LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
EDUCATION

NATIONAL
SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES
CONTROL TEST
13 MARCH 2024

MARKS: 100

TIME: 2 HOURS

THIS QUESTION PAPER CONSISTS OF 12 PAGES AND 2 DATA SHEETS

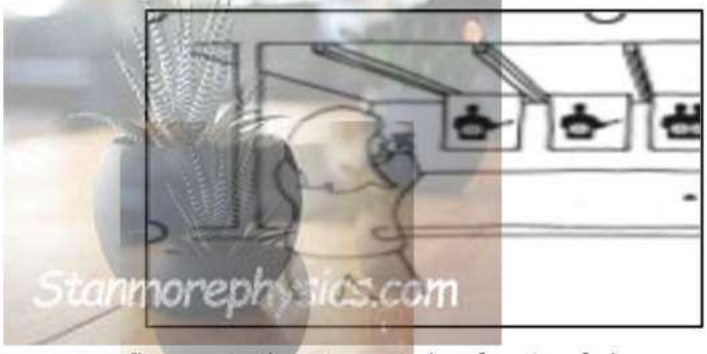
INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER SHEET/BOOK.
2. This question paper consists of SEVEN questions. Answer ALL questions in the ANSWER SHEET/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 pocket calculator.
6. You are advised to use the attached DATA SHEETS.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your FINAL numerical answers to a minimum of TWO decimal places where applicable.
9. Give brief motivations, discussions, et cetera where required.
10. Write neatly and legibly.

QUESTION 1

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write down only the letter A, B, C or D next to the question number (1.1 – 1.10) in your ANSWER SHEET/BOOK.

1.1 The diagram below shows a woman at a shooting range.



The woman fires at the target in front of her and immediately involuntarily sways backwards due to the shot taken. Which Physics law can be used to explain why the woman sways backwards after taking a shot?

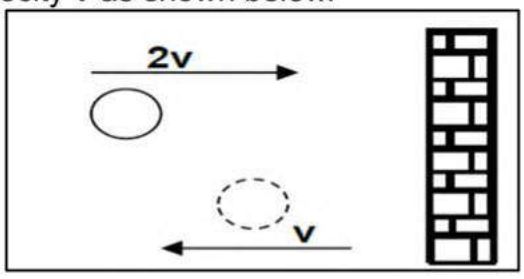
A Newton's law of universal gravitation

B Newton's second law of motion

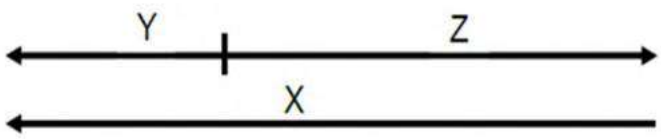
C Newton's third law of motion

D Newton's first law of motion (2)

1.2 A 10 *g* tennis ball travelling at velocity **2v** to the right strikes the wall and bounces with velocity **v** as shown below.



The vector diagram (not drawn to scale) representing the initial, final and change in momentum of the ball is indicated below with letters **X**, **Y** and **Z**.



Which of the vectors **X**, **Y** and **Z** represents the final momentum of the tennis ball?

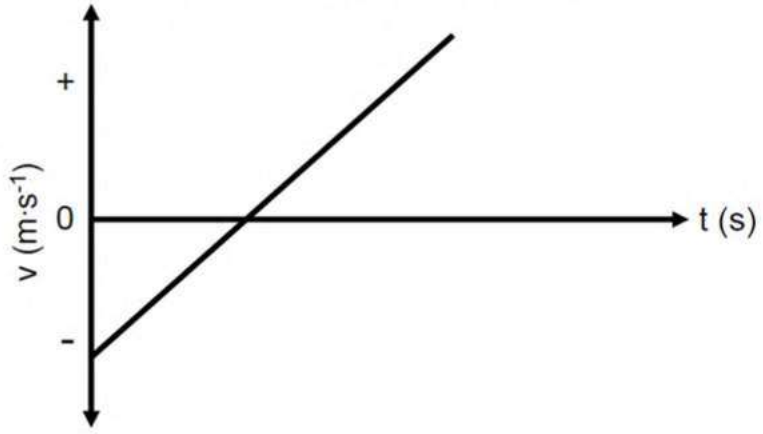
A X
B Y
C Z
D Both X and Y (2)

1.3 A bus with mass *5m* collides head-on with a car of mass *m*. The bus experiences a change in momentum of **x** kg·m·s^{-1} east due to the collision with the car. What is the change in momentum experienced by the car due to the collision with the bus?

A **x** kg·m·s^{-1}, east
B **x** kg·m·s^{-1}, west
C 5**x** kg·m·s^{-1}, east
D 5**x** kg·m·s^{-1}, west (2)

1.4 A velocity versus time graph describing the motion of a projectile is drawn below. Refer to the graph to answer QUESTION 1.4 and 1.5.

Graph of velocity versus time



Which ONE of the following combinations is TRUE for the direction of the initial motion and gravitational acceleration of this projectile?

	INITIAL MOTION OF THE PROJECTILE	GRAVITATIONAL ACCELERATION (m·s^{-2})
A	Upwards	-9,8
B	Downwards	-9,8
C	Upwards	+9,8
D	Downwards	+9,8

(2)

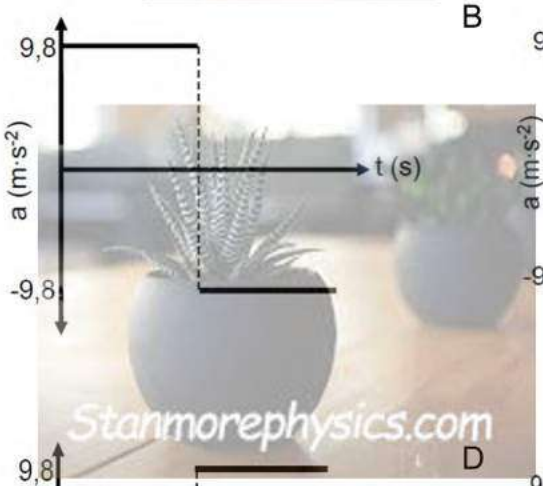
1.5 Which physical quantity can be calculated using the area under the graph?

A Speed
B Velocity
C Distance
D Displacement (2)

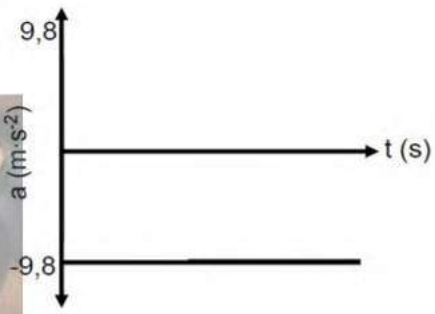
1.6 A ball is thrown towards the floor with velocity ***v*** from the top of a high building. The contact time of the ball with the ground is negligible. Ignore the effects of air resistance.

Which ONE of the following acceleration versus time graphs correctly represents the motion of the ball from the time it is thrown until it reaches a maximum height after it bounced off the floor? UPWARDS IS TAKEN AS POSITIVE.

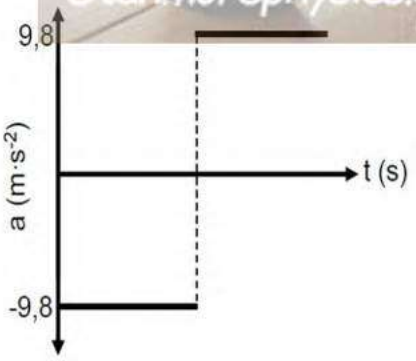
A



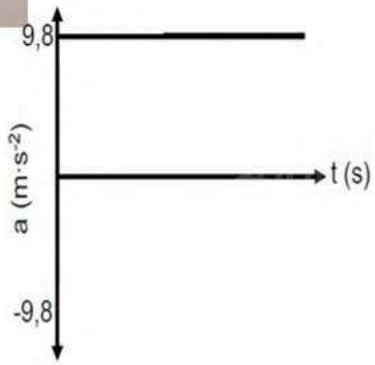
B



C

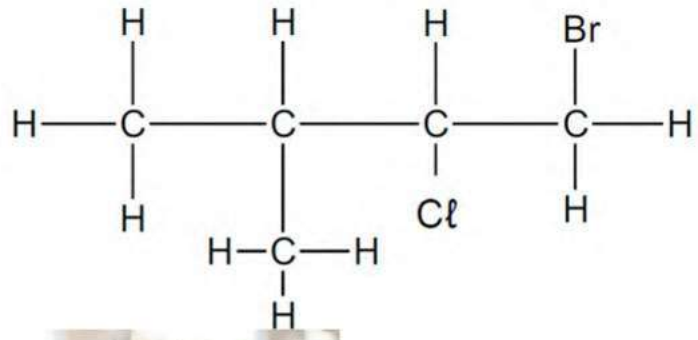


D



(2)

1.7 The following is the structural formula for an organic molecule.



Which ONE of the following is the correct IUPAC name of this organic molecule?

A 1-bromo-2-chloro-3-methylbutane

B 4-bromo-3-chloro-2-methylbutane

C 2-methyl-3-chloro-4-bromobutane

D 2-methyl-4-bromo-3-chlorobutane (2)

1.8 Which ONE of the following combinations correctly indicates the STRONGEST intermolecular forces found in ethanol, ethanoic acid and ethyl ethanoate respectively?

	ETHANOL	ETHANOIC ACID	ETHYL ETHANOATE
A	Hydrogen bonds	Dipole-dipole forces	Hydrogen bonds
B	Hydrogen bonds	Hydrogen bonds	Dipole-dipole forces
C	Hydrogen bonds	Hydrogen bonds	Hydrogen bonds
D	Dipole-dipole forces	Hydrogen bonds	Dipole-dipole forces

(2)

1.9 The MELTING POINT of a compound is the ….

A Minimum temperature at which it boils.

B Maximum temperature at which it boils.

C Temperature at which its vapour pressure equals atmospheric pressure.

D Temperature at which the solid and liquid phases of a substance are at equilibrium.

(2)

1.10 When butane is subjected to high temperatures and pressures, the following reaction takes place:

$$\text{Butane} \rightarrow \text{methane} + \mathbf{Y}$$

Which ONE of the following represents **Y**?

A $CHCCH_3$

B CH_2CHCH_3

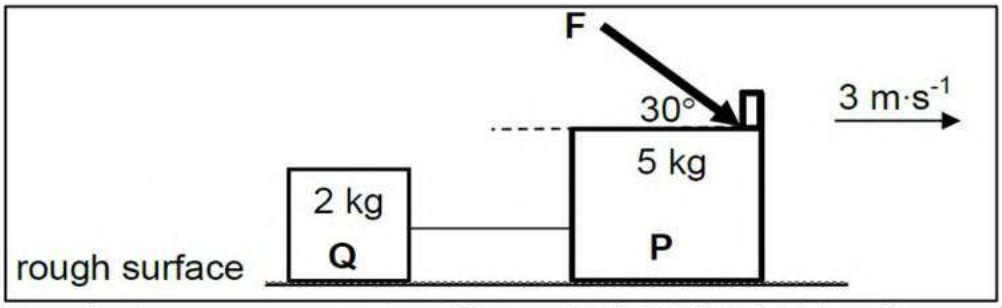
C $CH_3CH_2CH_3$

D $CH_3CHCHCH_3$ (2)

[20]

QUESTION 2

Two blocks, **P** and **Q**, resting on a rough horizontal surface, are connected by a light inextensible string. The blocks have masses 5 kg and 2 kg respectively. A constant force **F**, acting at an angle of 30° to the horizontal, is applied to the 5 kg block, as shown below:



The two blocks now move to the *right* at a CONSTANT SPEED of 3 $m \cdot s^{-1}$.

2.1 State Newton's First Law of Motion in words. (2)

2.2 Draw a labelled free-body diagram for block **P**. (5)

Block **P** and **Q** experience constant frictional forces of 2,5 N and 1 N respectively.

2.3 Calculate the magnitude of force **F**. (6)

The string connecting **P** and **Q** suddenly breaks while force **F** is still being applied.

2.4 Is the direction of the acceleration of block **Q** now towards the LEFT, or RIGHT? Explain your answer. (3)

2.5 How will the net force acting on block **P** be affected. Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

[17]

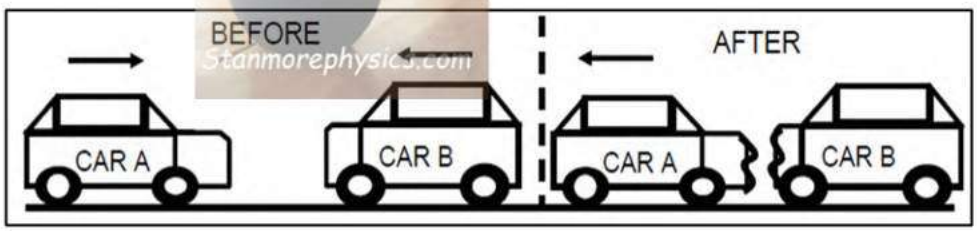
QUESTION 3

3.1 During a snooker game, two balls **X** and **Y** collide elastically. Ball **X** has a mass of 1,56 kg and travels at 3 $m \cdot s^{-1}$ in a straight line. Ball **Y** with an UNKNOWN mass was stationary before ball **X** hit it. After collision, ball **X** becomes stationery and ball **Y** moves forward at 2 $m \cdot s^{-1}$ in a straight line.

3.1.1 Explain what is meant by the term *elastic collision*. (2)

3.1.2 Calculate the mass of ball **Y** by making use of energy principles. (4)

3.2 Car **A** fitted with crumple zones collides head-on with car **B** without the crumple zones. Car **A** of mass 1 350 kg moves eastwards at 20 $m \cdot s^{-1}$ before colliding with car **B** of mass 1 500 kg moving at 10 $m \cdot s^{-1}$ westward. Immediately after the collision, car **A** moves backwards at 5 $m \cdot s^{-1}$.



Friction can be ignored.

3.2.1 Nthabeleng, a Physical Sciences grade 12 learner at the scene, argues that "car **A**'s driver will be less injured compared to car **B**'s driver because car **A** is fitted with crumple zones". Is Nthabeleng correct? Choose from YES or NO. (1)

3.2.2 Explain the answer to QUESTION 3.2.1 (3)

3.2.3 State the *principle of conservation of linear momentum* in words. (2)

3.2.4 Calculate the velocity of car **B** after the collision. (4)

[16]

QUESTION 4

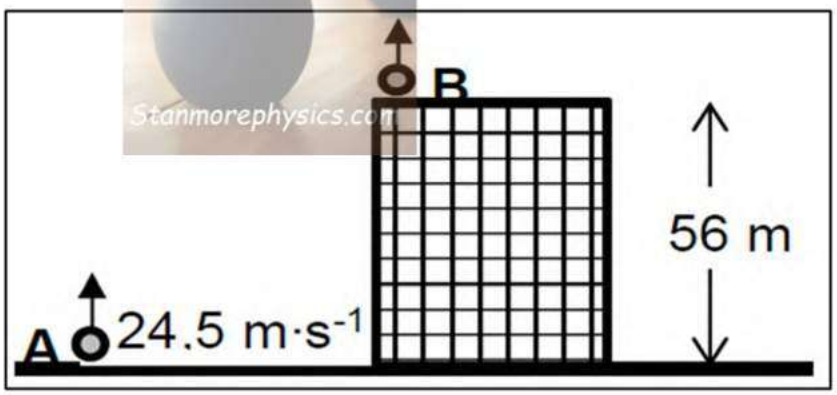
Ball **A** is projected vertically upwards from the GROUND, near a tall building, with a speed of 24,5 $m \cdot s^{-1}$. Ignore the effects of air friction.

4.1 Explain what is meant by the term *projectile*. (2)

4.2 Calculate the TOTAL time that ball **A** is in the air. (4)

4.3 Calculate the distance travelled by ball **A** during the LAST second of its fall. (4)

4.4 ONE SECOND after ball **A** is projected upwards, ball **B** is also projected vertically upwards, but from the ROOF of the building. The roof is 56 m above the ground. Both balls reach the ground at the SAME instant. Ignore the effects of air friction.



4.4.1 Calculate the speed at which ball **B** is projected upwards from the roof. (3)

4.4.2 Calculate the speed at which ball **B** reaches the ground. (3)

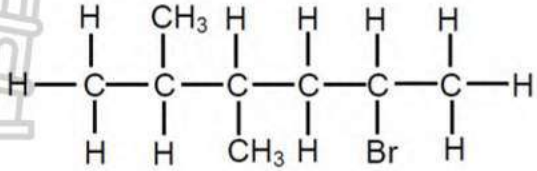
4.5 Sketch velocity-time graphs for the motion of both balls on the same set of axes. Clearly label the graphs for **A** and **B**. Indicate the following on the graphs:

- Time taken by both balls **A** and **B** to reach the ground.
- Time taken by ball **A** to reach its maximum height. (4)

[20]

QUESTION 5

The letters **A** to **E** in the table below represent five organic compounds.

A		**B**	C_3H_8O
C		**D**	Pentan-2-one
E	4-methylpent-2-yne		

Use the information in the table to answer the questions that follow:

5.1 For compound **D**, write down the:

5.1.1 Homologous series to which it belongs. (1)

5.1.2 IUPAC name of a FUNCTIONAL ISOMER. (2)

5.2 Write down the:

5.2.1 IUPAC name of compound **A.** (3)

5.2.2 STRUCTURAL FORMULA of compound **E.** (2)

5.3 Compound **B** is a primary alcohol.

5.3.1 Write down the meaning of the term *primary alcohol*. (2)

Compound **B** reacts with another organic compound **X** to form compound **C**.

Write down the:

5.3.2 Type of reaction that takes place. (1)

5.3.3 IUPAC name of compound **X.** (1)

[12]

QUESTION 6

The melting points and boiling points of four straight-chain ALKANES are shown in the table below:

COMPOUND	MELTING POINT (^{o}C)	BOILING POINT (^{o}C)
Pentane	-130	36,1
Hexane	-94	69
Heptane	-90,6	98,4
Octane	-57	125

6.1. Write down the predominant phase of the following alkanes at -100 ^{o}C. Choose from GAS, LIQUID or SOLID.

6.1.1 Pentane (1)

6.1.2 Octane (1)

6.2 Hexane is now compared to 2,2-dimethylbutane.

6.2.1 Define term *boiling point*. (2)

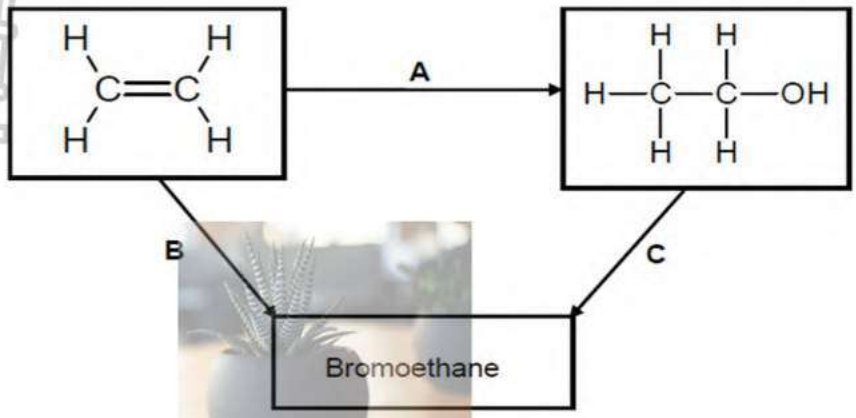
6.2.2 Is the boiling point of 2,2-dimethylbutane HIGHER THAN, LOWER THAN or EQUAL TO that of hexane? (1)

6.2.3 Fully explain the answer to QUESTION 6.2.2 (3)

[8]

QUESTION 7

Use the flow diagram below to answer the questions that follow.



7.1 Write the NAME of the TYPE of reaction represented by the following letters:

7.1.1 A (1)

7.1.2 B (1)

7.2 Apart from the alkene, another reactant and a catalyst are needed in reaction **A**. Write down the NAME or FORMULA of the:

7.2.1 Other reactant (1)

7.2.2 Catalyst (1)

7.3 Use STRUCTURAL FORMUAE to write down a balanced chemical equation for reaction **B**. (3)

[07]

TOTAL: 100 MARKS

DATA FOR PHYSICAL SCIENCES GRADE 12 TERM ONE

TABLE ONE: PHYSICAL CONSTANTS

NAME	SYMBOL	VALUE
Acceleration due to gravity	g	9,8 m·s^{-2}
Gravitational constant	G	6,63 x 10^{-11} N·m^2·kg^{-2}
Radius of Earth	R_E	6,38 x 10^6 m
Mass of Earth	M_E	5,98 x 10^{24} kg

TABLE 2: FORMULAE

MOTION

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

FORCE

$F_{net} = ma$	$p = mv$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$F = \frac{Gm}{r^2}$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$

WORK, ENERGY AND POWER

$W = F\Delta x\cos\theta$	$U = mgh$ or $E_p = mgh$
$K = \frac{1}{2}mv^2$ or $E_k = \frac{1}{2}mv^2$	$W_{net} = \Delta K$ or $W_{net} = \Delta E_k$
$W_{nc} = \Delta K + \Delta U$ or $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$	

TABLE 3: PERIODIC TABLE OF ELEMENTS

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

KEY/*SLEUTEL*

Atomic number
Atoomgetal

29
1,9 Cu
63,5

Electronegativity
Elektronegatiwiteit

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

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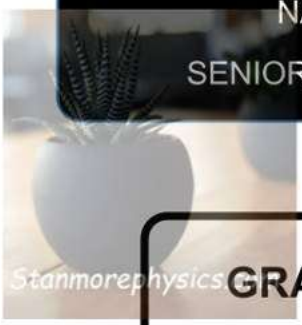
NATIONAL
SENIOR CERTIFICATE



GRADE 12

PHYSICAL SCIENCES
CONTROL TEST MARKING GUIDELINES
13 MARCH 2024

MARKS: 100

THIS MARKING GUIDELINE CONSISTS OF 11 PAGES

QUESTION 1

1.1 C ✓✓ (2)

1.2 B ✓✓ (2)

1.3 B ✓✓ (2)

1.4 C ✓✓ (2)

1.5 D ✓✓ (2)

1.6 B ✓✓ (2)

1.7 A ✓✓ (2)

1.8 B ✓✓ (2)

1.9 D ✓✓ (2)

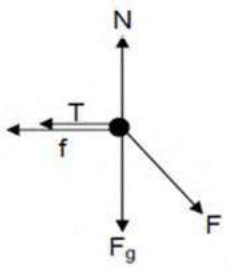
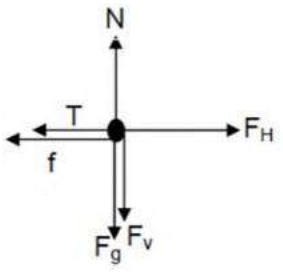
1.10 B ✓✓ (2)

[20]

QUESTION 2

2.1 A body will remain in its state of rest or motion at a constant velocity unless a non-zero resultant/net force acts on it. ✓✓ (2)

2.2

OPTION 1:	**OPTION 2:**
	

Acceptable labels		
F	**$F_{applied}$/Force applied/F_A**	✓
F_g	**w/F_w/weight/mg/gravitational force**	✓
N	**Normal (force)/F_{normal}/F_N**	✓
f	**Friction/F_f/f_k**	✓
T	**F_T/Tension**	✓

(5)

Notes:

- **Mark awarded for label and arrow.**

- **Do not penalise for length of arrow since drawing is not to scale.**
- **Any other additional force(s): 4/5**
- **If force(s) does/do not make contact with body: 4/5**

2.3

OPTION 1	**OPTION 2: SYSTEM APPROACH**
For Q:	$F_{net} = ma$
$F_{net} = ma$	$F_{net} = 0$ Any one ✓
$F_{net} = 0$ Any one ✓	$F_x - f_{kQ} - f_{kP} = 0$
$T - f_k = 0$	$F\cos 30^o - 1 - 2,5 = 0$ ✓
$T - 1$ ✓ $= 0$ ✓	$\therefore F = 4,04$ N ✓
$T = 1$ N	
	NB: Maximum marks: 3/6
For P:	
$F_{net} = ma$	
$F_{net} = 0$	
$F_x - T - f_k = 0$	
$F\cos 30^o$ ✓ $- 1 - 2,5 = 0$ ✓	
$\therefore F = 4,04$ N ✓	

(6)

2.4 LEFT ✓

- The only force acting on the object is frictional force. ✓
- According to Newton's Second Law, the body will accelerate in the direction of the (net) force. ✓

(3)

2.5 Increases ✓

(1)

[17]

QUESTION 3

3.1.1 The collision during which the total kinetic energy ✓ of the objects in the system is conserved/stays the same. ✓ (2)

3.1.2

$$\sum K_i = \sum K_f$$

$$\frac{1}{2}m_x v_{xi}^2 + \frac{1}{2}m_y v_{yi}^2 = \frac{1}{2}m_x v_{xf}^2 + \frac{1}{2}m_y v_{yf}^2$$

Any one ✓ (4)

$$\frac{1}{2}(1{,}56)(3)^2 + \frac{1}{2}(m)(0)^2 \checkmark = \frac{1}{2}(1{,}56)(0)^2 + \frac{1}{2}(m)(2)^2 \checkmark$$

$$m = 3{,}51\ kg \checkmark$$

3.2.1 Yes ✓ (1)

3.2.2 **No negative marking from QUESTION 3.2.1**

- Crumple zones increase the collision time/contact time (Δt) ✓
- According to $F_{net} = \frac{\Delta p}{\Delta t}$, for constant Δp, $F_{net} \propto \frac{1}{\Delta t}$ ✓
- If Δt increases then F_{net} decreases, hence less damage ✓ (3)

3.2.3 The total linear momentum of an isolated system remains constant (is conserved) ✓✓ **(2 or 0)** (2)

3.2.4 **OPTION 1: EAST AS POSITIVE** (4)

$$\sum p_i = \sum p_f \checkmark$$

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

Any one ✓

$$(1350)(20) + (1500)(-10) \checkmark = (1350)(-5) + (1500)v_{Bf} \checkmark$$

$$v_{Bf} = -12{,}50\ m \cdot s^{-1}$$

$$= 12{,}50\ m \cdot s^{-1} \text{ eastwards} \checkmark$$

OPTION 2: WEST AS POSITIVE

$$\sum p_i = \sum p_f \checkmark$$

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

$$(1350)(-20) + (1500)(10) \checkmark = (1350)(5) + (1500)v_{Bf} \checkmark$$

$$v_{Bf} = -12{,}50\ m \cdot s^{-1} \checkmark$$

$$v_{Bf} = 12{,}50\ m \cdot s^{-1} \checkmark \text{ eastwards}$$

[16]

QUESTION 4

4.1 An object which has been given an initial velocity and on which the only force acting is the gravitational force. ✓✓ (2)

4.2 (4)

OPTION 1 **Upward positive** $v_f = v_i + a\Delta t$ ✓ $-24,5 = 24,5$ ✓ $+ (-9,8)\Delta t$ ✓ $\Delta t = 5\ s$ ✓	**OPTION 2** **Downward positive** $v_f = v_i + a\Delta t$ ✓ $24,5 = -24,5$ ✓ $+ (9,8)\Delta t$ ✓ $\Delta t = 5\ s$ ✓
OPTION 3 **Upward positive** $v_f = v_i + a\Delta t$ ✓ $0 = 24,5$ ✓ $+ (-9,8)\Delta t$ ✓ $\Delta t = 2,5\ s$ Total time = 2,5 + 2,5 = 5 s ✓	**OPTION 4** **Downward positive** $v_f = v_i + a\Delta t$ ✓ $0 = -24,5$ ✓ $+ (9,8)\Delta t$ ✓ $\Delta t = 2,5\ s$ Total time = 2,5 + 2,5 = 5 s ✓
OPTION 5 **Upward positive** $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ 0 ✓ $= 24,5\Delta t + \frac{1}{2}(-9,8)\Delta t^2$ ✓ $\Delta t = 5\ s$ ✓	**OPTION 6** **Down positive** $\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓ 0 ✓ $= -24,5\Delta t + \frac{1}{2}(9,8)\Delta t^2$ ✓ $\Delta t = 5\ s$ ✓

4.3 **POSITIVE MARKING FROM QUESTION 4.3** (4)

OPTION 1

Upward positive

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

$$\Delta y_{last} = \Delta y_{(5)} - \Delta y_{(4)}$$

$$= \left\{24,5(5) + \frac{1}{2}(-9,8)(5)^2\right\}\checkmark - \left\{24,5(4) + \frac{1}{2}(-9,8)(4)^2\right\}\checkmark$$

$$\Delta y_{last} = -19,6\ m$$

$$\textbf{Distance} = |\Delta y| = 19,6\ m \checkmark$$

(4)

OPTION 2

Downward positive

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

$$\Delta y_{last} = \Delta y_{(5)} - \Delta y_{(4)}$$

$$= \left\{-24.5(5) + \frac{1}{2}(9,8)(5)^2\right\} \checkmark - \left\{-24,5(4) + \frac{1}{2}(9.8)(4)^2\right\} \checkmark$$

$$\Delta y_{last} = 19,6\ m$$

$$\text{Distance} = |\Delta y| = 19,6\ m \checkmark$$

OPTION 3

Upward positive

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

$$= (24,5(4) \checkmark + \frac{1}{2}(-9,8)(4)^2 \checkmark$$

$$= 19,6\ m$$

$$\text{Distance} = |\Delta y| = 19,6\ m \checkmark$$

OPTION 4

Downward positive

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

$$= (-24,5(4) \checkmark + \frac{1}{2}(9,8)(4)^2 \checkmark$$

$$= 19,6\ m$$

$$\text{Distance} = |\Delta y| = 19,6\ m \checkmark$$

OPTION 5

Upward positive

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

$$\Delta y = 24,5(1) \checkmark + \frac{1}{2}(-9,8)(1)^2 \checkmark$$

$$= 19,6\ m$$

$$\text{Distance} = |\Delta y| = 19,6\ m \checkmark$$

OPTION 6

Downward positive

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

$$\Delta y = -24,5(1) \checkmark + \frac{1}{2}(9,8)(1)^2 \checkmark$$

$$= -19,6\ m$$

$$\text{Distance} = |\Delta y| = 19,6\ m \checkmark$$

OPTION 7

Upward positive

$$v_f = v_i + g\Delta t$$

$$= 24,5 + (-9,8)(4)$$

$$= -14,7\ m \cdot s^{-1} \checkmark$$

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

$$= -14,7(1) + \frac{1}{2}(-9,8)(1)^2 \checkmark$$

$$= -19,6\ m \checkmark$$

OPTION 8

Downward positive

$$v_f = v_i + g\Delta t$$

$$= -24,5 + 9,8(4)$$

$$= 14,7\ m \cdot s^{-1} \checkmark$$

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

$$= 14,7(1) + \frac{1}{2}(9,8)(1)^2 \checkmark$$

$$= 19,6\ m \checkmark$$

4.4.1 **POSITIVE MARKING FROM QUESTION 4.2** (3)

OPTION 1	**OPTION 2**
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$ ✓
$-56 = v_i(4) + \frac{1}{2}(-9,8)(4)^2$ ✓	$56 = v_i(4) + \frac{1}{2}(9,8)(4)^2$ ✓
$v_i = 5,6\ m\cdot s^{-1}$ ✓	$v_i = -5,6\ m\cdot s^{-1}$
	$v_i = 5,6\ m\cdot s^{-1}$ ✓

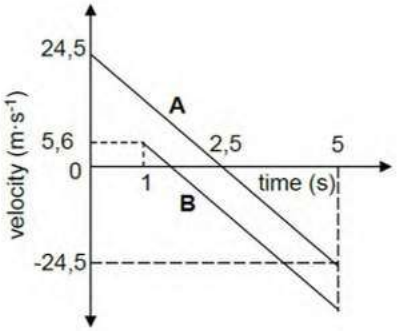
4.4.2 **POSITIVE MARKING FROM QUESTION 4.4.1** (3)

OPTION 1	**OPTION 2**
Upward positive	**Downward positive**
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$= 5,6 + (-9,8)(4)$ ✓	$= -5,6 + (9,8)(4)$ ✓
$= -33,6\ m\cdot s^{-1}$	$= 33,6\ m\cdot s^{-1}$ ✓
$= 33,6\ m\cdot s^{-1}$ ✓	

4.5 **POSITIVE MARKING FROM QUESTION 4.2 AND 4.3**

OPTION 1

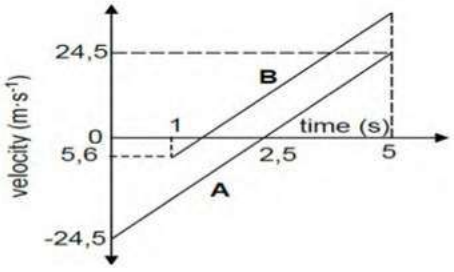
Upward positive



Marking criteria	
Correct shape of **A**	✓
Correct shape of graph **B** parallel to **A** below **A**.	✓
Time at which both **A** and **B** reach the ground 5 s	✓
Time for **A** to reach the maximum height 2,5 s.	✓

OPTION 2

Downward positive



Marking criteria	
Correct shape of **A**	✓
Correct shape of graph **B** parallel to **A** above **A**.	✓
Time at which both **A** and **B** reach the ground 5 s	✓
Time for **A** to reach the maximum height 2,5 s.	✓

(4)

[20]

QUESTION 5

5.1.1 Ketone (s) ✓ (1)

5.1.2 Pentanal (2)

ACCEPT:

2,2-dimethylpropanal

2-methylbutanal

3-methylbutanal

Marking criteria

- Correct functional group, i.e. – al ✓
- Whole name correct ✓

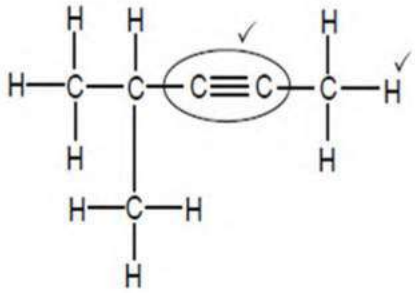
5.2.1 5-bromo-2,3-dimethylhexane

Marking criteria

- Correct stem i.e. hexane ✓
- All substituents (bromo and dimethyl) correctly identified ✓
- IUPAC name completely correct including numbering, sequence, hyphens and commas. ✓

(3)

5.2.2



Marking criteria

- Whole structure correct. **2/2**
- Only functional group correct **½**

If:

- Molecular formula 0/2
- Condensed structural formula ½

(2)

5.3.1 The C atom bonded to the hydroxyl group is bonded to only one other C-atom. ✓✓ **(2 or 0)** (2)

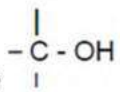
OR

The hydroxyl group/-OH is bonded to a C atom which is bonded to two hydrogen atoms. ✓✓ **(2 or 0)**

OR

The hydroxyl group/functional group/-OH is bonded to a primary C atom/ the first C atom. ✓✓ **(2 or 0)**

OR

The functional group  is bonded to only one other C-atom. ✓✓ **(2 or 0)**

5.3.2 Esterification/condensation ✓ (1)

5.3.3 Butanoic acid ✓ (1)

[12]

QUESTION 6

6.1.1 Liquid ✓ (1)

6.1.2 Solid ✓ (1)

6.2.1 (2)

Marking criteria
If any one of the underlined key phrases in the **correct context** is omitted, deduct 1 mark.

The temperature at which the vapour pressure equals the atmospheric (external) pressure. ✓✓

6.2.2 Lower than ✓ (1)

6.2.3 (3)

Marking criteria
• Compare structures ✓ • Compare the strength of intermolecular forces ✓ • Compare the energy required to overcome intermolecular forces ✓

2,2-dimethylbutane

Structure:

- More branched/more compact/more spherical/smaller surface area (over which intermolecular forces act). ✓

Intermolecular forces:

- Weaker/less intermolecular forces/Van der Waals forces/London forces/Dispersion forces. ✓

Energy:

- Less energy needed to overcome or break intermolecular forces/Van der Waals forces. ✓

OR

Hexane

Structure:

- Longer chain length/unbranched/less compact/less spherical/larger surface area (over which intermolecular forces act) ✓

Intermolecular forces

- Stronger/more intermolecular forces/Van der Waals force/London force/dispersion forces. ✓

Energy

- More energy needed to overcome or break intermolecular forces/Van der Waals forces. ✓

[08]

QUESTION 7

7.7.1 Addition/hydration ✓ (1)

7.1.2 Addition/halogenation/bromination ✓ (1)

7.2.1 Water/H_2O ✓ (1)

7.2.2 (Dilute) sulphuric acid/H_2SO_4 **OR** (Dilute) phosphoric acid/H_3PO_4 ✓ (1)

7.3

(3)

NOTE: Do not penalise HBr

[07]

TOTAL: 100 MARKS