education
Department: Education
GAUTENG PROVINCE

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES:

CONTROLLED TEST

MARKS: 100

TIME: 2 hours

This question paper consists of 13 pages and 3 data sheets.

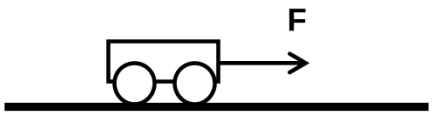
INSTRUCTIONS AND INFORMATION

1. Write your NAME in the appropriate space on the ANSWER BOOK.
2. This question paper consists of ELEVEN 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 the 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 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

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A-D) of the answer next to the question number (1.1 – 1.10) in the ANSWER BOOK.

1.1 A trolley moves on a flat, horizontal surface when a constant force, F, is applied to it.



Which **ONE** of the following physical quantities will **ALWAYS** remain constant while the trolley is moving?

A momentum
B acceleration
C kinetic energy
D gravitational potential energy

(2)

1.2 An object, moving vertically upwards, reaches a maximum height and falls back to the ground. Ignore air resistance. Which **ONE** of the following statements is **TRUE**? The object experiences an acceleration which ….

A is always downwards
B is first upwards and then downwards
C is first downwards and then upwards
D decreases first and then increases

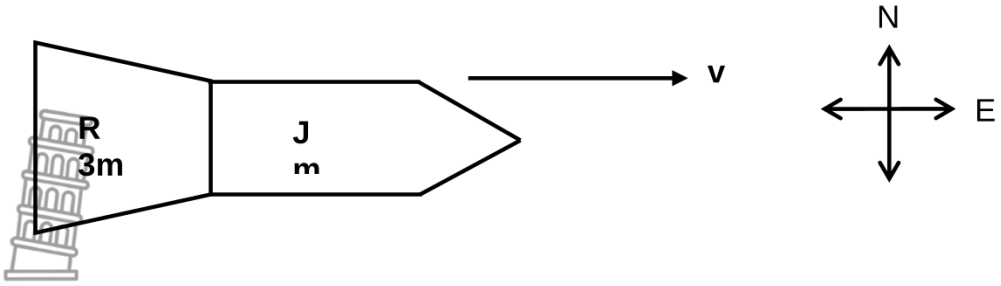
(2)

1.3 A satellite experiences a gravitational force of magnitude **F** on the surface of the earth. The radius of the earth is **R**. The satellite now circles the earth at an unknown height above the surface of the earth and experiences a gravitational force of magnitude ¼ **F**. This unknown height is ….

A **R**
B 2 **R**
C 3 **R**
D 4 **R**

(2)

1.4 A spacecraft, made up of two modules R and J of masses **3m** and **m** respectively, is travelling horizontally at a velocity **v** due east. An explosion causes the two modules to separate.

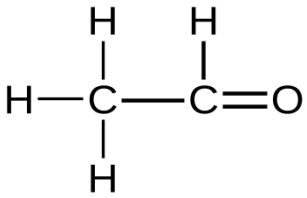


Module J continues in its original direction immediately after the explosion with a velocity of 3**v**. What will be the **magnitude and direction** of module R's velocity immediately after the explosion?

	Magnitude of velocity of R	**Direction of R after explosion**
A	1 **v**	East
B	1 **v**	West
C	⅓ **v**	East
D	⅓ **v**	West

(2)

1.5 Consider the structural formula of an organic compound below.



Which ONE of the following is the correct IUPAC name of this compound?

A Ethanone

B Ethene.

C Ethanol

D Ethanal. (2)

1.6 Which ONE of the following reaction types can be used to prepare ETHENE from bromoethane?

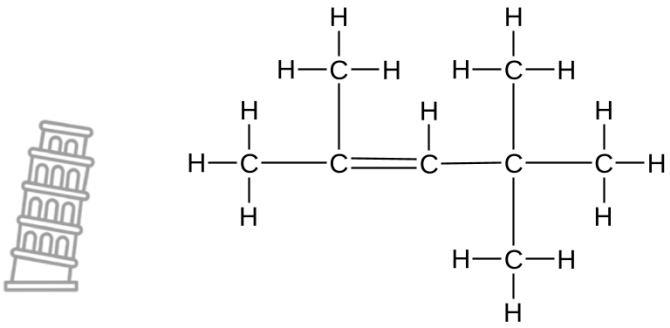
A Hydrogenation

B Substitution

C Dehydrohalogrnation

D Addition (2)

1.7 Consider the structural formula of an organic compound below.



Which ONE of the following is the correct IUPAC name of this compound?

A 2,2,4-trimethylpent-2-ene
B 2,2,4-trimethylpent-3-ene
C 2,4,4-trimethylpent-2-ene
D 2,4,4-trimethylpent-3-ene (2)

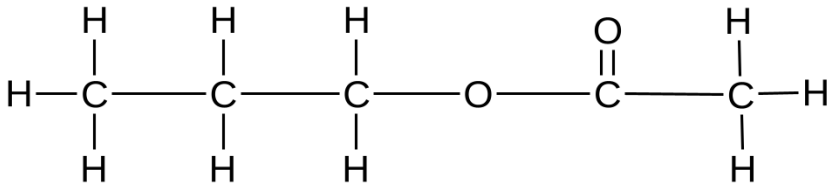
1.8 The following equation represents the cracking of a hydrocarbon at high temperature and pressure:

$$C_{11}H_{24} \longrightarrow 2C_2H_4 + \mathbf{Y} + C_4H_{10}$$

Which ONE of the following is the IUPAC name of product **Y**?

A Prop-1-ene.
B Propane.
C Ethene.
D Ethane. (2)

1.9 Consider the structural formula of a compound below.



Which ONE of the following pairs of reactants can be used to prepare this compound in the laboratory?

A Propanoic acid and ethanol
B Propanoic acid and methanol
C Ethanoic acid and propan-1-ol
D Methanoic acid and propan-1-ol (2)

1.10 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)

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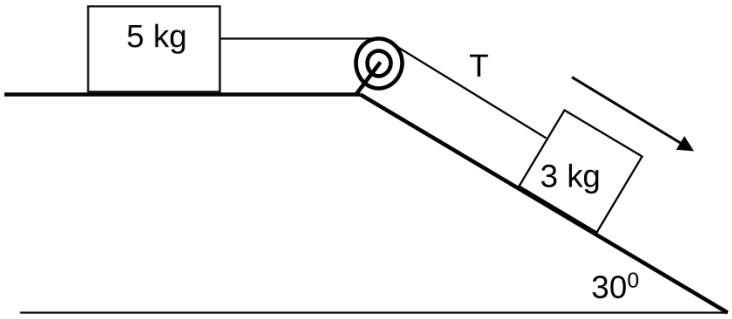
QUESTION 2 (Begin on a new page.)

Two blocks of masses 5 kg and 3 kg respectively are connected by a light inextensible string that runs over a light frictionless pulley as shown in the diagram below. The 5 kg block experience a frictional force of 8 N and the coefficient of kinetic friction between the 3 kg block and the surface of the inclined plane is 0,15.



2.1 Define the term *frictional force.* (2)

2.2 Draw a labelled free-body diagram to indicate all the forces acting on the 3 kg block. (3)

2.3 Calculate the:

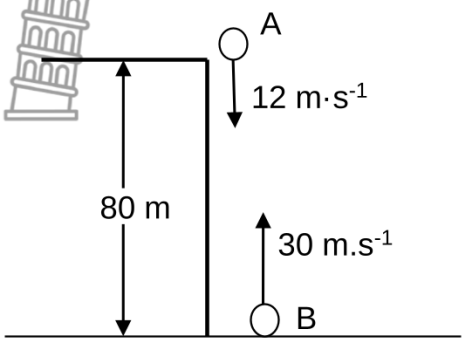
2.3.1 Magnitude of the frictional force acting between the 3 kg block and the surface of the inclined plane (3)

2.3.2 Magnitude of the tension **T** in the string (6)

[14]

QUESTION 3 (Begin on a new page.)

Ball **A** is thrown vertically downwards from the top of a building, 80 m high, at a velocity of 12 m·s^{-1}. At the same instant a second identical ball **B** is thrown upwards at a velocity of 30 m·s^{-1}. Ball **A** and ball **B** pass each other after 2,135 s. Ignore all effects of air friction.



3.1 Give the direction of the acceleration of ball **B** while moving upwards. (1)

3.2 Calculate the velocity of ball **B** the moment it passes ball **A**. (3)

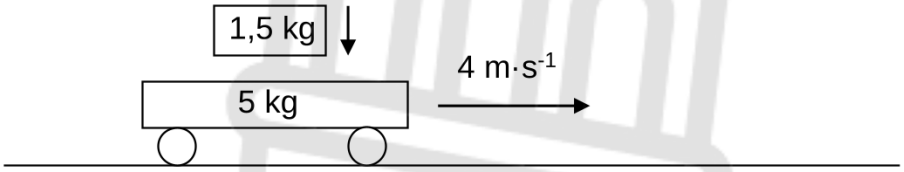
3.3 Calculate the distance between ball **A** and **B** 2,5 s after it was projected. (6)

3.4 Sketch a position-time graph for the motion of ball **A** till it reaches the ground as well as for the motion of ball **B** until it passes ball **A**. Use the ground as zero position. Clearly indicate the time at which the balls pass each other. (3)

[13]

QUESTION 4 (Begin on a new page.)

A trolley, mass 5 kg, moves at 4 m·s^{-1} east across a frictionless horizontal surface. A brick of mass 1,5 kg is dropped onto the trolley.



4.1 Define in words the *Law of Conservation of Momentum*. (2)

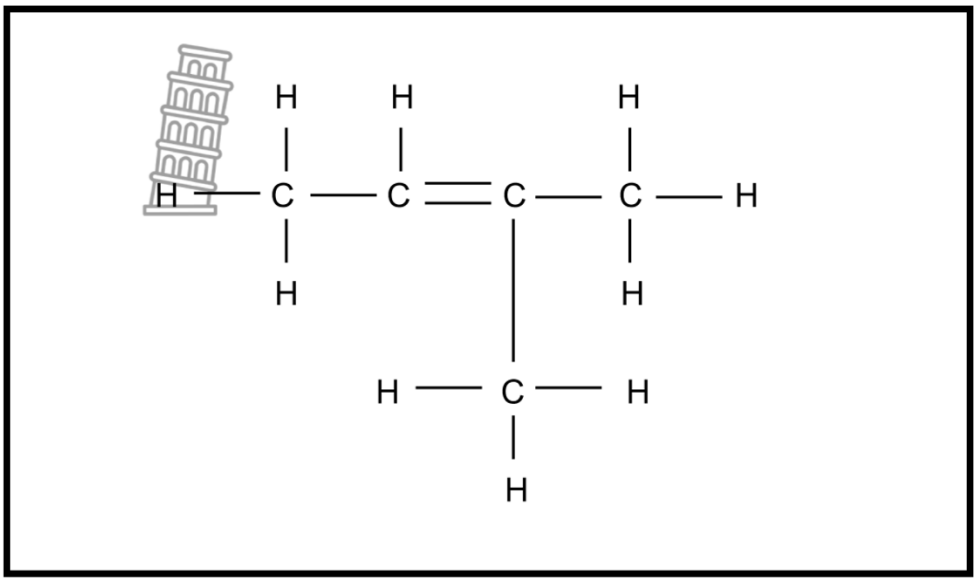
4.2 State the condition for an elastic collision. (1)

4.3 Calculate the change in momentum of the 5 kg trolley. (5)

[8]

QUESTION 5

5.1 The structural formula of an unsaturated compound is given below.



5.1.1 Define the term *unsaturated* compound. (2)

5.1.2 Write down the IUPAC name of the compound. (2)

5.2 Butanoic acid is a FUNCTIONAL isomer of methyl propanoate.

5.2.1 Write down the NAME of the functional group of butanoic acid. (2)

5.2.2 Draw the STRUCTURAL formula of butanoic acid. (2)

5.2.3 Draw the STRUCTURAL formula of methyl propanoate. (2)

5.2.4 Explain why butanoic acid and methyl propanoate are described as FUNCTIONAL isomers. (2)

5.2.5 Write down the IUPAC name of the alcohol used to prepare methyl propanoate. (2)

5.2.6 Write down the IUPAC name of a POSITIONAL isomer of methyl propanoate. (2)

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QUESTION 6 [START ON A NEW PAGE]

A learner conducts an investigation to determine the boiling points of different organic compounds. The data is recorded in the table below.

	FORMULA	**MOLECUAR MASS ($g \cdot mol^{-1}$)**	**BOILING POINT (^oC)**
A	$CH_3(CH_2)_4OH$	88	138
B	$CH_3(CH_2)_3CHO$	86	103
C	$CH_3(CH_2)_2CO_2H$	88	164
D	$CH_3(CH_2)_4CH_3$	86	69

6.1 Write down the IUPAC name for compound **B**. (2)

6.2 Is compound **A** considered as a PRIMARY, SECONDARY or TERTIARY alcohol? Give a reason for the answer. (2)

6.3 The boiling point of compound **B** is now compared with the boiling point of compound **D**.

6.3.1 Is this a fair comparison? Write down YES or NO. Refer to the data in the table and give a reason for the answer. (2)

6.3.2 Refer to INTERMOLECULAR forces and explain why compound **B** has a higher boiling point than compound **D**. (3)

6.4 Another learner investigates the vapour pressure of the compounds in the table.

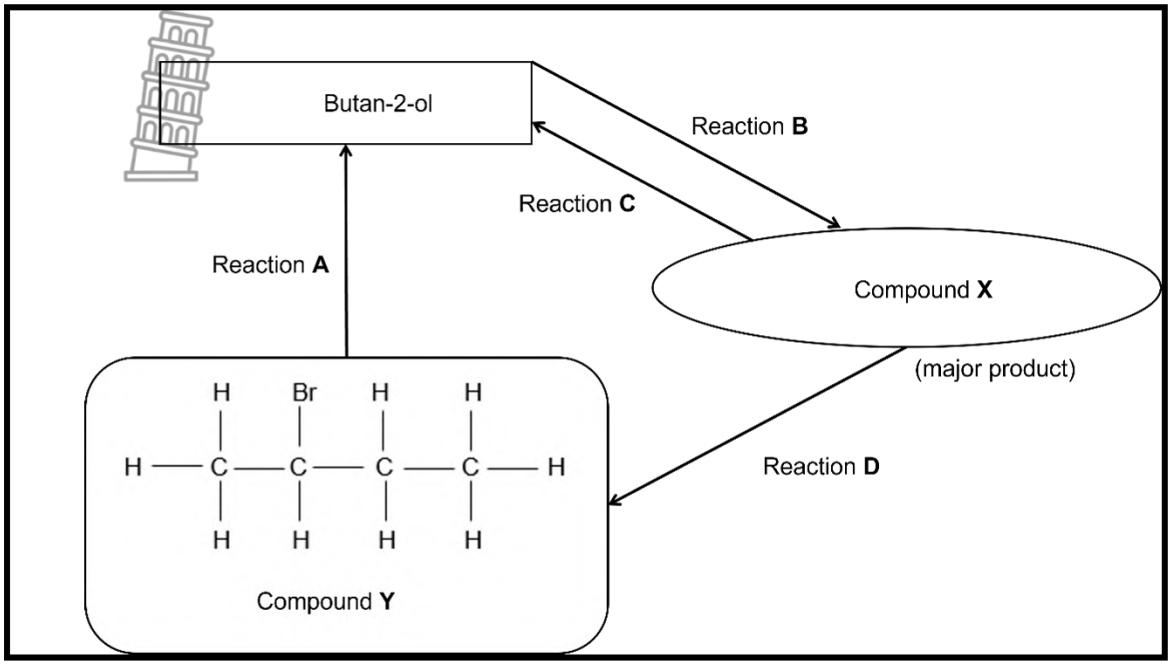
6.4.1 Define the term vapour *pressure*. (2)

6.4.2 Which compound, **A** or **C** has the HIGHEST vapour pressure? (2)

[13]

QUESTION 7 [START ON A NEW PAGE]

The flow diagram below represents the interconversion between the following three organic compounds: butan-2-ol, compound **X** and compound **Y**.



7.1 Reaction **B** represents the ELIMINATION of water from butan-2-ol to form compound **X**.

7.1.1 Write down the NAME of a catalyst required in reaction **B**. (1)

7.1.2 Name the TYPE of elimination reaction represented by reaction **B**. (1)

7.1.3 Using STRUCTURAL FORMULAE, write down a balanced equation for reaction **B**. (4)

7.2 State the TWO reaction conditions for reaction **A**? (2)

7.3 Which GENERAL type of reaction takes place in reaction **C**? (2)

7.4 Write down the:

7.4.1 IUPAC name of compound **Y**. (2)

7.4.2 Reaction condition for reaction **D**. (2)

[14]

Grand Total: 100

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

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 gravitasiekonstant*	G	$6,67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3,0 \times 10^{8}\ m{\cdot}s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}\ J{\cdot}s$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^{9}\ N{\cdot}m^2{\cdot}C^{-2}$
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}\ kg$

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*

$F_{net} = ma$	$p = mv$	$f_K = \mu_K N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$	$f_S = \mu_S N$

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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$	
$P = Fv$		

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s} f_s$ $f_L = \frac{v \pm v_L}{v \pm v_b} f_b$	$E = hf$ or/*of* $E = h\frac{c}{\lambda}$
$E = W_o + E_k$ where/*waar* $E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_k = \frac{1}{2}mv^2$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{V}{d}$	$E = \frac{F}{q}$
$V = \frac{W}{q}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	emf (ε) = I(R + r) emk (ε) = I(R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\,\Delta t$
W = Vq W = VIΔt W= $I^2R\Delta t$ W= $\frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ P = VI P = I^2R P = $\frac{V^2}{R}$

ALTERNATING CURRENT/*WISSELSTROOM*

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