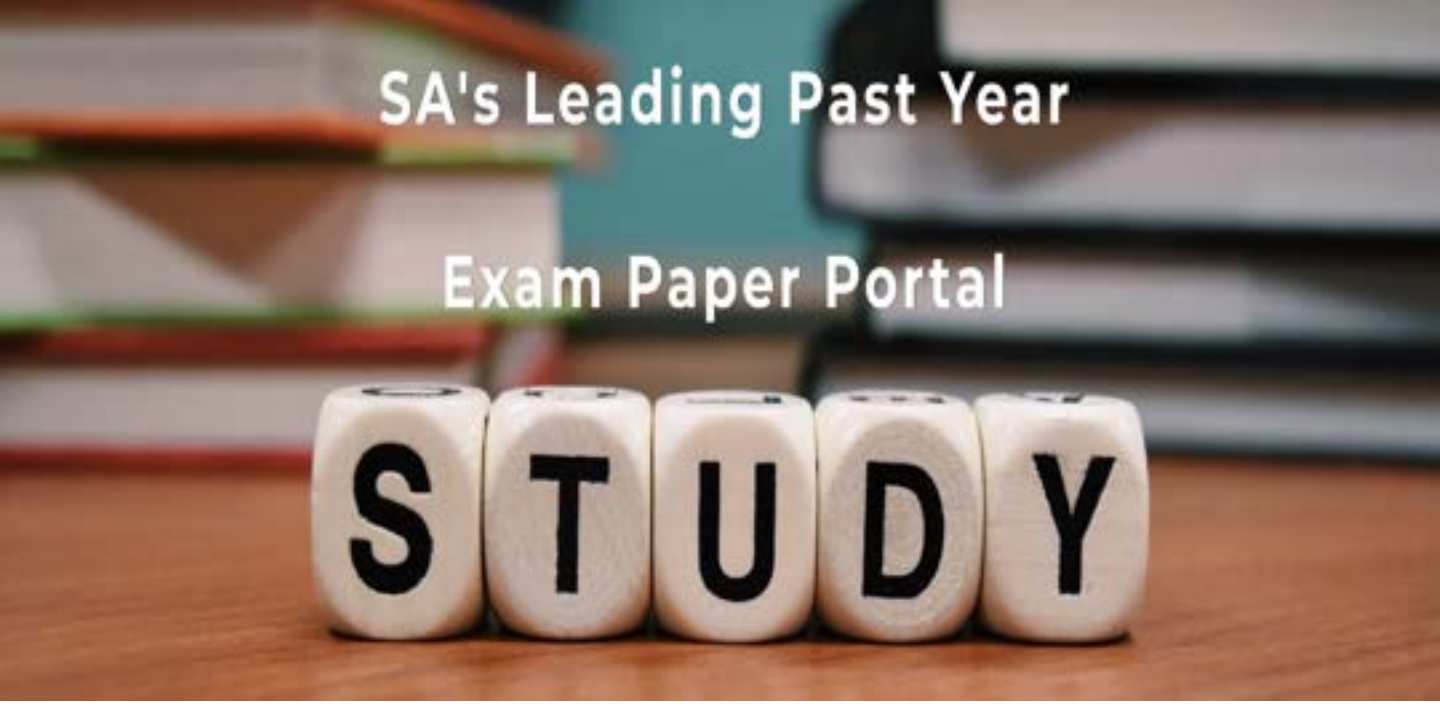

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GRADE 12

PHYSICAL SCIENCES

MARCH 2023

MARKS: 100

TIME: 2 HOURS

This paper consists of 12 pages and three information sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.

2. This question paper consists of EIGHT questions. Answer ALL questions in the ANSWER BOOK.

3. Start EACH question on a NEW page in the ANSWER BOOK.

4. Number the answers correctly according to the numbering system used in this question paper.

5. Leave one line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable pocket calculator.

7. You may use appropriate mathematical instruments.

8. You are advised to use the attached DATA SHEETS.

9. Show ALL formulae and substitutions in ALL calculations.

10. Round off your FINAL numerical answers to a minimum of TWO decimal places where applicable.

11. Give brief motivations, discussions, et cetera where required.

12. 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 BOOK.

1.1 A suitcase is at rest on a table. Which ONE of the following is the reaction force to the weight of the suitcase, as described by Newton's Third Law?

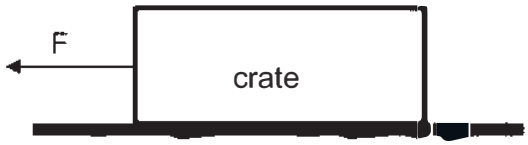
A Force of the table on Earth

B Force of suitcase on Earth

C Force of the suitcase on the table

D Force of the table on the suitcase (2)

1.2 A horizontal force **F** is applied to a crate causing it to move over a rough, horizontal surface as shown below.



The kinetic frictional force between the crate and the surface on which it is moving depends on …

A the applied force F.

B how fast the crate is moving on the surface.

C the upward force exerted by the surface on the crate.

D the surface area of the crate in contact with the floor. (2)

1.3 Object **P** exerts a gravitational force F on object **Q** when the distance between their centres is ***r***.

The distance *r* is now DOUBLED.

Which ONE of the following represents the gravitational force that **P** now exerts on **Q**?

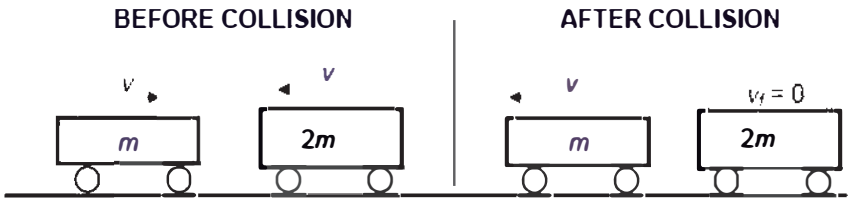
A ¼ F

B ½ F

C 2F

D 4F (2)

1.4 An object of mass m moving at velocity v collides head-on with an object of mass $2m$ moving in the opposite direction at velocity v. Immediately after the collision the smaller mass moves at velocity v in the opposite direction and the larger mass is brought to rest. Refer to the diagram below. Ignore the effects of friction.



Which ONE of the following is CORRECT?

	TOTAL MOMENTUM	TOTAL KINETIC ENERGY
A	Conserved	Conserved
B	Not conserved	Conserved
C	Conserved	Not conserved
D	Not conserved	Not conserved

(2)

1.5 A ball is thrown vertically upwards. Which ONE of the following physical quantities has a non-zero value at the instant the ball changes direction?

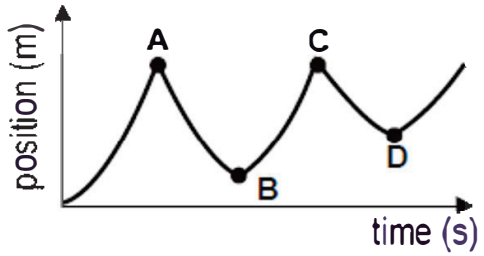
A Velocity

B Momentum

C Acceleration

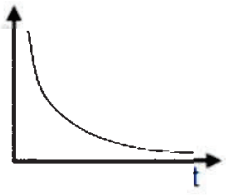
D Kinetic energy (2)

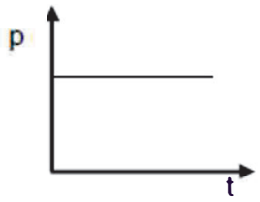
1.6 A ball is released from rest from a certain height above the floor and bounces off the floor a number of times. The position-time graph represents the motion of the bouncing ball from the instant it is released from rest.

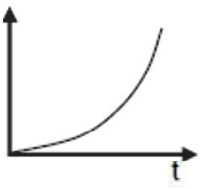


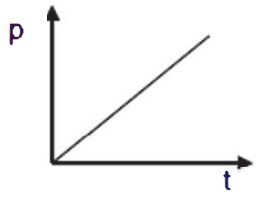
When ignoring air resistance, which point (**A**, **B**, **C** or **D**) on the graph represents the position time coordinates of the maximum height reached by the ball after the SECOND bounce? (2)

1.7 Which ONE of the following momentum versus time graphs represents the motion of an object that starts from rest and moves in a straight line under the influence of a constant net force?

A


B


C


D


(2)

1.8 Impulse is equal to the …

A final momentum of a body.

B initial momentum of a body.

C Change in momentum of a body.

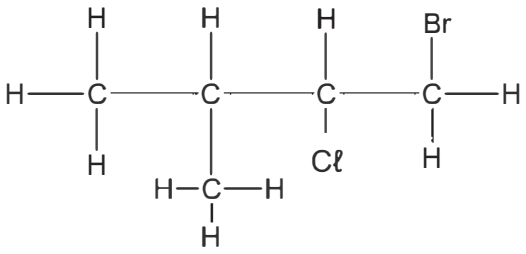
D rate of change in momentum of a body. (2)

1.9 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)

1.10 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

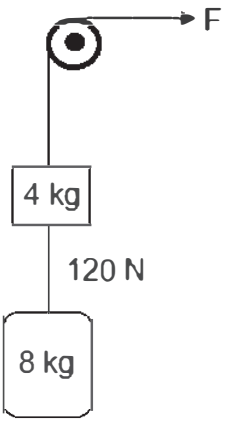
C 2-methyl-3-chloro-4-bromobutane

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

[20]

QUESTION 2

Two blocks of masses 4 kg and 8 kg respectively are connected by light, inextensible string. A second light, inextensible string attached to block 4 kg block, runs over a frictionless pulley. A constant horizontal force, **F**, pulls the second string as shown in the diagram. The magnitude of the tension between the two blocks is 120 N. Ignore the effects of air resistance.



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

2.2 Draw a labelled free body diagram showing all the forces acting on the 4 kg block. (3)

2.3 Calculate the magnitude of force **F** applied on the system when it is accelerating. (5)

[10]

QUESTION 3

Two metal balls **A** and **B** are rolling along in a horizontal straight line towards each other in a closed system. Ball **A** with a mass of 0,75 kg is rolling at a speed of 4 $m \cdot s^{-1}$. Ball **B** with a mass of 1,25 kg collides head on with ball **A** at a speed of 3 $m \cdot s^{-1}$. After collision ball **A** rolls in the direction opposite to its initial direction at a speed of 2,5 $m \cdot s^{-1}$.

3.1 Calculate the change in momentum experienced by ball **A** due to the collision. (4)

3.2 Use the change in momentum of ball **B** to calculate the velocity of ball **B** after collision. (4)

3.3 What is the net change in momentum for the whole system (ball **A** and ball **B**)? (1)

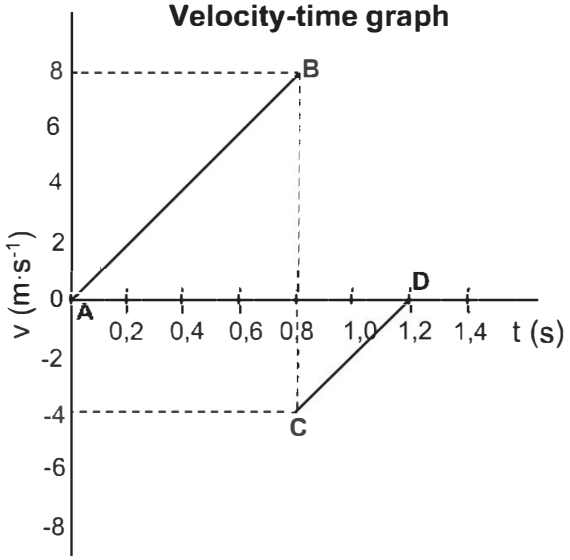
3.4 Calculate the magnitude of the average force that ball **A** and ball **B** exert on each other during collision if the two balls are in contact for 0,2 s. (3)

3.5 Is the collision ELASIC or INELASTIC? Explain the answer by means of calculations. (5)

[17]

QUESTION 4

4.1 The graph below shows the velocity-time graph for the ball that is dropped and bounces. Ignore air resistance.



Two learners argue about the ball in the above scenario. One learner says the ball is a projectile, while the other says it is not.

4.1.1 Define the term *projectile.* (2)

4.1.2 Describe the motion of the ball between points **A** and **B** on the graph above. (2)

4.1.3 From the graph, determine the:

(i) direction in which the ball is moving between points **C** and **D** (1)

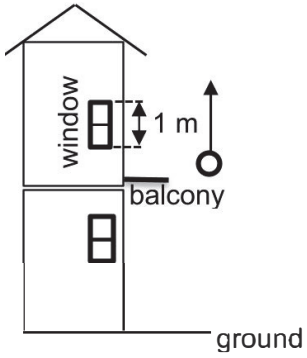
(ii) number of times the ball bounces (1)

(iii) time at which the ball is at its maximum height (1)

4.1.4 Explain why the velocity at **C** is less than that at **B**. (2)

4.2 A ball is thrown vertically upwards, from a balcony of a tall building, with a velocity of 12 $m \cdot s^{-1}$. On its way up, the ball passes a window which has a height of 1 m. The balcony is 4 m above the ground. The velocity of the ball at the bottom of the window is 8,1 $m \cdot s^{-1}$.

Ignore the effects of air resistance.



4.2.1 Define the term *free fall*. (2)

4.2.2 Calculate the:

(i) time taken for the ball to reach its maximum height (3)

(ii) maximum height reached by the ball (3)

(iii) The time the ball takes to reach the top of the window (4)

4.2.3 Draw a velocity versus time graph for the motion of the ball from the moment that the ball is thrown upwards until it comes back to the position it was thrown from. Use the point from which the ball was thrown as reference.

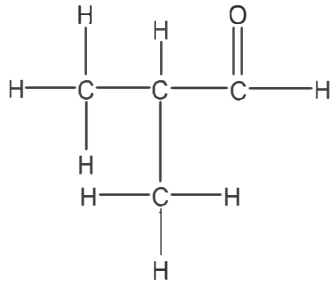
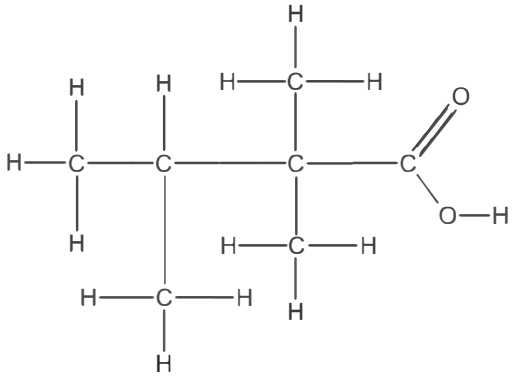
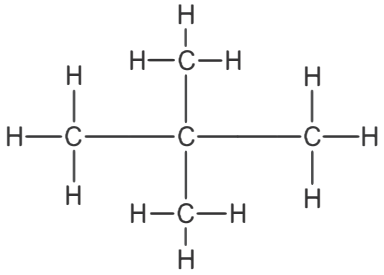
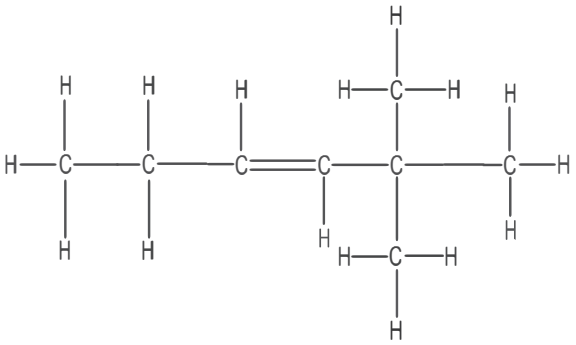
Clearly indicate the following on your graph:

- The velocity with which the ball was thrown upwards.
- The time taken by the ball to reach its maximum height.
- The velocity with which the ball arrives on the ground. (3)

[24]

QUESTION 5

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

A	2,2,5-trimethylhex-3-yne	**B**	$CH_3(CH_2)_3CH_3$
C		**D**	
E		**F**	

5.1 Write down the:

5.1.1 Letters that represent TWO organic compounds that are isomers of each other (1)

5.1.2 Type of isomers (CHAIN, FUNCTIONAL or POSITIONAL) identified in QUESTION 5.1.1 (1)

5.1.3 GENERAL FORMULA of the homologous series to which compound **D** belongs (1)

5.1.4 NAME of the functional group of compound **C** (1)

5.2 Write the IUPAC name of:

5.2.1 Compound **B** (1)

5.2.2 Compound **F** (3)

5.3 Write down the structural formula of compound **A** (3)

[11]

QUESTION 6

Compounds **A**, **B** and **C**, shown in the table below, are used to investigate a factor which influences the boiling point of organic compounds.

	COMPOUND
A	CH_3CH_2CHO
B	$CH_3CH_2CH_2CHO$
C	$CH_3CH_2CH_2CH_2CHO$

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

6.2 Which ONE of the compounds (**A, B** or **C)** has the highest boiling point? Explain (2)

6.3 For this investigation, write down the:

6.3.1 Independent variable (1)

6.3.2 Dependent variable (1)

6.4 Write down the names of the two types of van der Waals forces that occur between the molecules of compound **A**. (2)

6.5 How will the vapour pressure of 2-methylpropanal compare to that of compound **B**? Write down only HIGHER THAN, LOWER THAN or EQUAL TO. Fully explain the answer. (4)

The boiling points of compounds **D** and **E**, shown in the table below are now compared.

	COMPOUND
D	CH_3CH_2COOH
E	$CH_3CH_2CH_2CH_2OH$

6.6 Write down the NAME of the functional group of:

6.6.1 **D** (1)

6.6.2 **E** (1)

6.7 The boiling point of compound **D** is HIGHER than that of compound **E**. Explain fully. (4)

[18]

GRAND TOTAL: 100

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WTENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

TABLE 1: PHYSICAL CONSTANTS / *TABEL 1: FISIESE KONSTANTES*

NAME / *NAAM*	SYMBOL / SIMBOOL	VALUE / WAARDE
Acceleration due to gravity *Swaartekgagversnelling*	g	9,8 $m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstante*	G	6,67 x 10^{-11} $N \cdot m^2 \cdot kg^2$
Radius of the Earth *Radius van die Aarde*	R_E	6,38 x 10^6 m
Mass of the Earth *Massa van die Aarde*	M_E	5,98 x 10^{24} kg
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	6,63 x 10^{-34} J·s
Coulomb's constant *Coulomb se konstante*	k	9,0 x 10^{-9} $N \cdot m^2 \cdot C^{-2}$
Charge of electron *Lading op elektron*	e	-1,6 x10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 10^{-31} kg

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

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ or/*of* $F = G\frac{m_1 m_2}{r^2}$	$g = G\frac{M}{d^2}$ or/*of* $g = G\frac{M}{r^2}$

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* $\Delta E_k = E_{kf} - E_{ki}$
$W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = F v_{ave}$ / $P_{gemiddeld} = F v_{gemiddeld}$	

WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ or/*of* $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/*of* $E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(\max)}$ or/*of* $E = W_0 + K_{max}$ where/*waar* $E = hf$ and/*en* $W_0 = hf$ and/*en* $E_{k(\max)} = \frac{1}{2}mv_{max}^2$ or/*of* $K_{max} = \frac{1}{2}mv_{max}^2$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	$emf(\varepsilon) = I(R + r)$ $emk(\varepsilon) = I(R + r)$
$R_s = R_1 + R_2 + \ ...$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{\mathrm{R}}$

ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{ave} = V_{rms}I_{rms}$ / $P_{gemiddeld} = V_{wgk}I_{wgk}$ $P_{ave} = I_{rms}^2R$ / $P_{gemiddeld} = I_{wgk}^2R$ $P_{ave} = \frac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \frac{V_{wgk}^2}{R}$