KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES

COMMON TEST

MARCH 2023

MARKS : 100

TIME : 2 Hours

This question paper consists of 10 pages and 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your NAME in the appropriate spaces 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. 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. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A-D) next to the question number (1.1-1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 A body slides along a frictionless horizontal surface at CONSTANT VELOCITY. For which ONE of the following pairs are the magnitudes of both physical quantities ZERO?

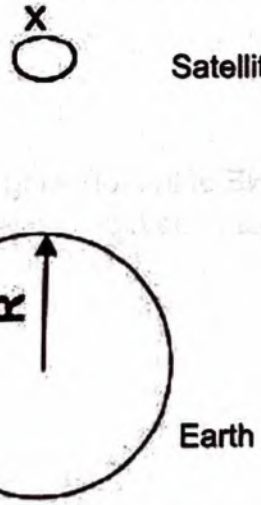
A Displacement and momentum.

B Acceleration and momentum.

C Displacement and net force.

D Acceleration and net force. (2)

1.2 A satellite orbits the Earth at a point X, where the gravitational force is a quarter (¼) of the gravitational force it experiences on the surface of the Earth.



If the radius of the Earth is **R**, then the height of the satellite ABOVE THE SURFACE of the Earth will be…

A 4R

B 2R

C R

D ½ R (2)

1.3 A girl standing in a lift observes a 10N mass piece suspended from a spring balance that is fixed to the roof of the lift. She sees that the reading on the spring balance is GREATER than 10N for a short time interval. During this time interval the lift is....

A not moving.

B moving at constant velocity.

C accelerating upwards.

D accelerating downwards. (2)

1.4 A ball of mass m hits a wall at a speed of v and rebounds in a straight line in the opposite direction with the same speed.

The magnitude of the change in momentum of the ball will be...

A 0

B 2mv

C ½ mv

D mv (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 Acceleration

B Kinetic energy

C Momentum

D Velocity (2)

1.6 The molecular formula of an organic compound is $C_4H_{10}O$. Which ONE of the following is the FUNCTIONAL GROUP of the organic compound?

A Formyl group

B Hydroxyl group

C Carboxyl group

D Carbonyl group (2)

1.7 A FUNCTIONAL ISOMER of ethyl propanoate is . . .

A C_4H_9CHO.

B $C_5H_{11}COOH$.

C C_4H_9COOH.

D $CH_3(CH_2)_3CHO$. (2)

1.8 Which ONE of the following is the EMPIRICAL FORMULA of 2 – methylpentane?

A C_3H_7

B C_6H_{14}

C C_6H_{12}

D C_3H_6 (2)

1.9 Which ONE of the following represents a product of the thermal cracking of butane?

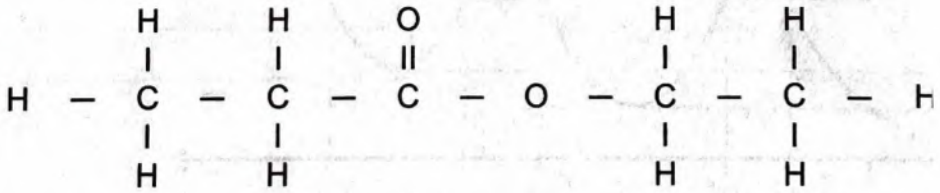
A C_2H_2

B C_2H_4

C C_4H_6

D C_4H_{10} (2)

1.10 Consider the structural formula of an organic compound given below:



This compound is the product of the reaction between . . .

A ethanol and propanoic acid.

B propanol and propanic acid.

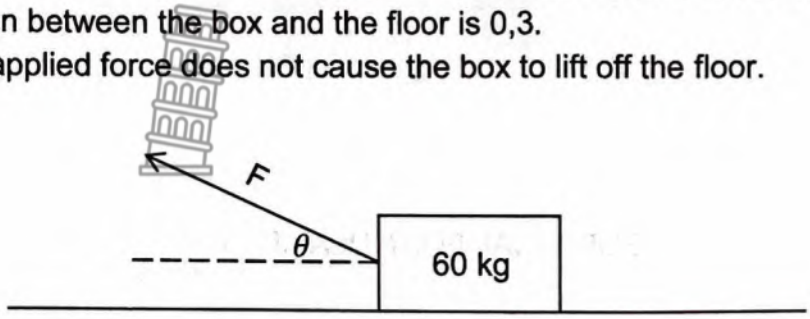
C ethanol and ethanoic acid.

D propanol and ethanoic acid. (2)

[20]

QUESTION 2 (Start on a new page.)

A force of magnitude F is applied at an angle θ with the horizontal to a box of mass 60 kg placed on the floor. With force F applied, the magnitude of the maximum static frictional force between the floor and the box is 140 N . The coefficient of static friction between the box and the floor is 0,3.
The applied force does not cause the box to lift off the floor.



2.1 Define *normal force*. (2)

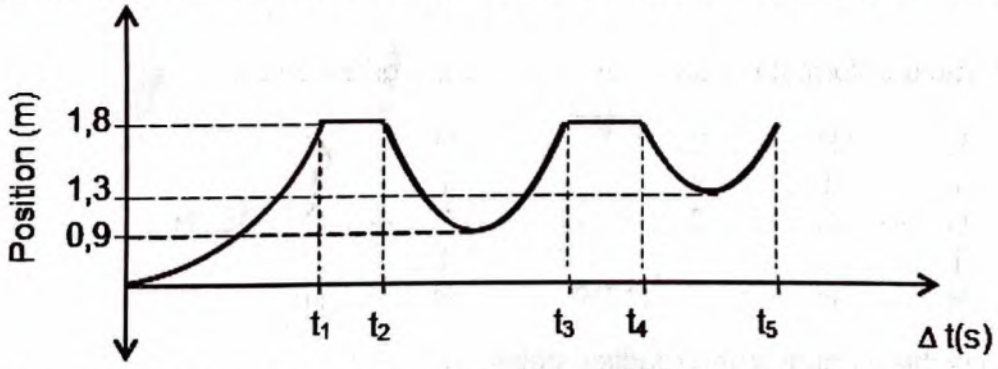
2.2 Draw the free body diagram showing all forces acting on the box. (4)

2.3 Calculate the magnitude of the normal force when the static frictional force is at its maximum. (3)

2.4 Determine the angle θ (4)
[13]

QUESTION 3 (Start on a new page.)

A ball of mass 0,5 kg is projected vertically downwards from a height of 1,8 m with an initial velocity of 2 m.s^{-1}. The ball hits the ground and bounces two times.
The position – time graph for the motion of the ball from the instant it is projected until it hits the ground after the second bounce is shown below. Ignore the effects of friction.



3.1 Write down the maximum vertical height reached by the ball after the SECOND bounce? (1)

3.2 The ball strikes the ground with a speed of 6,27 m.s^{-1} and is in contact with the ground for 0,2 s during the first bounce.

3.2.1 Calculate the time t_1 as indicated on the graph. (4)

3.2.2 Determine the velocity with which the ball leaves the ground after the first bounce. (4)

3.2.3 Calculate the magnitude of the force exerted by the ground on the ball during the first bounce. (4)

3.3 Draw a velocity – time graph for the motion of the ball from the time that it is projected to the time it rebounds to a height of 0.9 m.

Clearly show the following on your graph:

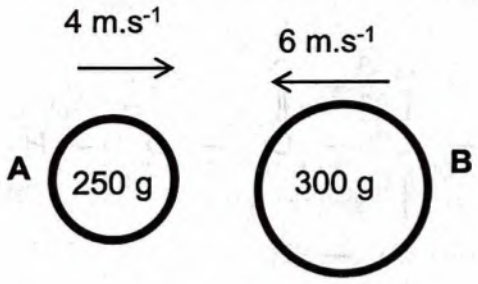
- The time when the ball hits the ground
- The velocity of the ball when it hits the ground
- The velocity of the ball when it rebounds off the ground.

(3)
[16]

QUESTION 4 (Start on a new page.)

Two balls, A and B, of mass 250 g and 300 g respectively collide head-on. Before the collision, ball A was moving at a velocity of 4 $m.s^{-1}$ to the right and ball B at 6 $m.s^{-1}$ to the left. After the collision ball A moved to the left with a velocity of 2 $m.s^{-1}$.

Before collision



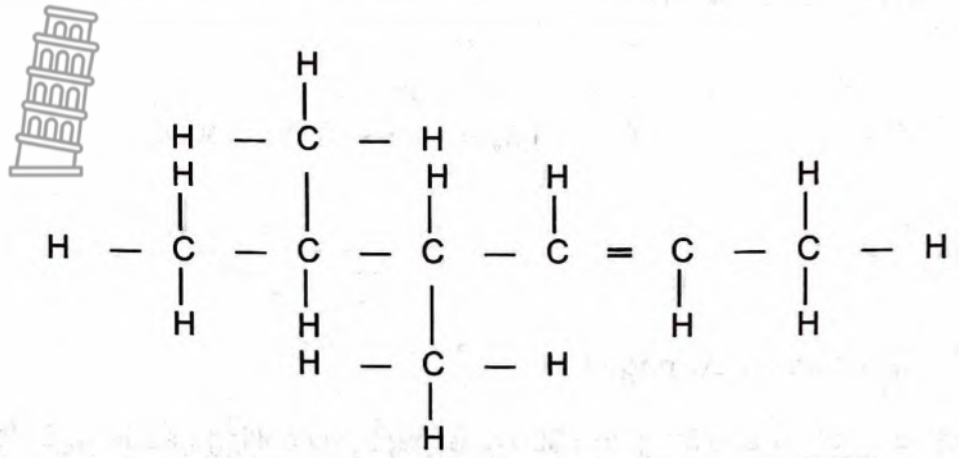
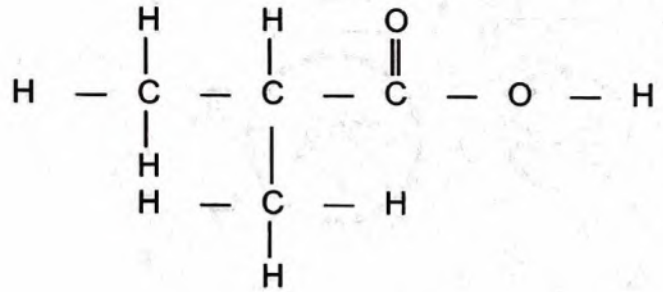
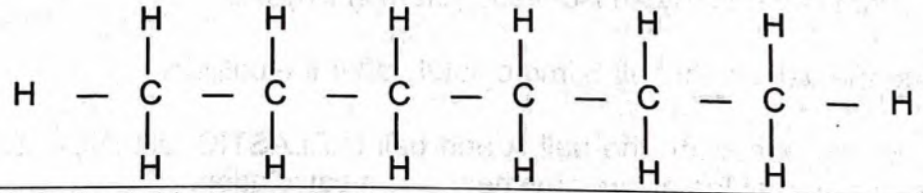
4.1 Explain what is meant by an *isolated system* in Physics. (2)

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

4.3 Is the collision between the ball A and ball B ELASTIC OR INELASTIC? Show how you arrived at the answer by means of a calculation. (5)
[11]

QUESTION 5 (Start on a new page.)

Consider the letters A to E in the table below:

A	
B	$C_4H_{10}O$
C	$CH_3CCCH_2CH_3$
D	but – 2 – ene
E	
F	

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

5.1 Write down the:

5.1.1 IUPAC name of compound A. (3)

5.1.2 Letter that represents a compound that belongs to the same homologous series as ethyne. (1)

5.1.3 NAME of the functional group of compound E. (1)

5.1.4 General formula of the homologous series to which compound A belongs. (1)

5.2 Compound B represents a TERTIARY alcohol. Write down the structural formula of compound B. (2)

5.3 Compound D has CHAIN and POSITIONAL isomers.

5.3.1 Define *positional isomer* (2)

5.3.2 Write down the IUPAC NAME of the POSITIONAL isomer of compound D (1)

5.3.3 Write down the structural formula of a CHAIN isomer of compound D (2)

5.4 Is compound C saturated or unsaturated? Give a reason for the answer (2)

5.5 Compound F undergoes complete combustion. Write a balanced equation using MOLECULAR FORMULAE to represent the reaction that takes place. (3)
[18]

QUESTION 6 (Start on a new page.)

The table below shows the results obtained during a practical investigation. Two experiments were conducted to determine the BOILING POINTS of compounds under the same conditions.

Experiment	Compound		Molecular Mass ($g.mol^{-1}$)	Boiling Point (°C)
1	A	CH_3COOH	60,5	11,8
	B	$CH_3(CH_2)_2COOH$	88,1	163
2	C	$CH_3CH_2CH_2OH$	60,1	97
	D	$CH_3(CH_2)_3CH_2OH$	88,1	137

6.1 Define *boiling point*. (2)

6.2 Apart from the conditions for determining boiling points, state the controlled variable for experiment 1. (1)

6.3 Write down the general conclusion for this investigation. (2)

6.4 Which compound will have the highest vapour pressure? (1)

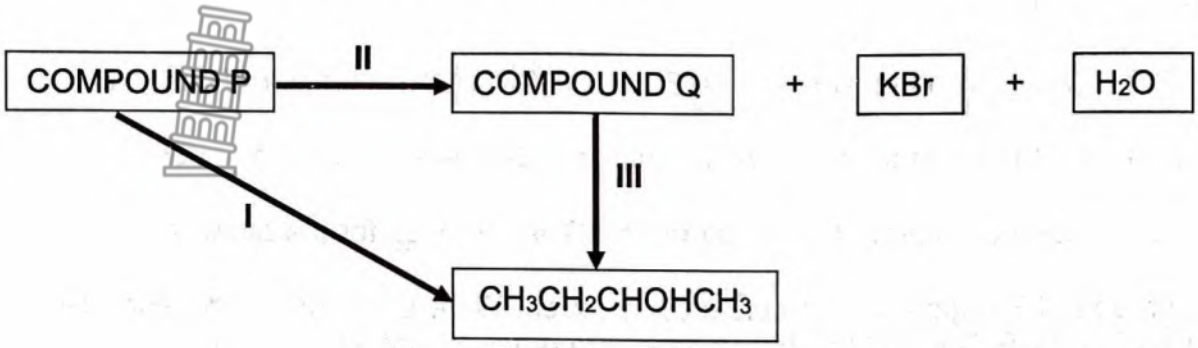
6.5 The boiling points of compounds B and D are compared.

6.5.1 Write down the independent variable for this comparison. (1)

6.5.2 Fully explain the difference in the boiling points of the two compounds. (3)
[10]

QUESTION 7 (Start on a new page.)

In the flow diagram below **I, II** and **III** represent organic reactions. P and Q are different organic compounds. Q is the major organic product.



7.1 Name the TYPE of substitution reaction represented by reaction **I**. (1)

7.2 Write down the STRUCTURAL formula for compound Q. (2)

7.3 Name the inorganic reagent used in reaction **III** (1)

7.4 Write down the type of reaction represented by reaction **III** (1)

7.5 The same INORGANIC reagent is used in reactions **I** and **II**.
Write down

7.5.1 The NAME or FORMULA of the inorganic reagent used. (1)

7.5.2 ONE difference between the inorganic reagent used in reactions **I** and **II**. (2)

7.6 Write down the IUPAC name of:

7.6.1 Compound P (2)

7.6.2 The organic product of reaction **III** (2)

[12]

TOTAL MARKS: [100]

DATA FOR PHYSICAL SCIENCES (PHYSICS) GRADE 12

GEGEWENS VIR FISIESE WETENSKAPPE (FISIKA) GRAAD 12

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	G	6,67 x 10^{-11} $N.m^2.kg^{-2}$

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

FORCE/*KRAG*

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

DATA FOR PHYSICAL SCIENCES GRADE 12
CHEMISTRY

TABLE 1: PHYSICAL CONSTANTS:

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 electron*	E	$-1{,}6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6{,}02 \times 10^{23}$ mol^{-1}

TABLE 2: FORMULAE

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ 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	

TABLE 3: THE 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)
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	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	La 139	1,6 Hf 179	Ta 181	W 184	Re 186	Os 190	Ir 192	Pt 195	Au 197	Hg 201	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	Rn
0,7 Fr	0,9 Ra 226	Ac															

58	59	60	61	62	63	64	65	66	67	68	69	70	71
Ce 140	Pr 141	Nd 144	Pm	Sm 150	Eu 152	Gd 157	Tb 159	Dy 163	Ho 165	Er 167	Tm 169	Yb 173	Lu 175
90	91	92	93	94	95	96	97	98	99	100	101	102	103
Th 232	Pa	U 238	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

KEY

Atomic number

Electronegativity → 29 / 1,9 Cu / 63,5 ← Symbol

Approximate relative atomic mass