LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF EDUCATION

NATIONAL SENIOR CERTIFICATE EXAMINATION

GRADE 12

PHYSICAL SCIENCES

24 MARCH 2025

MARKS:

TIME: 2 Hours

This question paper consists of 12 pages.

Please turn over

INSTRUCTIONS AND INFORMATION

1.   Write your NAME in the appropriate space on the ANSWER BOOK.

2.   This question paper consists of SEVEN questions. Answer ALL the 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 subquestions, for example between QUESTION 2.1 and QUESTION 2.2.

6.   You may use a non-programmable 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.

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

12.   Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various 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 numbers (1.1-1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1   A FORMYL GROUP of is the functional group of …

    A   alcohols.

    B   aldehydes.

    C   haloalkanes.

    D   ketones.   (2)

1.2   The number of carbon atoms in an ALKYNE with 14 hydrogen atoms is …

    A   7.

    B   8.

    C   9.

    D   10.   (2)

1.3   Which ONE of the following arranges the organic compounds in order of INCREASING VAPOUR PRESSURE?

    A   Methylbutane, dimethylpropane, pentane

    B   Dimethylpropane, methylbutane, pentane

    C   Pentane, methylbutane, dimethylpropane

    D   Pentane, dimethylpropane, methylbutane   (2)

1.4   Which ONE of the following will decolourise orange bromine water RAPIDLY?
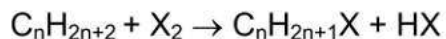
    A $C_5H_{10}O_2$

    B $C_5H_{10}O$

    C C_5H_{12}

    D C_5H_{10} (2)

Please turn over

1.5 The reaction of alkanes with halogens (X_2) can be represented by the following general equation:

$$C_nH_{2n+2} + X_2 \rightarrow C_nH_{2n+1}X + HX$$

The reaction above is an example of a/an …

  A   Substitution.

  B   Elimination.

  C   Condensation.

  D   Addition.   (2)

1.6 A FUNCTIONAL (GROUP) ISOMER of butyl ethanoate is …

  A   2-methylpentanoic acid.

  B   2-methylhexanoic acid.

  C   Ethyl butanoate

  D   Propyl propanoate   (2)

1.7 A constant net force applied to block **P** causes it to accelerate at 5 m·s^{-2}. The SAME net force applied to block **Q** causes an acceleration of 2,5 m·s^{-2}. What is the RATIO of the mass of block **P** to the mass of block **Q** ($m_P : m_Q$)?

  A   1 : 2

  B   2 : 1

  C   1 : 4

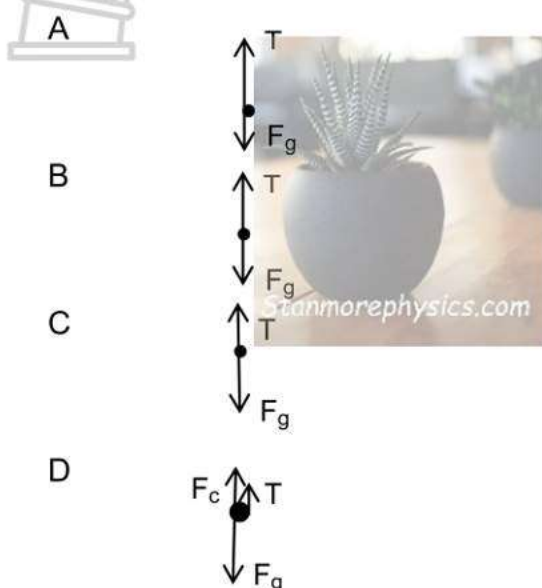 D   4 : 1   (2)

Please turn over

1.8 An elevator (lift) suspended by a cable is moving UPWARDS and SLOWING TO A STOP.

Neglect the effects of air resistance.

Which ONE of the following free-body diagrams for the elevator is CORRECT?

A $\quad$ $\uparrow$ T
$\qquad$ $\bullet$
$\qquad$ $\downarrow$ F_g

B $\quad$ $\uparrow$ T
$\qquad$ $\bullet$
$\qquad$ $\downarrow$ F_g

C $\quad$ $\uparrow$ T
$\qquad$ $\bullet$
$\qquad$ $\downarrow$ F_g

D $\quad$ F_c $\uparrow$ $\uparrow$ T
$\qquad$ $\bullet$
$\qquad$ $\downarrow$ F_g

(2)

1.9 A ball dropped from rest, ELASTICALLY collides with the ground and bounces once.

Take the point of release as the zero position.

Neglect the effects of air resistance.

Which ONE of the following position-time sketch graphs below CORRECTLY represents the motion of the ball?

A

B

C

D

(2)

Please turn over
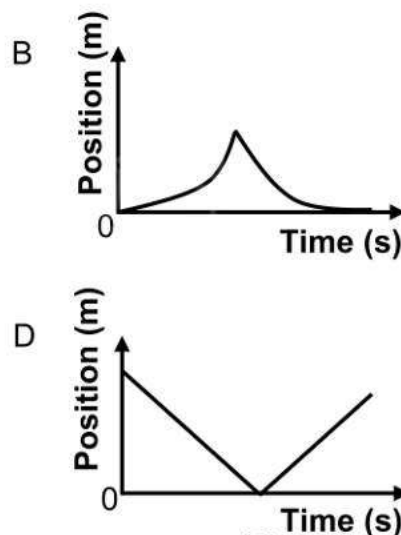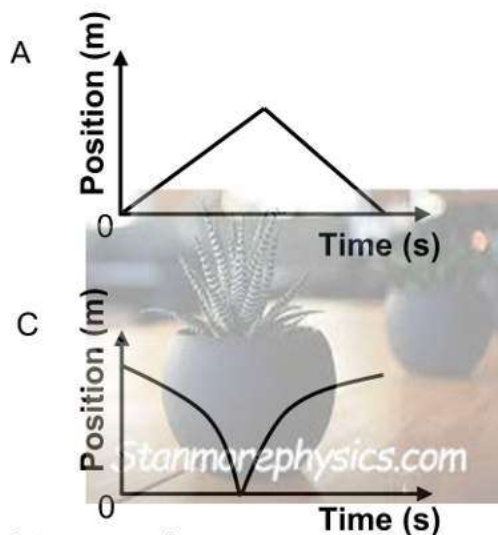
1.10 If an object has a velocity **x** and a kinetic energy **y**, then its momentum is given by …

A $\dfrac{y}{x^2}$.

B $\dfrac{xy}{2}$.

C $\dfrac{2y}{x}$.

D $\dfrac{2x}{y}$.

(2)

[20]

QUESTION 2 (Start on a new page)

P to **U** in the table below represents six organic compounds.

A	Pentanal	B	$CH_3CH_2COCH_2CH_3$
C		D	
E		F	Methyl propanoate

2.1 Define the term *functional group*. (2)

2.2 Write down the:

2.2.1 LETTER that represents the functional (group) isomer of compound **C** (1)

2.2.2 IUPAC name of the **alcohol** used to prepare compound **F** (1)

2.2.3 STRUCTURAL FORMULA of the functional group of compound **A** (1)

2.2.4 GENERAL FORMULAR of the homologous series to which compound **B** belongs (1)

2.2.5 Type of isomers represented by compounds **A** and **B** (1)

2.2.6 IUPAC name of the acid used to prepare compound **F** (1)

2.3 Write down the IUPAC name of:

2.3.1 Compound **D** (2)

2.3.2 Compound **E** (2)

2.3.3 Compound **B** (2)

[14]

QUESTION 3 (Start on a new page)

Grade 12 learners conduct an investigation to determine the relationship between *boiling point* and the *number of carbon atoms* in straight-chain alkanes.
The results obtained are shown in the sketch graph below.
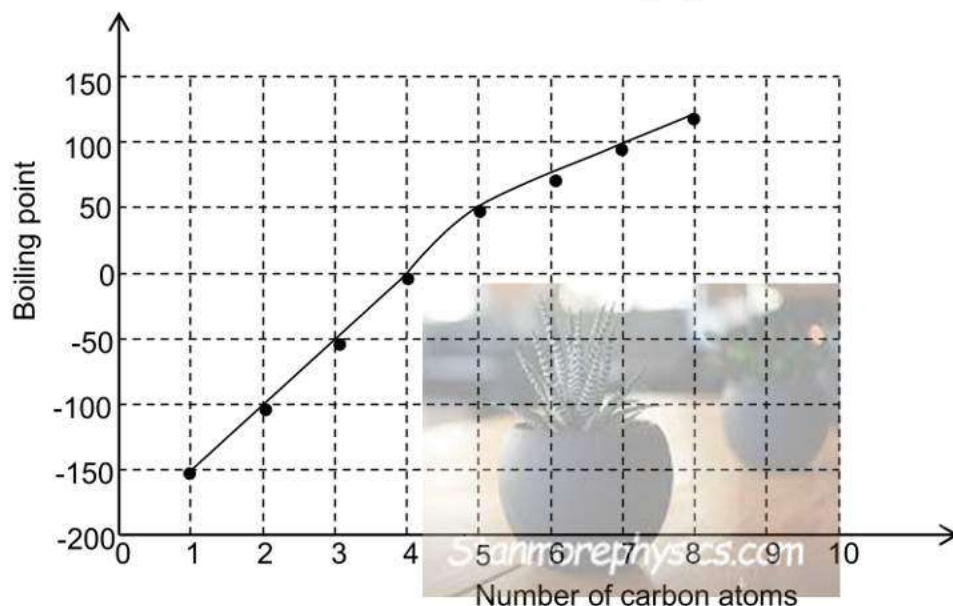
3.1 State the difference in MOLAR MASS between the successive members of the SAME homologous series. (1)

3.2   Name, **systematically**, the alkane with the HIGHEST boiling point.   (1)

3.3   Write down the IUPAC name of the alkane that is the FIRST to be a liquid at room temperature (25° C).   (1)

3.4   Write down the:

      3.4.1   Independent variable   (1)

      3.4.2   Control variable   (1)

3.5   Briefly explain why only straight-chain alkanes are used in this investigation.   (1)

3.6   Will the boiling point of the *structural isomer of butane* be HIGHER THAN, LOWER THAN, or EQUAL TO that of butane?   (1)

3.7   Explain the answer to QUESTION 3.6 above.   (3)

[10]

QUESTION 4 (Start on a new page)

The flow diagram below shows how **2-bromobutane** can be used to prepare organic compounds. **A-F** represent organic reactions.
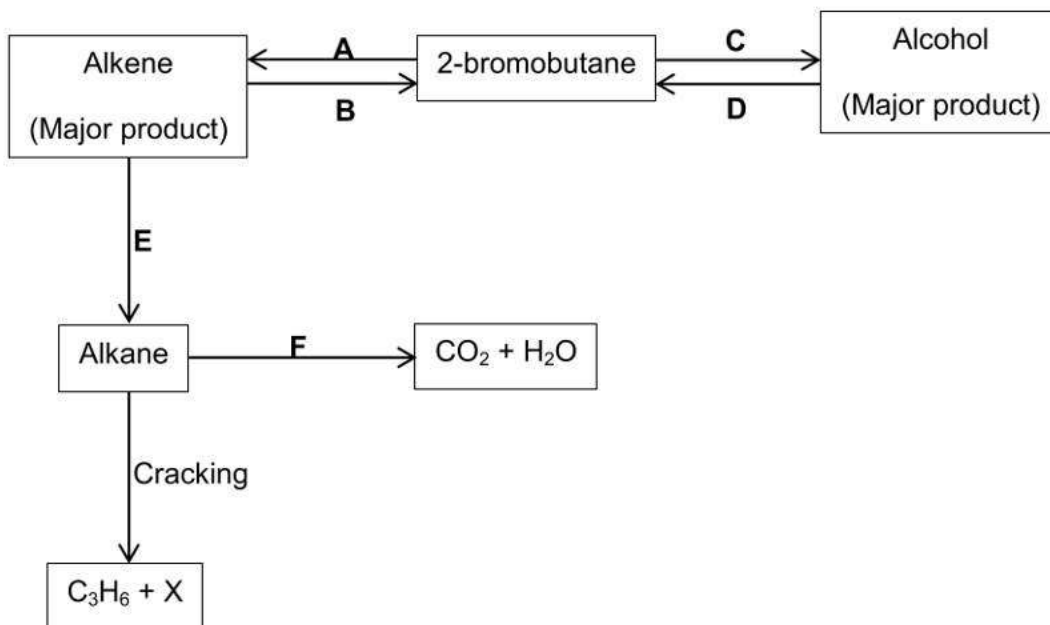
4.1   Classify 2-bromobutane as a PRIMARY, SECONDARY, or TERTIARY haloalkane.   (1)

4.2 Write down the type of reaction represented by:

    4.2.1   F   (1)

    4.2.2   A   (1)

    4.2.3   C   (1)

    4.2.4   D   (1)

    4.2.5   E   (1)

4.3 Write down the NAME or FORMULA of the inorganic reagent in reaction:

    4.3.1   B   (1)

    4.3.2   D   (1)

    4.3.3   E   (1)

4.4 State the IUPAC name of compound **X**. (1)

4.5 For reaction **B**, write down a balanced equation using STRUCTURAL FORMULAE. (4)

[14]

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QUESTION 5 (Start on a new page)

The diagram below shows an apparatus that can be used to determine "**g**", the acceleration of free-fall. Two different masses, **m₁** and **m₂**, are attached to a light inextensible cord which hangs over an ideal pulley, as shown in the diagram below.
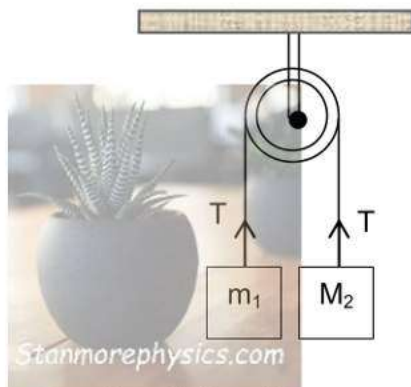

The system has acceleration "**a**", with **m₂** going down and m₁ going up. This acceleration can be determined experimentally. The tension in the cord is **T** when the system moves.

5.1 Write down the NAME of the force in the cord. (1)

5.2 Draw a labeled free-body diagram for **m₂**. (2)

5.3 Show that the expression for "**g**" in terms of the masses and the system acceleration "**a**", is $\dfrac{(m_1 + m_2)a}{m_2 - m_1}$. ( )

5.4 If **m₁** = 1,9 kg and **m₂** = 2,1 kg, calculate the value of "**g**" if the system moves through 0,245 m in 1 s, STARTING FROM REST. ( )

[ ]

QUESTION 6 (Start on a new page)

As a runaway scientific balloon ascends at 19,6 m·s⁻¹, one of its instrument packages breaks free of a harness and **free-falls**. The graph below represents the vertical velocity of the package versus-time, from **before** it breaks free to **when it reaches the ground.**
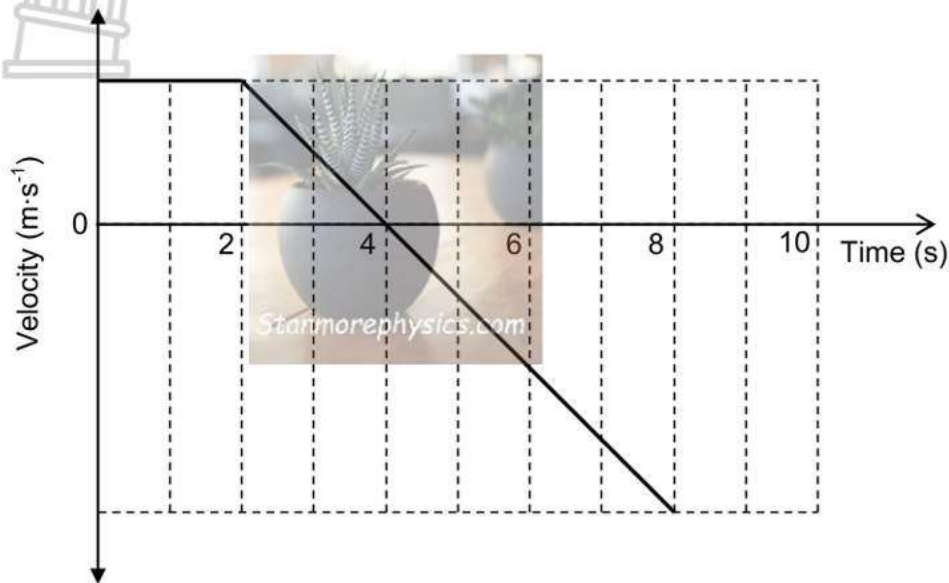

6.1   Explain what is meant by the term *projectile*.   (2)

6.2   Calculate the:

    6.2.1   Maximum height above the break-free point that the package reaches   ( )

    6.2.2   Height of the break-free point above the ground   ( )

6.3   Sketch a corresponding **position-time graph** for the motion of the package as depicted in the velocity-time graph above.

         TAKE THE GROUND AS THE REFERENCE POSITION.

                                                                                                          ( )
                                                                                                          [ ]

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QUESTION 7 (Start on a new page)

A ball having a mass of 150 g strikes a wall with a speed of 5,2 m·s^{-1} and rebounds with only 50% of its initial kinetic energy.
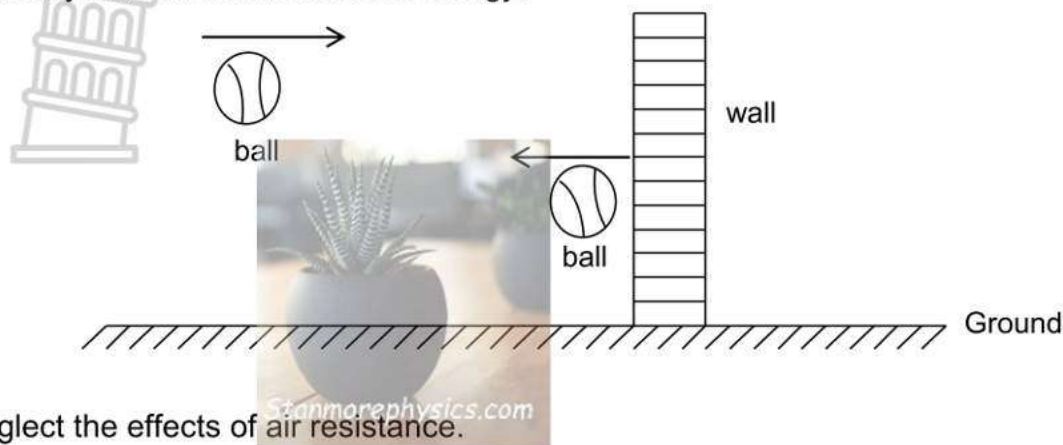
Neglect the effects of air resistance.

7.1 Define, in words, the term *momentum* as applied in physics. (2)

7.2 Calculate the impulse on the wall from the ball. ( )

7.3 The ball is in contact with the wall for 7,6 x 10^{-3} s.
Calculate the average net force on the ball from the wall during this time interval. ( )

7.4 Sketch labeled vector diagrams (not to scale) to illustrate the relationship among the initial momentum (p_i), final momentum (p_f) and change in momentum (Δp) for the ball. ( )

[ ]
TOTAL : **[100]**