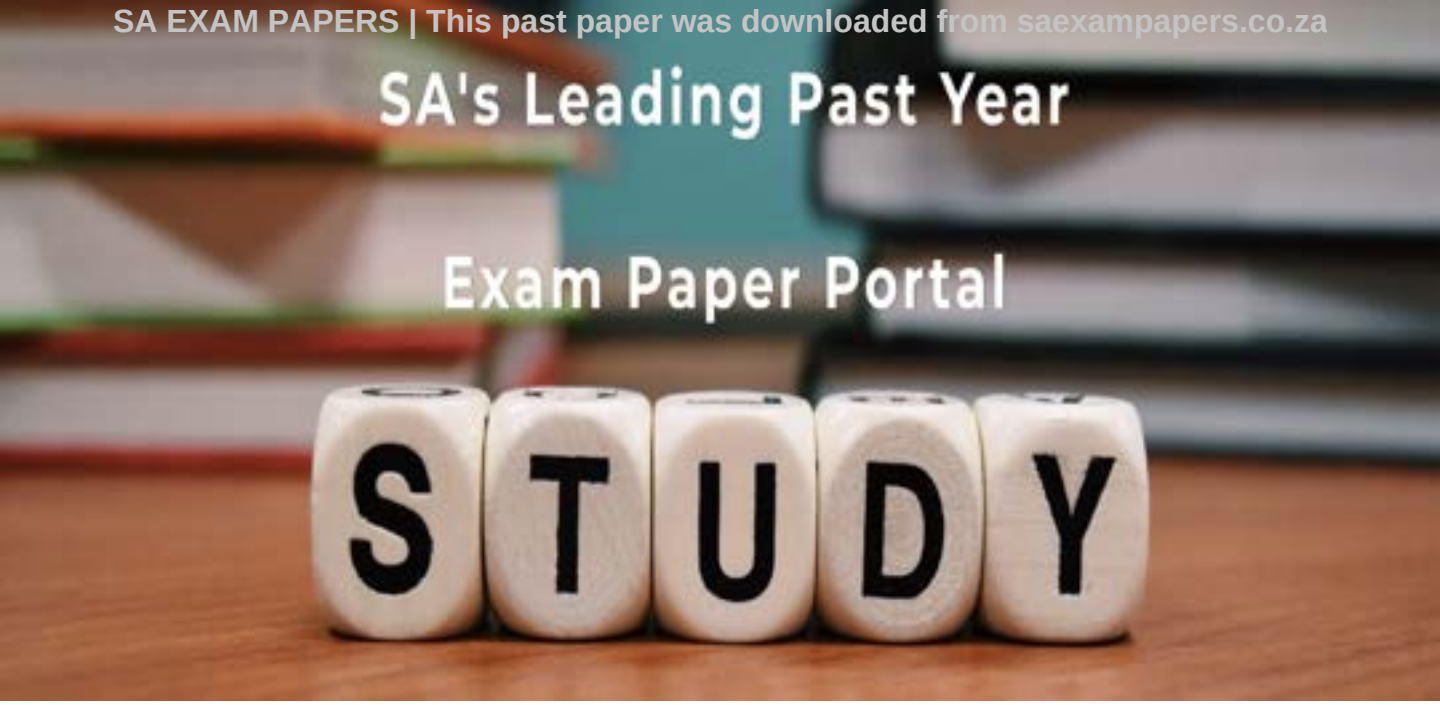


education

Department of Education
FREE STATE PROVINCE

CONTROL TEST

GRADE 12

PHYSICAL SCIENCES

MARCH 2024

MARKS: 100

TIME: 2 HOURS

This paper consists of 12 pages and one information sheet.

INSTRUCTIONS AND INFORMATION

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

2. This question paper consists of 6 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.

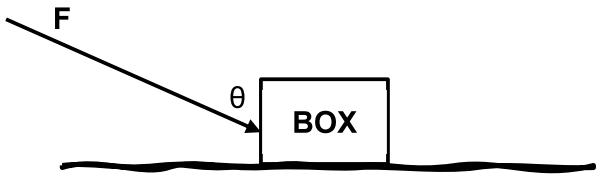
11. Give brief motivations, discussions, et cetera where required.

12. Write neatly and legibly.

QUESTION 1: 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 down only the letter A, B, C or D next to the question number (1.1–1.10) in your ANSWER BOOK.

1.1 The diagram below shows the box being pushed along a rough horizontal surface by the force **F** which makes an angle of θ with the vertical.



The correct expression for calculating the weight of the box is:

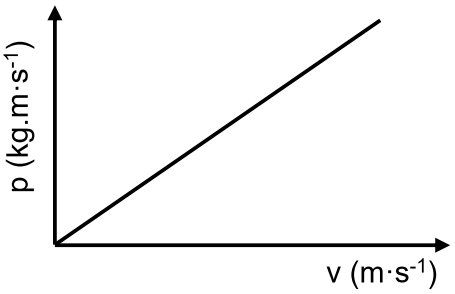
A N + Fcosθ

B N - Fcosθ

C N + Fsinθ

D N - Fsinθ (2)

1.2 The relationship between the velocity and momentum of an object is represented through the sketch graph below.



Which physical quantity is represented by the gradient of the above graph?

A Mass

B Impulse

C Acceleration

D Displacement (2)

1.3 The rate of change in momentum is equal to …

A impulse.

B net force.

C momentum.

D change in momentum. (2)

1.4 Which one of the following combinations in the table best describes the effect of the arrestor beds on the force and the velocity of the truck during an emergency stop?

	FORCE	VELOCITY
A	Increase	Increase
B	Increase	Decrease
C	Decrease	Increase
D	Decrease	Decrease

(2)

1.5 Stone **X** is thrown vertically upwards with speed ***v*** from the top of a building. At the same time, a second stone **Y** is thrown vertically downwards with the same speed ***v*** from the top of the same building. Air resistance is negligible. Which one of the following statements is true about the speeds at which the stones hit the ground?

A The speed of stone **X** is equal to the speed of stone **Y**.

B The speed of stone **X** is greater than the speed of stone **Y**.

C The speed of stone **Y** is greater than the speed of stone **X**.

D The speed of stone **X** can only be compared to the speed of stone **Y** when the height of the building is known. (2)

1.6 When the projectile approaches its maximum height, its velocity will ...

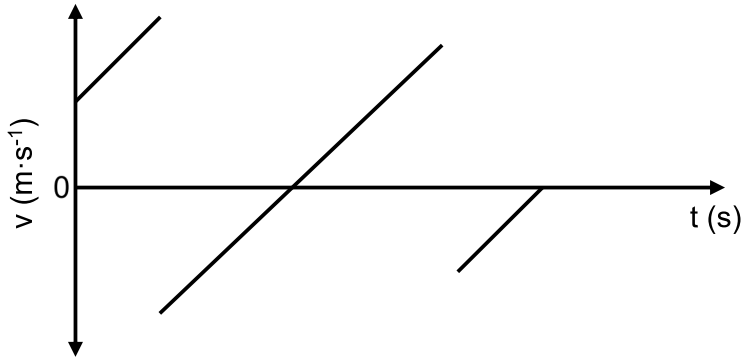
A be zero.

B increase.

C decrease.

D remain constant. (2)

1.7 Motion of a projectile which bounces off the floor several times is represented through a velocity versus time graph below.



Which of the statements below are INCORRECT about the motion of the projectile?

(i) Initially the projectile goes upwards.

(ii) Projectile bounces twice off the floor.

(iii) Initial velocity of the projectile is zero.

(iv) Upward motion was taken as positive.

A i and ii only

B i, ii, iii and iv

C i, iii and iv only

D ii, iii and iv only (2)

1.8 Which one of the following is the correct condensed structural formula of 2,3-dichloro-2-methylpentane?

A $CH_3CH(CH_3)CC\ell_2CH_2CH_3$

B $CH_3CC\ell(CH_3)CHC\ell CH_2CH_3$

C $CH_3CC\ell_2CH(CH_3)CH_2CH_3$

D $CH_3CH_2CH_2CHC\ell CHC\ell CH_3$ (2)

1.9 Which one of the following molecular formulae represents an alkyne?

A C_6H_{10}

B C_6H_{12}

C C_6H_{14}

D C_7H_{14} (2)

1.10 Which one of the following organic compounds has the HIGHEST boiling point?

A butane

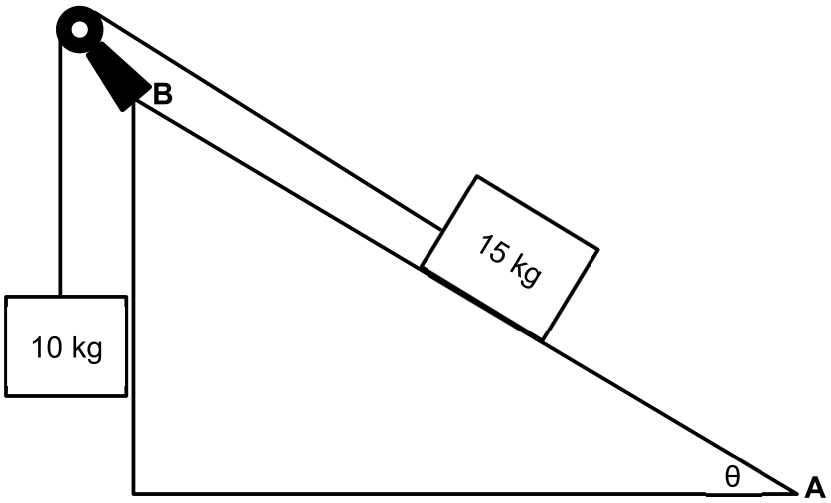
B butanone

C butan-1-ol

D butanoic acid (2)
[20]

QUESTION 2

Two blocks, 10 kg and 15 kg are attached to each other with a light inextensible string moving over a frictionless pulley as shown in the diagram below.
Slope AB has a SMOOTH surface and makes an angle θ with the horizontal.



Both blocks are stationary.

2.1 State Newtons' first law of motion. (2)

2.2 Draw the free-body diagram showing ALL the forces acting on the 15 kg block. (3)

2.3 Calculate angle θ. (5)
[10]

QUESTION 3

A metal ball **A**, with mass 750 g, rolls horizontally in a straight line towards a stationary metal ball **B**, with mass 500 g, as shown below. Metal ball **A** travels at a constant speed of 5 $m \cdot s^{-1}$ before colliding with metal ball **B**. Due to the collision, metal ball **A** experiences an impulse of 6 N·s to the left.
The system is *isolated*.

3.1 Define the term *impulse*. (2)

3.2 Write down the magnitude and direction of the change in momentum experienced by metal ball B due to its collision with metal ball A. (2)

3.3 Calculate the velocity of the metal ball B immediately after collision. (4)

After the collision with metal ball **A**, metal ball **B** collide with another metal ball **C**, with mass 900 g, which is travelling at 10 $m \cdot s^{-1}$ to the left. Metal ball **B** moves at 2 $m \cdot s^{-1}$ to the left after the collision.

3.4 What does it mean that the system is *isolated*? (2)

3.5 Calculate the speed of metal ball C after the collision. (4)

3.6 Use a calculation to prove whether the collision between metal ball B and metal ball C is elastic or inelastic collision. (5)
[19]

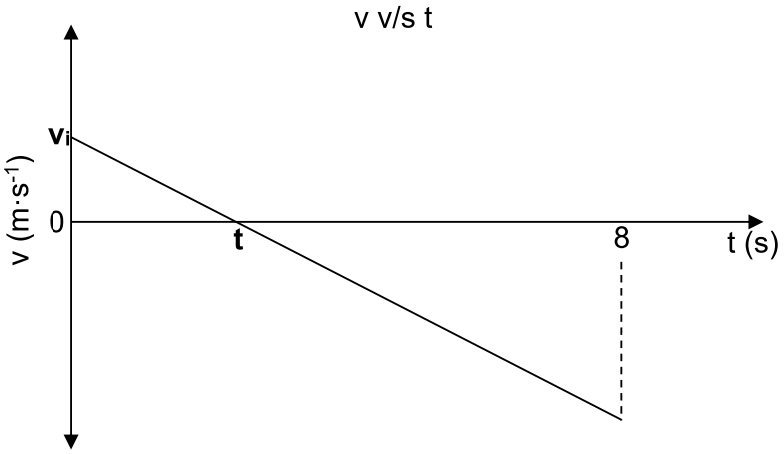
QUESTION 4

A helicopter picks up a package through a cord from the ground as shown below. The package is then pulled up at CONSTANT VELOCITY of 10 $m \cdot s^{-1}$.

4.1 Will the package be considered a projectile while being pulled up? Write down YES or NO. (1)

4.2 Give a reason for your answer to question 4.1. (1)

When the package reaches a certain height ***h***, the cord break and the package undergo *free fall*. The motion of the package after the cord breaks until it hits the ground is represented through the velocity-time graph below.



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

4.4 Write down the following:

4.4.1 value of v_i. (1)

4.4.2 magnitude and direction of the acceleration of the package at time t. (2)

4.5 Calculate:

4.5.1 time *t*. (3)

4.5.2 the speed the package hits the ground with. (3)

4.5.3 the displacement the package covered in the last 2 s of its fall. (6)

4.6 Draw a displacement-time graph for the motion of the package from the moment the cord breaks until it reaches the ground.
TAKE THE GROUND AS THE REFERENCE POINT.

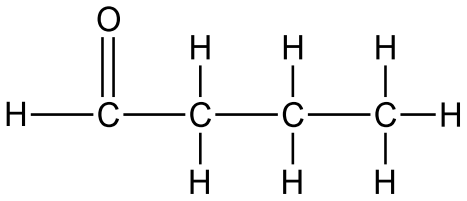
Indicate the following on your graph:

- Height ***h*** from which the cord brakes.
- Time t.
- The time the package reaches the ground. (5)

[24]

QUESTION 5

The letters A to D represent four organic compounds from DIFFERENT homologous series.

A	$CH(CH_3)_2CH(CH_3)CH_2CCCH_3$	**B**	
C	C_5H_{10}	**D**	Propyl ethanoate

5.1 Define the term homologous series. (2)

5.2 Write down the:

5.2.1 NAME of the homologous series to which compound B belongs. (1)

5.2.2 NAME of the functional group of compound A. (1)

5.2.3 Letter representing the UNSATURATED hydrocarbon. (1)

5.3 Write down the IUPAC name of:

5.3.1 Compound A. (3)

5.3.2 FUNCTIONAL isomer of compound B. (2)

5.4 Write down the STRUCTURAL FORMULA of:

5.4.1 The FUNCTIONAL group of the functional isomer of compound D. (2)

5.4.2 Compound D. (2)

5.4.3 STRAIGHT chain isomer of compound C. (2)
[16]

QUESTION 6

A group of learners investigate the effect of different factors on the melting points of different organic molecules of comparable molecular mass. The results from their investigation are shown in the table below.

ORGANIC MOLECULE.	MOLECULAR MASS ($g.mol^{-1}$)	MELTING POINT.
Butane	58	-138°C
Methylpropane	58	-159,6°C
Propan-1-ol	60	-126°C
Ethanoic acid	60	16°C

Use the information in the above table to answer the questions below:

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

6.2 Fully explain the difference in the melting points of butane and methylpropane. (3)

6.3 Is ethanoic acid a SOLID or LIQUID at room temperature? (1)

6.4 How does the vapour pressure of propan-1-ol compare to that of ethanoic acid?
Write down LOWER THAN, HIGHER THAN or EQUAL TO. (1)

6.5 Fully explain the answer to question 6.4. (4)

[11]

GRAND TOTAL: 100

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	9,8 $m \cdot s^{-2}$
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 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* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^{\ 2} = v_i^{\ 2} + 2a\Delta x$ 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*

$F_{net} = ma$	$p = mv$
$f_s^{\ max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1 m_2}{d^2}$ 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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	