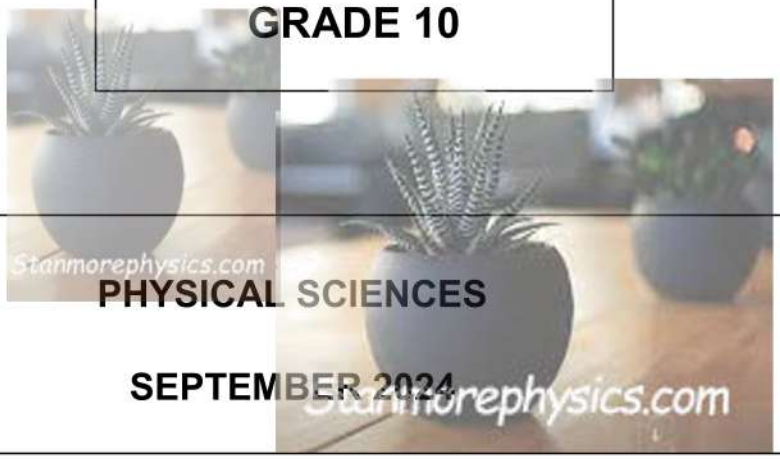
education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10



PHYSICAL SCIENCES

SEPTEMBER 2024

MARKS: 100

TIME: 2 HOURS

This question paper consists of 15 pages.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of SIX questions. Answer ALL the questions.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Write neatly and legibly.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the DATA SHEETS that are attached.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places

QUESTION 1

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the best answer and write the correct letter (A – D) next to the question number (1.1 – 1.5) on the ANSWER SHEET

1.1 A car is travelling at a speed of $30 m \cdot s^{-1}$ on a straight road. What would be the speed of the car in $km \cdot h^{-1}$?

A $30 km \cdot h^{-1}$

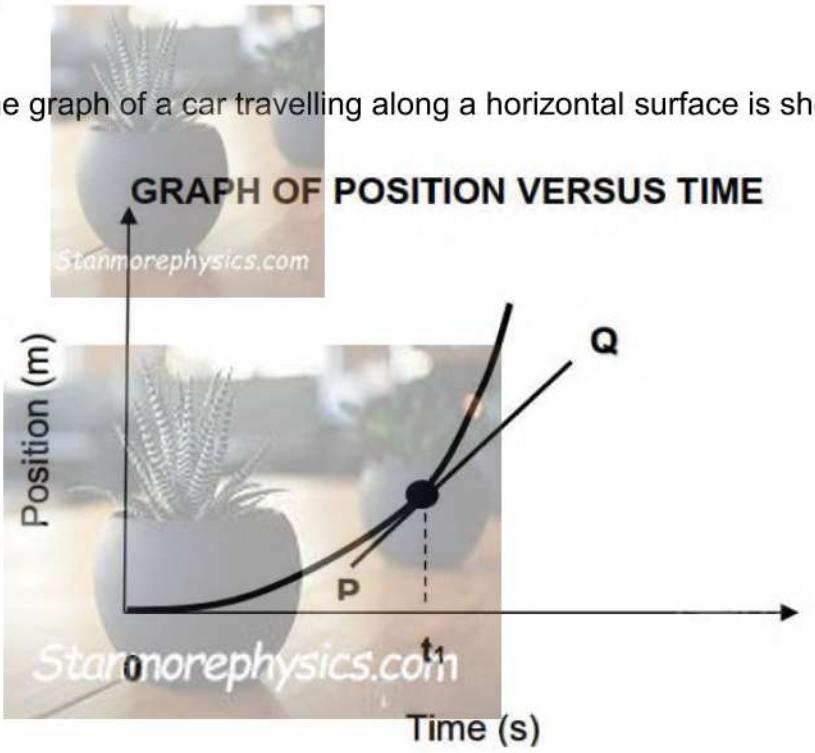
B $130 km \cdot h^{-1}$

C $8.33 km \cdot h^{-1}$

D $108 km \cdot h^{-1}$

(2)

1.2 The position- time graph of a car travelling along a horizontal surface is shown below



Tangent PQ is the tangent to the curve at time t_1.

Which one of the following is equal to the gradient of PQ?

A Average velocity over the period 0 t0 t_1

B Instantaneous velocity at time t_1

C Average acceleration over the period 0 t0 t_1

D Instantaneous acceleration at time t_1

(2)

1.3 The table below shows the changes in the velocity of the car in intervals of 4 seconds.

Time(s)	0	4	8	12	16	20	24	28	32
Velocity(ms^{-1})	0	7	14	21	28	28	28	28	28

Which one of the following is CORRECT for the acceleration of the car?

A Increases initially for 16s then remains constant.

B Is initially constant for 16 seconds then becomes zero

C Is initially constant for 16 seconds and then decreases

D Increases initially for 16s and then becomes zero.

$4A\ell\,(s) + 3O_2\,(g) \rightarrow A\ell_2O_3\,(s)$ (2)

1.4 Consider the balanced chemical equation below:

Which one of the following is the correct number of oxygen atoms required to form 4 moles of aluminium oxide? **($A\ell I_2O_3$)**

A $6 \times 6{,}02 \times^{23}$

B $12 \times 6{,}02 \times^{23}$

C $3 \times 6{,}02 \times^{23}$

D $36 \times 6{,}02 \times^{23}$

(2)

1.5 Consider the following unbalanced chemical equation below:

$NH_3 + O_2 \rightarrow NO + H_2O$

Which ONE of the sets of coefficients will balance the equation?

A 2,2,2,3

B 2.3.2.3

C 5.4.5.6

D 4.5.4.6

(2)

[10]

QUESTION 2

2.1 The diagram below shows two learners applying forces on the box. In diagram (a), the two learners apply a force of 5N each on the box, in the same direction. And in diagram (b), the two learners apply forces of 5N and 3N in opposite directions respectively.

a)

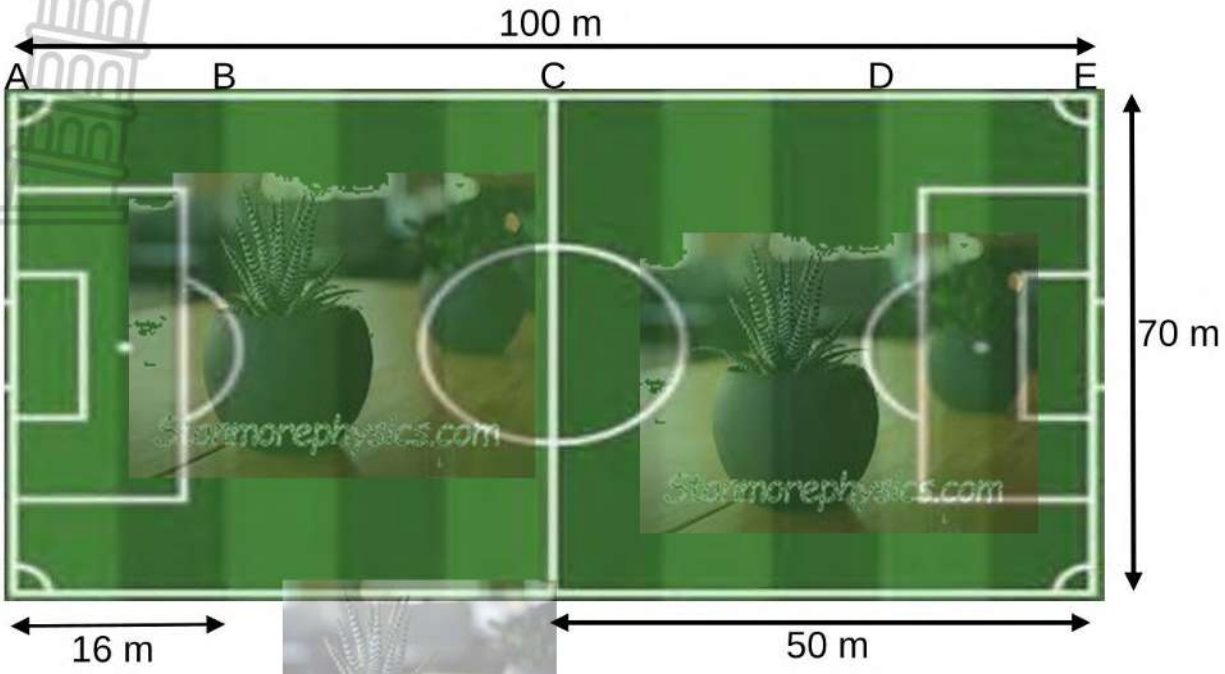
b)

2.1.1 Define the term resultant vector. . (2)

2.1.2 Draw a vector diagram showing all forces for diagram (a) and the resultant vector. (3)

2.1.3 Draw a vector diagram showing all forces for diagram (b) and the resultant vector. (3)

2.2 The diagram below represents a school soccer field.



.

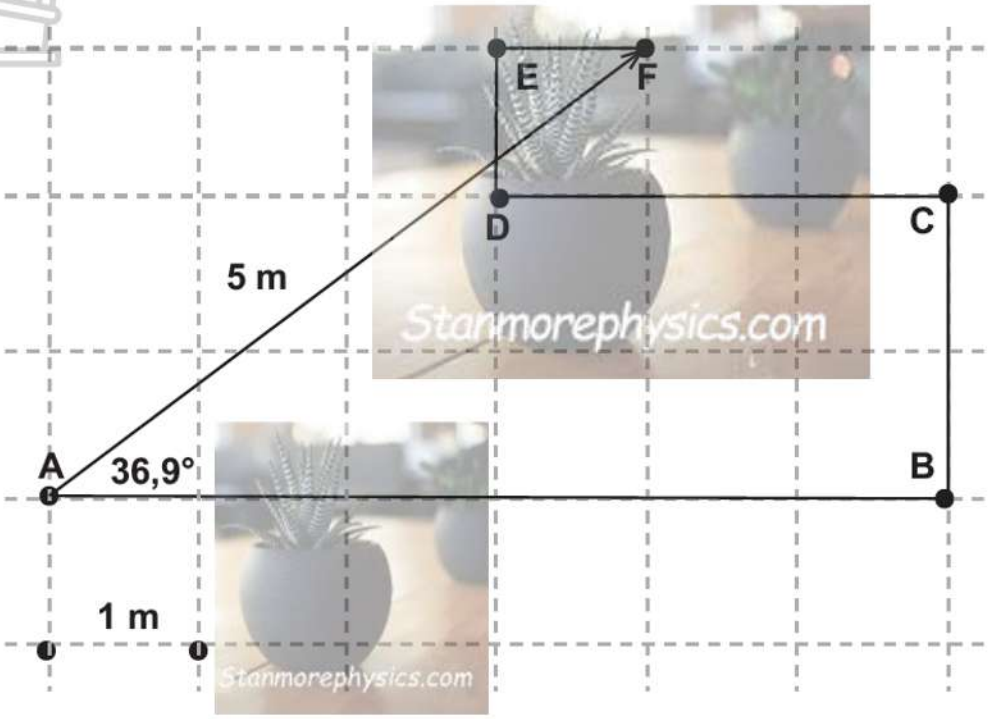
2.2.1 . Define one-dimensional motion (2)

2.2.2 A learner ran from C to D and back to C, and then from C to E in 1,5 minutes. (4)
Calculate the learner's average speed.

[14]

QUESTION 3

3.1 An object moves from A to B to C to D to E to F in 30 seconds, as shown in the diagram below.



3.1 Distinguish clearly the difference between distance and displacement. (4)

3.2 Calculate the distance travelled in 30 s. (2)

3.3 The vector drawn from A to F shows the object's displacement in 30 s. With reference to the definition of displacement, explain why this vector gives the object's displacement, and write down the magnitude and direction of its displacement. (4)

3.4 Calculate the average speed of the object in 30 s. (3)

3.5 Calculate the magnitude of its average velocity in 30 s. (4)

3.6 The forklift starting from Point X needs to pick up a package from Point Y, which is due east of Point X.

The package is thereafter transported to a table, which lies 350 metres due west of Point X. The entire trip takes the driver 2 minutes to complete.

3.6.1 Define the term average velocity in words. (1)

3.6.2 Calculate the average velocity of the forklift for the entire trip. (3)

3.6.3 The average speed of the forklift is $3.75 m \cdot s^{-1}$. (4)
Determine the position of Point Y relative

[25]

QUESTION 4

4.1 The truck mechanic conduct tests after the repair. A truck starts from rest at a traffic light and accelerates for 4 seconds in an easterly direction. A person on the road measures the change in position during equal time intervals. The results obtained are recorded in the table below.

Time (s)	Position (m)
0	0
1	10
2	20
3	30
4	40

For the tests, write down the:

4.1.1 Independent variable (1)

4.1.2 Dependent variable. (1)

4.2 Use the information in the table above and drawn an accurate position-time graph on the graph paper on the attached ANSWER SHEET. (4)

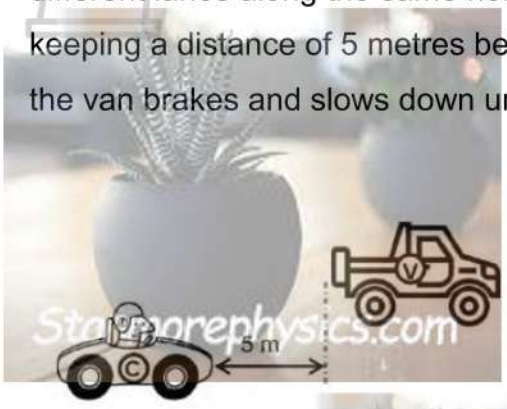
4.3 Calculate the gradient of the graph. (3)

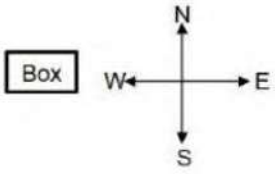
4.4 Which physical quantity is represented by the gradient of the graph? (1)

[10]

QUESTION 5

5.1 A car C and a van V are both travelling at a constant velocity of 25 $m \cdot s^{-1}$ east, on different lanes along the same horizontal road. The driver of the car follows the van, keeping a distance of 5 metres between them. Seeing a box on his lane, the driver of the van brakes and slows down uniformly to stop in 5 seconds.



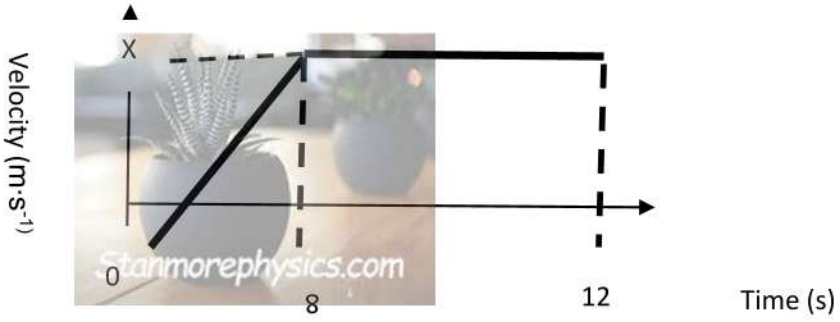


5.1.1 Define acceleration. (1)

5.1.2 Calculate the acceleration of the car while slowing down. (3)

5.1.3 If the car continued at its original motion, how far ahead of the van will the car be when the van stops? (5)

5.2 After passing the box, the van takes off from rest and accelerates uniformly at $4 m \cdot s^{-2}$ for 8 seconds. It thereafter travels at a constant velocity of X $m \cdot s^{-1}$ for a further 4 seconds as shown in the diagram below.



5.2.1 Describe uniform acceleration using words. (2)

5.2.2 Use the GRAPH to determine the value of X. (3)

5.2.3 Sketch the acceleration vs time graph for the 12 seconds represented in the graph above. Indicate the relevant time and acceleration values on the graph. (3)

[17]

QUESTION 6

6.1 Sulphur dioxide (SO_2) reacts with oxygen(O_2) to form sulphur trioxide (SO_3), as shown in the balanced equation below.

$$\mathbf{2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)}$$

In one such reaction, a volume of 2450 cm^3 sulphur trioxide (SO_3), is formed at STP

State ONE MOLE in words. (2)

6.2 Calculate

6.2.1 The number of moles of SO_3 formed. (3)

6.2.2 Mass of SO_2 reacted. (4)

6.2.3 Number of oxygen molecules that reacted. (4)

6.3 The analysis of a compound made up of the elements sodium (Na), sulphur(S) and oxygen(O) provides the following percentage composition by mass.

ELEMENT	PERCENTAGE COMPOSITION
Sodium (Na)	29.11%
sulphur(S)	40.51%
oxygen(O)	30.38%

6.3.1 Define the term empirical formula in words. (2)

6.3.2 Determine the empirical formula of the compound (5)

6.3.3 Determine the percentage composition of water (H_2O) in hydrated copper sulphate ($CuSO_4 \cdot 5\ H_2O$) (4)

[24]

T O T A L: 100

4.2 Information sheets – Paper 1 (Physics)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
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
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$U = mgh$ or/*of* $E_P = mgh$	$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$

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

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf$ or/*of* $E = h\frac{c}{\lambda}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$Q = I\Delta t$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
$R_s = R_1 + R_2 + \ldots$	$V = \frac{W}{Q}$

4.3 Information sheets – Paper 2 (Chemistry)

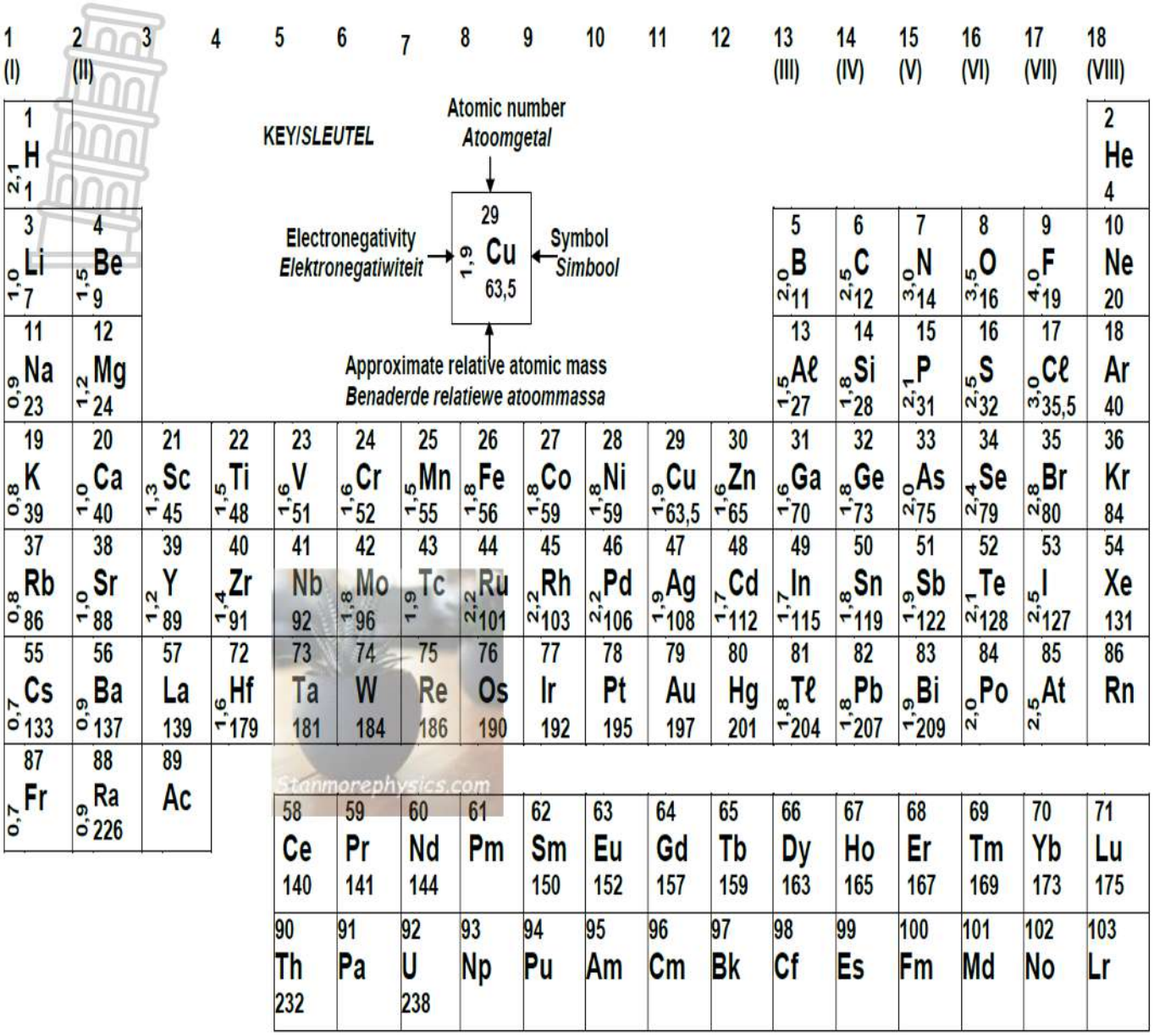
TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

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

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



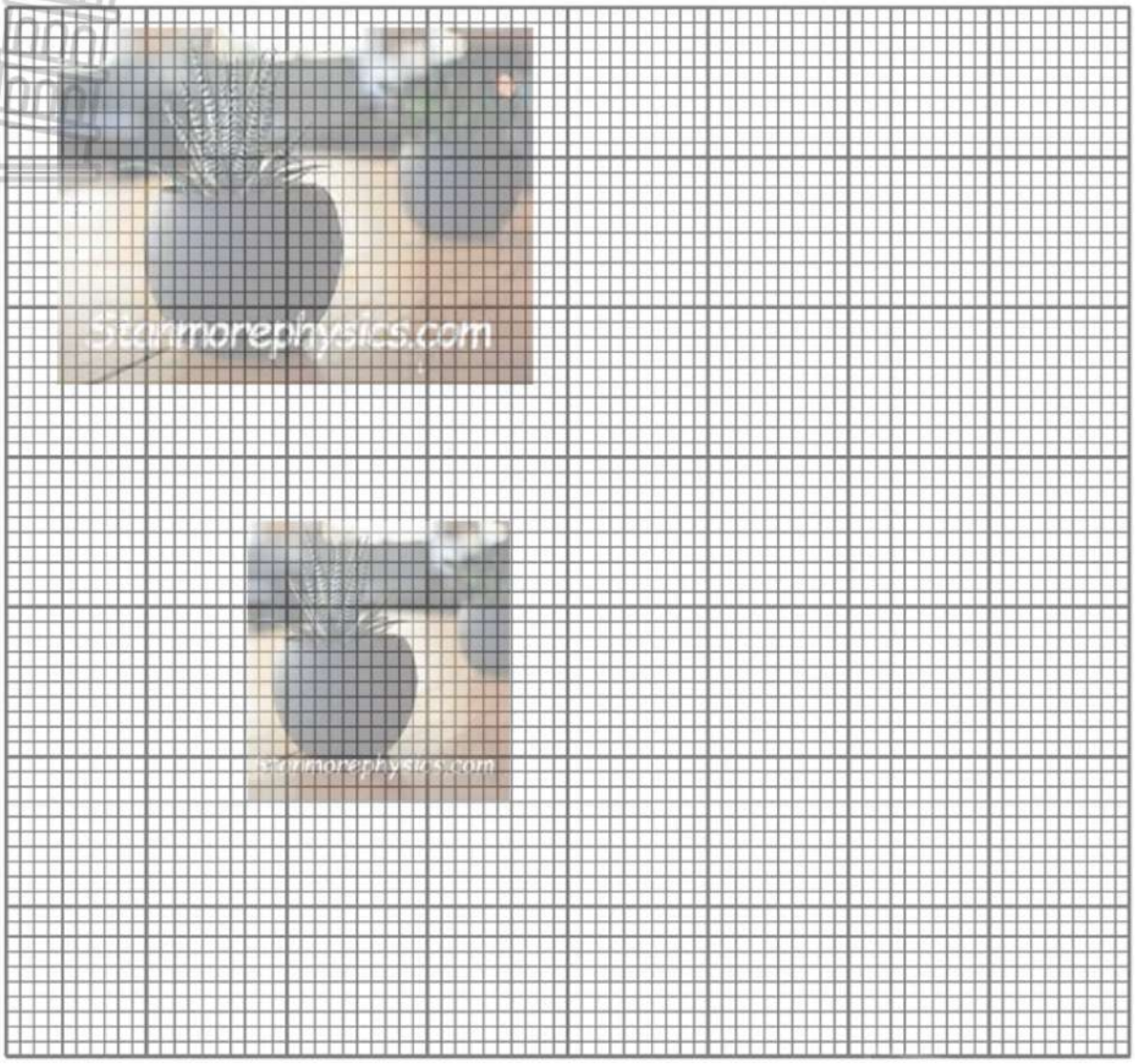
1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 2,1 H 1																	2 He 4
3 1,0 Li 7	4 1,5 Be 9											5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 0,9 Na 23	12 1,2 Mg 24											13 1,5 Aℓ 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	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

NAME_____

SURNAME_____

4.2



education
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE
NASIONALE SENIOR SERTIFIKAAT

GRADE / GRAAD 10

PHYSICAL SCIENCES / FISIESE WETENSKAPPE

MARKING GUIDELINES
NASIENRIGLYNE

SEPTEMBER 2024

MARKS/PUNTE: 100

These marking guidelines consist of 7 pages.
Hierdie nasienriglyne bestaan uit 7 bladsye.

QUESTION/VRAAG 1

1.1 D ✓✓ (2)

1.2 B ✓✓ (2)

1.3 B ✓✓ (2)

1.4 B ✓✓ (2)

1.5 D ✓✓ (2)

[10]

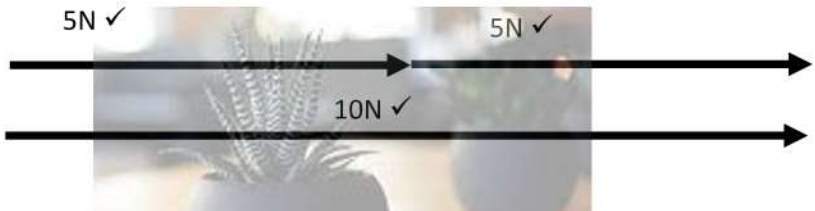
QUESTION/VRAAG 2

2.1

2.1.1 the single vector having the same effect as two or more vectors together. **(2)**

die enkele vektor wat dieselfde effek het as twee of meer vektore saam ✓✓

2.1.2 **(3)**



2.1.3 **(3)**

2.2

2.2.1 Motion along a straight line./ Beweging in 'n reguitlyn ✓✓ **(2)**

2.2.2 $\Delta x = CD + DC + CE$

$\Delta x = 34m + 34m + 50m$

$\Delta x = 118\ m$✓

$Averge\ speed = \frac{total\ distance}{total\ time}$✓ / $gemiddelde\ spoed = \frac{totale\ afstand}{totale\ tyd}$

$= \frac{118}{90}$✓

$= 1{,}31\ m \cdot s^{-1}$✓ (4)

[14]

QUESTION/VRAAG 3

3.1 Distance - the total path length travelled✓ and it is a scalar quantity✓ (4)
Afstand - die totale padlengte afgelê en dit is 'n skalaar hoeveelheid.

Displacement - the difference in position in space ✓and it is a vector quantity. ✓
Verplasing - die verandering in posisie in ruimte en dit is 'n vektorhoeveelheid.

3.2 Total distance travelled / Totale afstand afgelê = 12m✓✓ (2)

3.3 displacement is a vector quantity that points from the initial to the final position. ✓✓ (4)
verplasing is 'n vektorhoeveelheid wat van die begin na die finale verandering in posisie wys.

Displacement / verplasing is 5m✓ 53.1^0 ✓

3.4 $speed/spoed = \frac{distance/afstand}{time/tyd}$✓

$speed/spoed = \frac{12}{30}$✓

$speed/spoed = 0.4m \cdot s^{-1}$✓ (3)

3.5 $v = \frac{\Delta x}{t}$✓

$v = \frac{5}{30}$✓

$v = 0.167m \cdot s^{-1}$✓ 53.1^0✓ (4)

3.6

3.6.1 the rate of change of position. ✓ (1)
die tempo van verandering van posisie.

3.6.2 $v = \frac{\Delta x}{\Delta t}$✓

$v = \frac{350}{120}$✓

$v = 2.912m \cdot s^{-1}$ ✓$WEST/WES$✓ (3)

3.6.3 $speed/spoed = \frac{distance/afstand}{time/tyd}$✓

$3.75 = \frac{distance/afstand}{120}$✓

$distance/afstand = 450$✓

$450 = 2XY + 350$

$XY = 50m$ (4)

$\therefore \frac{point}{punt} Y\ is\ 50m$ $EAST/OOS$✓

[25]

QUESTION/VRAAG 4

4.1

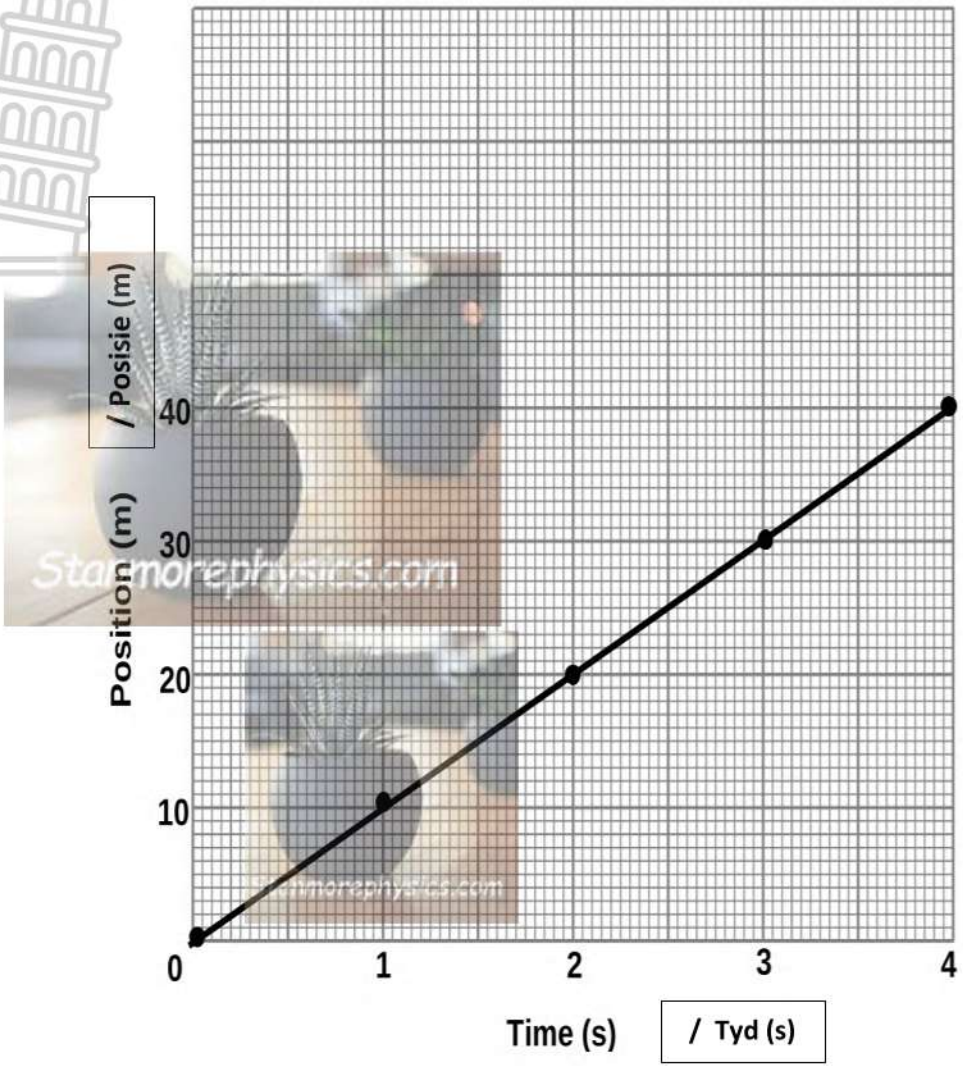
4.1.1 Time/ Tyd(s) ✓ (1)

4.1.2 Position/Posisie (m) ✓ (1)

4.2

The graph of position (m) versus time (s)

Die grafiek van posisie (m) teen tyd (s)



Marking criteria

Title/heading Titel/Opskrif	✓
Correct Axis / Asses korrek	✓
Shape of graph/ Vorm van grafiek	✓✓

(4)

4.3

$gradient/gradiënt = \frac{\Delta x}{\Delta t}$ ✓

$= \frac{40 - 0}{4 - 0}$ ✓

$= 10m \cdot s^{-1}$ ✓

(3)

4.4 Average velocity./ Gemiddelde snelheid ✓ (1)

[10]

QUESTION/VRAAG 5

5.1

5.1.1 the rate of change of velocity./Tempo van verandering van snelheid ✓ (1)

5.1.2

OPTION/ OPSIE1	OPTION/ OPSIE 2
$a = \frac{\Delta v}{\Delta t}$✓ $a = \frac{0x25}{5}$✓ $a = -5m \cdot s^{-2}$ $a = 5m \cdot s^{-2}$ *west*✓	$v_f = v_i + a\Delta t$✓ $0 = 25 + a(5)$ ✓ $a = -5m \cdot s^{-2}$ $a = 5m \cdot s^{-2}$ *west*✓

(3)

5.1.3

POSITIVE MARKING FROM POSITIEWE MERK VANAF QUESTION/VRAAG 5.1.2	
OPTION/ OPSIE 1	**OPTION/ OPSIE 2**
VAN/ BAKKIE $\Delta x = \frac{v_f + v_f}{2}\Delta t$✓ $\Delta x = \frac{0+25}{2} \times 5$✓ $\Delta x = 62.5m$	**VAN/ BAKKIE** $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $\Delta x = 25 \times 5 + \frac{1}{2}(-5) \times 5^2$✓ $\Delta x = 62.5m$
CAR/ KAR $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓ $\Delta x = 25 \times 5 + \frac{1}{2}0 \times 5^2$✓ $\Delta x = 125m$	**CAR/ KAR** $\Delta x = v_i\Delta t$✓ $\Delta x = 25 \times 5$✓ $\Delta x = 125m$
distance between the vehicles ... afstand tussed die voertuie $= 125 - 62.5 - 5 = 57.5m$✓	

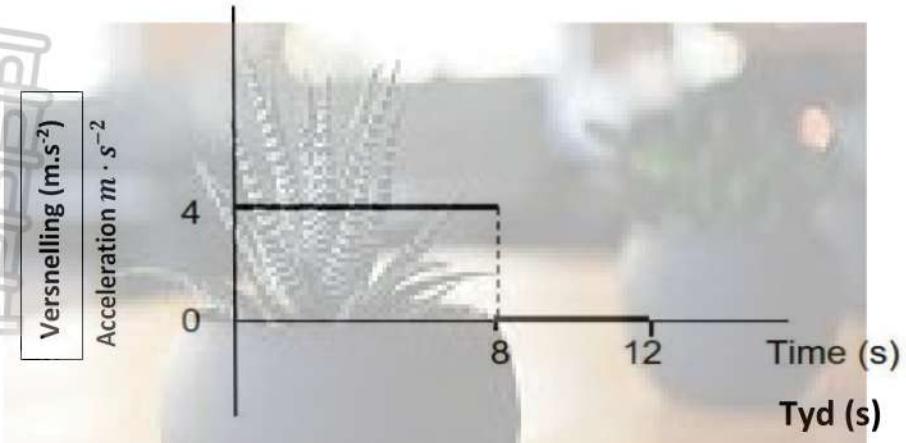
(5)

5.2

5.2.1 The velocity of an object changes with the same amount during each time interval. (2)
Die snelheid van 'n voorwerp verander met dieselfde hoeveelheid gedurende elke tydinterval.✓✓

5.2.2 $a == \frac{\Delta v}{\Delta t}$✓
$4 = \frac{X-0}{8-0}$✓
$X = 32\ m \cdot s^{-1}$✓ (3)

5.2.3



(3)

MARKING CRITERIA/ MERK AANWYSINGS	
Horizontal line at $4m \cdot s^{-2}$ from 0 to 8 seconds Horisontale lyn by 4m.s^{-2} vanaf 0 tot 8 sekondes	✓
Horizontal line at 0 $m \cdot s^{-2}$ from 8 to 12 seconds Horisontale lyn by 0 m.s^{-2} vanaf 8 tot 12 sekondes	✓
Shape (2 parallel horizontal lines that are disjointed Vorm (2 parallelle horisontale lyne wat geskei is.	✓

[17]

QUESTION/VRAAG 6

6.1 Is the number of particles (atoms, molecules, formula-units) present in mole (N_A = 6,023 x 10^{23} mol^{-1}). that is the same amount of atoms as in 12g C12✓✓

Is die aantal deeltjies (atome, molekules, formule-eenhede) teenwoordig in EEN mol (N_A = 6,023 x 10^{23} mol^{-1}), wat dieselfde is as wat daar atome is in 12g C12

(Avogadro's law states that "equal volumes of all gases, at the same temperature and pressure, have the same number of molecules.") (2)

6.2

6.2.1 $$n(SO)_2 = \frac{V}{V_m} ✓$$

$$n(SO)_2 = \frac{2.45}{22.4} ✓$$

$$n(SO)_2 = 0.11mol ✓$$

(3)

6.2.2 **POSITIVE MARKING FROM/ POSITIEWE MERK VANAF 6.2.1**

$SO_2 : SO_3$

2 : 2✓

(4)

$n(SO)_2 = 0.11mol$

$n(SO)_2 = \frac{m}{M}$ ✓

$0.11 = \frac{m}{64}$ ✓

$m(SO)_2 = 7.04g$ ✓

6.2.3 **POSITIVE MARKING FROM/ POSITIEWE MERK VANAF 6.2.1**

$O_2 : SO_3$

1 : 2 ✓

$n(SO)_2 = 0.055mol$

$n(O)_2 = \frac{N}{N_A}$ ✓

$0.055 = \frac{N}{602 \times 10^{23}}$ ✓

$N(O)_2 = 3.31 \times 10^{22} O_2 molecules \ldots . molekules$ ✓ (4)

6.3

6.3.1 the simplest whole-number ratio of atoms in a compound. ✓✓
/ die eenvoudigste heelgetalverhouding van atome in 'n verbinding (2)

6.3.2 Consider 100g. Gegee 100g

Element	Mass(a)(g) Per 100g	$n = \frac{m}{M}$	Simplest ratio Eenvoudigste verhouding	
Na	29.11	$n = \frac{29.11}{23} = 1.27$ ✓	$\frac{1.27}{1.27} = 1 \times 2 = 2$	Obtaining all simplest ratio ✓ Verkry oral die eenvoudigste verhouding
S	40.51	$n = \frac{40.51}{32} = 1.27$ ✓	$\frac{1.27}{1.27} = 1 \times 2 = 2$	
O	30.38	$n = \frac{30.38}{16} = 1.9$ ✓	$\frac{1.9}{1.27} = 1 \times 3 = 3$	
Empirical formula/ Empiriese formule ✓			$Na_2S_2O_3$	

(5)

6.3.3 $M(CuSO_4 \cdot 5H_2O) = 63.4 + 32 + 16 \times 4 + 5 \times 2 + 5 \times 16$ (4)

$249.5g \cdot mol^{-1}$✓

$$\%H_2O = \frac{5 \times 18✓}{249.5} \times 100 \quad ✓$$

$$\%H_2O = 36.7\%✓$$

[24]

T O T A L/ T O T A A L: 100