

Hillcrest High School

PHYSICAL SCIENCE P1

Nov 2023

Grade 11

MARKS: 100

TIME: 2 Hours

EXAMINER: Ms N. Badenhorst

MODERATOR: Mrs J. Knox-Whitehead

Instructions:

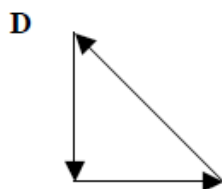
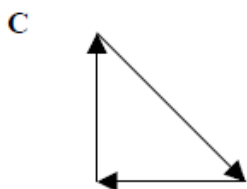
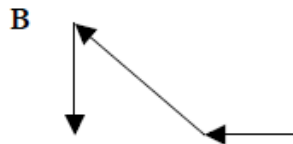
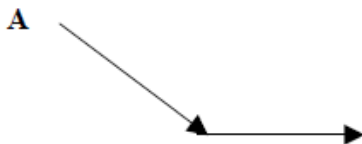
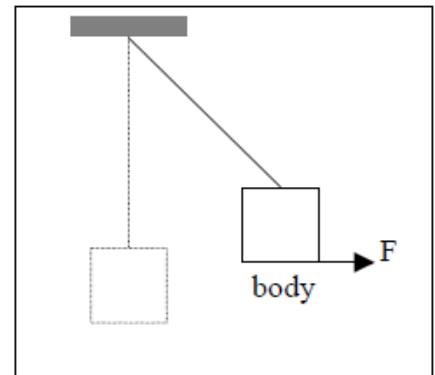
1. Answer ALL the questions.
2. This question paper consists of TWO sections:
3. SECTION A (10)
SECTION B (90)
4. Answer SECTIONS A and B in the ANSWER BOOK.
Non-programmable calculators may be used.
5. Appropriate mathematical instruments may be used.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Data sheets are attached for your use.
8. Give brief motivations, discussions, et cetera where required.
9. Numbers must be rounded off to two decimal places

SECTION A**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 number (1.1-1.5) in the answer book.

1.1 A force F is used to pull a body, which is suspended from a string to one side as shown in the diagram to the right. The body is in equilibrium.

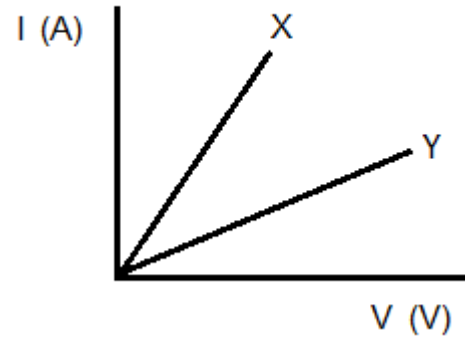
Which of the following vector diagrams represents all forces acting on the body?



1.2 Ohm's law is verified by adding more cells to a circuit and measuring the p.d across the resistor and the current in the circuit. Study the graph below:

The resistance of X compared to Y is:

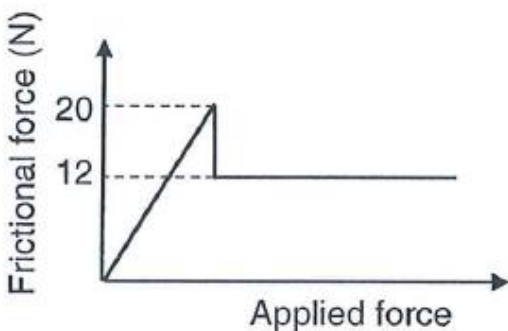
- A Lower
- B Greater than
- C The same
- D non-ohmic



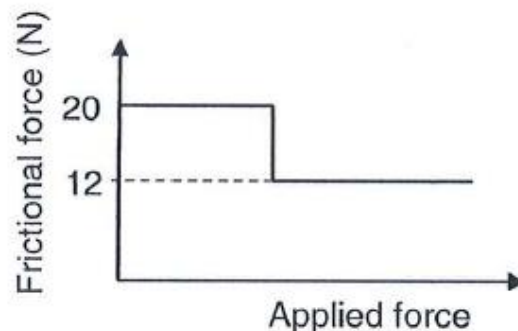
1.3 A block is at rest on a rough horizontal surface. The maximum static frictional force on the block is 20 N and the kinetic frictional force on the block is 12 N.

A spring scale is connected to the block. While pulling on the spring scale a learner increases the force until the block accelerates.

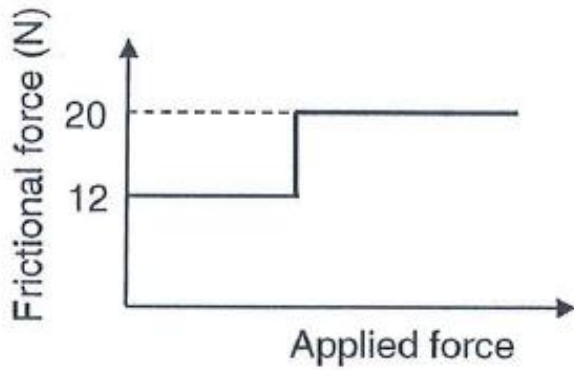
Which ONE of the following graphs best represents the relationship between the frictional force and the applied force on the block?



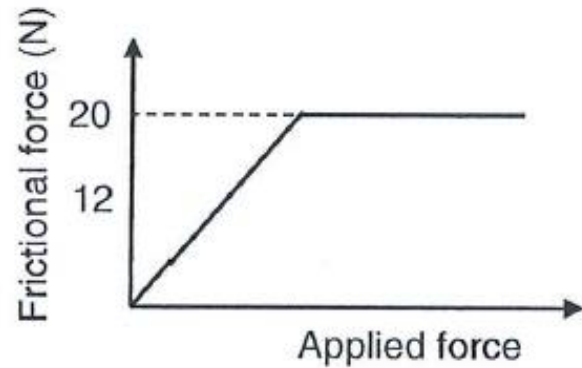
A



B



C



D

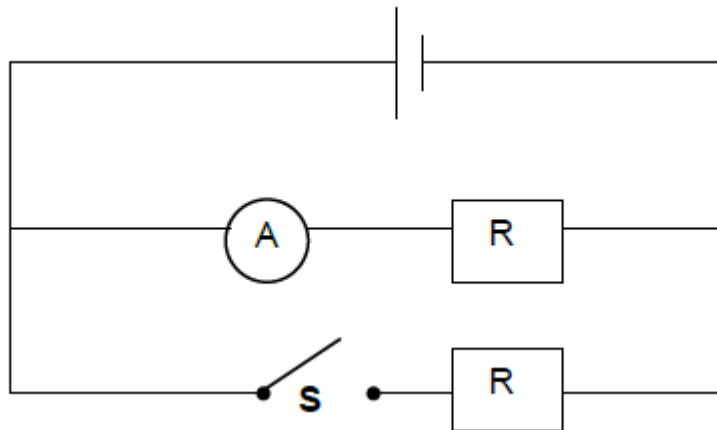
1.4 Two small metal spheres, **X** and **Y**, on isolated stands carry charges of +2 nC and -6 nC respectively. Sphere **X** experiences a force **F** due to the charge on sphere **Y**.

The spheres are brought into contact with each other and placed back in their original positions.

The magnitude of the electrostatic force that sphere **X** now experiences, is...

- A $\frac{F}{3}$
- B $3F$
- C $6F$
- D $12F$

1.5 Two IDENTICAL resistors are connected in parallel as shown in the circuit diagram below. The internal resistance of the cell and resistance of the connecting wires can be ignored.



When switch **S** is open, the reading of the **ammeter** is I . When the switch **S** is closed, the reading of **ammeter** will be...

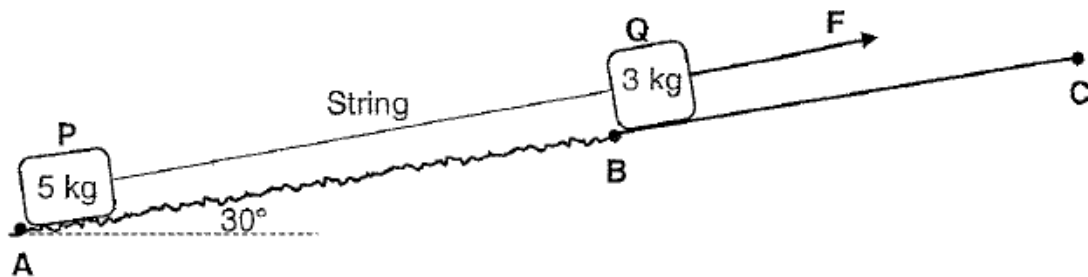
- A I
- B $2I$
- C $\frac{I}{2}$
- D 0

[2 x 5 = 10]

Section B**Question 2**

A block of mass 5 kg is connected to a block of mass 3 kg by a light inextensible string. Both blocks are at **rest** on a plane inclined at an angle of 30° to the horizontal. Block **P** is on a **rough section** of the incline AB, while **block Q is on a frictionless section BC** as shown in the diagram below.

The blocks remain at rest when a force F is applied parallel to the plane of the block Q. The static frictional force on block P is 16,97 N parallel to the plane, upwards.

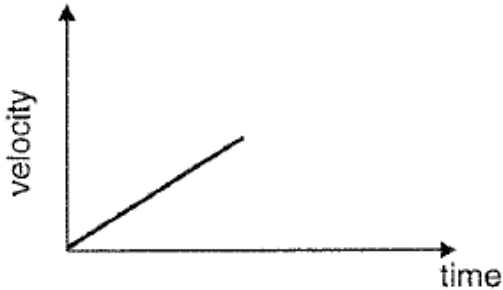


- 2.1 State *Newton's First Law* in words. (2)
- 2.2 Draw a labelled free-body diagram for block P. (4)
- 2.3 Calculate the magnitude of force F . (3)

The applied force **F is now increased to 85 N**. The kinetic frictional force on block P is 4,5 N.

- 2.4 Apply Newton's Second Law on each of the blocks to calculate the magnitude of the acceleration of the blocks. (5)

While the blocks are still accelerating up the slope the string between the blocks suddenly breaks. Learners plot a velocity-time graph for the motion of **P** and **Q** before the string breaks, as shown below.



2.5 Redraw the graph above in your ANSWER BOOK.

On the same set of axis, complete(continue) this graph by drawing the graphs for each block, after the string connecting the two blocks has broken. (The applied force is still acting on block Q). Label each graph clearly as P and Q. (3)

[17]

Question 3

The radius of Earth is 5 times, and the mass is 153 times that of planet X.

3.1 State Newton's law of universal gravitational in words. (2)

3.2.1 Calculate the acceleration due to gravity on the surface of planet X. (3)

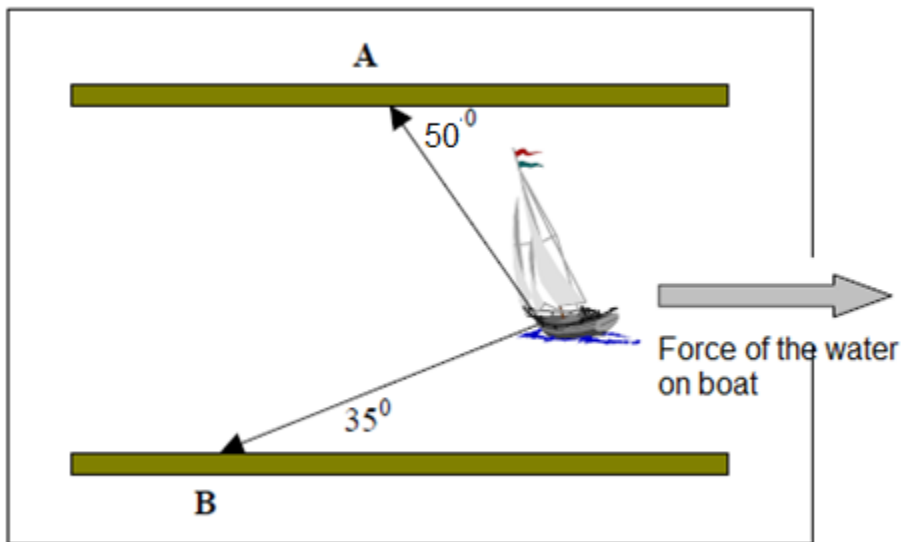
3.2.2 How does the gravitational constant G on planet X compare with that on the surface of EARTH?

Write down only GREATER THAN, LESS THAN, or EQUAL TO. (1)

[6]

Question 4

A sailing boat is kept motionless in a fast-flowing river by ropes held by two boys, A and B, on opposite banks as shown in the diagram below. The water exerts a force 450 N (parallel to the bank) on the boat. The angles of the ropes connecting A and B with the boat, with respect to the riverbank, are 50° at A and 35° at B as shown in the diagram below.



4.1.1 Draw a triangle of forces indicating all the forces acting on the boat. (3)

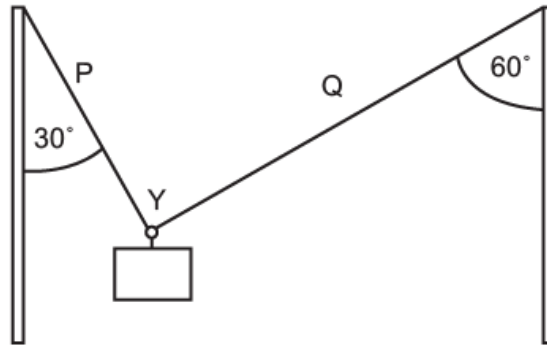
4.1.2 By means of an accurate vector diagram, using a scale of $1\text{ cm} = 50\text{ N}$, or by calculation, determine the magnitude of the forces, A and B, acting on the boat.

(4)

[7]

Question 5

Two light ropes are strung between two vertical struts. A mass m of weight w hangs from the ropes attached to a ring at point Y.

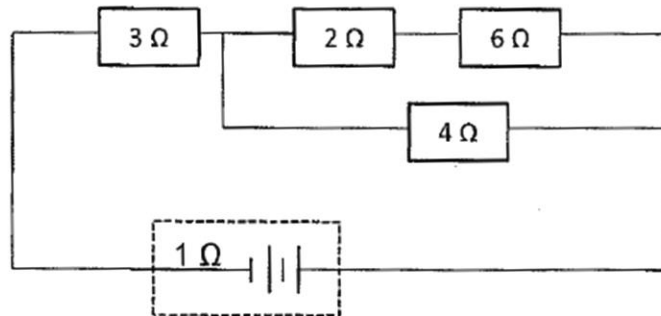


- 5.1 Draw a fully labelled free-body diagram of all the forces acting at point Y. (3)
- 5.2 Are the forces acting at point Y in equilibrium? Explain your answer. (2)
- 5.3 The tension in rope P is 600 N. Calculate the tension in rope Q. (4)
- 5.4 The maximum force that either string can support is 600 N. Calculate the maximum mass of the block that can be supported. (4)

[13]

Question 6

A battery with a 12 V emf and 1 Ω internal resistance is connected in a circuit as shown below.



6.1 Define emf in words.

(2)

6.2 Calculate the:

6.2.1 Total resistance of the external circuit.

(3)

6.2.2 Voltmeter reading across the 4 Ω resistor.

(5)

6.2.3 Energy dissipated in the 4 Ω resistor in 2 minutes.

(4)

[14]

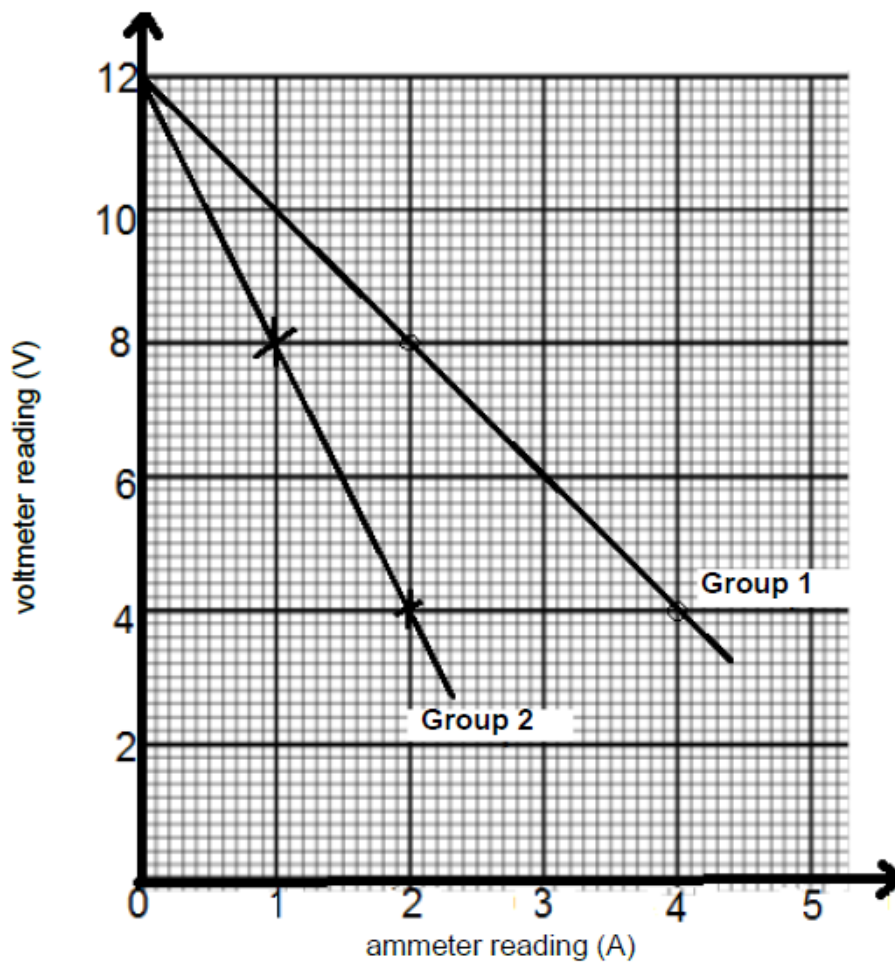
Question 7

7.1 Grade 11 learners are conducting an experiment to determine the INTERNAL RESISTANCE of a battery. The learners were divided into two groups:

Group 1 used battery 1 with an internal resistance r_1

Group 2 used battery 2 with an internal resistance r_2

The results of each group are shown in the graph below.



- 7.1.1 Explain why the voltmeter reading across the battery decreases as the current increases. Use appropriate equation(s) in physics in your explanation. (3)
- 7.1.2 Which group, 1 or 2, used a battery with greater internal resistance? (1)
- 7.1.3 Use the graph to determine the internal resistance of the battery used by learners in group 1. (3)

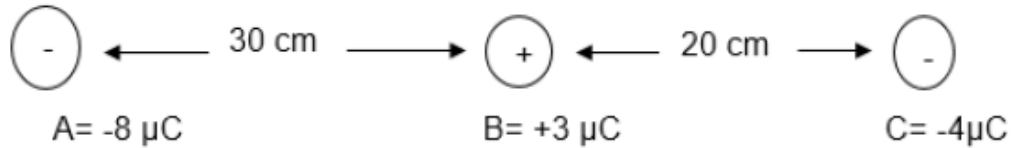
[7]

Question 8

8.1 State *coulomb's law* in words.

(2)

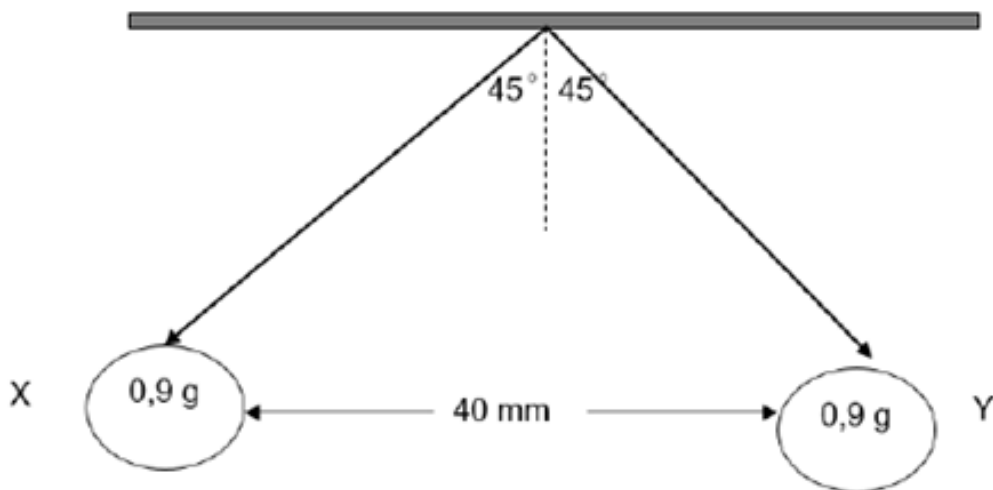
8.2 Three charged particles A, B and C are arranged in a line as shown in the diagram.



8.2.1 Calculate the magnitude and direction of net electrostatic force on particle C due to the other two charges.

(4)

8.3 Two small identical metal spheres, X and Y, each with a mass of 0,9 g hang from the same fixed point from threads of equal length. When the spheres receive equal charges, they repel each other and come to rest with their centres 40 mm apart and the threads making an angle of 45° with the vertical.



8.3.1 Draw a free body diagram to show all the forces acting on Y. (3)

8.4 Calculate the:

8.4.1 Magnitude and direction of electrostatic force that X exerts on Y. (write your answer in scientific notation.) (3)

8.4.2 Charge on each sphere. (3)

[15]

Question 9

In the diagram below the nett electric field at a point **p** due to charges **V** and **W** is $2 \times 10^{-2} \text{NC}^{-1}$ to the right. The distance between **V** and **p** is 2 cm and between **p** and **W** is 3 cm. The **magnitudes** of charges **V** and **W** are equal. Charges **V** and **W** attract each other.



9.1 Determine the nature of the charge on **W** (only write POSITIVE or NEGATIVE). (1)

9.2 Draw the electric field lines around charge **W**. (3)

9.3 Define an electric field in words. (2)

9.4 Calculate the charge on **V**. (5)

[11]

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 <i>Swaartekragversnelling</i>	g	$9,8 \text{ m}\cdot\text{s}^{-2}$
Universal gravitational constant <i>Universele gravitasiekonstant</i>	G	$6,67 \times 10^{-11} \text{ N}\cdot\text{m}^2\cdot\text{kg}^{-2}$
Radius of the Earth <i>Radius van die Aarde</i>	R_E	$6,38 \times 10^6 \text{ m}$
Mass of the Earth <i>Massa van die Aarde</i>	M_E	$5,98 \times 10^{24} \text{ kg}$
Speed of light in a vacuum <i>Spoeid van lig in 'n vakuum</i>	c	$3,0 \times 10^8 \text{ m}\cdot\text{s}^{-1}$
Planck's constant <i>Planck se konstante</i>	h	$6,63 \times 10^{-34} \text{ J}\cdot\text{s}$
Coulomb's constant <i>Coulomb se konstante</i>	k	$9,0 \times 10^9 \text{ N}\cdot\text{m}^2\cdot\text{C}^{-2}$
Charge on electron <i>Lading op elektron</i>	e	$-1,6 \times 10^{-19} \text{ C}$
Electron mass <i>Elektronmassa</i>	m_e	$9,11 \times 10^{-31} \text{ kg}$

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

$F_{\text{net}} = ma$	$p = mv$
$F_{\text{net}} \Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = \frac{Gm_1 m_2}{r^2}$	$g = \frac{Gm}{r^2}$
$f_s^{\text{max}} = \mu_s N$	$f_k = \mu_k N$

WAVES, SOUND AND LIGHT / GOLWE, KLANK EN LIG

$v = f \lambda$	$T = \frac{1}{f}$
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ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$E = \frac{F}{q}$	$V = \frac{W}{q}$
$n = \frac{Q}{e}$ 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)
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$q = I \Delta t$
$W = Vq$ $W = VI \Delta t$ $W = I^2 R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$