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PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES: CONTROL TEST 2

13 SEPTEMBER 2024

MARKS: 100

TIME: 2 HOURS

This question paper consists of 9 pages and 2 data sheets

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INSTRUCTIONS AND INFORMATION

1. This question paper consists of **SIX (6)** questions. Answer ALL questions in the ANSWER SHEET.
2. Start EACH question on a NEW page.
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 pocket calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use 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 where applicable.
10. Give brief motivations, discussions, et cetera where required.
11. Write neatly and legibly.

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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 (1.1–1.9) in the ANSWER SHEET, for example 1.10 D.

1.1 Which ONE of the following pairs of physical quantities consists of scalar only?

A Weight, mass, temperature and velocity

B Time, mass, distance and speed

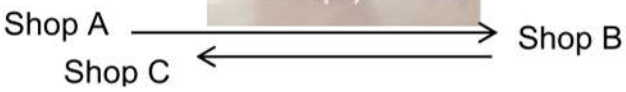
C Displacement, force, acceleration and velocity

D Velocity, speed, weight and time (2)

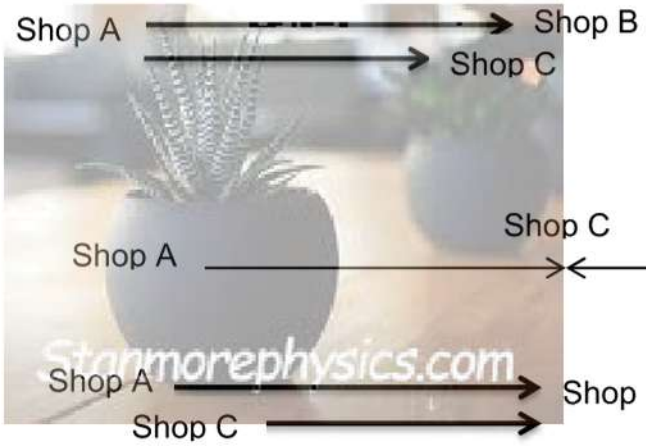
1.2 In a shopping mall, shop A and shop B are 200m apart, between the two shops there is shop C situated 60 m away from shop A. A shopper enters into shop A then to shop B, while in shop B, the shopper realized that he has passed shop C. The shopper then went to shop C to buy the items he was looking for.

Which ONE of the vector diagrams represents the correct movement of the shopper?

A



B



C

D

(2)

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1.3 A car is moving at a speed of 60 km.h^{-1}, in cm.s^{-1} the car is moving at …

A 216 cm.s^{-1}

B 63,6 cm.s^{-1}

C 16,67 cm.s^{-1}

D 1666,67 cm.s^{-1} (2)

1.4 The slope of a tangent to a position versus time graph represents the …

A Average acceleration.

B Instantaneous velocity.

C Average velocity.

D Instantaneous acceleration. (2)

1.5 Which physical quantity represents the area under the acceleration vs time graph?

A Velocity

B Displacement

C Acceleration

D Time (2)

1.6 The unbalanced equation for a chemical reaction is shown below.

$$H_{2(g)} + N_{2(g)} \rightarrow NH_{3(g)}$$

Which ONE of the following represents the coefficients of reactants and product in the BALANCED equation?

	H_2	N_2	NH_3
A	1	1	2
B	2	1	2
C	3	1	2
D	3	2	2

(2)

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1.7 One mole of H_2SO_4 contains …

A 1 molecule.

B 7 atoms.

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

D $42,14 \times 10^{23}$ molecules. (2)

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1.8 Which ONE of the following represents 1 mole of a substance?

A 16 g oxygen gas

B 2 g hydrogen gas

C 22,4 dm^3 copper

D 22,4 cm^3 nitrogen gas (2)

1.9 The empirical formula of a certain carbon compound is CH_2O.
Which ONE of the following can be the molecular formula of this compound?

A $C_3H_4O_2$

B $C_2H_4O_3$

C $C_2H_4O_2$

D $C_2H_6O_2$ (2)

[18]

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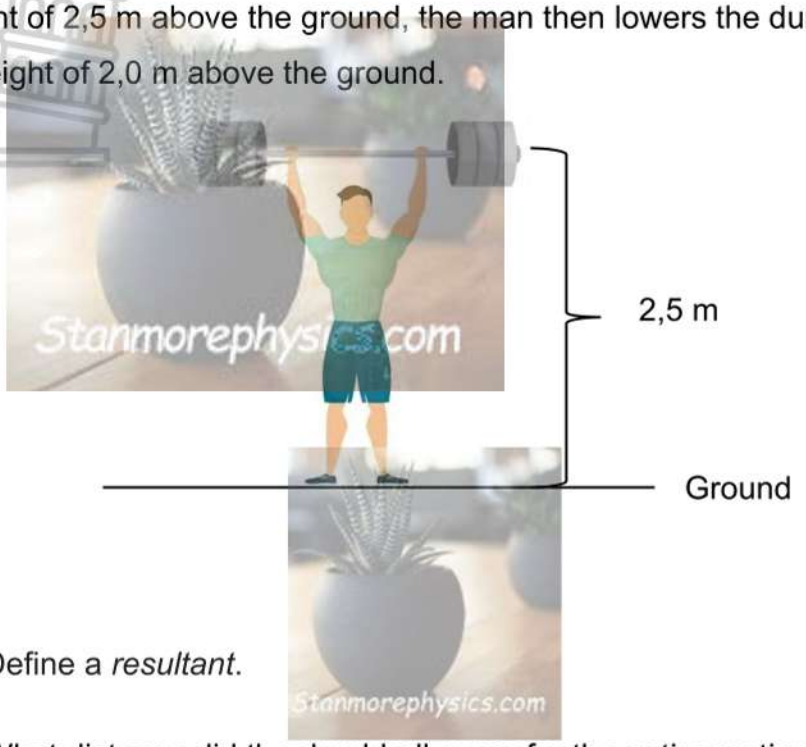
QUESTION 2 (Start on a new page)

The man indicated on the picture below lifts the dumbbell upwards from the ground to the height of 2,5 m above the ground, the man then lowers the dumbbell downwards to the height of 2,0 m above the ground.



2.1 Define a *resultant*. (2)

2.2 What distance did the dumbbell cover for the entire motion? (1)

2.3 What is the displacement of the dumbbell for the entire motion? (2)

2.4 By means of a vector diagram (using scale of 1 m : 20 mm), determine the displacement of the dumbbell for the entire motion. (4)

2.5 If it takes the dumbbell 8 seconds to cover the entire distance, calculate the dumbbell's average speed. (3)

[12]

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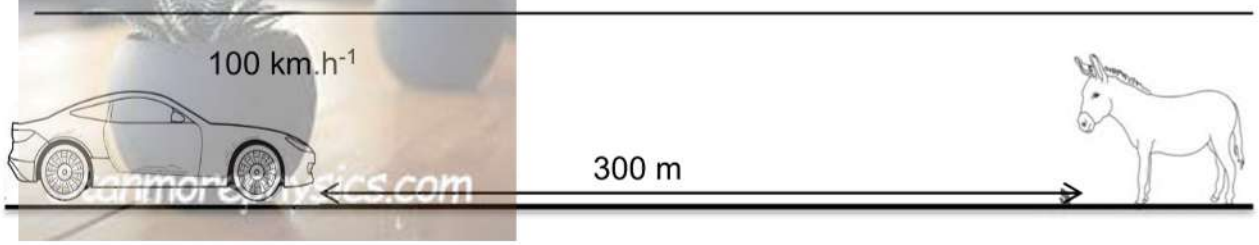
QUESTION 3 (Start on a new page)

A driver of a motor car driving at a constant velocity of 100 km.h^{-1} sees a stationary donkey ahead of him on the road when he is 300 m away. The driver takes exactly three seconds (3 s) to react before he applies the brakes as hard as he can. It takes a further 10 seconds for the motor car to come to a stop.



3.1 Define the term *distance*. (2)

3.2 Convert 100 km.h^{-1} to m.s^{-1} (3)

3.3 Calculate the distance covered by the motor car for the first 3 seconds. (3)

3.4 Will the motor car hit the donkey or not? Substantiate your answer with relevant calculations (hint: make only use of the following formula

$\Delta x = (\frac{v_i+v_f}{2})\Delta t)$ (6)

3.5 Will the stopping distance of the motor car INCREASE or DECREASE when the road is wet and slippery?

By referring to velocity and time, briefly explain how you arrived at the answer. (3)

[17]

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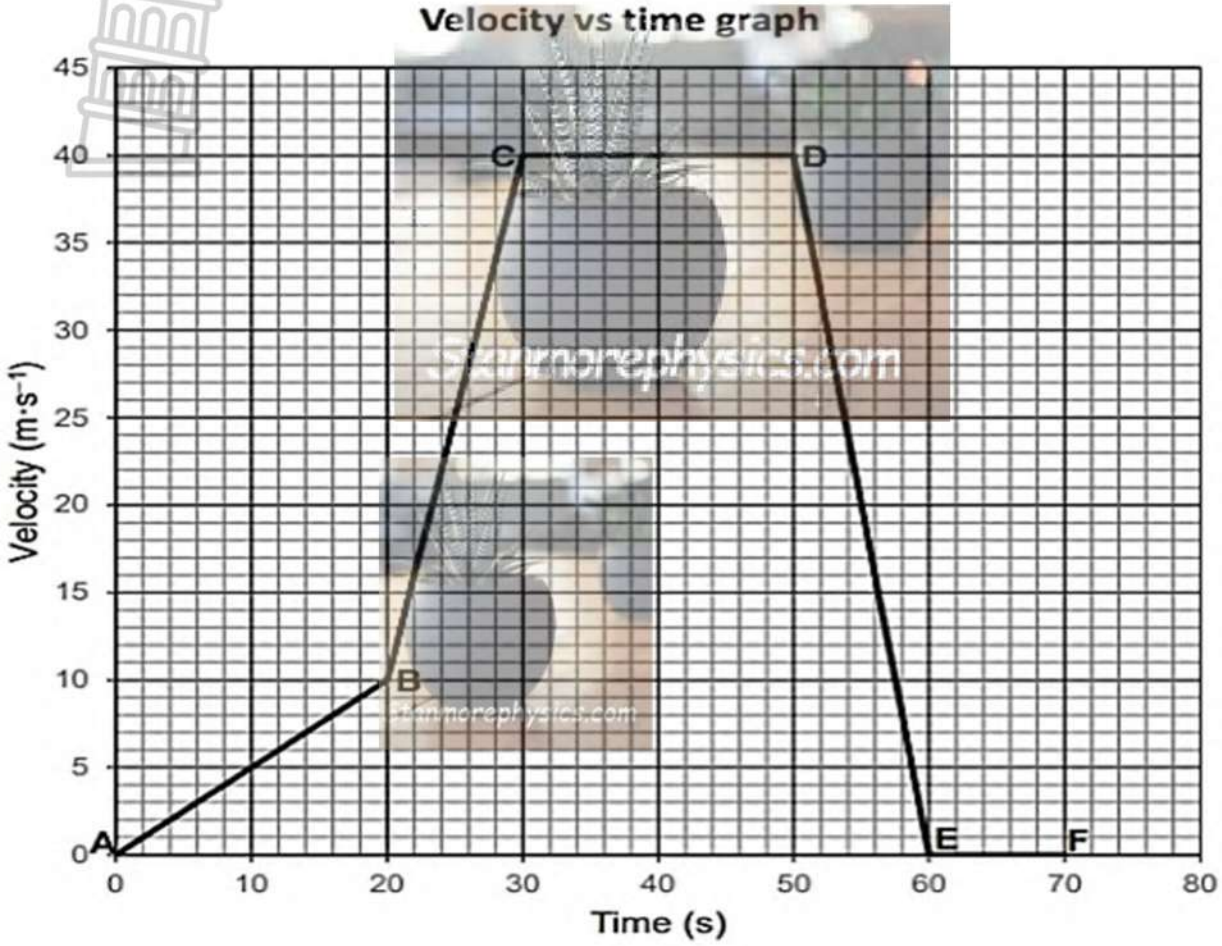
QUESTION 4 (Start on a new page)

Study the velocity versus time graph below for the motion of a car travelling **east**.



4.1 Define the term *acceleration*. (2)

4.2 Use the graph to describe the motion of the car in the following sections (refer to both the velocity and acceleration of the car in your answer):

4.2.1 AB (2)

4.2.2 BC (2)

4.2.3 DE (2)

4.3 Calculate the acceleration of the car between A and B. (4)

4.4 Without using equation of motion. Calculate the distance covered by the car from A to F. (6)

[18]

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QUESTION 5 (Start on a new page)

8 g of Calcium completely reacted with 500 cm^3 of Nitric acid solution of unknown concentration according to the following balanced equation:

$$Ca_{(s)} + 2HNO_{3(aq)} \rightarrow Ca(NO_3)_{2(aq)} + H_{2(g)}$$

5.1 Identify the diatomic element in the above equation. (1)

5.2 Define the term *concentration*. (2)

5.3 Calculate the:

5.3.1 Number of moles of Ca that reacted. (3)

5.3.2 Concentration of HNO_3 solution. (4)

5.3.3 Volume of H_2 gas formed at STP. (4)

5.3.4 Mass of H_2 in grams. (3)

5.3.5 Percentage yield if 0,35 g of H_2 is produced at the end of the reaction. (3)

[20]

QUESTION 6 (Start on a new page)

6.1 A sample of compound **V** contains 54,56% C, 9,09% H and 36,35% O

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

6.1.2 Use calculation to determine the empirical formula of compound **V.** (6)

6.2 When 150 g hydrated aluminium chloride ($A\ell C\ell_3.nH_2O$) is dry, its mass decreases by 89,595 g.

6.2.1 Define *water of crystallisation*. (2)

6.2.2 Determine the value of n in $A\ell C\ell_3.nH_2O$. (5)

[15]

TOTAL: 100

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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* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$

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

KEY/*SLEUTEL*

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

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

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 H 1 (2,1)																	2 He 4
3 Li 7 (1,0)	4 Be 9 (1,5)											5 B 11 (2,0)	6 C 12 (2,5)	7 N 14 (3,0)	8 O 16 (3,5)	9 F 19 (4,0)	10 Ne 20
11 Na 23 (0,9)	12 Mg 24 (1,2)											13 Aℓ 27 (1,5)	14 Si 28 (1,8)	15 P 31 (2,1)	16 S 32 (2,5)	17 Cℓ 35,5 (3,0)	18 Ar 40
19 K 39 (0,8)	20 Ca 40 (1,0)	21 Sc 45 (1,3)	22 Ti 48 (1,5)	23 V 51 (1,6)	24 Cr 52 (1,6)	25 Mn 55 (1,5)	26 Fe 56 (1,8)	27 Co 59 (1,8)	28 Ni 59 (1,8)	29 Cu 63,5 (1,9)	30 Zn 65 (1,6)	31 Ga 70 (1,6)	32 Ge 73 (1,8)	33 As 75 (2,0)	34 Se 79 (2,4)	35 Br 80 (2,8)	36 Kr 84
37 Rb 86 (0,8)	38 Sr 88 (1,0)	39 Y 89 (1,2)	40 Zr 91 (1,4)	41 Nb 92	42 Mo 96 (1,8)	43 Tc (1,9)	44 Ru 101 (2,2)	45 Rh 103 (2,2)	46 Pd 106 (2,2)	47 Ag 108 (1,9)	48 Cd 112 (1,7)	49 In 115 (1,7)	50 Sn 119 (1,8)	51 Sb 122 (1,9)	52 Te 128 (2,1)	53 I 127 (2,5)	54 Xe 131
55 Cs 133 (0,7)	56 Ba 137 (0,9)	57 La 139	72 Hf 179 (1,6)	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 Tℓ 204 (1,8)	82 Pb 207 (1,8)	83 Bi 209 (1,9)	84 Po (2,0)	85 At (2,5)	86 Rn
87 Fr (0,7)	88 Ra 226 (0,9)	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 10

PHYSICAL SCIENCES: CONTROL TEST 2
FISIESE WETENSKAPPE: KONTROLE TOETS 2

MARKING GUIDELINE/*NASIENRIGLYNE*

13 SEPTEMBER 2024

MARKS/*PUNTE*: 100

This Marking Guideline consists of 8 pages/

Hierdie nasienriglyne bestaan uit 8 bladsye .

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QUESTION 1/*VRAAG 1*

1.1	B ✓✓	(2)
1.2	A ✓✓	(2)
1.3	D ✓✓	(2)
1.4	B ✓✓	(2)
1.5	A ✓✓	(2)
1.6	C ✓✓	(2)
1.7	C ✓✓	(2)
1.8	B ✓✓	(2)
1.9	C ✓✓	(2)
		[18]

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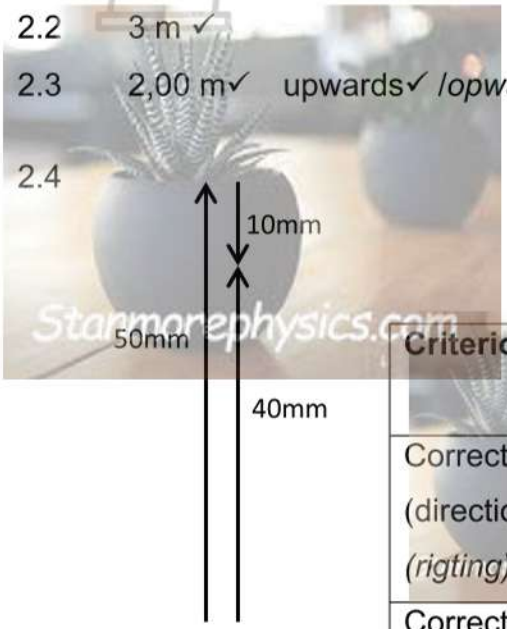
QUESTION 2/*VRAAG 2*

2.1 Resultant is the single vector having the same effect as two or more vectors together.✓✓ / *Resultant is die enkele vektor wat dieselfde effek het as twee of meer vektore saam* (2)

2.2 3 m ✓ (1)

2.3 2,00 m✓ upwards✓ /*opwaarts* (2)

2.4



Criterion/*kriteria*	Mark allocation/ ***puntetoekenning***
Correct arrows (direction)/ *Korrekte pyle (rigting)*	All ✓ /*almal*
Correct values/ *korrekte waardes*	All ✓ /*almal*
Correct measurements / *korrekte afmetings*	At least 2✓ /*ten minste 2*

Displacement/*verplasing* is 40 mm ÷ 2 = 2 m✓ (4)

2.5

$$\textbf{Speed}/\boldsymbol{spoed} = \frac{\Delta x}{\Delta t} \checkmark$$

$$= \frac{3}{8} \checkmark$$

$$= 0{,}375\ m.s^{-1} \checkmark$$

(3)

[12]

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QUESTION 3/*VRAAG 3*

3.1 Distance is the total path length travelled. ✓✓ / *Afstand is die totale padlengte afgelê* (2)

3.2 $\frac{100\ km}{1h} \times \frac{1000\ ✓}{60 \times 60 ✓}$

$= 27{,}78\ m.s^{-1}$ ✓ (3)

3.3

Positive marking from 3.2/*positiewe merk vanaf 3.2* **Option 1/*Opsie 1***	**Positive marking from 3.2/*positiewe merk vanaf 3.2*** **Option 2/*Opsie 2***
$\Delta x = (\frac{v_i + v_f}{2})\Delta t$ ✓ $= \left(\frac{27{,}78 + 27{,}78}{2}\right)(3)$ ✓ $= 83{,}34\ m$ ✓	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ $= (27{,}78)(3) + 0$ ✓ $= 83{,}34\ m$ ✓

(3)

3.4 **Positive marking from 3.2 qne 3.3 /*positiewe merk vanaf 3.2 en 3.3***

The motor car will not hit ✓the donkey/

Die motor sal nie die donkie tref nie

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

$= \left(\frac{27{,}78 + 0}{2}\ ✓\right)(10)$ ✓

$= 138{,}90\ m$ ✓

Distance to be travelled in the next 10 seconds/ *afstand beweeg in die volgende 10 sekondes* = 300 – 83,34 = 216,66✓

Distance travelled is less ✓than distance to reach the donkey / *Afstand afgelê is minder as afstand om die donkie te bereik*

(6)

3.5 Increases ✓/*Toeneem*

For the same change in velocity, ✓the stopping time will increase. ✓/ *Vir dieselfde verandering in snelheid sal die stilhou tyd toeneem.* (3)

[17]

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QUESTION 4/*VRAAG 4*

4.1 Acceleration is the rate of change of velocity. ✓✓/ *Versnelling is die tempo van verandering van snelheid.* (2)

4.2.1
- The car starts from rest and velocity increases to 10m.s^{-1} in 20 seconds. ✓
- Car moves east at a constant velocity/uniform acceleration ✓ /
- *Die motor begin vanuit rus en snelheid neem toe tot 10m.s^{-1} in 20 sekondes.*
- *Motor beweeg teen konstante snelheid/uniforme versnelling oos.*

(2)

4.2.2
- The car continues to increase velocity from 10m.s^{-1} to 40m.s^{-1} in 10 seconds✓
- The car moves east at a constant/uniform acceleration but greater than that in section AB. ✓ /
- *Die motor verhoog snelheid van 10m.s^{-1} na 40m.s^{-1} in 10 sekondes*
- *Die motor beweeg teen konstante/uniforme versnelling oos, maar groter as dié in afdeling AB.*

(2)

4.2.3
- Velocity of the car decreases from 40m.s^{-1} to 0m.s^{-1} in 10 seconds. ✓
- The car decelerates constantly/uniformly east, until it stops. ✓/
- *Snelheid van die motor neem af van 40m.s^{-1} tot 0m.s^{-1} in 10 sekondes.*
- *Die motor vertraag konstant/uniform oos totdat dit stop in 10 sekondes.*

(2)

4.3

Option 1/*Opsie 1*	**Option 2/*Opsie 2***
$v_f = v_i + a\Delta t$✓ 10✓ $= 0 + a(20)$✓ $a = 0{,}50\ m.s^{-2}$ East✓/*oos*	$a = \frac{\Delta v}{\Delta t}$✓ $= \frac{10 - 0}{20 - 0}$✓ $a = 0{,}50\ m.s^{-2}$ East✓/*oos*

(4)

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4.4 **Option 1/*Opsie 1***

$\text{Distance} = \text{area of bottom trapezium} + \text{area of top trapezium}$ /

Afstand = opv van onderste trapesium + opv van boonste trapesium

$\text{Distance}/afstand = \frac{1}{2}(60 + 38\ ✓)(10)\ ✓ + \frac{1}{2}(38 + 20\ ✓)(30)\ ✓ + 0✓$

$= 1360\ m\ ✓$

Option 2/*Opsie 2*

$\text{Distance} = \text{area of bottom triangle} + \text{area of bottom rectangle}$

$+ \text{area of bottom triangle} + \text{area of top trapezium}$

Afstand = opv van onderkant van driehoek + opv van onderkant van reghoek + opv van onderste driehoek + opv van boonste trapesium

$= \frac{1}{2} \times 20 \times 10\ ✓ + 38 \times 10\ ✓ + \frac{1}{2} \times 2 \times 10\ ✓ + \frac{1}{2}(38 + 20\ ✓) \times 30\ ✓$

$= 1360\ m\ ✓$ (6)

[18]

QUESTION 5/*VRAAG 5*

5.1 H_2 ✓ (1)

5.2 Concentration as the number of moles of solute per cubic decimetre of solution. ✓✓ / *Konsentrasie as die aantal mol opgeloste stof per kubieke desimeter oplossing*

OR/*OF*

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

5.3.1 $n = \frac{m}{M}$ ✓

$= \frac{8}{40}$ ✓

$= 0{,}20\ mol$ ✓ (3)

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5.3.2 $n_{ca}:n_{HNO_3}$

$1:2$

$n_{HNO_3} = \frac{0,2}{1} \times 2$ ✓

$= 0,4\ mol$

$c = \frac{n}{V}$ ✓

$= \frac{0,4}{0,5}$ ✓

$= 0,80\ \text{mol.dm}^{-3}$ ✓ (4)

5.3.3 $n_{ca}:n_{H_2}$

$1:1$

$n_{H_2} = \frac{0,2}{1} \times 1$ ✓

$= 0,2\ \text{mol}$

$n = \frac{V}{V_m}$ ✓

$0,2 = \frac{V}{22,4}$ ✓

$V = 4,48\ dm^3$ ✓ (4)

5.3.4 $\text{m} = \text{Mn}$ ✓

$= 2 \times 0,2$ ✓

$= 0,40\ \text{g}$ ✓ (3)

5.3.5 $\text{Percentage yield} = \frac{\text{Actual mass}}{\text{Theoretical mass}} \times 100\%$ ✓ / $\%\ opbrengs = \frac{Ware\ massa}{teoretiese\ massa} \times 100\%$

$= \frac{0,35}{0,4} \times 100\%$ ✓

$= 87,50\ \%$ ✓ (3)

[20]

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QUESTION 6/*VRAAG 6*

6.1.1 Empirical formula is the simplest whole-number ratio of atoms in a compound. ✓✓ / *Empiriese formule is die eenvoudigste heelgetalverhouding van atome in 'n verbinding.* (2)

6.1.2

Formula/*Formule*	C	H	O
$n = \frac{m}{M}$ ✓	$\frac{54,56}{12}$ $= 4,55$ ✓	$\frac{9,09}{1}$ $= 9,09$ ✓	$\frac{36,35}{16}$ $= 2,27$ ✓
Divide by the smallest number✓ / *deel deur kleinste getal*	$\frac{4,55}{2,27}$ $= 2$	$\frac{4,55}{2,27}$ $= 4$	$\frac{2,77}{2,27}$ $= 1$
Empirical formula/ *empiriese formule*	C_2H_4O ✓		

(6)

6.2.1 Water of crystallisation is water that is stoichiometrically bound into a crystal. ✓✓/ *Kristallisasiewater is water wat stoïgiometries in 'n kristal gebind is.* (2)

6.2.2 $m_{AlCl_3} = 150 - 89,595$✓

$= 60,405$

Formula/*formule*	nH_2O	AℓCℓ3
$n = \frac{m}{M}$	$\frac{89,595}{18}$ ✓ $= 4,9775$	$\frac{60,405}{133,5}$ ✓ $= 0,45247$
Divide by the smallest number✓/*deel deur kleinste getal*	$\frac{4,9775}{0,45247}$ $= 11$	$\frac{0,45247}{0,45247}$ $= 1$
Value of n/*waarde van n*	$n = 11$✓	

(5)

[15]

TOTAL/*TOTAAL*: 100

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