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KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES

COMMON TEST

MARCH 2022

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MARKS : 100

TIME : 2 Hours

This question paper consists of 10 pages and 3 data sheets

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INSTRUCTIONS AND INFORMATION

1. Write your centre number and examination number 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 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.

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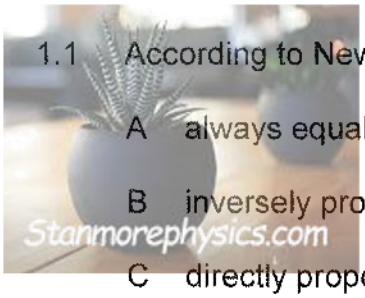
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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 (1.1-1.6) in the ANSWER BOOK, for example 1.11 D.



1.1 According to Newton's Second Law of Motion, the acceleration of an object is ...

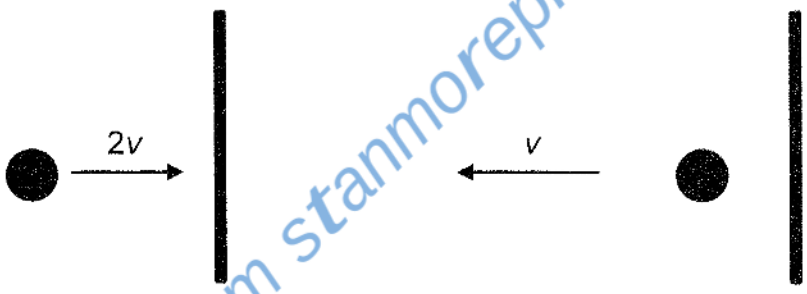
A always equal to its mass.

B inversely proportional to its mass.

C directly proportional to its mass.

D independent of its mass. (2)

1.2 A ball, moving horizontally, hits a wall with a speed $2v$. The ball then bounces back horizontally with a speed v, as shown in the diagram below.



Which ONE of the following combinations regarding the linear momentum and the total kinetic energy of the ball for the collision above is CORRECT? Assume that the ball-wall system is isolated.

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

(2)

1.3 An object falls freely in a vacuum near the surface of the Earth. Which ONE of the following statements regarding the motion of the object is CORRECT?

A The rate of change of velocity of the object will remain constant.

B The rate of change of velocity of the object will increase uniformly.

C The velocity of the object will decrease uniformly.

D The velocity of the object will remain constant. (2)

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1.4 Which ONE of the following compounds is SATURATED?

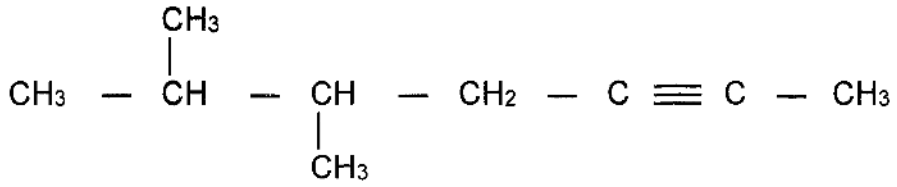
A $CH_3CHCHCH_3$

B $CH_3CH_2CHCH_2$

C $CH_3CH(CH_3)CH_3$

D $CH_3C(CH_3)_2CHCH_2$ (2)

1.5 The structural formula of an organic compound is given below:



The IUPAC name of the above compound is:

A 2,3-dimethylhept-2-yne.

B 5,6–dimethylhept–2–yne.

C 2,3–dimethylhept–5–yne.

D 5,6–dimethylhept–3–yne. (2)

1.6 Consider the reaction represented below:

$$CH_3CH_2CH_2CH_2CH_3 \longrightarrow C_2H_6 + X$$

Which ONE of the following correctly gives the type of reaction that takes place and the homologous series to which the product X belongs?

	TYPE OF REACTION	HOMOLOGOUS SERIES
A	addition	alkane
B	addition	alkene
C	elimination	alkane
D	elimination	alkene

(2)

6 x 2 =**[12]**

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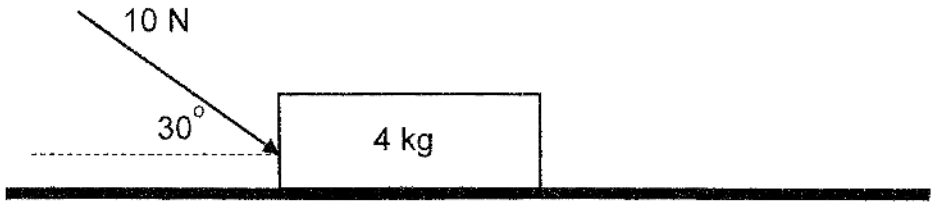
QUESTION 2 (Start on a new page.)

2.1 A crate of mass 4 kg is being pushed to the right across a *rough* horizontal surface by a constant force of magnitude 10 N that acts at an angle of 30^0 to the horizontal.



2.1.1 State *Newton's Second Law* in words (2)

2.1.2 Draw a free body diagram for the crate (4)

A constant frictional force of 2 N acts between the surface and the crate.

Calculate the magnitude of the:

2.1.3 Normal force on the crate (3)

2.1.4 Acceleration of the crate (4)

If the angle of the 10 N force is reduced, how will this affect the magnitude of the: (Choose from INCREASES, DECREASES or REMAIN THE SAME)

2.1.5 Normal force calculated in question 2.1.3 above. (1)

2.1.6 Acceleration of the crate calculated in 2.1.4 above. Explain the answer. (3)

2.2 State *Newton's Law of Universal Gravitation* in words. (2)

2.3 Calculate the acceleration due to gravity for an object on the surface of the Earth. (3)
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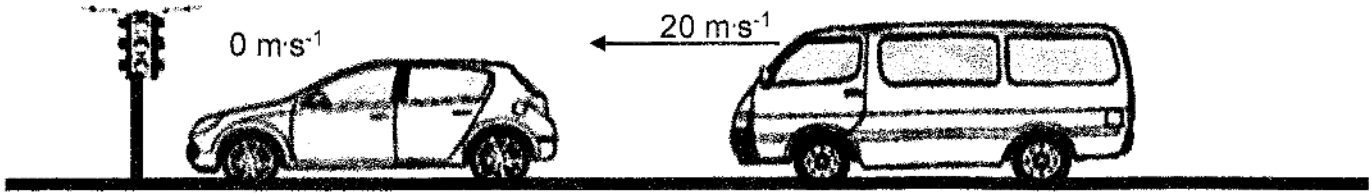
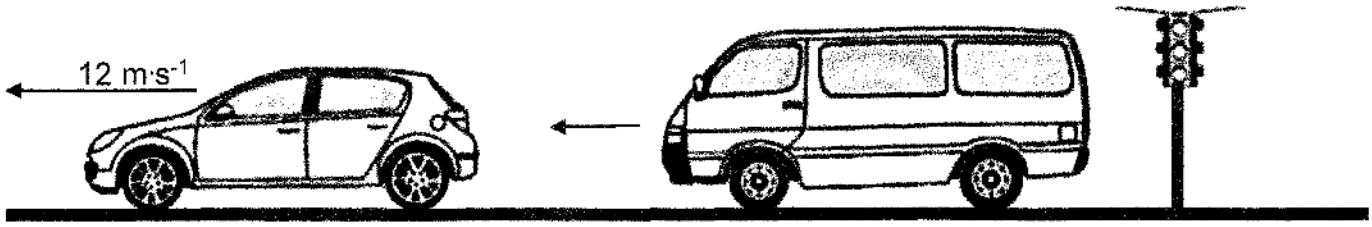
QUESTION 3 (Start on a new page.)

A car of mass 1 500 kg is stationary at a traffic light. It is hit from behind by a minibus of mass 2 000 kg travelling at a speed of 20 m·s^{-1}. Immediately after the collision the car moves forward at 12 m·s^{-1}.

Before



After



3.1 State the *Law of Conservation of Linear Momentum* in words. (2)

3.2 Calculate the speed of the minibus immediately after the collision. (4)

3.3 The driver of the minibus is NOT wearing a seatbelt.

Describe the motion that the driver undergoes immediately after the collision. (1)

3.4 Name the law of physics which can be used to explain your answer about the motion of the driver in QUESTION 3.3. (1)

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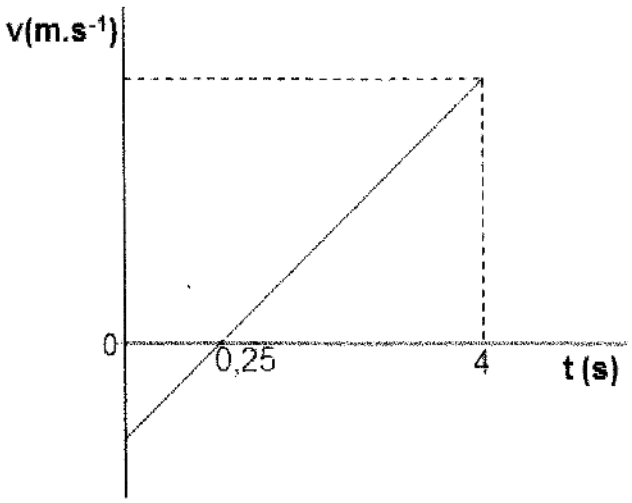
QUESTION 4 (Start on a new page.)

The following velocity- time graph is obtained for an object in free fall. Neglect any air resistance.



4.1 Explain what is meant by the term *free fall* (2)

4.2 Use the above graph to describe fully the motion of the object. (3)

4.3 Calculate the initial velocity of the object. (3)

4.4 Calculate the final velocity of the object. (3)

4.5 Draw a position – time sketch graph for the entire motion of the object. Take the starting position as the zero position. Indicate all relevant times on the graph. (3)

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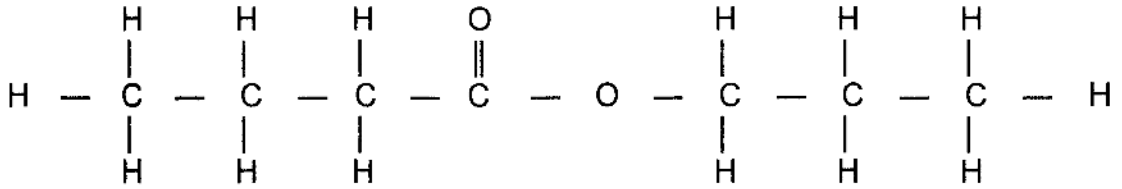
QUESTION 5 (Start on a new page.)

The letters A to E in the table below represent five organic compounds.

A	
B	2-methylbutanoic acid
C	Pentan-2-ol
D	2,2,4-trimethylhexane
E	C_4H_8

Use the above table to answer the following questions:

5.1 For compound A, write down:

5.1.1 The name of the homologous series to which it belongs. (1)

5.1.2 Its IUPAC name. (2)

5.1.3 The name of the homologous series to which its FUNCTIONAL ISOMER belongs. (1)

5.2 Define *functional group*. (2)

5.3 Write down the name of the functional group of compound B. (1)

5.4 Draw the structural formula of the functional group of compound E. (1)

5.5 Define *structural isomers*. (2)

5.6 Consider compound C:

5.6.1 Classify compound C as a primary, secondary or tertiary alcohol. Give a reason for the answer. (2)

5.6.2 Draw the structural formula of the POSITIONAL ISOMER of compound C. (2)

5.7 Compound D is a hydrocarbon.

5.7.1 Define the term *hydrocarbon*. (2)

5.7.2 Draw the structural formula for compound D. (3)

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QUESTION 6 (Start on a new page.)

An investigation was conducted to determine the boiling points of **straight** chain organic compounds, X, Y and Z, from three different homologous series. The table below reflects the results obtained.

ORGANIC COMPOUND	BOILING POINT (°C)
X	-89,00
Y	78,40
Z	118, 50

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

6.2 Which compound, X, Y or Z will have the lowest vapour pressure at room temperature? Give a reason for the answer. (2)

6.3 Which compound X, Y or Z is a gas at room temperature? (1)

6.4 Write an investigative question for the above investigation. (2)

6.5 Give a reason why all three compounds used in the investigation are straight chain compounds. (1)

6.6 The homologous series to which the compounds, X, Y and Z belong were randomly identified as alcohols, alkanes and carboxylic acids.

6.6.1 Which compound, X, Y or Z has the carboxyl group as the functional group? (1)

6.6.2 Explain the answer to question 6.5.1 (4)

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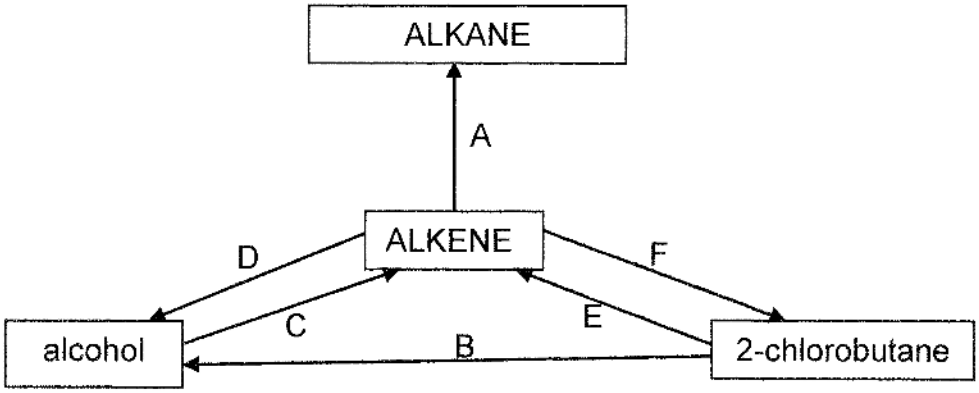
QUESTION 7 (Start on a new page.)

In the flow diagram below, the letters A, B, C, D, E and F represent organic reactions.



Use the information in the flow diagram to answer the following questions:

7.1 Write down the type of reaction represented by:

7.1.1 A. (1)

7.1.2 E. (1)

7.2 Name the type of:

7.2.1 elimination reaction represented by C. (1)

7.2.2 addition reaction represented by F. (1)

7.3 Reaction B is a substitution reaction.

Write down:

7.3.1 Type of substitution reaction represented by B. (1)

7.3.2 TWO reaction conditions for this reaction. (2)

7.4 Besides heating under reflux, state one other reaction condition for reaction E. (1)

7.4 Using condensed structural formulae, write down a balanced chemical equation for reaction D. (4)

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TOTAL: 100

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NSC

TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABEL 3: DIE PERIODIEKE TABEL VAN ELE

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1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	1513] (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 **Ce** 140	59 **Pr** 141	60 **Nd** 144	61 **Pm**	62 **Sm** 150	63 **Eu** 152	64 **Gd** 157	65 **Tb** 159	66 **Dy** 163	67 **Ho** 165	68 **Er** 167	69 **Tm** 169	70 **Yb** 173	71 **Lu** 175
90 **Th** 232	91 **Pa**	92 **U** 238	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lr**

KEY/*SLEUTEL*

Atomic number *Atoomgetal*

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

Approximate relative atomic mass *Benaderde relatiewe atoommassa*

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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 gravitasiekonstante*	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 electron*	e^-	$-1,6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}\ kg$
Mass of Earth *Massa van Aarde*	M	$5,98 \times 10^{24}\ kg$
Radius of Earth *Radius van Aarde*	R_E	$6,38 \times 10^{6}\ m$

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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

$F_{net} = ma$	$p = mv$
$f_{s(max)} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$g = \frac{Gm}{r^2}$

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 $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{av} = F \cdot v_{av}$ / $P_{gem} = F \cdot v_{gem}$	

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