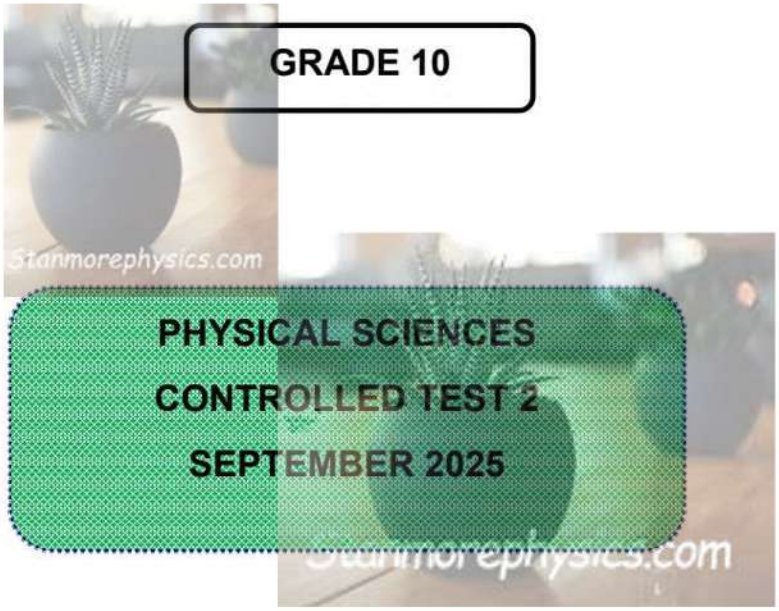
LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 10



PHYSICAL SCIENCES
CONTROLLED TEST 2
SEPTEMBER 2025

MARKS: 100

TIME: 2 HOURS

This question paper consists of 12 pages including DATA SHEETS.

INFORMATION AND INSTRUCTIONS

1. Write your name and surname, as well as your class on the provided ANSWER BOOK.
2. The Question paper consists of **SIX** questions. Answer ALL questions on the provided ANSWER BOOK.
3. Start EACH question on a new page.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two sub-questions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. It is recommended that you use the provided DATA SHEET.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your final answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, et cetera where required.
10. You may use a non-programmable calculator and appropriate mathematical instruments.
11. Write neatly and legibly.

QUESTION 1 (MULTIPLE CHOICE QUESTIONS)

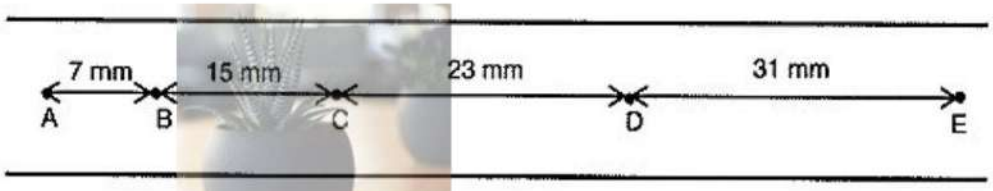
Various options are provided as answers to the following questions. Choose the answer and write only letter (A – D) next to the question number (1.1 – 1.8) in the ANSWER SCRIPTS, for example 1.9 A.

1.1 Which ONE of the following combinations is correct?

	Distance	Displacement	Velocity
A.	Scalar	Scalar	Scalar
B.	Scalar	Vector	Vector
C.	Vector	Scalar	Vector
D.	vector	vector	scalar

(2)

1.2 A trolley runs down a slope, pulling a ticker tape behind it through a ticker timer. A portion of the tape is shown below and represents the distances moved during equal intervals.

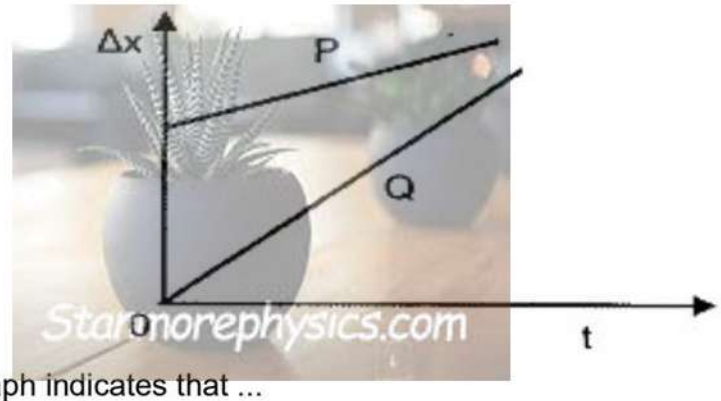


The ticker tape represents an acceleration that is ...

A. zero
B. uniform
C. increasing
D. decreasing

(2)

1.3 The motion of two objects, **P** and **Q**, are represented in the following position versus time graph.



The graph indicates that ...

A. **Q** is moving faster than **P**.

B. **P** and **Q** are accelerating uniformly.

C. **P** and **Q** are on a collision course.

D. **P** and **Q** are moving in opposite directions. (2)

1.4 An object, starting from rest, experiences a constant acceleration *a*, when increasing its velocity to *v*.
The acceleration, when increasing the velocity from *v* to 2*v* in the same time, will be ...

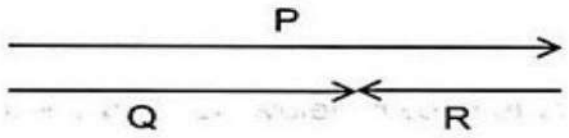
A. *a*

B. 2*a*

C. $\frac{1}{2}$ *a*

D. 4*a* (2)

1.5 Consider the vector diagram below:



Which ONE of the following is the correct relationship between vectors **P**, **Q** and **R**?

A. **P** = **Q** + **R**

B. **R** = **P** + **Q**

C. **Q** = **P** + **R**

D. **P** + **Q** + **R** (2)

1.6 Consider the balanced equation for the reaction below:

$$N_2(g) + 3H_2(g) \rightarrow 2\,NH_3(g)$$

What is the minimum volume of Hydrogen (H_2) required to form 22,4 dm^3 of ammonia (NH_3) at STP?

A. 22,4 dm^3

B. 3 x 22,4 dm^3

C. 1,5 x 22,4 dm^3

D. $\frac{2}{3}$ x 22,4 dm^3 (2)

1.7 Which ONE of the following contains 6,02 x 10^{23} ATOMS?

A. 1 mole of CO_2

B. 16 g of O_2 gas

C. 22,4 dm^3 of N_2 gas at STP

D. 18 g of H_2O (2)

1.8 Which ONE of the following expressions is correct for the percentage composition of water (H_2O) in $Na_2SO_4.10H_2O$?

A. $\frac{18}{142}$ x 100

B. $\frac{18}{322}$ x 100

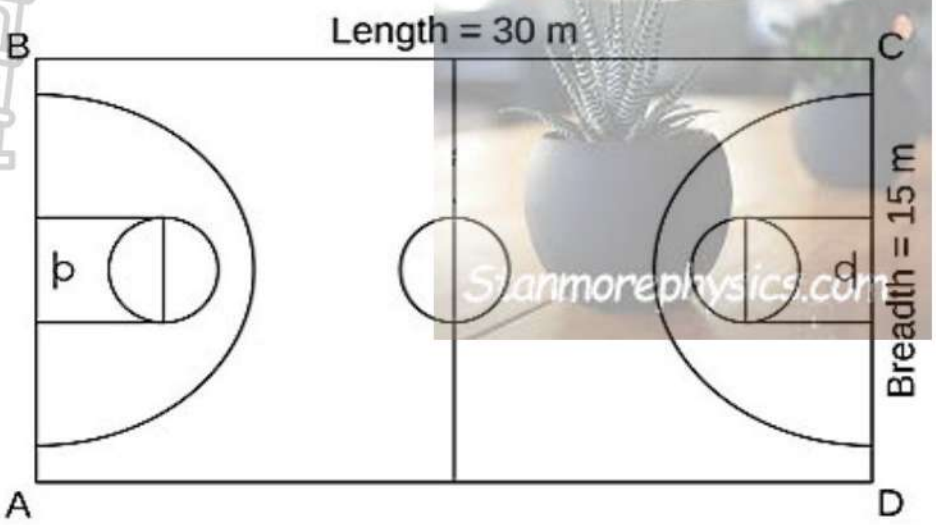
C. $\frac{180}{322}$ x 100

D. $\frac{180}{142}$ x 100 (2)

[16]

QUESTION 2 (Start on a new page)

A basketball player runs around the basketball court during a training session.



In one such training sessions, he runs from **A** to **D**, then back to the centre line from **D,** goes back to **D** and finally back to **A**.

2.1 Calculate the total distance covered by the player. (1)

2.2 Calculate the time it took the player to complete the session if his average speed was 2,5 $m.s^{-1}$. (3)

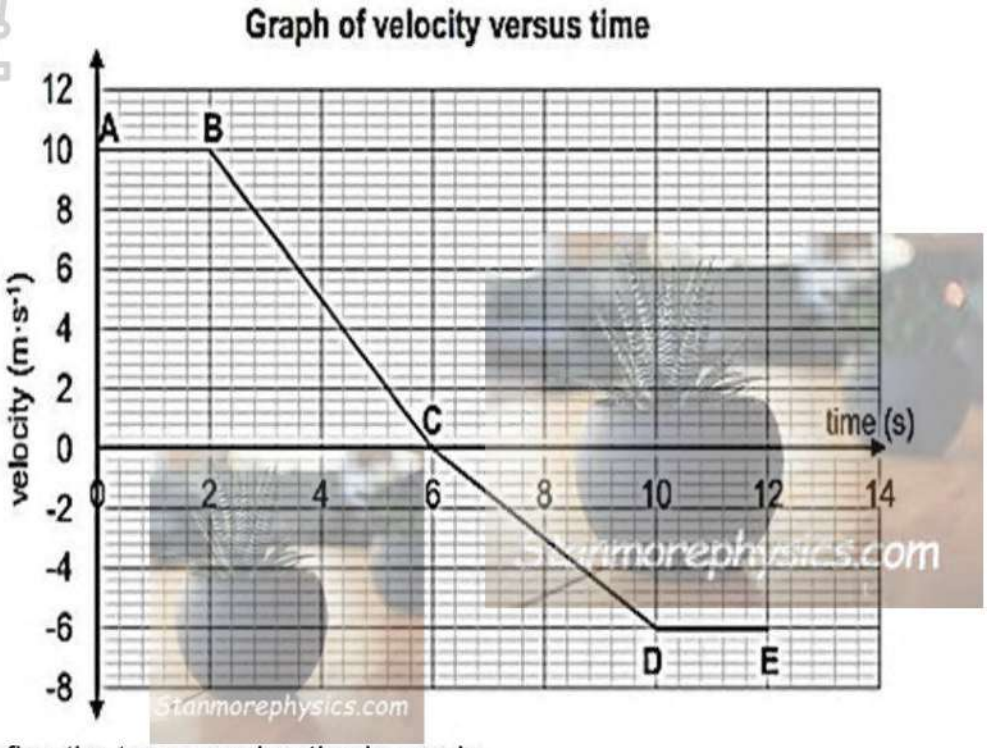
2.3 Define the term *average velocity* in words. (2)

2.4 Determine the average velocity of the athlete. (2)

[8]

QUESTION 3 (Start on a new page)

The velocity versus time graph below represents the motion of a car over a time period of 12 seconds. The car initially moves NORTH.



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

3.2 Describe the motion of the car from **C** to **E**. (3)

3.3 WITHOUT USING EQUATIONS OF MOTION, calculate:

3.3.1 Distance that the car travels from **A** to **C**. (4)

3.3.2 Acceleration of the car between **B** and **C**. (4)

3.4 How does the magnitude of acceleration of the car between **B** and **C** compare to the magnitude of its acceleration between **C** and **D**? Choose from GREATER THAN, SMALLER THAN or EQUAL TO. (1)

3.5 Refer to the graph and give a reason for the answer to QUESTION 3.4. (1)

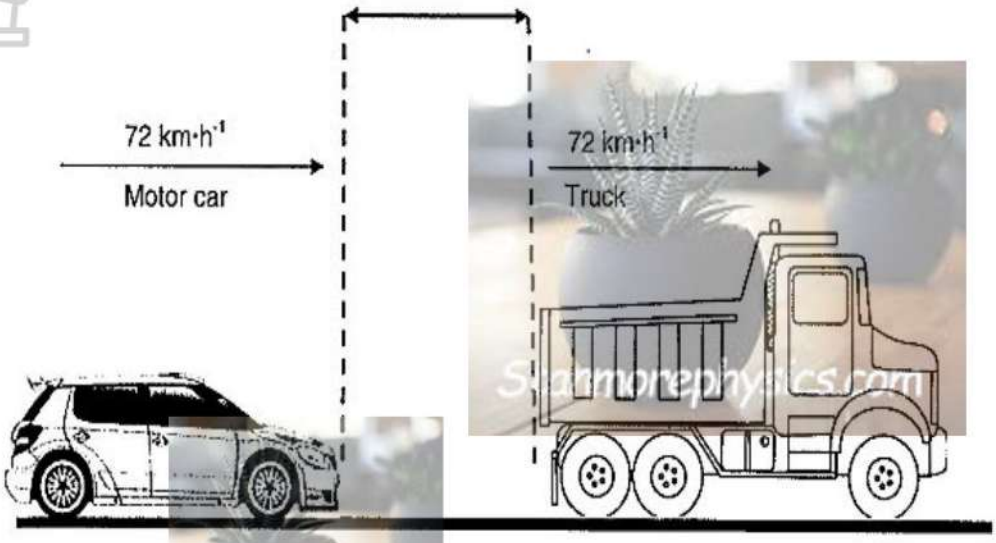
3.6 Write down the direction of the resultant displacement of the car. (1)

3.7 Use an equation of motion to calculate the instantaneous velocity of the car at t = 5 s. (4)

[20]

QUESTION 4 (Start on a NEW page)

A motor car is 100 m behind the truck. Both the vehicles are travelling in the same direction at 72 km.h^{-1}. The truck drives over the landmine, which explodes, causing it to stop at that point.



The driver of the motor car takes 0,4 s before he applies the car's brakes. Once the brakes are applied the car slows down uniformly at 2,5 m.s^{-2}.

4.1 Explain the term **'slows down uniformly at 2,5 m.s^{-2}'**. (2)

4.2 Show that 72 km.h^{-1} = 20 m.s^{-1}. (2)

4.3 Determine the distance travelled by the motor car during the 0,4 s reaction time. (3)

4.4 Calculate the total time taken for the motor car to come to rest, from the instant that the driver saw the landmine exploding. (4)

4.5 Will the motor car stop before reaching the wreck of the truck? Show all working in your answer. (5)

[16]

QUESTION 5 (Start on NEW page)

5.1 You are given 25 g of sodium sulphate (Na_2SO_4).

5.1.1 Calculate the number of moles of sodium sulphate crystals. (3)

5.1.2 Calculate the number of sodium atoms present in 25 g of sodium sulphate crystals. (4)

5.2 A substance contains 40% Carbon, 6,67% Hydrogen, and 53,53% Oxygen by mass.

5.2.1 Define the term *empirical formula*. (2)

5.2.2 Determine the empirical formula of the substance. (5)

5.2.3 If the molecular mass of the substance is 60 $g.mol^{-1}$, determine its molecular formula. (2)

[16]

QUESTION 6 (Start on a NEW page)

6.1 Solid Potassium chlorate ($KClO_3$) is heated to produce potassium chloride and oxygen gas according to the chemical equation given below.

$$KC\ell O_3 \rightarrow KC\ell + O_2$$

6.1.1 Balance the given chemical equation. (2)

6.1.2 Calculate the mass of the potassium chlorate that must be used to produce 160 g of potassium chloride. (4)

6.1.3 Calculate the volume of oxygen gas produced at STP if 200 g of potassium chloride is produced. (4)

6.2 Potassium oxide crystals, K_2O are dissolved in 250 cm^3 of water to produce Potassium hydroxide solution of concentration 0,25 $mol.dm^{-3}$. The potassium hydroxide (KOH) solution is reacted completely with sulphuric acid according to the balanced chemical equation.

$$2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$$

6.2.1 Define the term *concentration* in words. (2)

6.2.2 Calculate the maximum mass of K_2SO_4 that can be produced. (4)

6.2.3 When this experiment was done in the school laboratory, 0,87 g of K_2SO_4 was produced. Calculate the percentage yield of K_2SO_4. (4)

6.3 The molar mass of hydrated copper sulphate is found to be 249,5 $g.mol^{-1}$. The formula of hydrated copper sulphate is $CuSO_4.XH_2O$.

Calculate the number of moles of water of crystallisation (X) in the compound. (4)

[24]

TOTAL = 100

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	$6,63 \times 10^{-34}\ J{\cdot}s$
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 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	$1,6 \times 10^{-19}\ C$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

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

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

KEY/*SLEUTEL*

Atomic number / *Atoomgetal*	29
Electronegativity / *Elektronegatiwiteit*	1,9
Symbol / *Simbool*	Cu
Approximate relative atomic mass / *Benaderde relatiewe atoommassa*	63,5

Each cell: atomic number, electronegativity and symbol, approximate relative atomic mass.

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

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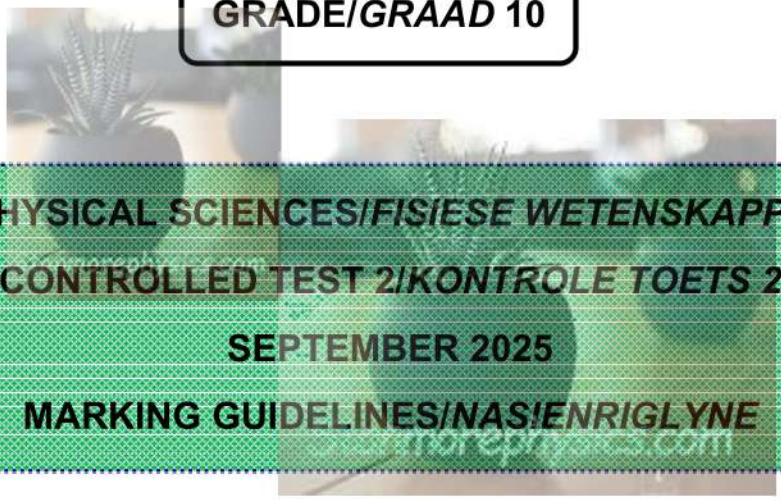
GRADE/*GRAAD* 10



PHYSICAL SCIENCES/*FISIESE WETENSKAPPE*

CONTROLLED TEST 2/*KONTROLE TOETS 2*

SEPTEMBER 2025

MARKING GUIDELINES/*NASIENRIGLYNE*

MARKS/*PUNTE*: 100

These marking guidelines consists of 8 pages./Hierdie nasienriglyne bestaan uit 8 bladsye

QUESTION 1/*VRAAG 1*

1.1 B ✓✓ (2)

1.2 B ✓✓ (2)

1.3 A ✓✓ (2)

1.4 A ✓✓ (2)

1.5 C ✓✓ (2)

1.6 C ✓✓ (2)

1.7 B ✓✓ (2)

1.8 C ✓✓ (2)

[16]

QUESTION 2/*VRAAG 2*

2.1 90 m ✓ (1)

2.2 $v = \frac{\Delta x}{\Delta t}$ ✓

$2,5 = \frac{90}{\Delta t}$ ✓

$\Delta t = 36$ s ✓ (3)

2.3 Rate of change of position. ✓✓/ *Tempo van verandering van posisie* (2)

2.4 0 $m.s^{-1}$ ✓✓ (2)

[8]

QUESTION 3/*VRAAG 3*

3.1 Rate of change of velocity ✓✓/ *Tempo van verandering van snelheid* (2)

3.2 **C – D**

- The car moves in opposite direction. ✓/ *Die motor beweeg in die teenoorgestelde rigting*
- Increasing velocity/constant acceleration ✓/ *Toenemende snelheid/konstante versnelling*

D – E

- The car moves with a constant velocity south/in opposite direction. ✓/ *Die motor beweeg teen 'n konstante snelheid suid/in teenoorgestelde rigting*. (3)

3.3 3.3.1 Area A – B = l x b

= 10 x 2 ✓

= 20 m

Area B – C = $\frac{1}{2}$ b.h

= $\frac{1}{2}$ (4)(10) ✓

= 20 m

Total distance/*totale afstand* = 20 + 20 ✓

= 40 m ✓ (4)

3.3.2 $a = \frac{\Delta v}{\Delta t}$ ✓

$= \frac{0 - 10}{6 - 2}$ ✓

= -2,5 m.s^{-2}

= 2,5 m.s^{-2} South ✓/*suid* (4)

3.4 GREATER THAN ✓/*GROTER AS* (1)

3.5 Slope of graph **BC** is steeper than **CD** ✓/ *Die helling van grafiek **BC** is steiler as **CD**.* (1)

3.6 North ✓/*noord* (1)

3.7 **OPTION 1/*OPSIE 1***

$v_f = v_i + a\Delta t$ ✓

= 10✓ + (-2,5)(5 – 2) ✓

= 2,5 m.s^{-1} North ✓/*noord*

OPTION 2/*OPSIE 2*

$v_f = v_i + a\Delta t$ ✓

$= 5$ ✓$+ (-2,5)(1)$ ✓

$= 2,5$ m.s^{-1} North ✓/*noord* (4)

[20]

QUESTION 4/*VRAAG 4*

4.1 Velocity decreases by 2,5 m.s^{-1} every second. ✓✓/ *Snelheid neem elke sekonde met 2,5 m.s^{-1} af.* (2)

4.2 $\frac{72\ 000 \text{ m}}{3\ 600 \text{ s}}$ ✓

$= 20$ m.s^{-1} ✓

OR/*OF*

$\frac{72}{3,6}$ ✓

$= 20$ m.s^{-1} ✓ (2)

4.3 **OPTION 1/*OPSIE 1***

$\Delta x = v \times \Delta t$ ✓

$= 20 \times 0,4$ ✓

$= 8$ m ✓

OPTION 2/*OPSIE 2*

$\Delta x = v_i\Delta t + \frac{1}{2} a\Delta t^2$ ✓

$= (20)(0,4) + \frac{1}{2}(0)(0,4)^2$ ✓

$= 8$ m ✓

OPTION 3/*OPSIE 3*

$\Delta x = \frac{(v_f + v_i)}{2} \times \Delta t$ ✓

$= \frac{(20 + 20)}{2} \times 0,4$ ✓

$= 8$ m ✓ (3)

4.4 $v_f = v_i + a\Delta t$ ✓

0 ✓ $= 20 + (-2,5)\Delta t$ ✓

$\Delta t = 8$ s

$\Delta t_{total} = 0,4 + 8$

$= 8,4$ s ✓ (4)

4.5 **OPTION 1/*OPSIE 1***

$v_f^2 = v_i^2 + 2a\Delta x$ ✓

$(0)^2 = (20)^2 + 2(-2,5)\Delta x$ ✓

$\Delta x = 80$ m ✓

The motor car will stop. ✓/ *Die motor sal stop.*

Since it comes to a halt within (80 + 8) m ✓ (which is less than 100 m)/ *Aangesien dit tot stilstand kom binne (80 + 8) m (wat minder as 100 m is)*

POSITIVE MARKING FROM 4.3/ *POSITIEWE PUNTE VANAF 4.3*

OPTION 2/*OPSIE 2*

$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓

$= (20)(8) + \frac{1}{2}(-2,5)(8)^2$ ✓

$= 80$ m ✓

The motor car will stop. ✓/ *Die motor sal stop*.

Since it covers (80 + 8) m✓ which is less than 100 m./ *Aangesien dit (80 + 8) m dek, wat minder as 100 m is.*

(5)

[16]

QUESTION 5/*VRAAG 5*

5.1 5.1.1 $n = m/M$ ✓

$= 25/142$ ✓

$= 0,18$ moles ✓/*mol* (3)

5.1.2 $n = N/N_A$ ✓

$0,18 = N/6,02 \times 10^{23}$ ✓

$= 1,08 \times 10^{23} \times 2$ ✓

$= 2,16 \times 10^{23}$ atoms ✓ (4)

5.2 5.2.1 The simplest whole number ratio of atoms in a compound. ✓✓/ *Die eenvoudigste heelgetalverhouding van atome in 'n verbinding.* (2)

5.2.2

Element	Mass/*massa*	n = m/M	Simplest ratio/*eenvoudigste verhouding*
C	40	40/12 = 3,33 ✓	1
H	6,67	6,67/1 = 6,67 ✓	2 ✓
O	53,3	53,33/16 = 3,33 ✓	1

(5)

Empirical formula/*empiriese formule*: **CH_2O** ✓

5.2.3 $M(CH_2)$ 30 $g.mol^{-1}$

$n = 60/30$ ✓

$= 2$

molecular formula/*molekulêre formule* **$C_2H_4O_2$** ✓ (2)

[16]

QUESTION 6/*VRAAG 6*

6.1 6.1.1 $2KClO_3$ ✓ → $2KCl + 3O_2$ ✓ (2)

6.1.2 n(KCl) = m/M
= 160/74.5 ✓
= 2,1476 moles/*Mol*

$KClO_3$: KCl
2,1476 : 2,1476 ✓

m = n x M
= 2,1476 x 122,5 ✓
= 263,08 g ✓ (4)

6.1.3 m = n x M
= 200/74,5 ✓
= 2,6845 moles/*mol*

O_2 : KCl
3 : 2
x : 2,6845
4,0267 ✓

V = n x V_m
= 4,0267 x 22,4 ✓
= 90,20 dm^3 ✓ (4)

6.2 6.2.1 Concentration is the amount of a substance present per volume of solution. ✓✓/ *Konsentrasie is die hoeveelheid van 'n stof wat per volume oplossing teenwoordig is.* (2)

6.2.2 n = c x V
= 0,25 x 0,25 ✓
= 0,0625 moles/*mol*

KOH : K_2SO_4
2 : 1
0,0625 : 0.03125 ✓

m = nM
= 0.03125 x 174 ✓
= 5,44 g ✓ (4)

6.2.3 % yield = actual yield/theoretical yield x 100 ✓ /
% opbrengs = werklike opbrengs/teoretiese opbrengs x 100
= 0,87/5,44 ✓ x 100 ✓
= 15,99 % ✓ (4)

6.3 $M(CuSO_4.H_2O) = 249,5\ g.mol^{-1}$
$M(CuSO_4) = 159,5\ g.mol^{-1}$ ✓
$M(H_2O) = 249,5 – 159,5$ ✓
= 90 g
n = m/M (4)
= 90/18 ✓
= 5
x = 5 or/*of* $CuSO_4.5H_2O$ ✓

[24]

TOTAL/*TOTAAL* = 100