GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

# PROVINCIAL EXAMINATION

# NOVEMBER 2023

# GRADE 11

## PHYSICAL SCIENCES: PHYSICS

## PAPER 1

**TIME:** 3 hours

**MARKS:** 150

**13 pages + 2 data sheets**

EXEMPLAR

**INSTRUCTIONS AND INFORMATION**

1. Write your name in the appropriate space in the ANSWER BOOK.
2. This question paper consists of NINE questions. Answer ALL questions in the ANSWER BOOK except QUESTION 3.5.1 which has to be answered on the graph paper attached to this question paper. Write your name in the appropriate space on the graph paper.
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. 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, etc. where required.
12. Write neatly and legibly.

EXEMPLAR

## 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) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 A.

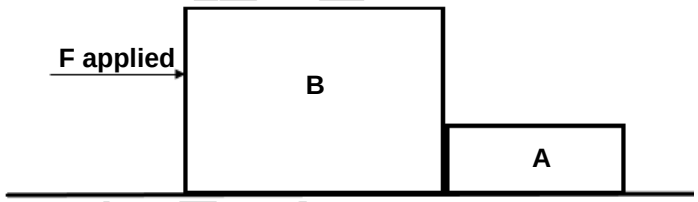
1.1 The statements below refer to vector and scalar quantities.

(i) A vector has magnitude and direction while a scalar has magnitude only.
(ii) A scalar quantity can always be added to a vector quantity.
(iii) Force is an example of a vector quantity, while distance is an example of a scalar quantity.

Which of the above statements is/are TRUE?

A (i) and (ii) only
B (i) and (iii) only
C (ii) and (iii) only
D (i) only (2)

1.2 A learner pushes two blocks **A** and **B** across a rough horizontal surface, at constant velocity. The mass of block **A** is less than that of block **B**.




How does the force $F_1$, that block **A** exerts on block **B**, compare in magnitude with force $F_2$, that block **B** exerts on block **A**?

A $F_1 = F_2 \neq 0$
B $F_1 = F_2 = 0$
C $F_1 > F_2$
D $F_1 < F_2$ (2)

1.3 Two forces, $F_1$ and $F_2$, act on a point. If $F_1$ and $F_2$ act in the same direction, the maximum resultant has a magnitude of 15 N. If forces $F_1$ and $F_2$ act in opposite directions, the magnitude of the minimum resultant is 3 N. The magnitude of the two forces, in Newton, is:

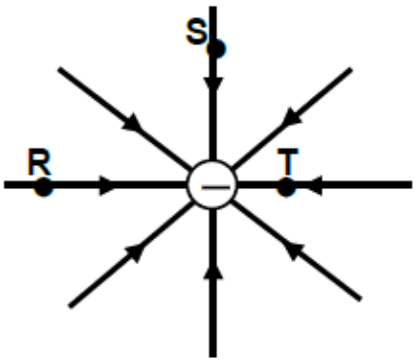
A 8 and 7
B 12 and 3
C 11 and 4
D 9 and 6 (2)

EXEMPLAR

1.4 The gravitational acceleration on a planet twice the mass of Earth and half the radius of Earth will be …

A 9,8 $m.s^{-2}$.
B 19,6 $m.s^{-2}$.
C 39,2 $m.s^{-2}$.
D 78,4 $m.s^{-2}$. (2)

1.5 The diagram below represents the electric field pattern around a negative point charge. R, S and T are points at different distances from the negative point charge.




The magnitude of the electric field of the point charge is the ...

A greatest at point R.
B greatest at point S.
C greatest at point T.
D the same at points R, S and T. (2)

1.6 Two identical conducting spheres that have positive charges $Q_1$ and $Q_2$ (double the charge of $Q_1$), are separated by a distance r. If they are made to touch each other and then separated to the same distance, the force between them will be …

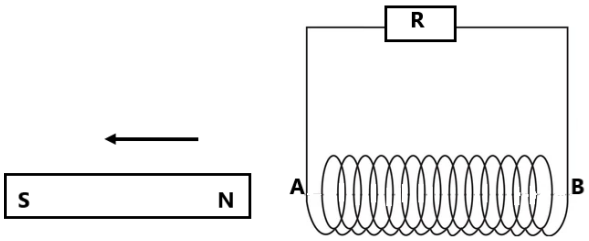
A zero.
B bigger than before.
C smaller than before.
D the same as before. (2)

1.7 Which of the following will give the most effective (strongest) electromagnet?

A A single wire with a high current flowing through it.
B A single wire with a low current flowing through it.
C Many turns of wire in a coil with a low current flowing through the coil.
D Many turns of wire in a coil with a high current flowing through the coil. (2)

EXEMPLAR

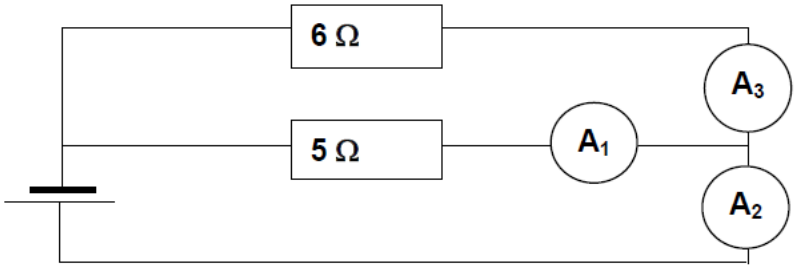
1.8 The diagram below shows a magnet that is being moved away from a solenoid.




Which of the following statements is CORRECT?

A The induced current will flow from **A** to **B** as it moves through the resistor.
B The induced current will flow from **B** to **A** as it moves through the resistor.
C No current will flow through the resistor.
D Alternating current will flow through the resistor. (2)

1.9 The circuit diagram represented below contains two resistors and three identical ammeters, registering readings $I_1$, $I_2$ and $I_3$ respectively.




Which of the following statements is INCORRECT**?**

A $I_2 = I_1 + I_3$.
B $I_1$ is less than $I_3$.
C $I_2$ is the current in the cell.
D $I_3$ is the current in the 6 Ω resistor. (2)

1.10 The meaning of a potential difference of 15V is …

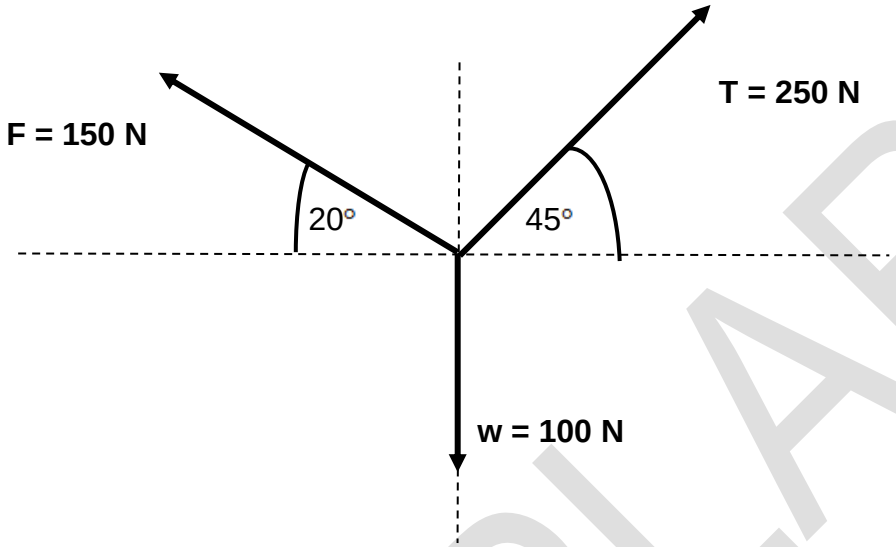
A when a current of 5A flows through a circuit with a resistance of 3Ω.
B when 15 joules of energy is delivered to each Coulomb of charge travelling in the circuit.
C when 45 watts are used with a current of 3A.
D when the EMF is 15V. (2)

**[20]**

EXEMPLAR

**QUESTION 2 (Start on a new page.)**

Consider the three forces acting on an object as shown in the diagram below.




2.1 Define the term *resultant of a vector*. (2)

2.2 Determine the magnitude and direction of the resultant horizontal and vertical forces. (4)

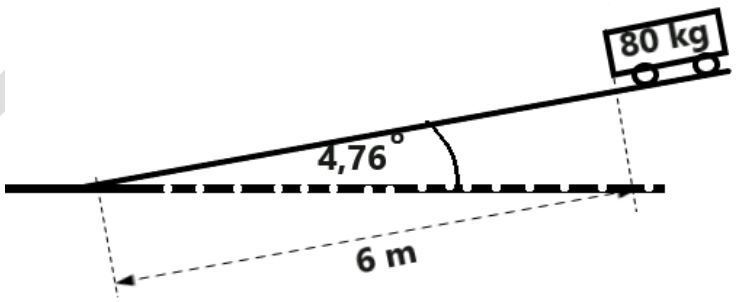
2.3 Determine the magnitude and direction of the resultant force acting on the object. (5)

2.4 Give the magnitude and bearing of the force that can balance the system. (2)

**[13]**

**QUESTION 3 (Start on a new page.)**

National Building Regulations for trolley and wheelchair ramps specify that a ramp must be 6 m in length, while the angle of the ramp must be 4,76°. The combined mass of the trolley and its contents is 80 kg. The coefficient of static friction between the wheels of the trolley and the ramp is 0,1.




3.1 Define the term *static frictional force.* (2)

EXEMPLAR

3.2 Draw a labelled free body diagram of all the forces acting on the trolley at the top of the ramp, just as it starts to roll down the ramp. (3)

3.3 While the trolley is at the top of the ramp, calculate the magnitude of the maximum force of static friction. (3)

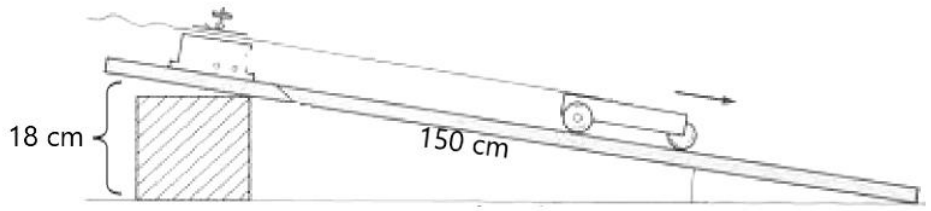
3.4 If the ramp is longer than 6 m, a less steep gradient is required. For a ramp of a less steep gradient, state whether the following would INCREASE, DECREASE or REMAIN THE SAME.

3.4.1 The coefficient of static friction (1)

3.4.2 The force of static friction (1)

3.4.3 Explain the answer to QUESTION 3.4.2 in scientific terms. (2)

3.5 Learners in the Physical Sciences laboratory perform an experiment with a trolley and a wooden block on a ramp. The aim of this experiment is to compare kinetic friction to static friction by plotting the values of the two experiments on the same set of axes.




The following values were recorded for this experiment.

| READINGS | Normal (A) (TROLLEY) (in N) | $f_s$ (A) (in N) | Normal (B) (BLOCK) (in N) | $f_s$ (B) (in N) |
|---|---|---|---|---|
| 1 | 6,80 | 0,185 | 6,80 | 0,15 |
| 2 | 7,75 | 0,21 | 7,75 | 0,17 |
| 3 | 8,70 | 0,235 | 8,70 | 0,19 |

3.5.1 Use the information in the table to plot a graph of both the trolley and the block ON THE SAME SET OF AXES. Label the graph of the trolley as A and the graph of the block as B. (4)

3.5.2 Which part of each of the graphs represents the coefficient of friction? (1)

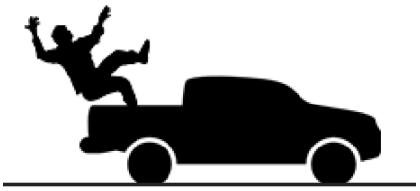
3.5.3 If the graph of the trolley represents static friction and the graph of the block represents kinetic friction, explain the difference between the coefficient of static friction and the coefficient of kinetic friction that can be observed on the graph. (2)

**[19]**

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**QUESTION 4 (Start on a new page.)**

A bakkie stops at a crossing. The driver of the bakkie suddenly pulls away. A person sitting at the back of the bakkie falls off.



4.1 Identify the law that will cause the person to fall off the back of the bakkie. (2)

4.2 Name the property of matter that will determine the inertia of an object. (1)

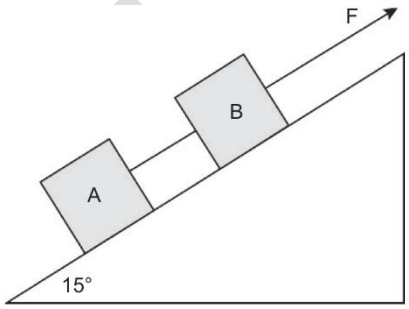
4.3 Give an example of a safety precaution that is used in motor vehicles to prevent such an incident. (1)

4.4 What should the net force on a man of 70 kg be if he sits inside the vehicle and moves at a constant velocity of 15 $m.s^{-1}$? (2)

**[6]**

**QUESTION 5 (Start on a new page.)**

Two blocks, **A** and **B**, are tied to each other by means of a light, inextensible string as indicated in the diagram below. Block **A** has a mass of 10 kg and experiences a frictional force of 29,88 N. Block **B** has a mass of 8 kg. The coefficient of kinetic friction of the rough incline is 0,31. A force **F** moves the blocks up the inclined plane at a constant velocity.




5.1 State *Newton's first law* in words. (2)

5.2 Draw a labelled free-body diagram for block **B**. (5)

EXEMPLAR

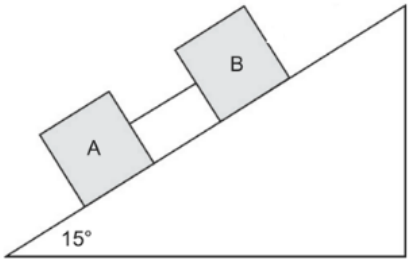
5.3 Calculate the:

5.3.1 Normal force acting on block **B**. (3)

5.3.2 Tension in the string. (3)

5.3.3 Force applied onto block **B**. (4)

The force applied on **B** is removed and the two blocks start to slide down the inclined plane.




5.4 State *Newton's second law of motion* in words. (2)

5.5 How will the frictional force experienced by block **A** change? (2)

5.6 Calculate the acceleration of the system. (5)

5.7 The two blocks reach a flat surface, with the same properties as the surface on the incline and continue to move on a flat surface till they finally stop.

5.7.1 How will the frictional force experienced by the blocks change on the flat surface? Write only INCREASES, DECREASES or REMAINS THE SAME. (1)

5.7.2 Explain the answer to QUESTION 5.7.1. (3)

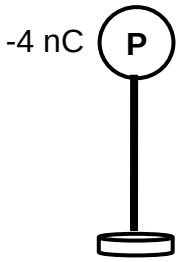
5.8 Identify a of Newton's third law of motion pair while the blocks are sliding down the inclined plane. (2)

**[32]**

EXEMPLAR

**QUESTION 6 (Start on a new page.)**

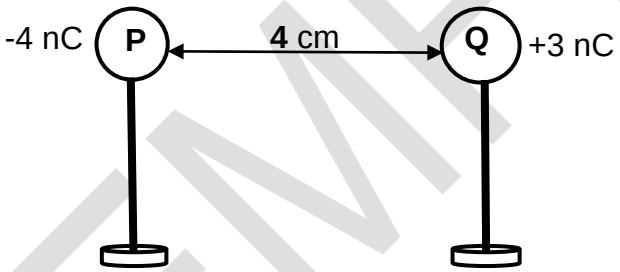
A small metal sphere **P** is placed on an insulated stand. The sphere carries a charge of -4 nC.




6.1 State the *principle of conservation of charge*. (2)

6.2 Calculate the number of electrons in excess on sphere **P**. (3)

A second identical metal sphere **Q**, carrying a charge of +3 nC, is placed 4 cm from sphere **P** as shown in the diagram below.




6.3 State *Coulomb's law* in words. (2)

6.4 Is the force that sphere **P** exerts on sphere **Q** a force of ATTRACTION or REPULSION? (1)

The spheres are now brought into contact with each other and then returned to their original positions.

6.5 Calculate the new charge on each sphere. (2)

6.6 Calculate the magnitude of the electrostatic force now exerted by sphere **P** on sphere **Q**. (4)

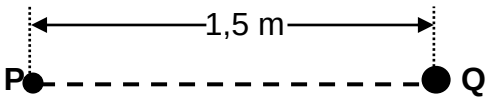
6.7 By what factor will the magnitude of the force in QUESTION 6.6 change if the distance between the spheres is halved? (Do not calculate the new value of the force.) (1)

**[15]**

EXEMPLAR

**QUESTION 7 (Start on a new page.)**

**P** is a point 1,5 m from a charged sphere **Q**. The electric field at **P** is 6 x $10^7$ N·$C^{-1}$ directed towards **Q**. Refer to the diagram below.

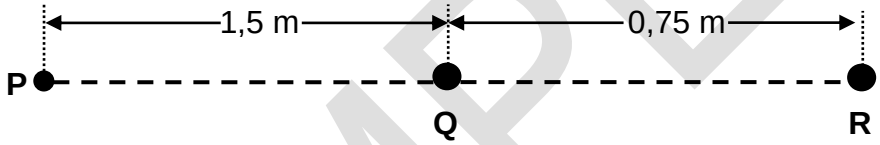



7.1 Define the term *electric field at a point*. (2)

7.2 Draw the electric field pattern caused by the charged sphere **Q**. (2)

7.3 Calculate the magnitude of the charge on sphere **Q**. (4)

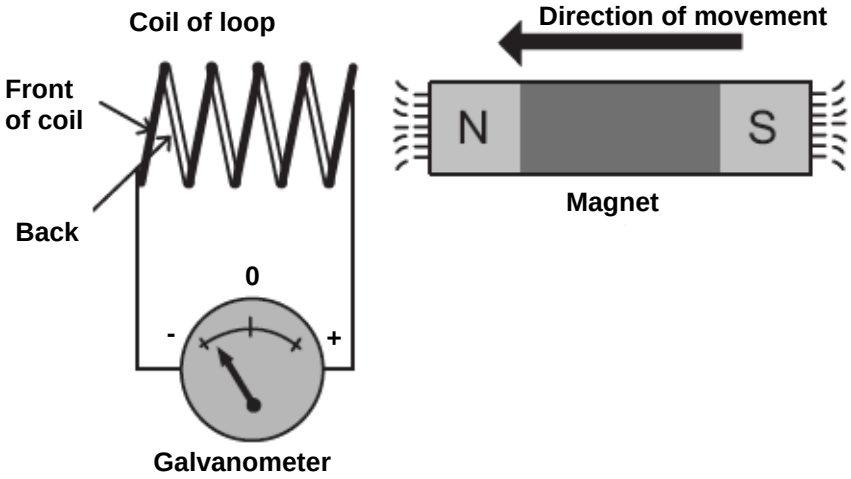
7.4 Another charged sphere, **R**, having an excess of $10^5$ electrons, is now placed 0,75 m to the right of charge **Q**. Calculate the net electric field strength at point **P**.




(5)
**[13]**

**QUESTION 8 (Start on a new page.)**

A magnet is brought near a solenoid or coil as shown in the diagram below.




8.1 State *Faraday's law of Electromagnetic induction*. (2)

8.2 Why does the galvanometer deflect as the magnet is brought close to the coil? (1)

EXEMPLAR

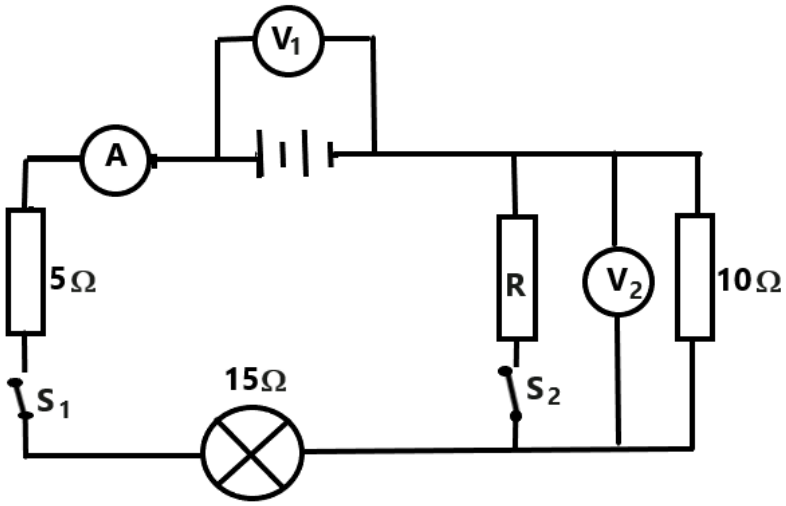
8.3 What rule can be used to predict the direction of the induced current? (1)

8.4 Give THREE ways in which the strength of the induced current can be increased. (3)

8.5 A coil with 200 windings (turns) is rotated so that the magnetic flux linkage with each winding changes from $5 \times 10^{-4}$ Wb to $1 \times 10^{-4}$ Wb in 0,2 s.
Calculate the induced emf in the coil. (3)
**[10]**

**QUESTION 9 (Start on a new page.)**

Study the circuit diagram below where the battery has an EMF of 15V. Ignore any internal resistance and answer the questions that follow.




9.1 State *Ohm's law* in words. (2)

9.2 Identify the resistor that is NOT an ohmic resistor. (2)

9.3 Give a reason for the answer to QUESTION 9.2. (2)

9.4 With Only switch **$S_1$** closed,

Calculate:

9.4.1 The total resistance of the circuit (2)

9.4.2 The reading on the ammeter (3)

9.4.3 The reading on **$V_2$** (2)

EXEMPLAR

Switch $S_2$ is now also closed. ($S_1$ remains closed.) The reading on the ammeter is 1,2 A.

9.5 What will you observe in connection with the brightness of the lamp? Choose from INCREASES, DECREASES or REMAINS THE SAME. (1)

9.6 Give reasons for your answer to QUESTION 9.5. (2)

9.7 Calculate:

9.7.1 The reading on $V_2$ (3)

9.7.2 The value of **R** (3)

**[22]**

**TOTAL: 150**

EXEMPLAR

**END**

# DATA FOR PHYSICAL SCIENCES GRADE 11
# PAPER 1 (PHYSICS)

## *GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11*
## *VRAESTEL 1 (FISIKA)*

### TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Acceleration due to gravity<br>*Swaartekragversnelling* | g | 9,8 $m \cdot s^{-2}$ |
| Gravitational constant<br>*Swaartekragkonstante* | G | 6,67 x $10^{-11}$ $N \cdot m^2 \cdot kg^{-2}$ |
| Radius of Earth<br>*Straal van Aarde* | $R_E$ | 6,38 x $10^6$ m |
| Coulomb's constant<br>*Coulomb se konstante* | K | 9,0 x $10^9$ $N \cdot m^2 \cdot C^{-2}$ |
| Speed of light in a vacuum<br>*Spoed van lig in 'n vakuum* | c | 3,0 x $10^8$ $m \cdot s^{-1}$ |
| Charge on electron<br>*Lading op electron* | e | -1,6 x $10^{-19}$ C |
| Electron mass<br>*Elektronmassa* | $m_e$ | 9,11 x $10^{-31}$ kg |
| Mass of the Earth<br>*Massa van die Aarde* | M | 5,98 x $10^{24}$ kg |

### TABLE 2: FORMULAE/*TABEL 2: FORMULES*

#### *M*OTION/*BEWEGING*

| | |
|---|---|
| $v_f = v_i + a\Delta t$ | $\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2$ |
| $v_f^2 = v_i^2 + 2a\Delta x$ | $\Delta x = \left( \frac{v_f + v_i}{2} \right) \Delta t$ |

#### FORCE/*KRAG*

| | |
|---|---|
| $F_{net} = ma$ | $w = mg$ |
| $F = \frac{Gm_1m_2}{r^2}$ | $\mu_s = \frac{f_{s(\max/maks)}}{N}$ |
| $\mu_k = \frac{f_k}{N}$ | |

EXEMPLAR

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

| | |
|---|---|
| $v = f\lambda$ | $T = \frac{1}{f}$ |
| $n_i \sin\theta_i = n_r \sin\theta_r$ | $n = \frac{c}{v}$ |

## ELECTROSTATICS/*ELEKTROSTATIKA*

| | |
|---|---|
| $F = \frac{kQ_1Q_2}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$ | $E = \frac{F}{q}$ |
| $E = \frac{kQ}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$ | $V = \frac{W}{Q}$ |

## ELECTROMAGNETISM/*ELEKTROMAGNETISME*

| | |
|---|---|
| $\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$ | $\Phi = BA\cos\theta$ |

## CURRENT ELECTRICITY/*ELEKTRIESE STROOMBANE*

| | |
|---|---|
| $I = \frac{Q}{\Delta t}$ | $R = \frac{V}{I}$ |
| $\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + ...$ | $R = r_1 + r_2 + r_3 + ...$ |
| $W = Vq$<br>$W = VI\Delta t$<br>$W = I^2R\Delta t$<br>$W = \frac{V^2\Delta t}{R}$ | $P = \frac{W}{\Delta t}$<br>$P = VI$<br>$P = I^2R$<br>$P = \frac{V^2}{R}$ |

EXEMPLAR