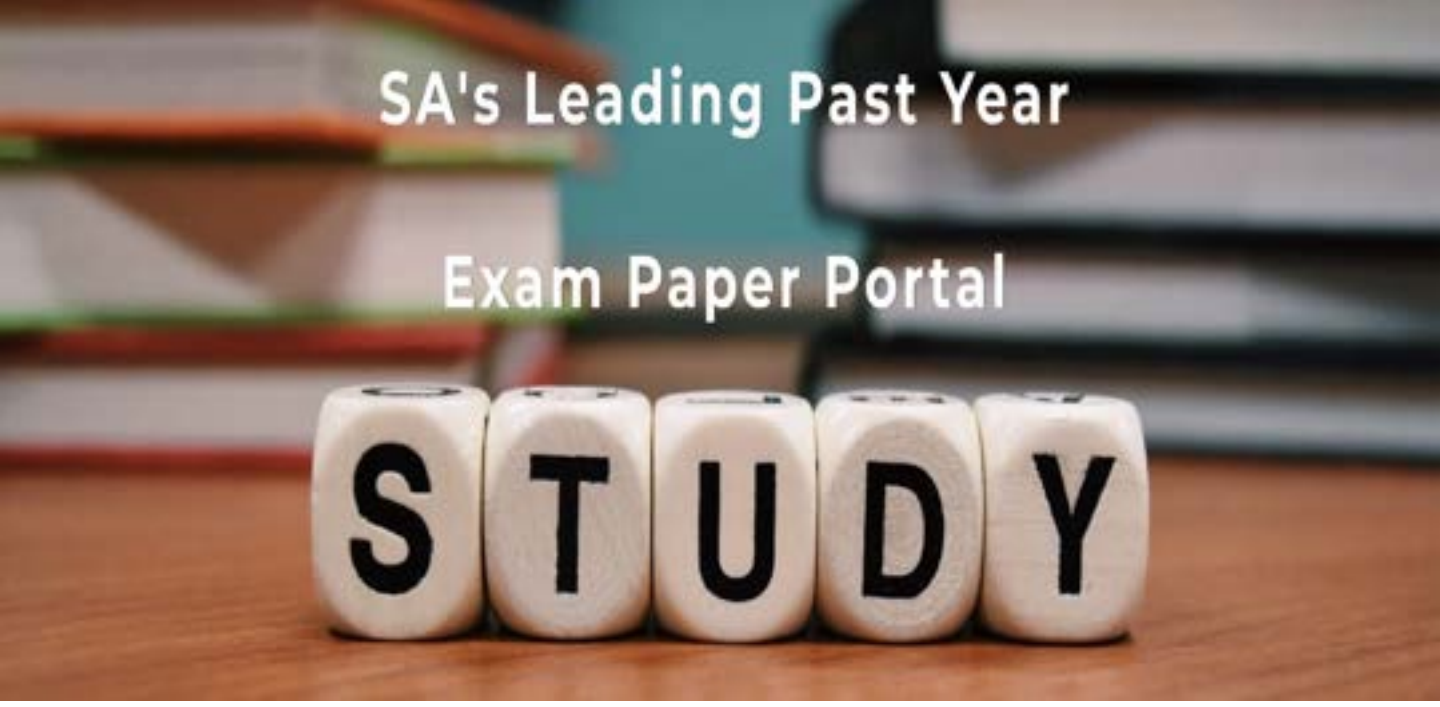

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KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES

COMMON TEST

APRIL 2021

MARKS : 100

TIME : 2 Hours

This question paper consists of 11 pages and 2 data sheets

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.

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 A car of mass 1000 kg pulls a trailer of mass 500 kg as shown.

According to Newton's third law of motion, which ONE of the following statements is TRUE?

A The car and trailer pull each other with a force that is equal in magnitude but opposite in direction. Therefore, the net force is zero and the trailer cannot move.

B The force that the car exerts on the trailer is greater than the force that the trailer exerts on the car. Therefore, the trailer moves forward.

C The action force from the car is quicker than the reaction force from the trailer, so they move forward.

D The action-reaction forces are equal in magnitude, but the force between the ground and wheels pushes them forward. (2)

1.2 When the momentum of an object of constant mass is doubled, then its kinetic energy will be ...

A halved.

B doubled.

C three times greater.

D four times greater. (2)

1.3 Two objects are released from the same height at the same time. One object has TWICE the weight of the other. Neglecting friction, which ONE of the following statements is CORRECT for the motion?

A The heavier object hits the ground first

B The lighter object hits the ground first.

C Both objects hit the ground at the same time

D On hitting the ground, the heavier object has a greater velocity than the lighter object (2)

1.4 Which ONE of the following compounds is a KETONE?

A $CH_3COCH_2CH_3$

B $CH_3COOCH_2CH_3$

C $CH_3CH_2CH_2CHO$

D $CH_3CH(OH)CH_2CH_3$ (2)

1.5 **P** and **Q** represent two organic compounds in the reactions below:

REACTION I: ethene $\xrightarrow{HBr}$ **P**

REACTION II: P $\xrightarrow[heat]{NaOH(aq)}$ **Q**

Which ONE of the following represents compound **Q?**

A CH_2CH_2

B CH_3CH_3

C CH_3CH_2OH

D CH_3CH_2Br (2)

1.6 $C_nH_{2n}O_2$ is the general formula for both . . .

A A ketone and an aldehyde.

B An ester and an aldehyde.

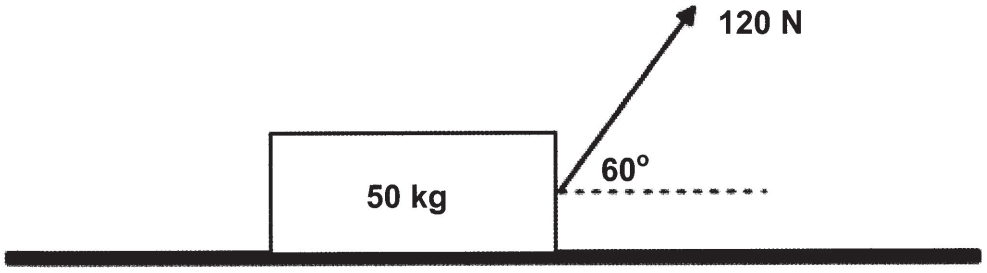
C A ketone and a carboxylic acid.

D An ester and a carboxylic acid. (2)

[12]

QUESTION 2

2.1 A box of mass of 50 kg, placed on a ROUGH horizontal surface, is pulled by a force of 120 N that acts at an angle of 60° to the horizontal. The box moves at a CONSTANT VELOCITY along the surface.



2.1.1 State *Newton's First Law of Motion* in words. (2)

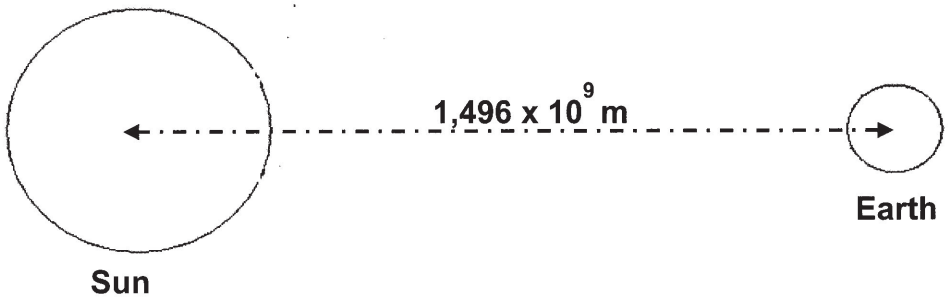
2.1.2 Draw a free-body diagram of ALL the forces acting on the box while it moves. (4)

2.1.3 The box is travelling at constant velocity. What can be deduced about the forces acting on the box? (1)

2.1.4 Calculate the normal force acting on the box. (3)

2.1.5 The angle of the applied force is now decreased. How will this affect the magnitude of the normal force?
Choose from INCREASES, DECREASES or REMAINS THE SAME
EXPLAIN the answer. (3)

2.2 The Sun and the Earth exert a gravitational force on each other.

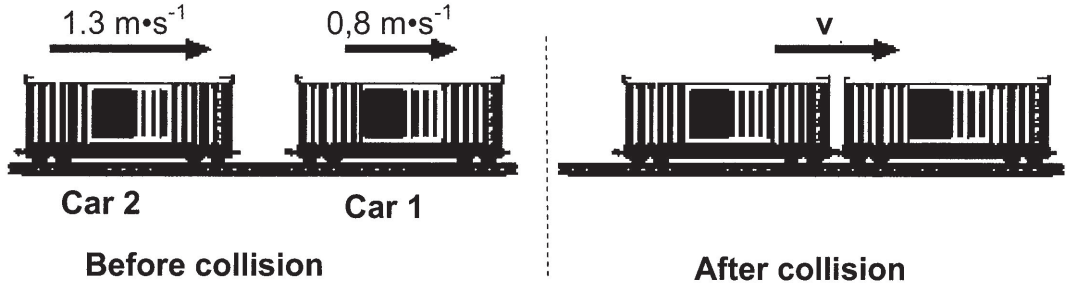


2.2.1 State Newton's law of Universal Gravitation in words. (2)

2.2.2 The mass of the Sun is 332 600 times greater than that of the Earth. The distance between the centres of the Sun and the Earth is $1{,}496 \times 10^{9}$ m. Calculate the gravitational force that the Sun exerts on the Earth. (4)
[19]

QUESTION 3

A goods train is being assembled in a yard. Car 2, of mass of 92 x 10^3 kg and moving with a velocity of 1.3 m•s^{-1} to the right collides with Car 1 of mass 65 x 10^3 kg that is moving to the right with a velocity of 0.80 m•s^{-1}. The two cars are joined together after the collision. Ignore the effects of friction.



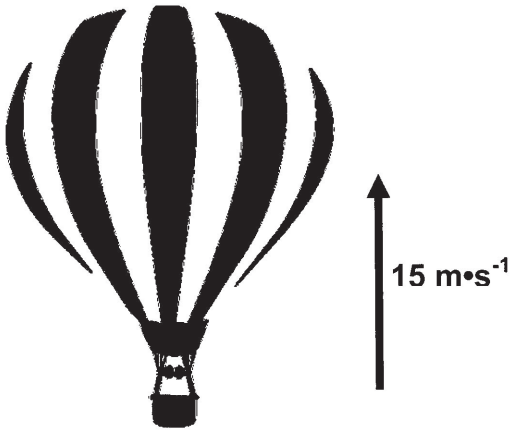
3.1 State the principle of conservation of momentum in words (2)

3.2 Calculate the magnitude of the velocity of the cars after the collision. (4)

3.3 Determine, by means of appropriate calculations, whether the collision between the two cars is elastic or inelastic. (5)
[11]

QUESTION 4

A hot air balloon is rising vertically at a constant velocity of 15 m•s^{-1}. When the balloon is at some unknown height above the ground, a stone is released from the balloon. The stone is observed to hit the ground with a velocity of 45 m•s^{-1}.



4.1 Define free fall (2)

4.2 Write down the magnitude and direction of the initial velocity of the stone when it is released (2)

4.3 Determine how high above the ground the hot air balloon was when the stone was released from it. (3)

4.4 Determine how long the stone took to hit the ground after being released. (3)

4.5 Sketch the position-time graph for the entire motion of the stone from the moment it was released from the hot air balloon to the moment it hits the ground. Use the ground as a zero reference point.

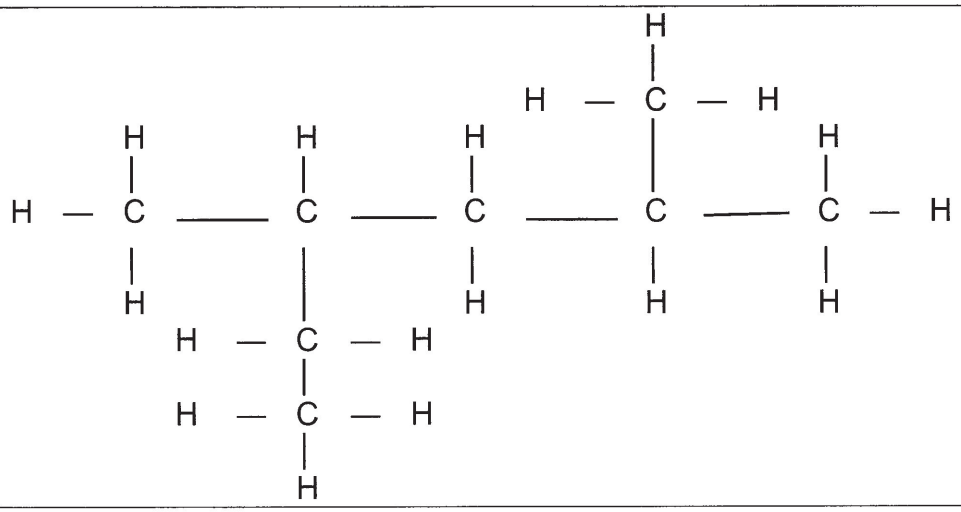
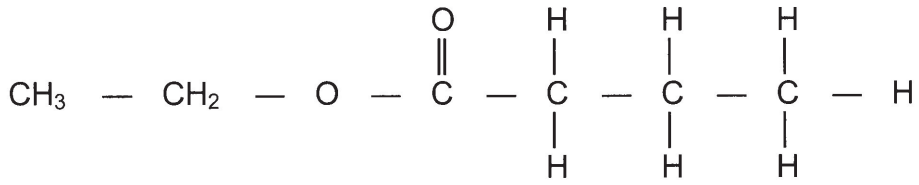
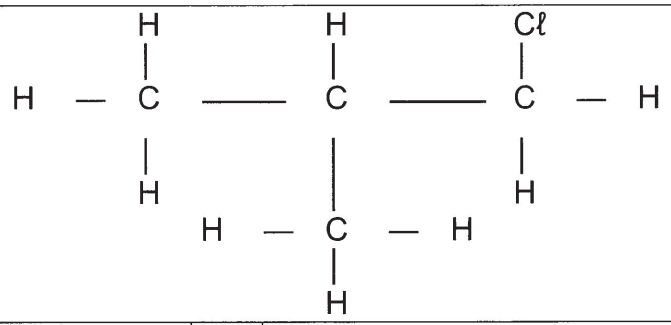
Indicate the following on your graph:

- Height when the stone is released.
- Time taken to hit the ground. (4)

[14]

QUESTION 5 (Start on a new page.)

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

A	
B	
C	

D	C_4H_8O	E	$CH_3CH(CH_3)CH(CH_3)CH_2CCCH_3$	F	$CH_3(CH_2)_3CH_2OH$

Use the above table to answer the following questions:

5.1 Write down the:

5.1.1 IUPAC name of compound **A**. (2)

5.1.2 IUPAC name of compound C. (2)

5.1.3 Name of the homologous series to which compound B belongs. (1)

5.2 Compound E is a hydrocarbon.

5.2.1 Define the term *hydrocarbon*. (2)

5.2.2 Is compound E a saturated or unsaturated compound? Give a reason for the answer. (2)

5.2.3 Write down the general formula of the homologous series to which compound E belongs. (1)

5.3 Write down the IUPAC name of a POSITIONAL ISOMER of compound F. (2)

5.4 D is the molecular formula of TWO functional isomers.

5.4.1 Define the term *functional isomer*. (2)

5.4.2 Draw the STRUCTURAL FORMULA of ONE of the FUNCTIONAL isomers of D. (2)

5.4.3 Write down the IUPAC name of the OTHER FUNCTIONAL isomer of D. (Hint: This is NOT the same compound as mentioned in Question 5.4.2) (2)

[18]

QUESTION 6 (Start on a new page.)

The boiling points of TWO organic compounds, A and B, were determined.

	FORMULA	MOLECULAR MASS ($g.mol^{-1}$)
A	$CH_3(CH_2)_2COOH$	88,1
B	$CH_3(CH_2)_3CH_2OH$	88,1

6.1 State the definition of *boiling point*. (2)

The following boiling points were obtained:

137 °C	163 °C

6.2 Write down the boiling point that is most likely to be that of compound A. (2)

6.3 Explain FULLY how you arrived at the answer. (4)

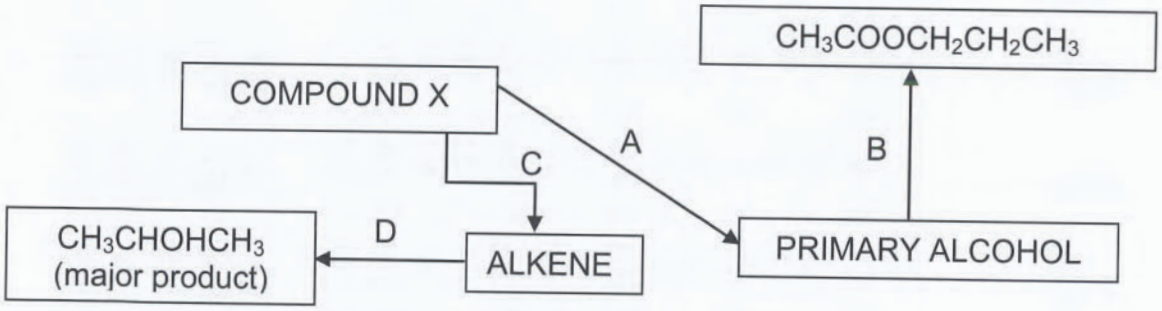
6.4 Write down the IUPAC name of the compound with the LOWER vapour pressure. (2)

6.5 The boiling point of another compound, $CH_3(CH_2)_2CH_2OH$ was also determined.
How will the boiling point of this compound compare to that of compound B?
Choose from GREATER THAN, LESS THAN or EQUAL TO.
Explain the answer. (3)
[13]

QUESTION 7 (Start on a new page.)

The flow diagram shows how COMPOUND X can be used to prepare other organic compounds. The letters A, B, C and D represent different organic reactions.

Compound X is a HALOALKANE.



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

7.1 Write down the type of:

7.1.1 Substitution reaction represented by A. (1)

7.1.2 Elimination reaction represented by C. (1)

7.2 Write down the type of reaction represented by:

7.2.1 B. (1)

7.2.2 D. (1)

7.3 Consider REACTION C. Write down

7.3.1 TWO reaction conditions for this reaction. (2)

7.3.2 IUPAC name of the alkene formed. (1)

7.4 Write down the name or formula of the inorganic reactant for REACTION A. (1)

7.5 Reaction B involves the reaction of an organic compound with a PRIMARY ALCOHOL.

7.5.1 Define the term *primary alcohol*. (2)

7.5.2 Write down the name or formula of the catalyst used in REACTION B. (1)

7.5.3 Write down the structural formula of the ORGANIC COMPOUND that reacts with the primary alcohol in REACTION B. (2)

[13]

TOTAL MARKS: [100]

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

TABLE 3: THE PERIODIC TABLE OF ELEMENTS

KEY/*SLEUTEL*

- Atomic number / *Atoomgetal*: 29
- Electronegativity / *Elektronegatiwiteit*: 1,9
- Symbol / *Simbool*: Cu
- Approximate relative atomic mass / *Benaderde relatiewe atoommassa*: 63,5

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)
1 H 1																	2 He 4
3 Li 7	4 1,5 Be 9											5 2,0 B 11	6 2,5 C 12	7 3,0 N 14	8 3,5 O 16	9 4,0 F 19	10 Ne 20
11 Na 23	12 1,2 Mg 24											13 1,5 Aℓ 27	14 1,8 Si 28	15 2,1 P 31	16 2,5 S 32	17 3,0 Cℓ 35,5	18 Ar 40
19 K 39	20 1,0 Ca 40	21 1,3 Sc 45	22 1,5 Ti 48	23 1,6 V 51	24 1,6 Cr 52	25 1,5 Mn 55	26 1,8 Fe 56	27 1,8 Co 59	28 1,8 Ni 59	29 1,9 Cu 63,5	30 1,6 Zn 65	31 1,6 Ga 70	32 1,8 Ge 73	33 2,0 As 75	34 2,4 Se 79	35 2,8 Br 80	36 Kr 84
37 Rb 86	38 1,0 Sr 88	39 1,2 Y 89	40 1,4 Zr 91	41 Nb 92	42 1,8 Mo 96	43 1,9 Tc	44 2,2 Ru 101	45 2,2 Rh 103	46 2,2 Pd 106	47 1,9 Ag 108	48 1,7 Cd 112	49 1,7 In 115	50 1,8 Sn 119	51 1,9 Sb 122	52 2,1 Te 128	53 2,5 I 127	54 Xe 131
55 Cs 133	56 0,9 Ba 137	57 La 139	72 1,6 Hf 179	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 1,8 Tℓ 204	82 1,8 Pb 207	83 1,9 Bi 209	84 2,0 Po	85 2,5 At	86 Rn
87 Fr	88 0,9 Ra 226	89 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

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	$6,38 \times 10^{6}\ m$

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