KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

MARKS: 100

DURATION: 2 hours

This question paper consists of 9 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of SEVEN 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

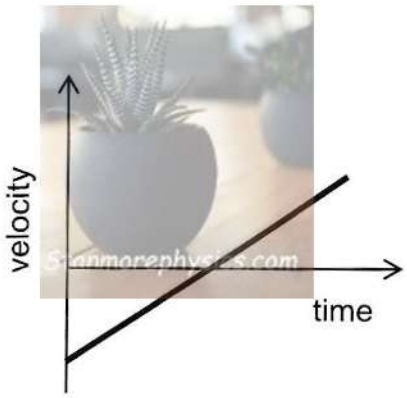
Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question number (1.1–1.8) in the ANSWER BOOK, for example 1.11 E.

1.1 Which ONE of the following pairs of physical quantities are BOTH vectors?

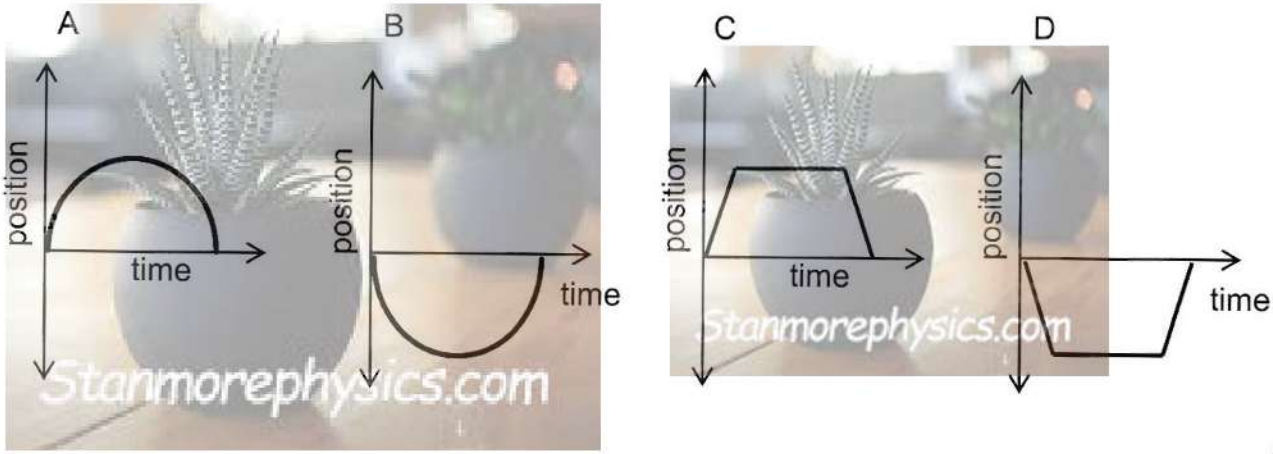
A Displacement and speed
B Distance and velocity
C Acceleration and force
D Mass and time

(2)

1.2 The velocity – time graph for a car travelling on a straight horizontal surface is shown below:



Which ONE of the following graphs is the correct position – time graph for the motion of the car?



(2)

1.3 Which ONE of the following statements is TRUE?
An object experiences negative acceleration when it is moving in the…

A negative direction at a constant speed.
B negative direction, experiencing a constant decrease in speed.
C positive direction, experiencing a constant decrease in speed.
D positive direction, experiencing a constant increase in speed.

(2)

1.4 Which ONE of the following gases occupies the largest volume at STP?

A 40 g of Ne(g)
B 6 g of $H_2(g)$
C 44 g of $CO_2(g)$
D 17 g of $NH_3(g)$

(2)

1.5 Consider the balanced chemical equation for the reaction below:

$$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$$

What is the minimum amount of oxygen (O_2) required to form 22,4 dm^3 of sulphur trioxide (SO_3) at STP?

A 22,4 dm^3
B 16 g
C 1 mol
D 44,8 dm^3

(2)

1.6 Which ONE of the following is the correct number of hydrogen (H) ATOMS in 2 moles of ammonium phosphate ($(NH_4)_3PO_4$)?

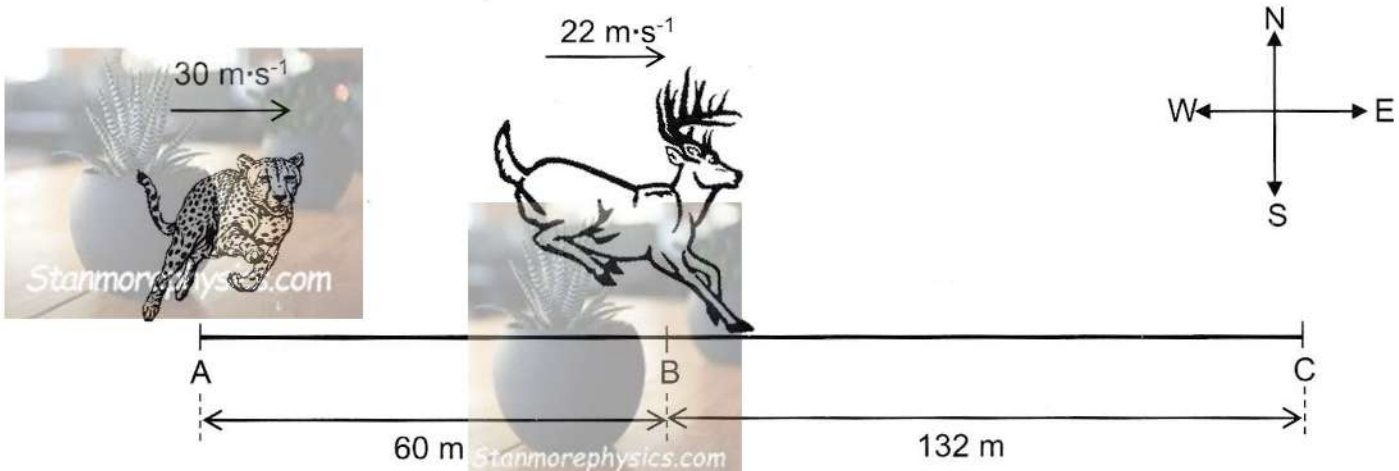
A $6,02 \times 10^{23}$
B $2 \times 6,02 \times 10^{23}$
C $12 \times 6,02 \times 10^{23}$
D $24 \times 6,02 \times 10^{23}$

(2)
[12]

SECTION A: PHYSICS

QUESTION 2 (Start on a new page.)

2.1 A cheetah travelling eastwards at a constant speed of 30 m·s^{-1} is in pursuit of a buck also moving eastwards at a constant speed of 22 m·s^{-1}. At the instant the cheetah reaches point A, the buck is at point B, as illustrated in the diagram below:



The distance between point A and point B is 60 m.

2.1.1 Calculate the time taken for the cheetah to reach point B. (4)

2.1.2 Determine the position of the buck relative to the cheetah, when the cheetah reaches point B. (3)

The cheetah speeds up at point B to eventually catch the buck at point C. From points B to C, the buck maintains its constant velocity of 22 m·s^{-1}. Point C is located 132 m due east of point B.

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

2.1.4 Determine the average velocity of the cheetah from point B to point C. (6)

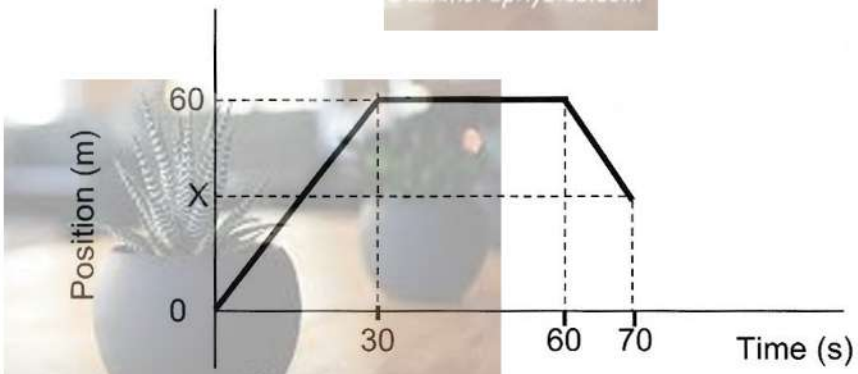
2.2 Three forces, F_1, F_2 and F_3 acts on a block on a frictionless horizontal surface as shown in the diagram below.
F_1 and F_2 have forces of 120 N right and 80 N right respectively. The magnitude of F_3, acting to the left, is unknown.

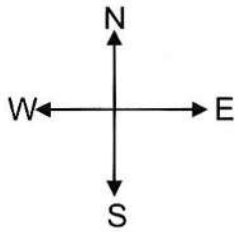
The RESULTANT FORCE acting on the box is 40 N right.

Using the tail-to-head method and a scale of 1 cm represents 20 N, draw an accurate vector diagram to determine the magnitude of the force, F_3, acting on the box. (5)
[20]

QUESTION 3 (Start on a new page.)

The **POSITION-TIME GRAPH** (not drawn to scale) for a cyclist initially moving west on a straight horizontal road is shown below:





3.1 Why does the position decrease after 60 seconds? (1)

3.2 Calculate the velocity of the cyclist for the first 30 seconds. (4)

3.3 Write down the acceleration of the cyclist for the first 30 seconds. (1)

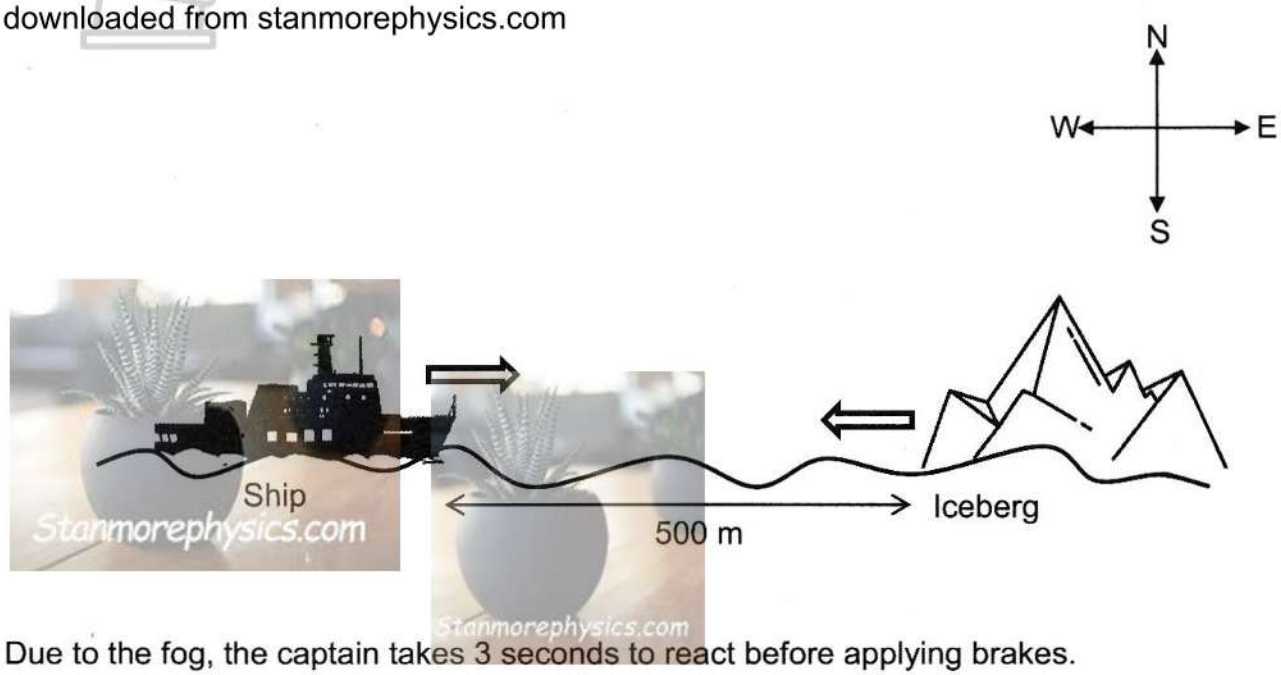
3.4 Explain the answer to QUESTION 3.3 referring to the shape of the graph. (2)

3.5 The MAGNITUDE of the velocity from 60 to 70 seconds is 2,5 $m \cdot s^{-1}$.

Using to graph only (no equations of motion), determine the total distance covered by the cyclist for the entire 70 second period. (4)
[12]

QUESTION 4 (Start on a new page.)

In the diagram below, a ship is travelling due east towards an iceberg on a foggy night, where the visibility is low.
The ship travels at a constant speed of 32 $m \cdot s^{-1}$ and is 500 m away from the iceberg.



Due to the fog, the captain takes 3 seconds to react before applying brakes.
The ship thereafter **slows down** at a uniform rate of 2,5 $m \cdot s^{-2}$.

4.1 Define the term *distance* in words. (2)

4.2 Determine the distance the ship travels during the reaction time. (2)

4.3 Calculate the time taken for the ship to stop after applying brakes. (4)

The iceberg moves toward the ship at a **constant speed of 5 $m \cdot s^{-1}$**, during the entire motion. After the brakes are applied, the ship covers a distance of **204.8 metres**.

4.4 Determine the distance between the ship and iceberg once the ship stops. (4)
[12]

SECTION B: CHEMISTRY

QUESTION 5 (Start on a new page.)

When potassium chlorate ($KClO_3$) decomposes upon heating, it produces potassium chloride (KCl) and oxygen (O_2) gas as represented in the balanced equation below:

$$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$$

In one such reaction, 30,3 g of potassium chlorate ($KClO_3$) is heated and decomposes completely at standard temperature and standard pressure (STP)

5.1 Define the term *one mole of a substance* in words. (2)

5.2 Calculate the:

5.2.1 Number of moles of $KClO_3$ decomposed. (4)

5.2.2 Number of KCl formula units formed. (4)

5.2.3 Volume of oxygen (O_2) formed (in dm^3) at standard temperature and standard pressure (STP). (4)

[14]

QUESTION 6 (Start on a new page)

6.1 A compound is made up of potassium (K), chromium (Cr) and oxygen (O) only. A **1 kg sample** of this compound has the following composition by mass:

Element	Mass(g)
Potassium (K)	265,31 g
Chromium (Cr)	353,74 g
Oxygen (O)	Remainder

6.1.1 Calculate the mass of oxygen(O) in the 1 kg sample of the compound. (2)

6.1.2 Determine the empirical formula of this compound. (6)

6.2 An unknown hydrated salt with the formula $X_2CO_3 \cdot 10H_2O$ contains 62,937% water (H_2O) by mass. downloaded from stanmorephysics.com

Determine the FORMULA of the element represented by the letter X. (5)

6.3 The combustion of ethyne(C_2H_2) is represented by the balanced equation below.

$$2C_2H_2\ (g) + 5O_2\ (g) \rightarrow 4CO_2\ (g) + 2H_2O\ (g)$$

In one such reaction, the TOTAL VOLUME of gas that forms when ethyne(C_2H_2) reacts with excess oxygen (O_2) is 90 cm^3.

Determine the volume of ethyne(C_2H_2) that reacted. (3)

[16]

QUESTION 7 (Start on a new page.)

The reaction between aluminium carbonate ($Al_2(CO_3)_3$) and hydrochloric acid (HCl) is represented by the balanced equation below.

$$Al_2(CO_3)_3\ (s) + 6HCl\ (aq) \rightarrow 2AlCl_3\ (aq) + 3CO_2\ (g) + 3H_2O\ (g)$$

0,45 dm^3 of HCl with a concentration of 0,4 $mol.dm^3$ reacts completely with excess $Al_2(CO_3)_3$ at standard temperature and standard pressure (STP).

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

7.2 Calculate the:

7.2.1 Number of moles of HCl that reacted. (3)

7.2.2 Mass of $Al_2(CO_3)_3$ that completely reacted with the 0,45 dm^3 of HCl. (4)

7.3 1,9 dm^3 of carbon dioxide (CO_2) is formed.

Determine the percentage yield of carbon dioxide (CO_2) (5)

[14]

TOTAL: 100

DATA FOR PHYSICAL SCIENCES GRADE 10

PHYSICS

TABLE 1: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	9,8 $m \cdot s^{-2}$
Speed of light in a vacuum	c	$3,0 \times 10^{8}$ $m \cdot s^{-1}$
Planck's constant	h	$6,63 \times 10^{-34}$ $J \cdot s$
Charge on electron	q_e	$-1,6 \times 10^{-19}$ C
Electron mass	m_e	$9,11 \times 10^{-31}$ kg

TABLE 2: FORMULAE

MOTION

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

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

Atomic number *Atoomgetal*

Electronegativity *Elektronegatiwiteit* → 29 / 1,9 Cu / 63,5 ← Symbol *Simbool*

Approximate relative atomic mass *Benaderde relatiewe atoommassa*

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
1 2,1 H 1																	
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

KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 10

PHYSICAL SCIENCES
COMMON TEST
MARKING MEMORANDUM
SEPTEMBER 2025

MARKS: 100

DURATION: 2 hours

QUESTION 1

1.1 C ✓✓ (2)

1.2 B✓✓ (2)

1.3 C ✓✓ (2)

1.4 B ✓✓ (2)

1.5 B ✓✓ (2)

1.6 D ✓✓ (2)

[12]

QUESTION 2

2.1

2.1.1 OPTION 1

$\text{speed} = \frac{\text{distance}}{\text{time}}$ OR $v = \frac{\Delta x}{\Delta t}$ ✓

$30 \checkmark = \frac{60 \checkmark}{\Delta t}$

$\Delta t = 2$ s ✓

OPTION 2

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

$60 \checkmark = (30)\Delta t + \frac{1}{2}(0)\Delta t^2 \checkmark$

$\Delta t = 2$ s ✓

OPTION 3

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

$60 \checkmark = \left(\frac{30 + 30}{2}\right)\Delta t \checkmark$

$\Delta t = 2$ s ✓ (4)

2.1.2 POSITIVE MARKING FROM 2.1.1

OPTION 1

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

$22 = \frac{\Delta x}{2}$ ✓

$\Delta x = 44$ m ✓ east (Accept: Right)✓

OPTION 2

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

$= (22)(2) + \frac{1}{2}(0)(2)^2 \checkmark$

$\Delta x = 44$ m ✓ east (Accept: Right)✓

OPTION 3

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

$= \left(\frac{22 + 22}{2}\right)(2) \checkmark$

$\Delta x = 44$ m ✓ east (Accept: Right)✓ (3)

2.1.3 The rate of change of position/ The total displacement over the total time.✓✓ (2)

2.1.4 OPTION 1

[POSITIVE MARKING FROM 2.1.1]

Time taken for the buck to move from B to C:

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$22 = \frac{132}{\text{time}} \checkmark$$

$\Delta t = 6$ s

Time taken for the cheetah to move from B to C = 6 – 2 ✓ = 4 s

$$v = \frac{\Delta x}{\Delta t} \checkmark$$

$$= \frac{132 \checkmark}{4 \checkmark}$$

v = 33 m·s^{-1} east ✓

OPTION 2

[POSITIVE MARKING FROM 2.1.2]

Distance covered by the buck = 132 – 44 ✓ = 88 m

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$22 = \frac{88}{\text{time}} \checkmark$$

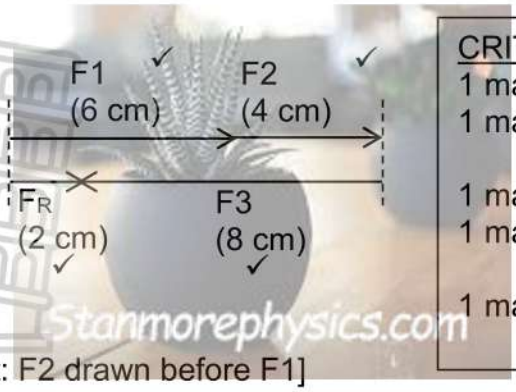
$\Delta t = 4$ s

$$v = \frac{\Delta x}{\Delta t} \checkmark$$

$$= \frac{132 \checkmark}{4 \checkmark}$$

v = 33 m·s^{-1} east ✓ (6)

2.2



CRITERIA
1 mark – F1 drawn with correct scale and direction
1 mark – F2 drawn from the head of F1 with correct scale and direction
1 mark – F_R drawn with correct direction and scale.
1 mark – F3 drawn right from the head of F2 with the correct scale and direction.
1 mark – Final answer (160 N). Can include on diagram or on its own.

[Accept: F2 drawn before F1]

$F_3 = 160$ N ✓ (5)

[20]

QUESTION 3

3.1 The cyclist changed direction / The direction changed from west to east. ✓ (1)

3.2 $v = \frac{\Delta x}{\Delta t}$ OR $v = \frac{y_2 - y_1}{x_2 - x_1}$ ✓

$= \frac{60 - 0}{30 - 0}$ ✓✓

= 2 m·s^{-1} west ✓ (4)

3.3 0 m·s^{-2} / Zero/ 0 ✓ (1)

3.4 The graph is a straight line OR Graph has a constant gradient. ✓
The velocity is constant. ✓ (2)

3.5 $v = \frac{y_2 - y_1}{x_2 - x_1}$

$-2,5$ ✓ $= \frac{60 - X}{60 - 70}$ ✓

X = 35 m

Distance = 60 + (60 – 35) ✓

= 85 m ✓ (4)

[12]

QUESTION 4

4.1 The total path length travelled. ✓✓ (2)

4.2 $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ OR $v = \frac{\Delta x}{\Delta t}$

$= 32(3) + \frac{1}{2}(0)(3)^2$ ✓ $32 = \frac{\Delta x}{(3)}$ ✓

$\Delta x = 96$ m ✓ $\Delta x = 96$ m ✓ (2)

4.3

OPTION 1	OPTION 2
$v_f = v_i + a\Delta t$ ✓	$v_f^2 = v_i^2 + 2a\Delta x$
0 ✓$= 32 + (-2,5)\Delta t$ ✓	$0^2 = (32)^2 + 2(-2,5)(\Delta x)$
$\Delta t = 12,8$ s ✓	$\Delta x = 204,8$ m

$\Delta x = \frac{v_f + v_i}{2}\Delta t$ ✓	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$204,8$ ✓$= \frac{0 + 32}{2}\Delta t$ ✓	$204,8$ ✓$= 32\Delta t + \frac{1}{2}(-2,5)\Delta t^2$ ✓
$\Delta t = 12,8$ s ✓	$\Delta t = 12,8$ s ✓ (4)

4.4 POSITIVE MARKING FROM 4.2 AND 4.3

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

$= 5$✓$(15,8) + \frac{1}{2}(0)(15,8)^2$ ✓ $= 5$✓$(15,8)$ ✓

$\Delta x = 79$ m $\Delta x = 79$ m

Distance $= 500 - 96 - 204,8 - 79$ ✓

$= 120,2$ m ✓ (4)

[12]

QUESTION 5

5.1 The amount of substance having same number of particles as there are atoms in 12 g carbon -12. OR That quantity of substance that contains $6,02 \times 10^{23}$ elementary particles.✓✓ (2)

5.2 [Calculation can be in a single table but mark according to the mark allocation]

5.2.1 $n(KClO_3) = \frac{m}{M}$ ✓

$n(KClO_3) = \frac{30,3✓}{122,5✓}$

$= 0,25$ mol✓ (4)

5.2.2 POSITIVE MARKING FROM 5.2.1

$KClO_3 : KCl$

1 : 1 (OR 2 : 2)

$n(KCl) = 0,25$ mol ✓

$n(KCl) = \frac{N}{N_A}$ ✓

$0,25 = \frac{N}{6,02 \times 10^{23}}$ ✓

N (KCl) = $1,51 \times 10^{23}$ KCl formula units ✓ (4)

5.2.3 POSITIVE MARKING FROM 5.2.1

$KClO_3 : O_2$ OR $KCl : O_2$

2 : 3

$n(O_2) = 0,375$ mol ✓

$n(O_2) = \frac{V}{V_m}$ ✓

$0,375 = \frac{V}{22,4}$ ✓

$V(O2) = 8,4$ dm^3 ✓ (Accept 8,51 dm^3) (4)

[14]

QUESTION 6

6.1.1 m (O) = 1000 – (265,31 + 353,74) ✓
= 380,95 g ✓ (2)

6.1.2 POSITIVE MARKING FROM 6.1.1

Element	mass (g)	$n = \frac{m}{M}$	Simplest Ratio		Simplest Ratio (Modified)	
K	265,31	$\frac{265,31}{39}$ ✓ $= 6,8$	$\frac{6,8}{6,8} = 1$	✓ (all simplest ratios)	1 x 2 = 2	✓ (all modified simplest ratios)
Cr	353,74	$\frac{353,74}{52}$ ✓ $= 6,8$	$\frac{6,8}{6,8} = 1$		1 x 2 = 2	
O	380,95	$\frac{380,95}{16}$ ✓ $= 23,81$	$\frac{23,81}{6,8} = 3,5$		3,5 x 2 = 7	

Empirical Formula: $K_2Cr_2O_7$ ✓ (6)

6.2 $\%\ H_2O = \frac{10 \times M(H_2O)}{M(X_2CO_3.10H_2O)} \times 100$

$62,937$✓ $= \frac{10 \times 18✓}{(2X + 12 + 16\times3)✓ + 10 \times 18✓} \times 100$

M(X) = 23 g.mol^{-1}

X is Na ✓ (5)

6.3

OPTION 1

$V(CO_2) = \frac{2}{3} \times 90$ OR $\frac{4}{6} \times 90$ ✓

= 60 cm^3

C_2H_2 : CO_2

1 : 2 (OR 2:4)

$V(C_2H_2) = \frac{1}{2} \times 60$ ✓

$V(C_2H_2)$ = 30 cm^3 ✓

OPTION 2

$V(H_2O) = \frac{1}{3} \times 90$ OR $\frac{2}{6} \times 90$ ✓

= 30 cm^3

C_2H_2 : H_2O

1 : 1 (OR 2:2)

$V(C_2H_2) = V(H_2O)$ ✓

$V(C_2H_2)$ = 30 cm^3 ✓

OPTION 3

6 gas moles → 90 cm^3

1 gas mole = $\frac{90}{6}$ ✓

= 15 cm^3

$V(C_2H_2)$ = 2 x 15 ✓

= 30 cm^3 ✓ (3)

[16]

QUESTION 7

7.1 The number of moles of solute ✓ per cubic decimetre of solution. ✓ OR
The number of moles of a substance ✓ per unit volume (of a solvent) ✓

[Calculation can be in a single table but mark according to the mark allocation]

7.2.1 $c(HCl) = \frac{n}{V}$ ✓

$0,4 = \frac{n}{0,45}$ ✓

$n(HCl) = 0,18$ mol ✓

7.2.2 POSITIVE MARKING FROM 7.2.1

$Al_2(CO_3)_3$: HCl

1 : 6

$n(Al_2(CO_3)_3) = 0,03$ mol ✓

$n(Al_2(CO_3)_3) = \frac{m}{M}$

$0,03$ ✓$= \frac{m}{234}$ ✓

$m(Al_2(CO_3)_3) = 7,02$ g ✓

7.2.3 POSITIVE MARKING FROM 7.2.1 AND 7.2.2

HCl: CO_2 OR $Al_2(CO_3)_3$: HCl

2 : 1 (or 6:3) 1 : 3

$n(CO_2) = 0,09$ mol ✓

$n(CO_2) = \frac{V}{V_m}$ ✓

$0,09 = \frac{V}{22,4}$ ✓

$V(CO_2) = 2,016\ dm^3$

$\%\ Yield = \frac{Actual\ Yield}{Theoretical\ Yield} \times 100$

$\%\ Yield = \frac{1,9}{2,016} \times 100$ ✓

$= 94,25\ \%$ ✓ (5)

[14]

TOTAL: 100