education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES: PHYSICS (P1)

SEPTEMBER 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 15 pages and 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name on the ANSWER BOOK.
2. This question paper consists of 10 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, e.g. 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, etc. 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. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1 A man pushes a wall with a constant force **F** but the wall does not move.

Which of the following Newton's laws of motion applies to this scenario?

(i) First law
(ii) Second law
(iii) Third law

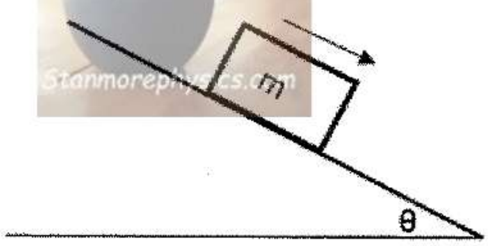
A (i) only

B (i) and (ii) only

C (i) and (iii) only

D (i), (ii) and (iii) (2)

1.2 A crate of mass **m** is sliding down a rough incline at a constant velocity.



Which ONE of the following statements regarding the magnitude of the normal force acting on the crate is correct?

The magnitude of the normal force acting on the crate is ...

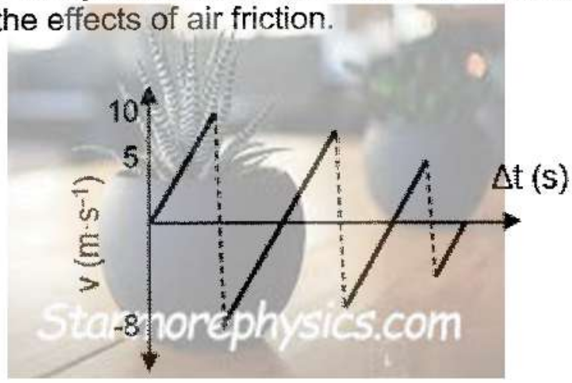
A equal to the component of the weight of the crate which is perpendicular to the slope.

B equal to the component of the weight of the crate which is parallel to the slope.

C greater than the component of the weight of the crate which is perpendicular to the slope.

D greater than the component of the weight of the crate which is parallel to the slope. (2)

1.3 The velocity-time graph below represents the bouncing movement of a ball. Ignore the effects of air friction.



Which ONE of the following statements about the motion of the ball is INCORRECT?

A The ball was dropped from a certain height.

B The ball lost some of its kinetic energy to heat and sound each time it is in contact with the ground.

C The ball experiences a constant acceleration each time it is in the air.

D The ball reaches maximum height 4 times after it was dropped. (2)

1.4 The net force **F** acts on an object of mass **m** to produce a change in momentum of **p** per second. If the net force **F** is DOUBLED, the new change in momentum will be …

A $\Delta \mathbf{p}$

B $2\,\Delta \mathbf{p}$

C $\frac{1}{2}\,\Delta \mathbf{p}$

D $4\,\Delta \mathbf{p}$ (2)

1.5 A block slides across a rough horizontal surface until it stops.

Which ONE of the following statements regarding the movement of the block is CORRECT?

A The net work done on the block is negative.

B The net force acting on the block is equal to ZERO.

C The change in kinetic energy of the block is positive.

D Mechanical energy during the motion of the block is conserved. (2)

1.6 An astronaut studies a star that is moving away from the earth.

Which ONE of the following combinations of frequency and wavelength is CORRECT about the star?

	FREQUENCY	WAVELENGTH
A	Increases	Decreases
B	Increases	Increases
C	Decreases	Increases
D	Decreases	Decreases

(2)

1.7 The electric field strength from a charged sphere **q** is **E** at a point that is a distance **r** away from the sphere.

The electric field strength will be … at a point that is **3 r** from the same charged sphere.

A $\frac{1}{3}$ **E**

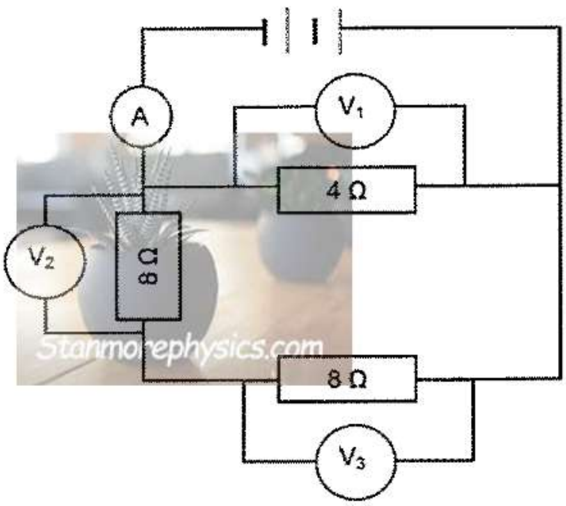
B $\frac{1}{9}$ **E**

C 3 **E**

D 9 **E**

(2)

1.8 In the circuit diagram below, the battery has negligible internal resistance. The resistance of the ammeter and the wires may also be ignored.



The reading on voltmeter V_3 is equal to …

A $V_1 \times V_2$

B $V_1 + V_2$

C $2V_1$

D $\frac{1}{2}V_1$ (2)

1.9 A DC motor has all these components except …

A a cell or battery.

B carbon brushes.

C split ring commutator.

D slip rings commutator. (2)

1.10 The line absorption spectrum, in terms of the energy transitions of atoms, will be from …

A zero to high energy level.

B high energy level to zero.

C low to high energy level.

D high to low energy level. (2)

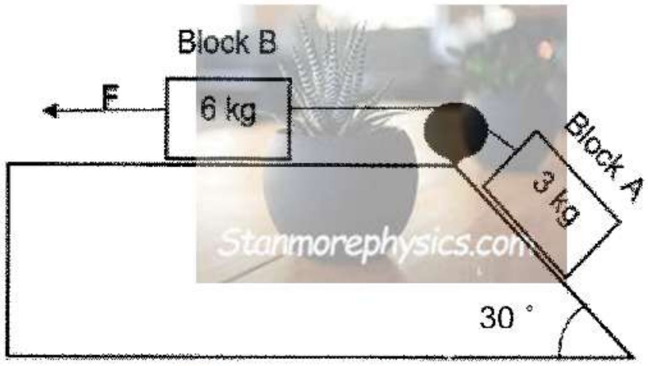
[20]

QUESTION 2 (Start on a new page.)

Block **A** of mass 3 kg is connected to block **B** of mass 6 kg by a light inextensible string passing through a frictionless pulley.

The 3 kg block lies on an incline that makes an angle of 30° with the horizontal.

Block **B** is pulled by a constant force **F** to the left, as shown in the diagram below. The blocks have an acceleration of 2 $m \cdot s^{-2}$ to the left.



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

The kinetic frictional forces acting on blocks **A** and **B** are 4,3 N and 7,2 N respectively.

2.2 Draw a labelled free-body diagram showing ALL the forces acting on block **A**. (4)

2.3 Calculate the magnitude of:

2.3.1 The tension in the string (4)

2.3.2 Force **F** (3)

2.4 How will the acceleration of block **B** change if the string breaks? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

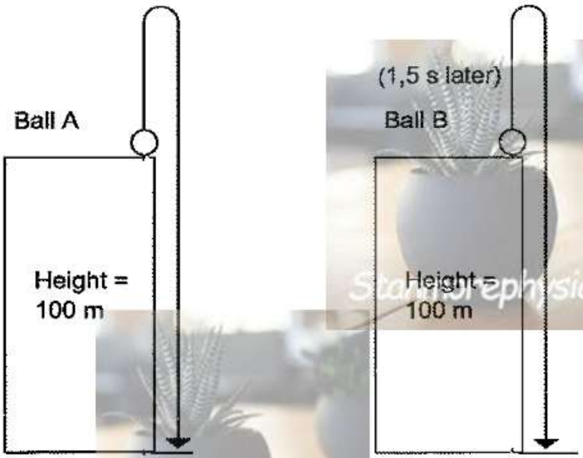
[14]

QUESTION 3 (Start on a new page.)

Ball **A** is thrown vertically upwards from the top edge of a building which is 100 m high and reaches its maximum height after 1,5 seconds. Ball **A** strikes the ground at time **t**.

An identical ball **B** is thrown vertically upwards from the same roof top when ball **A** is at maximum height.

Both balls **A** and **B** strike the ground with the SAME VELOCITY.



Ignore the effects of air friction.

3.1 Explain what is meant by a *projectile*. (2)

3.2 Using EQUATIONS OF MOTION ONLY, calculate the:

3.2.1 Maximum height reached by ball **A** above the ground (4)

3.2.2 Velocity at which ball **B** hits the ground (4)

3.2.3 Time it takes for both balls to hit the ground from the moment they were thrown (3)

3.3 Draw a labelled velocity versus time graphs, on the same set of axes for the motion of the two balls from the moment they were thrown until they strike the ground.

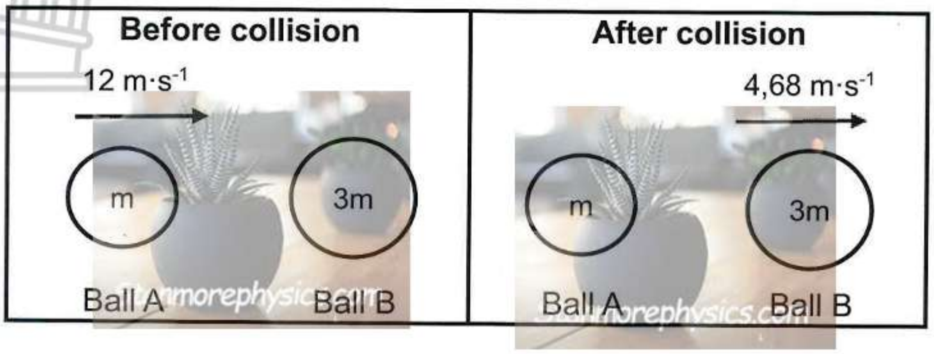
Clearly indicate the following on the graphs:

- The velocities with which each ball was thrown
- The time at which ball **B** was thrown
- The velocities with which the balls strike the ground
- The time at which ball **B** strike the ground (5)

[18]

QUESTION 4 (Start on a new page.)

Ball **A** of mass **m** moving to the right with a speed of 12 $m \cdot s^{-1}$ collides with a stationary ball **B** of mass **3m**. After collision, ball **B** moves to the right at 4,68 $m \cdot s^{-1}$.



Ignore all frictional and rotational effects.

4.1 Calculate the velocity of ball **A** after the collision. (4)

4.2 Prove, showing ALL calculations, that the collision of the two balls is INELASTIC. (4)

If the value of **m** is 0,05 kg and the balls are in contact with each other for 0,03 s during the collision.

4.3 Define the term *impulse*. (2)

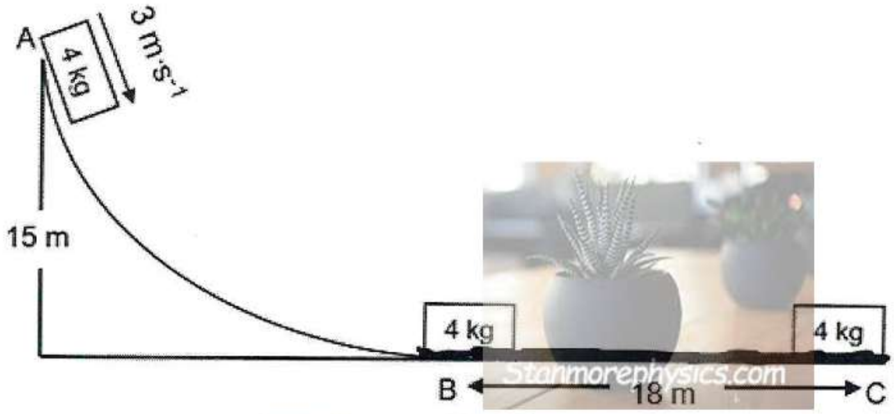
4.4 Determine the force that ball **A** exerts on ball **B** during the collision. (3)

[13]

QUESTION 5 (Start on a new page.)

A 4 kg block slides down a slope. As it passes point **A**, which is 15 m above the ground, its velocity is 3 m·s^{-1}. It slides down a smooth slope **AB**.

It then moves a distance of 18 m on a horizontal surface **BC** which applies a constant, non-conservative force, on the block until it stops at point **C**.



5.1 Name the non-conservative force acting on the block from point **B** to point **C**. (1)

5.2 Using ENERGY PRINCIPLES ONLY, calculate the:

5.2.1 Speed of the block at point **B** (3)

5.2.2 Magnitude of the non-conservative force acting on the block from point **B** to point **C** (4)

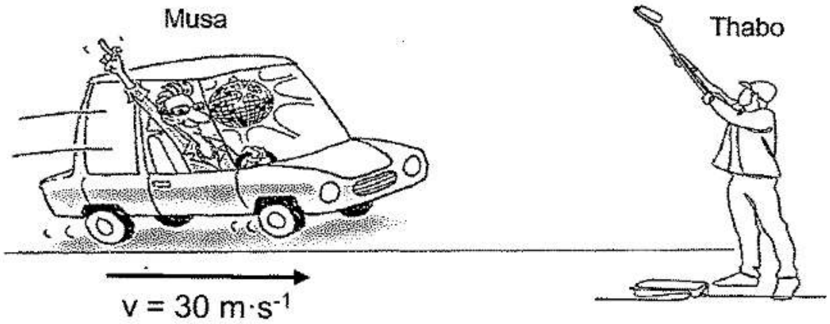
5.2.3 Coefficient of kinetic frictional force (3)

[11]

QUESTION 6 (Start on a new page.)

Musa is playing loud music from his car as he approaches Thabo who is standing on the sidewalk. Thabo has a wavelength detector which registers a wavelength of 350 mm coming from Musa's car.

Take the speed of sound in air to be 343 $m \cdot s^{-1}$.



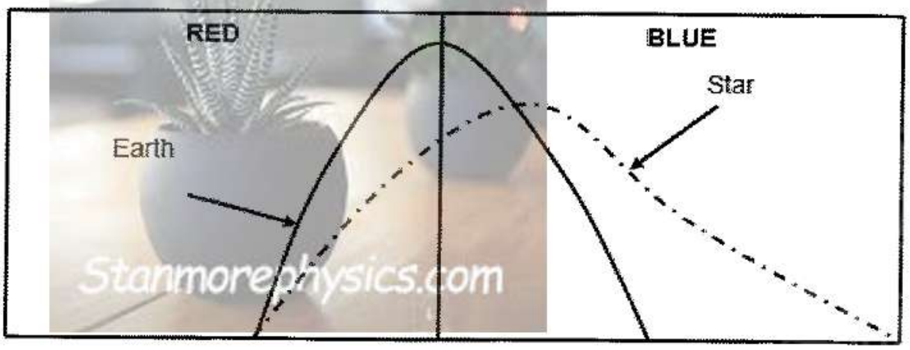
6.1 State the Doppler effect in words. (2)

6.2 Calculate the:

6.2.1 Frequency of the detected wavelength by Thabo's detector (3)

6.2.2 Wavelength of the sound produced by Musa's car radio if the car is moving at a constant speed of 30 $m \cdot s^{-1}$ (5)

6.3 Information of a distant star from earth is recorded in a laboratory and the results are shown in the diagram below.



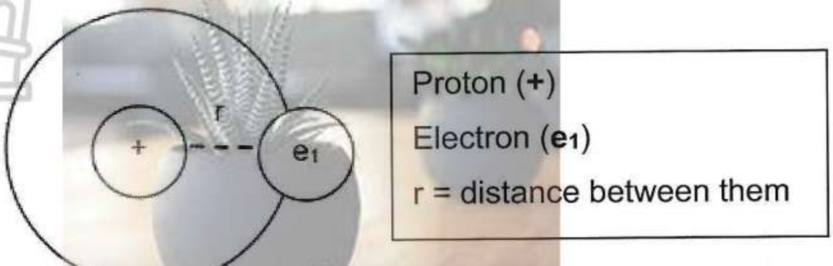
6.3.1 Is the star moving TOWARDS or AWAY FROM the earth? Choose from TOWARDS or AWAY FROM. (1)

6.3.2 Explain the answer to QUESTION 6.3.1 (2)

[13]

QUESTION 7 (Start on a new page.)

In an atom, the proton, in the nucleus is 3×10^{-12} m away from an electron in the orbital, as shown in the diagram below.



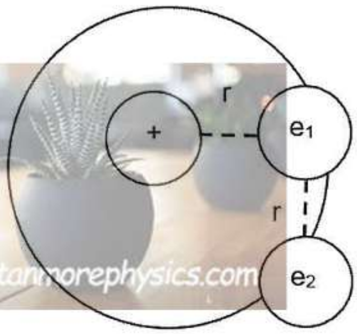
7.1 Draw the resultant electric field pattern that exists between the proton and the electron. (3)

7.2 State Coulomb's Law in words. (2)

7.3 Calculate the electrostatic force between the proton and the electron. (3)

The atom now gains an electron which is placed in such a way that the three particles make a right angle, as shown in the diagram below.

The distance between electrons e_1 and e_2 is equal to the distance between the proton and electron e_1. Assume that both electrons and the proton remain stationary at those positions.



7.4 Calculate the:

7.4.1 Net electrostatic force on the electron e_1 from the proton and electron e_2 (4)

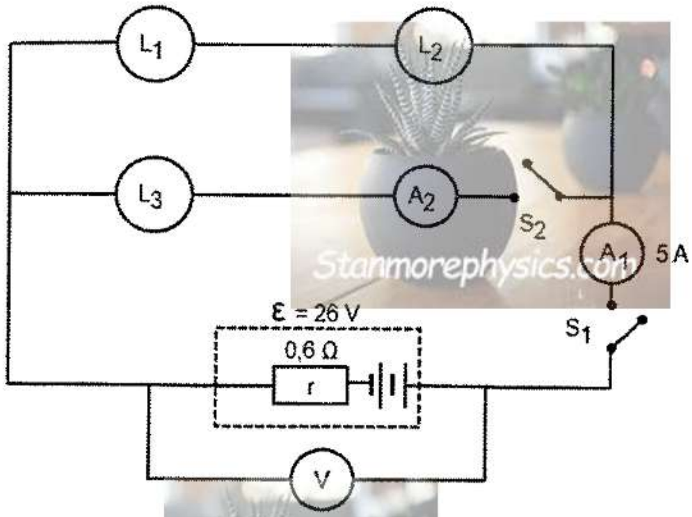
7.4.2 Magnitude of the net electric field strength at electron e_1 from the proton and electron e_2 (3)

[15]

QUESTION 8 (Start on a new page.)

The circuit diagram below shows three light bulbs, a voltmeter, a battery and two ammeters of negligible resistance.

L_1, L_2 and L_3 are IDENTICAL light bulbs, each with a resistance R.



The battery has an EMF of 26 V and an internal resistance of 0,6 Ω.

8.1 What is the function of the ammeter A_1 in this circuit? (1)

8.2 When both switches are closed, A_1 reads 5A.

Calculate the:

8.2.1 Reading on ammeter A_2 (3)

8.2.2 Value of R (5)

8.2.3 Voltmeter reading (3)

8.2.4 Energy dissipated by the light bulb that is in series with ammeter A_2 in 2 minutes (3)

8.3 Switch S_2 is now OPENED and S_1 remains closed.

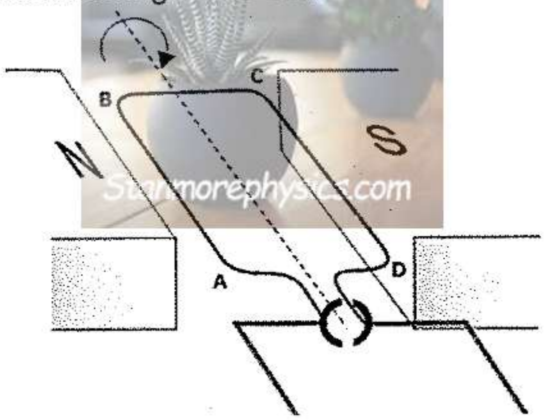
8.3.1 How will this change affect the value of the lost volts? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

8.3.2 Explain the answer to QUESTION 8.3.1. (3)

[19]

QUESTION 9 (Start on a new page.)

The simplified diagram below represents a DC generator with a coil rotating clockwise and current flowing in the coil.

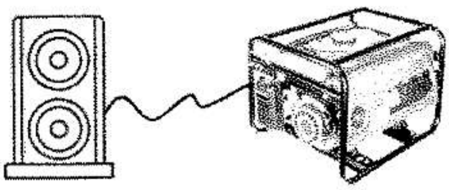


9.1 State the energy conversion that takes place in the generator. (2)

9.2 What is the direction of the current in the coil? Write **A to B** or **B to A**. (2)

9.3 State TWO changes that can be made to the generator to increase the EMF. (2)

A speaker is now connected to the device above, as shown in the diagram below.



The peak value of current of the speaker is 23 A and the speaker has a resistance of 13 Ω.

9.4 Define the *root mean square current*. (2)

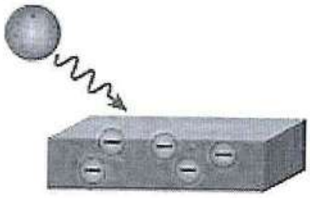
9.5 Calculate the:

9.5.1 Root mean square current of the speaker (3)

9.5.2 Peak value of the voltage (3)
[14]

QUESTION 10 (Start on a new page.)

During a photoelectric investigation, a packet of light energy, **A**, of 4,8 x 10^{-19} J is shone onto a metal surface, as shown in the diagram below.



The metal surface has a threshold frequency of 8,1 x 10^{14} Hz.

10.1 Give the term for the underlined phrase above. (1)

10.2 Define the term *threshold frequency*. (2)

10.3 Will this packet of light energy be able to eject an electron from the surface of this metal? Choose from YES or NO.
Support the answer with a suitable calculation. (4)

The packet of light energy, **A**, is now replaced by another one, **B**.

B with 7,68 x 10^{-19} J is allowed to shine on the same metal surface.

10.4 Calculate the maximum speed of the ejected photoelectrons when the packet of light energy, **B**, is shone onto the metal surface. (4)

10.5 How will the maximum speed of the ejected photoelectrons change if the intensity of the light energy, **B**, is decreased?
Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

10.6 Explain the answer to QUESTION 10.5. (1)
[13]

TOTAL: 150

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	$6{,}67 \times 10^{-11}\ N\cdot m^2\cdot kg^{-2}$
Radius of the Earth *Radius van die Aarde*	R_E	$6{,}38 \times 10^{6}\ m$
Mass of the Earth *Massa van die Aarde*	M_E	$5{,}98 \times 10^{24}\ kg$
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*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1m_2}{d^2}$ or/*of* $F = G\frac{m_1m_2}{r^2}$	$g = G\frac{M}{d^2}$ 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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	

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* $E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(max/maks)}$ or/*of* $E = W_0 + K_{(max/maks)}$ where/*waar* $E = hf$ and/*en* $W_0 = hf_0$ and/*en* $E_{k(max/maks)} = \frac{1}{2}mv^2_{max/maks}$ or/*of* $K_{max/maks} = \frac{1}{2}mv^2_{max/maks}$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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

ALTERNATING CURRENT/*WISSELSTROOM*

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