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KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES

PROVINCIAL STANDARDISED ASSESSMENT

MARCH 2026

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MARKS : 100

TIME : 2 Hours

This question paper consists of 10 pages and 4 data sheets

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INSTRUCTIONS AND INFORMATION

1. This question paper consists of SEVEN questions. Answer ALL the questions in your 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.

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QUESTION 1

Four possible options are provided as answers to the following questions. Each question has only ONE correct answer. Choose the correct answer and write the letter (A – D) next to the relevant question number (1.1 – 1.6) on the answer sheet.

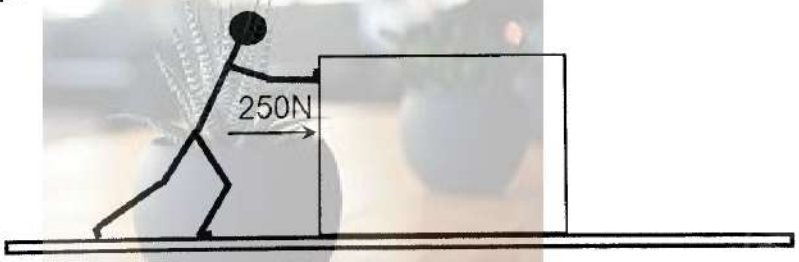
1.1 Which ONE of the following physical quantities is the rate of change of momentum?

A Impulse
B Acceleration
C Power
D Force (2)

1.2 An object is dropped from the top of a tall building. After time **t**, the object's momentum is **p**. What will the momentum of the object be after time **2t**? Ignore the effect of air friction.

A ½ p
B p
C 2p
D 3p (2)

1.3 A boy pushes a heavy box across a rough floor with a constant force of **250 N**. The box experiences a constant frictional force of **50 N** while it is moving.



The magnitude of the force exerted by the box on the boy is …

A 50 N
B 200 N
C 250 N
D 300 N (2)

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1.4 Consider the organic compounds (**I** to **IV**) shown below.

I:	$CH \equiv C - CH_2 - CH_3$
II:	$CH_3 - C \equiv C - CH_2 - CH_3$
III:	$CH_3 - C \equiv C - CH_3$
IV:	$CH_3 - C \equiv CH$

Which of the compounds above are positional isomers?

A I and II
B I and III
C I and IV
D II and III

(2)

1.5 In which one of the following alternatives are the three compounds listed in order of their increasing vapour pressure?

A Pentanoic acid; Pentan – 1 – ol; Pentane
B Pentane; Pentan – 1 – ol; Pentanoic acid
C Pentan – 1 – ol; Pentane; Pentanoic acid
D Pentan – 1 – ol; Pentanoic acid; Pentane

(2)

1.6 An organic compound **X** has the molecular formula $C_4H_8O_2$.
When **X** is heated with an excess of ethanol in the presence of concentrated sulfuric acid, a sweet-smelling compound forms.
When Compound **X** reacts with sodium carbonate solution, carbon dioxide is produced. Stanmorephysics

Which ONE of the following is the IUPAC name of compound **X**?

A Ethyl Ethanoate.
B Butanoic acid
C Butyl Ethanoate
D Ethyl Butanoate

(2)

[12]

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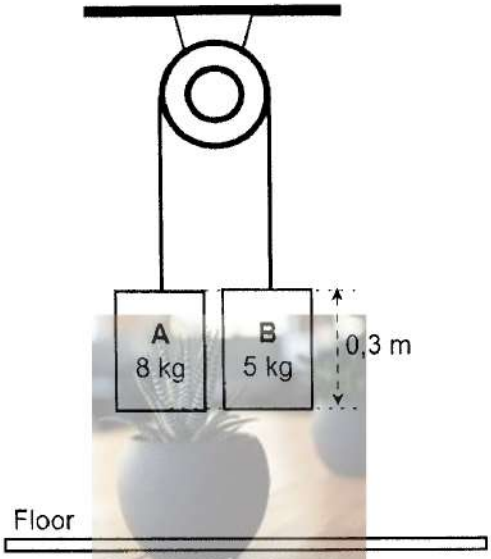
QUESTION 2

In the diagram below, two blocks, A and B, of mass 8 kg and 5 kg, respectively, are connected by a light, inextensible string. The string is passed over a light, frictionless pulley so that the blocks hang down as shown.
Initially, the blocks are held stationary at the same position above the floor. Each block is 0, 3 m high.



The blocks start moving when they are released.
Ignore air friction when answering the questions below.

2.1 Draw a Free-body diagram of ALL the forces acting on block B. (2)

2.2 State Newton's second law of motion in words. (2)

2.3 Calculate the blocks' acceleration after they are released. (4)

Block A touches the floor **a second** later after the release. The blocks come to rest as shown below.

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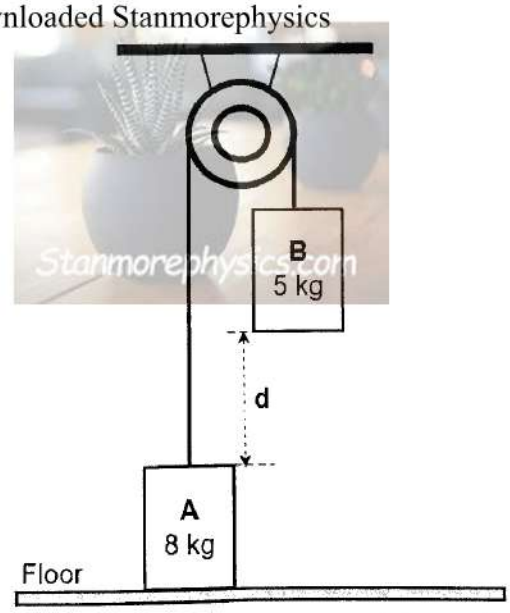

2.4 Calculate the vertical distance **d** measured from the top of block A to the bottom of block B at the instant block A touches the floor. (5)

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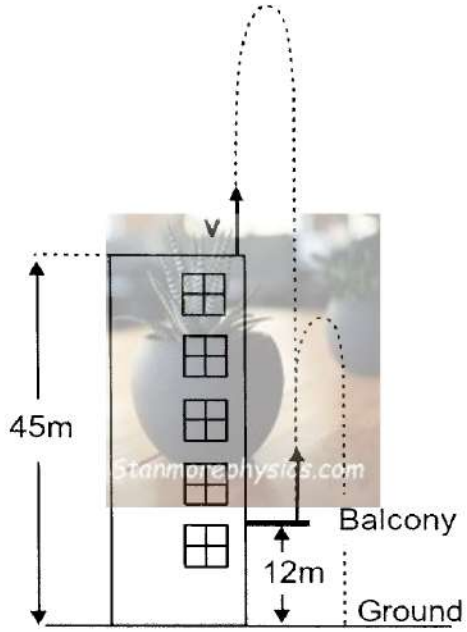
QUESTION 3

A soft ball with a mass of 0,3 kg is projected vertically upwards from the roof of a 45m tall building with velocity **v**. It hits the balcony below with a velocity of 29,36 $m.s^{-1}$, and bounces off with a velocity of 13,77 $m.s^{-1}$. The balcony is 12 m above the ground, as shown below. Ignore the effects of friction.



3.1 Define the term *Projectile*. (2)

3.2 Calculate:

3.2.1 The magnitude of the velocity **v**, with which the ball was thrown from the roof of the building. (4)

3.2.2 The velocity with which the ball strikes the ground. (3)

It takes 8,2 s from the time the ball is released from the roof until it strikes the ground.

3.3 Calculate the NET FORCE that the balcony surface exerted on the ball. (7)

[16]

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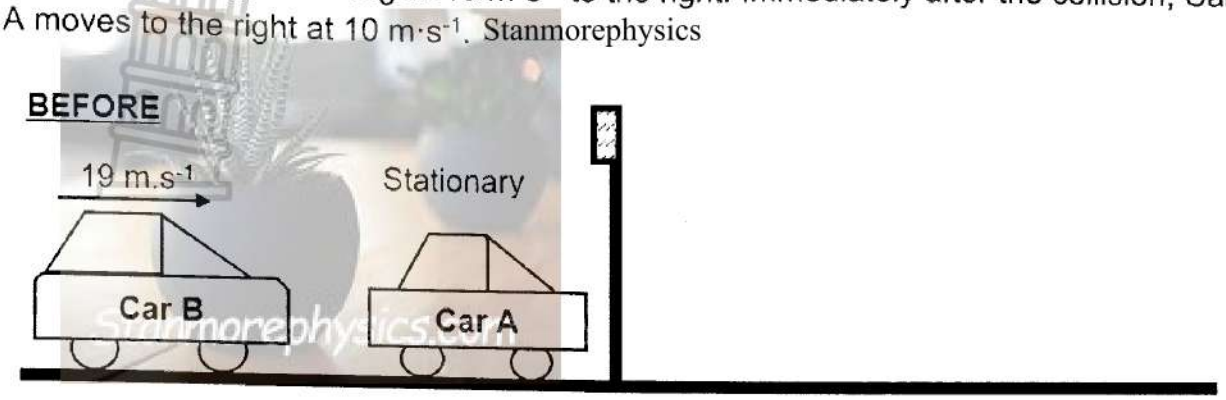
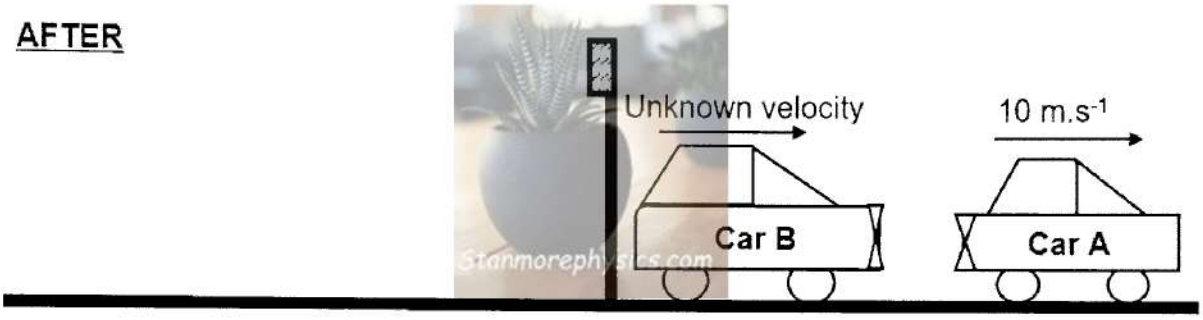
QUESTION 4

Car A of mass 900 kg is stationary at a traffic light when it is hit from behind by Car B, of mass 1100 kg, travelling at 19 m·s^{-1} to the right. Immediately after the collision, Car A moves to the right at 10 m·s^{-1}. Stanmorephysics





4.1 State the law of conservation of linear momentum in words. (2)

4.2 Calculate the velocity of car B immediately after the collision. (4)

4.3 "*Modern cars are designed to partially crumple on impact. A crumple zone is a specially designed part of a motor vehicle that is designed to deform or collapse during a collision.*"

Explain how crumple zones are used as a **safety measure** in motor vehicles. (2)

4.4 Determine, by means of a calculation, whether the collision between car A and car B is ELASTIC or INELASTIC. (5)

4.5 A traffic officer arrives at the accident scene and makes the following observation: "In a head-on collision involving two cars of different masses, the risk of passenger injury in the heavier car is lower than in the lighter car".
Use Physics principles to explain the observations made by the traffic officer. (2)

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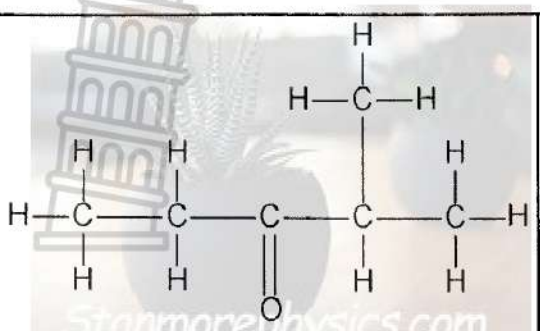
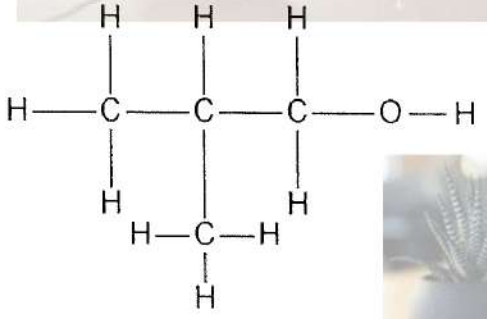
QUESTION 5 (Start on a new page)

The letters A to F in the table below represent six organic compounds.

A		**B**	Ethyl propanoate
C		**D**	$(CH_3)_2C(OH)CH_2CH_3$
E	Butane	**F**	CH_3CCCH_3

5.1 Define *homologous series*. (2)

5.2 To which homologous series does compound B belong? (1)

5.3 Draw the structural formula of compound B. (3)

5.4 Write down the LETTER that represents the following:

5.4.1 An unsaturated hydrocarbon. (1)

5.4.2 A compound with the general formula $C_nH_{2n}O$. (1)

5.5 Write down:

5.5.1 The IUPAC name of compound A. (2)

5.5.2 The IUPAC name of compound D. (2)

5.5.3 The balanced equation, using MOLECULAR FORMULA, of the complete combustion of compound E. (3)

[15]

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QUESTION 6 (Start on a new page)

The boiling points of various primary straight-chain alcohols are provided in the table below.

Alcohol	Boiling point (°C)
Methanol	65
Ethanol	78
Propan – 1 – ol	97
Butan – 1 – ol	118
Pentan – 1 – ol	138

6.1 Write down the NAME of the functional group of alcohols. (1)

6.2 Define the term *boiling point*. (2)

6.3 Which ONE of the alcohols mentioned above is the LEAST flammable at room temperature?
Explain your answer by referring to vapour pressure and risk of ignition. (3)

6.4 Use the information in the table above to answer the following questions.

6.4.1 On the graph paper provided, draw a graph of Boiling point versus the number of carbons in each alcohol. Stanmorephysics (4)

6.4.2 State the trend shown on the graph. (2)

6.4.3 Explain your answer in 6.4.2 by referring to the TYPE and STRENGTH of the intermolecular forces involved. (3)

[15]

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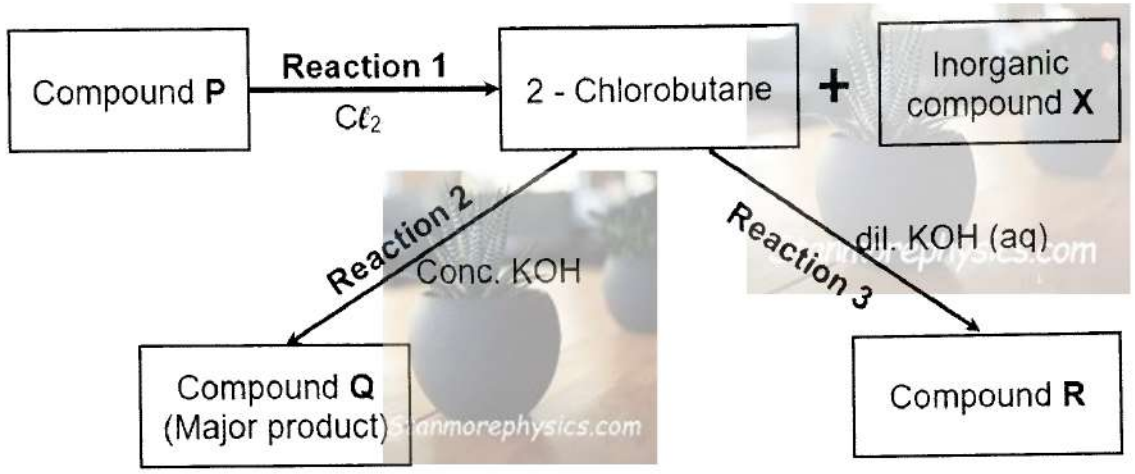
QUESTION 7 (Start on a new page)

7.1 The following equation represents the cracking of a hydrocarbon at high temperature and pressure:

$$C_{11}H_{24} \rightarrow 2C_2H_4 + \mathbf{Y} + C_4H_{10}$$

Draw the structural formula of compound **Y**. (2)

7.2 The flow diagram below shows the preparation of different organic compounds using compound P, which has the general formula $\mathbf{C_nH_{2n+2}}$.



7.2.1 Write down ONE reaction condition for Reaction 1. (1)

7.2.2 Is 2-chlorobutane a PRIMARY, SECONDARY, or TERTIARY haloalkane? Explain your answer. (2)

7.2.3 Write down the balanced equation, using STRUCTURAL FORMULAE for Reaction 3. (4)

7.3 **Reaction 2,** in the flow diagram above, is an elimination reaction during which the organic compound Q and TWO inorganic compounds are formed.

Write down:

7.3.1 The NAME of this type of elimination reaction. (1)

7.3.2 The IUPAC name of Compound Q. (2)

7.3.3 The FORMULA of EACH inorganic product formed during Reaction 2. (2)

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TOTAL MARKS: [100]

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DATA FOR PHYSICAL SCIENCES GRADE 12 PAPER 1 (PHYSICS)
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12 VRAESTEL 1 (FISIKA)

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	$6,63 \times 10^{-34}$ $J \cdot s$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^{9}$ $N \cdot m^2 \cdot C^{-2}$
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*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v\Delta t - \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/*of* $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v + v_f}{2}\right)\Delta t$

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$

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

$W = F\Delta x\cos\theta$	$U = mgh$ or/*of* $E_p = mgh$
$K = \frac{1}{2}mv^2$ or/*of* $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or/*of* $W_{net} = \Delta E_k$ $\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$P = \frac{W}{\Delta t}$	$P = Fv$

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DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

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}

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TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/*by* 298 K	
$E_{cell\theta} = E_{cathode\theta} - E_{anode\theta}$ / $E_{\theta sel} = E_{katode\theta} - E_{anode\theta}$ or/*of* $E_{cell\theta} = E_{reduction\theta} - E_{oxidation\theta}$ / $E_{\theta sel} = E_{reduksie\theta} - E_{oksidasie\theta}$ or/*of* $E_{cell\theta} = E_{oxidising\theta\ agent} - E_{reducing\theta\ agent}$ / $E_{\theta sel} = E_{oksideermi\theta\ ddel} - E_{reduseermi\theta\ ddel}$	

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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)
2,1 H 1																	2 He 4
1,0 Li 7	1,5 Be 9											2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	10 Ne 20
0,9 Na 23	1,2 Mg 24											1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	18 Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56	1,8 Co 59	1,8 Ni 59	1,9 Cu 63,5	1,6 Zn 65	1,6 Ga 70	1,8 Ge 73	2,0 As 75	2,4 Se 79	2,8 Br 80	36 Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	41 Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101	2,2 Rh 103	2,2 Pd 106	1,9 Ag 108	1,7 Cd 112	1,7 In 115	1,8 Sn 119	1,9 Sb 122	2,1 Te 128	2,5 I 127	54 Xe 131
0,7 Cs 133	0,9 Ba 137	57 La 139	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	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	86 Rn
0,7 Fr 87	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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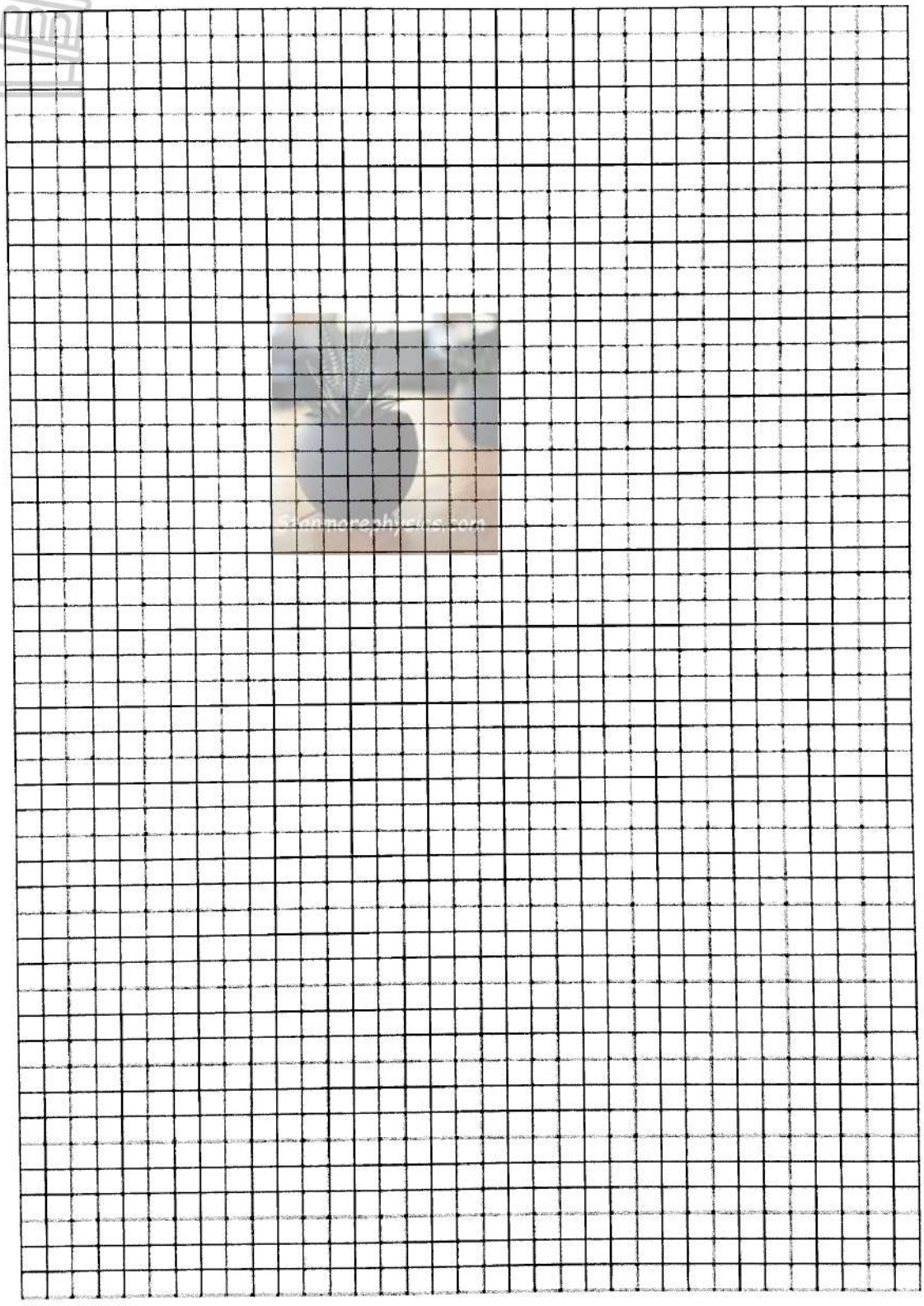
NOTE: Tear this page off and submit it with your answer booklet.

Learner's name: _____

6.4.1



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FINAL

KWAZULU-NATAL PROVINCE
EDUCATION
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NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES

PROVINCIAL STANDARDISED ASSESSMENT

MARKING GUIDELINES

MARCH 2026

MARKS : 100

These marking guidelines consist of 7 pages.

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QUESTION 1

1.1 D ✓✓ (2)

1.2 C ✓✓ (2)

1.3 C ✓✓ (2)

1.4 B ✓✓ (2)

1.5 A ✓✓ (2)

1.6 B ✓✓ (2)

[12]

QUESTION 2

2.1

(2)

2.2 When a net force acts on an object, the object will accelerate in the direction of the net force with an acceleration that is directly proportional to the net force ✓ and inversely proportional to the mass of the object. ✓

(2)

2.3

Block A	**Block B**
Fnet=ma ✓	T – Fg = ma
Fg – T = ma	T – 5 x 9,8 = 5a ✓… eqn 2.
8 x 9,8 – T = 8a ✓…. eqn 1.	
a = 2, 26 m.s^{-2} ✓	

(4)

2.4 **POSITIVE MARKING FROM 2.3**

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

$= 0 + \frac{1}{2} \times 2,26 \times 1^2$ ✓

= 1, 13 m

d = 1, 13 + 1, 13 ✓– 0, 3 ✓

= 1, 96 m ✓

(5)

[13]

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QUESTION 3

3.1 An object that has been given an initial velocity and then moves under the influence of the gravitational force only. ✓✓ (2)

3.2.1

Upward as positive	Downward as positive
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$(-29,36)^2$ ✓$= v_i^2 + \underline{2(-9,8)(-33)}$✓	$(29,36)^2$ ✓$= v_i^2 + 2(9,8)(33)$✓
$v_i = 14,67\ m.s^{-1}$ ✓	$v_i = 14,67\ m.s^{-1}$ ✓

(4)

3.2.2

Upward as positive	Downward as positive
$v_f^2 = v_i^2 + 2a\Delta y$ ✓	$v_f^2 = v_i^2 + 2a\Delta y$ ✓
$= \underline{(13,77)^2 + 2(-9,8)(-12)}$✓	$= (-13,77)^2 + 2(9,8)(12)$✓
$v_i = \underline{20,61\ m.s^{-1}, \text{downward}}$ ✓	$v_i = \underline{20,61\ m.s^{-1}, \text{downward}}$ ✓

(3)

3.3 **POSITIVE MARKING FROM 3.2.1 and 3.2.2**

Time from the roof to the balcony

Upward as positive	Downward as positive
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$\underline{(-29,36) = 14,67 + (-9,8)\Delta t}$ ✓	$\underline{(29,36) = -14,67 + (9,8)\Delta t}$ ✓
$\Delta t = 4,49\ s$	$\Delta t = 4,49\ s$

Time from the balcony to the ground

Upward as positive	Downward as positive
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$\underline{(-20,61) = 13,77 + (-9,8)\Delta t}$ ✓	$\underline{(20,61) = -13,77 + (9,8)\Delta t}$ ✓
$\Delta t = 3,51\ s$	$\Delta t = 3,51\ s$

Contact time: $\underline{8,2 - (4,49 + 3,51)}$ ✓$= 0,2\ s$

$$Fnet = \frac{m(v_f - v_i)}{\Delta t}$$ ✓

$$Fnet = \frac{0,3(13,77 - (-29,36))}{0,2}$$ ✓

Fnet = $\underline{64,70\ N, \text{upward}}$ ✓ (7)

[16]

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QUESTION 4

4.1 The total linear momentum of an isolated system is conserved. ✓✓ (2)

4.2 $\sum p_{before} = \sum p_{after}$

$m_A v_{Ai} + m_B v_{Bi} = m_A v_{Af} + m_B v_{Bf}$ ✓

$0 + \underline{(1100 \times 19)}$ ✓ $= \underline{(900 \times 10) + 1100 v_{Bf}}$ ✓

$V_f = \underline{10,82 \text{ m.s}^{-1}, \text{ to the right}}$ ✓ (4)

4.3 Crumple zones <u>increase the collision time</u>✓, which <u>reduces the net force</u> ✓experienced by the cars. (2)

4.4 **POSITIVE MARKING FROM 4.2**

$\sum$ Ek before $= ½ m_A v_{Ai}^2 + ½ m_B v_{Bi}^2$ ✓

$= 0 + \underline{½ \times 1100 \times 19^2}$ ✓

$= 198550$ J

$\sum$ Ek after $= ½ m_A v_{Af}^2 + ½ m_B v_{Bf}^2$

$= \underline{½ \times 900 \times 10^2 + ½ \times 1100 \times (10,82)^2}$ ✓

$= 109389,82$ J

$\sum$ Ekbefore $\neq \sum$ Ekafter ✓

Collision is INELASTIC ✓ (5)

4.5 Newton's third law: Both cars experience equal force. ✓
Newton's second law: Acceleration is inversely proportional to the mass. ✓
Therefore, a heavier car experiences smaller acceleration than a lighter car. (2)

[15]

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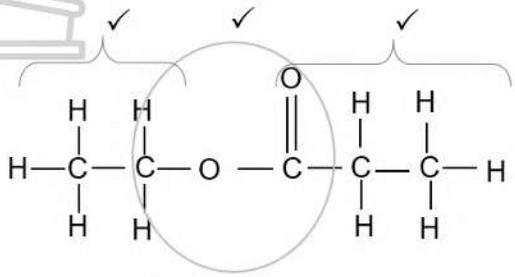
QUESTION 5

5.1 A series of organic compounds that can be described by the same general formula. ✓✓ (2)

5.2 Esters. ✓ (1)

5.3  (3)

5.4.1 F ✓ (1)

5.4.2 A ✓ (1)

5.5.1 2-methylpentan-3-one ✓✓ (2)

5.5.2 2-methylbutan-2-ol ✓✓ (2)

5.5.3 $2C_4H_{10} + 13O_2$ ✓→ $8CO_2 + 10H_2O$ ✓ Bal. ✓ (3)

[15]

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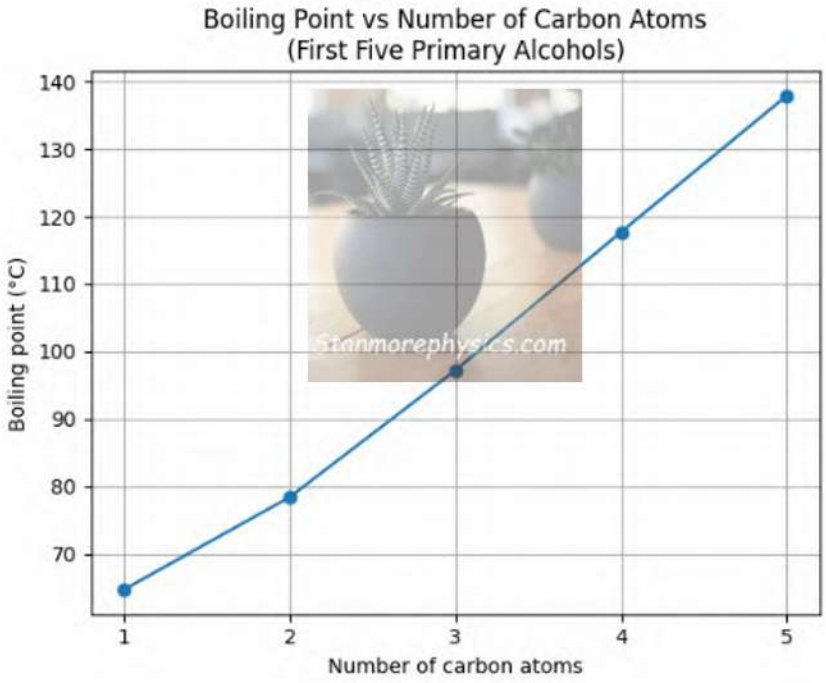
QUESTION 6

6.1 Hydroxyl (group) ✓ (1)

6.2 The temperature at which the vapour pressure of a substance equals the atmospheric pressure. ✓✓ (2)

6.3
- Pentan-1-ol. ✓
- It has the lowest vapour pressure. ✓
- It produces fewer flammable vapours at room temperature, which reduces the risk of ignition. ✓ (3)

6.4.1



Marking criteria:
- Both axes correctly labelled with appropriate scale: ✓
- All five points plotted accurately: ✓✓
- Graph with a positive gradient: ✓

(4)

6.4.2 The boiling point increases as the number of carbon atoms/chain length/surface area/molecular mass increases. ✓✓ (2 or 0) (2)

6.4.3 As the number of carbon atoms increases,
the London/Dispersion forces ✓ get stronger. ✓
More energy is required to overcome the intermolecular forces. ✓ (3)

[15]

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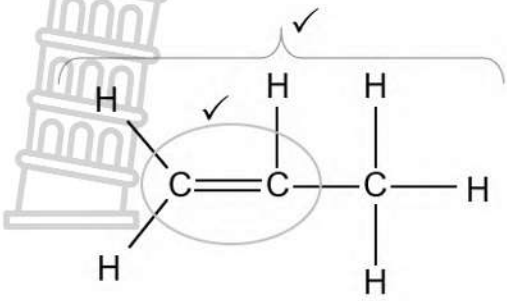
QUESTION 7

7.1

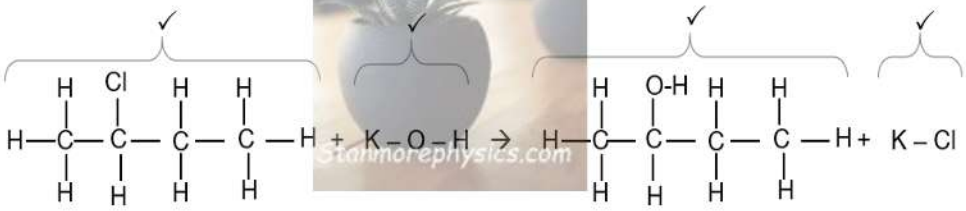


(2)

7.2.1 Heat or Light ✓ (1)

7.2.2 Secondary. ✓
The carbon atom bonded to the halogen/Cl is attached to two other carbon atoms (in the compound). ✓ (2)

7.2.3



(4)

7.3.1 Dehydrohalogenation. ✓ (1)

7.3.2 But-2-ene ✓✓ (2 or 0) (2)

7.3.3 KCl ✓ and H_2O ✓ (2)

[14]

TOTAL MARKS: [100]

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