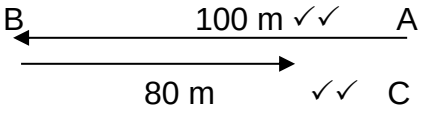
7.1.2 tail-to-head method ✓ (1)

7.1.3 **V** ✓ (1)

7.1.4 The learner did not use north as 0° ✓ nor did he measure clockwise. ✓
OR
The learner uses the x-axis (east) as 0° as in mathematics and measures anti-clockwise which is incorrect according to Physical Sciences. (2)

7.2.1 The motion along a straight line. ✓✓ (2)

7.2.2



(4)

7.2.3 20 m ✓ due west to position A ✓ (2)

[14]

TOTAL: 100

TAXONOMY LEVELS					
GRADE 10					
PHYSICAL SCIENCES					
8 September 2025 Control test					
MARKS: 100					
QUESTION	RECALL	COMPREHENSION	ANALYSIS APPLICATION	EVALUATION SYNTHESIS	TOTAL
DESIRED %	15%	40%	35%	10%	100%
1.1				2	
1.2		2			
1.3	2				
1.4				2	
1.5	2				
1.6		2			
1.7		2			
2.1	2				
2.2		4			
2.3		6			
2.4		6			
3.1	2				
3.2				4	
3.3			3		
3.4			4		
4.1	2				
4.2			4		
4.3			2		
4.4	2				
4.5.1			5		
4.5.2		2			
5.1	1				
5.2	2				
5.3.1			4		
5.3.2			3		
5.3.3			3		
6.1			2		
6.2.1			3		
6.2.2			3		
6.3			3		
7.1.1	2				
7.1.2		1			
7.1.3		1			
7.1.4				2	
7.2.1	2				
7.2.2		4			
7.2.3		2			
Total	**19**	**32**	**39**	**10**	**100**
Actual %	**19,0**	**32,0**	**39,0**	**10,0**	**100,0**
Desired %	**15%**	**40%**	**35%**	**10%**	**100**