education

Department:
Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATION - 2007

PHYSICAL SCIENCE P1

STANDARD GRADE

FEBRUARY/MARCH 2007

304-2/1

MARKS: 150

PHYSICAL SCIENCE SG: Paper 1

2 hours

304 2 1E SG

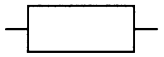
This question paper consists of 13 pages and a data sheet consisting of 2 pages.

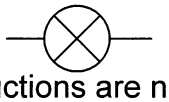
X05

GAUTENG

GENERAL INSTRUCTIONS

1. Write your examination number (and centre number if applicable) in the appropriate spaces on the answer book.
2. Answer ALL the questions.
3. Non-programmable calculators may be used.
4. Appropriate mathematical instruments may be used.
5. A data sheet is attached for your use.
6. NOTE! The following circuit diagram symbols are used in this paper:

Resistor:  instead of 

Bulb:  instead of 

7. Marks may be forfeited if instructions are not followed.

QUESTION 1

INSTRUCTIONS

1. Answer this question on the answer sheet on the inside cover of your answer book.

2. Four possible answers, indicated by A, B, C and D, are supplied with each question. Each question has only ONE correct answer. Choose only that answer which, in your opinion, is the correct or best one and mark the appropriate block on the ANSWER SHEET with a cross (X).

3. Do not make any other marks on the answer sheet. Any calculations or writing that may be necessary when answering this question should be done in the answer book and must be deleted clearly by means of a diagonal line drawn across the page.

4. If more than one block is marked, no marks will be awarded for that answer.

EXAMPLE
QUESTION: The SI unit of time is ...

A t.
B h.
C s.
D m.

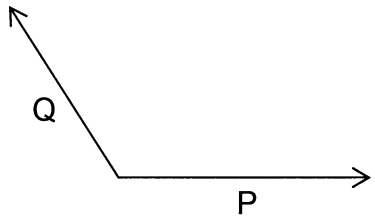
ANSWER:

A	B	C	D

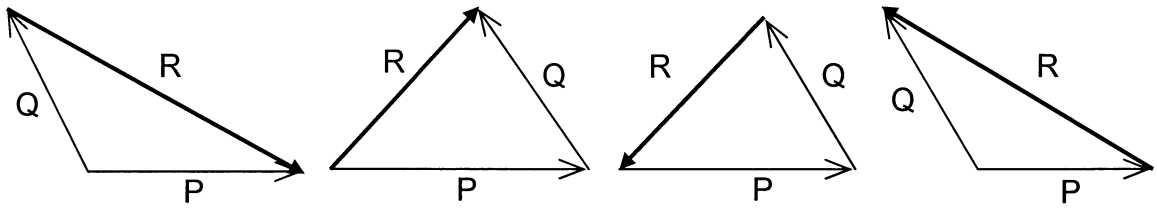
[NOTE: This layout may vary, depending on the type of answer sheet used by the province.]

QUESTION 1

1.1 P and Q are two forces acting simultaneously on an object in different directions producing a resultant force R.

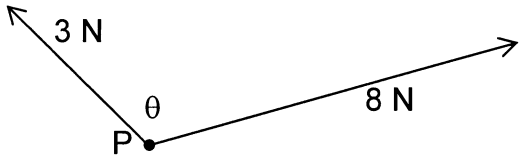


Which ONE of the following diagrams correctly represents the three forces?



(3)

1.2 Two forces, 3 N and 8 N, act simultaneously at point P. The angle θ between them can be changed.



Which ONE of the following CANNOT be a possible magnitude of the resultant force of these two forces?

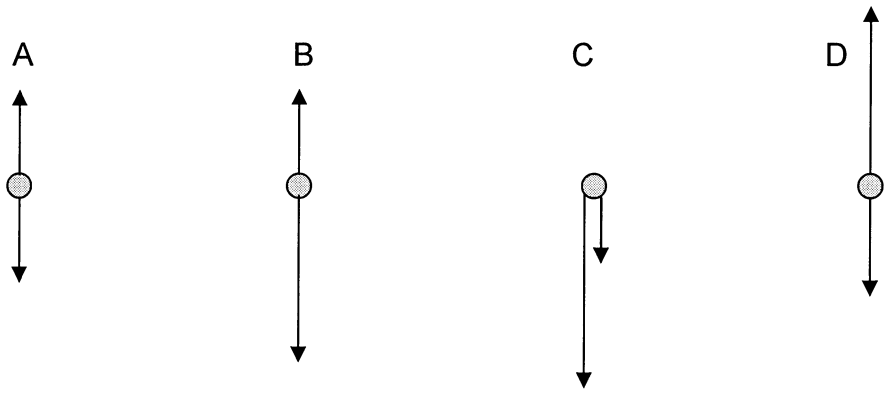
A 5 N

B 8 N

C 11 N

D 12 N (3)

1.3 Thabo drops a book from a window on the third floor of his apartment. Which ONE of the following diagrams correctly shows the forces acting on the book before reaching terminal velocity? The lengths of the arrows indicate the magnitudes of the forces. The effects of air resistance CANNOT be ignored.



(3)

1.4 Which ONE of the statements below is true for a body moving in a straight line with a constant, non-zero acceleration?

A Its rate of change of displacement remains constant.

B Its rate of change of distance remains constant.

C Its rate of change of velocity remains constant.

D The force acting in the direction of motion changes at a constant rate. (3)

1.5 A car accelerates uniformly from rest. After undergoing a displacement **s** it has a velocity **v**. Which ONE of the following is its velocity if it undergoes twice the displacement at the same uniform acceleration?

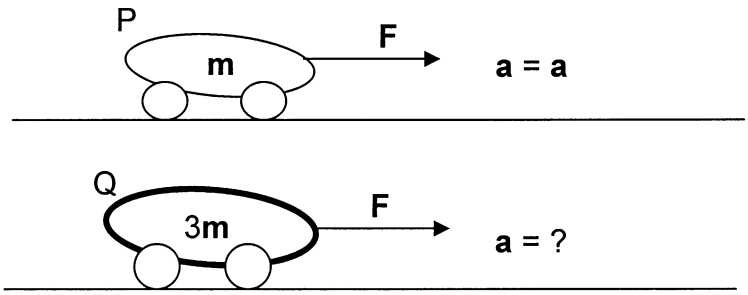
A $\frac{1}{4}\mathbf{v}$

B $\frac{1}{2}\mathbf{v}$

C $2\mathbf{v}$

D $\sqrt{2}\,\mathbf{v}$ (3)

1.6 Trolley P, mass **m**, rests on a frictionless, horizontal surface. A force **F** is applied, causing the trolley to accelerate with magnitude **a**, as shown. Trolley P is replaced with another trolley Q, mass 3**m**.



What is the acceleration of trolley Q if the same force **F** is applied to it?

A $\frac{1}{3}\mathbf{a}$

B $\frac{1}{2}\mathbf{a}$

C $2\mathbf{a}$

D $3\mathbf{a}$ (3)

1.7 The acceleration due to gravity on the moon is approximately one-sixth that on Earth. Consider a ball dropped from a height of 1 m on Earth and an identical ball dropped from a height of 1 m on the moon. Assume both balls fall freely.

Which ONE of the following combinations correctly represents the comparisons between the masses of the balls, as well as the increase in kinetic energy on the earth and on the moon?

	Mass	**Increase in kinetic energy**
A	the same	the same
B	the same	greater on Earth
C	greater on Earth	the same
D	greater on Earth	greater on Earth

(3)

1.8 Which ONE of the following statements concerning the inertia of a body is true?

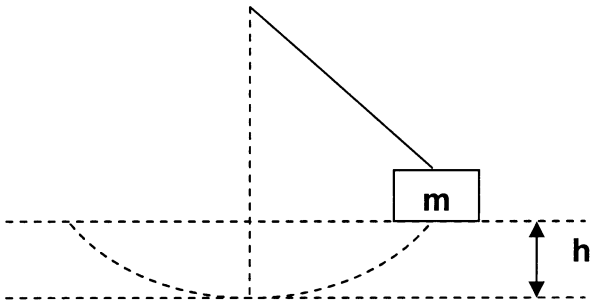
A Inertia is inversely proportional to the mass of the body.

B Inertia is only a property of bodies, which have no forces acting on them.

C Inertia is that force acting on a body, which resists any change in its state of motion.

D Inertia is that property of a body, which resists any change in its state of motion. (3)

1.9 A block of mass **m**, attached to the end of a light, inelastic rope, is released from a vertical height **h**, as shown. Disregard air resistance.



Which ONE of the following can be used to determine the maximum speed that the block reaches?

A $\sqrt{\mathbf{gh}}$

B $\sqrt{2\mathbf{gh}}$

C **gh**

D 2**gh** (3)

1.10 An object, mass **m**, is speeding up uniformly on a rough, horizontal surface. It undergoes a displacement **s** at an acceleration of magnitude **a**. The magnitude of the frictional force experienced is $\mathbf{F_f}$. Which ONE of the following can be used to determine the **work done** by the applied force on the object?

A **mas**

B $\mathbf{F_f.s}$

C **mas** + $\mathbf{F_f.s}$

D **mas** - $\mathbf{F_f.s}$ (3)

1.11 Two identical, metal spheres P and Q, on insulated stands, carry charges of +10 nC and −6 nC respectively (Figure 1). P and Q are now brought into contact with each other (Figure 2).

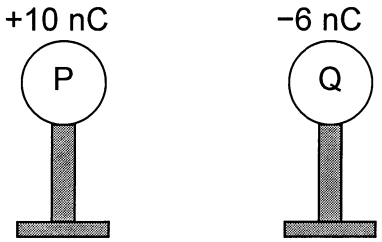


Figure 1

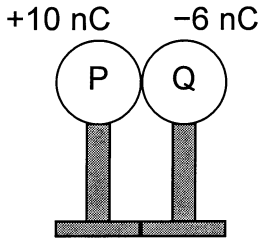


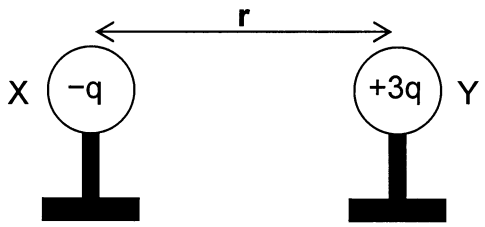
Figure 2

What is the charge on each of P and Q if they are separated and moved back to their original positions?

	Charge on P	Charge on Q
A	+4 nC	+4 nC
B	+4 nC	−4 nC
C	+2 nC	−2 nC
D	+2 nC	+2 nC

(3)

1.12 Two small, identical, metal spheres X and Y, on insulated stands, carry charges of −q and +3q respectively. When their centres are a distance **r** apart, X exerts an electrostatic force of magnitude **F** on Y.



Y is then brought closer to X without touching, and placed a distance $\frac{1}{3}\mathbf{r}$ from X. Which ONE of the following gives the magnitude of the electrostatic force that X now exerts on Y?

A $9\mathbf{F}$

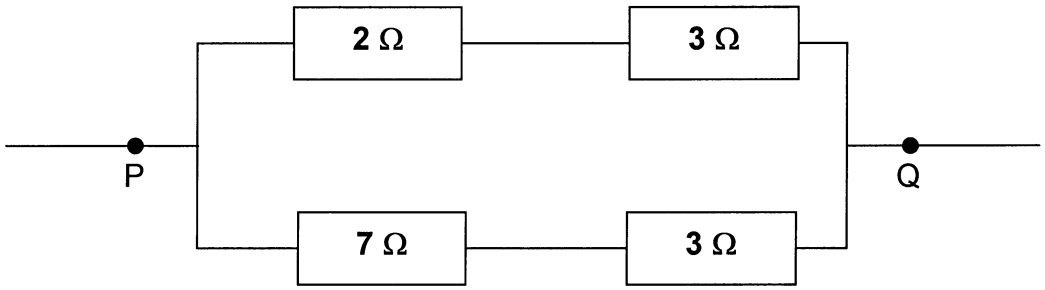
B $3\mathbf{F}$

C $\frac{1}{3}\mathbf{F}$

D $\frac{1}{9}\mathbf{F}$

(3)

1.13 In a section of a circuit represented below, a potential difference **V** is applied across PQ.



Which ONE of the following gives the current in the 7 Ω resistor?

A $\frac{\mathbf{V}}{3}$

B $\frac{\mathbf{V}}{5}$

C $\frac{\mathbf{V}}{7}$

D $\frac{\mathbf{V}}{10}$ (3)

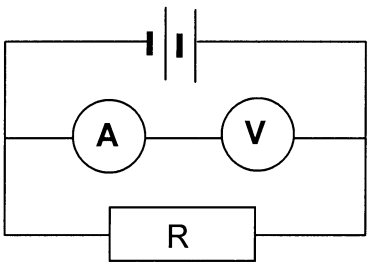
1.14 Two parallel conductors, carrying currents $\mathbf{I}_1$ and $\mathbf{I}_2$ in opposite directions, are placed a distance **d** apart. Which ONE of the following combinations is correct for the direction and the type of force exerted by one conductor on the other?

	Direction of force	**Type of force**
A	attraction	magnetic
B	attraction	electric
C	repulsion	magnetic
D	repulsion	electric

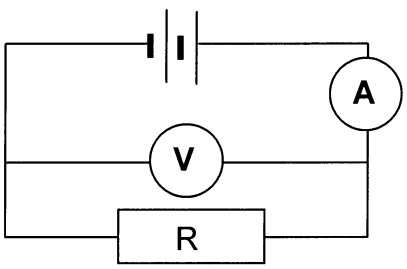
(3)

1.15 Which ONE of the circuits represented below can be used to determine the resistance of resistor R?

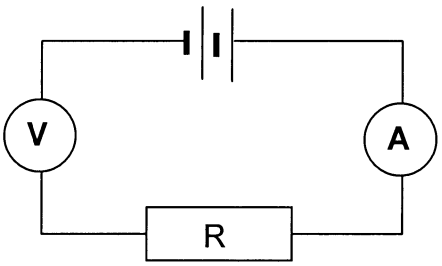
A



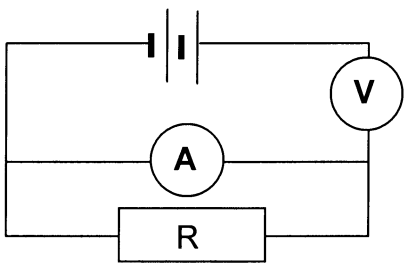
B



C



D



(3)

(15 x 3) **[45]**

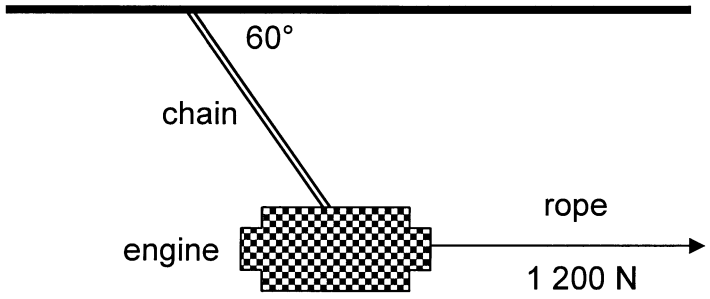
ANSWER QUESTIONS 2 TO 8 IN THE ANSWER BOOK.

INSTRUCTIONS

1. Start each question on a NEW PAGE in the ANSWER BOOK.
2. Leave a line between subsections, for example 2.1 and 2.2.
3. Show ALL the formulae, as well as the calculations, including substitutions.
4. Number the answers exactly as the questions are numbered.

QUESTION 2 [START ON A NEW PAGE]

In a workshop, the engine of a car is removed by means of a system consisting of a rope and a chain. The chain forms an angle of 60° with the horizontal and the horizontal force applied by the rope is equal to 1 200 N as indicated in the diagram below. Assume the chain remains straight.



2.1 State, in words, the **triangle rule** for three forces in equilibrium. (3)

2.2 Determine, either by making use of a scale drawing (1 cm represents 200 N) or by means of a calculation, the mass of the engine. If a calculation is done, include a rough triangle of forces, showing at least two angles. (7)

2.3 If the angle between the chain and the horizontal is decreased, the force exerted by the chain will change. Will it increase or decrease? Explain. (3)
[13]

QUESTION 3 [START ON A NEW PAGE]

Tina, a skydiver, together with her parachute, have a total mass of 65 kg. She falls from a stationary helicopter, hovering above a soccer field. Initially her parachute is not open and she falls freely for the first 3 s.

3.1 Assume that the force of air resistance on Tina is negligible in the first 3 s. Calculate the **magnitude** of her velocity at the end of the 3 s interval. (5)

3.2 The moment Tina opens her parachute, she immediately experiences an **upward resultant** force. Draw a diagram to show the two forces acting on Tina, the instant the parachute opens, which produce this resultant force. Name these forces and indicate their directions. The lengths of the arrows must indicate the relative magnitudes of the forces. (4)

At a certain point in her fall, Tina experiences a resultant force of 156 N upwards.

3.3 State, in words, **Newton's Second Law of Motion**. (3)

3.4 Calculate the **magnitude** of her acceleration at this stage. (4)

3.5 Calculate the **magnitude** of the force of air resistance on the Tina-parachute combination at this stage. (4)

[20]

QUESTION 4 [START ON A NEW PAGE]

Hailstones fall vertically onto the roof of a parked car. The **terminal velocity** of one of the hailstones is 6,2 $m.s^{-1}$. The mass of this hailstone is 0,0015 kg.

4.1 Explain the term **terminal velocity**. (2)

4.2 After hitting the car's roof, the hailstone rebounds vertically with a speed of 4,5 $m.s^{-1}$. Calculate the change in momentum of the hailstone. Assume the mass of the hailstone does not change upon impact. (6)

4.3 Calculate the kinetic energy of the hailstone just before it hits the roof of the car. (4)

4.4 Some of the kinetic energy of the hailstone is 'lost' after it has collided with the roof of the car. Explain what happens to the 'lost' energy. (2)

[14]

QUESTION 5 [START ON A NEW PAGE]

A toy car, mass 3 kg, has a powerful electrical motor (engine) marked 600 W, of which 363 W is used to accelerate it from rest for 2,0 s.

5.1 Define, in words, **power**. (2)

5.2 Calculate the amount of energy transferred to accelerate the toy car during the 2,0 s. (4)

5.3 Calculate the speed of the toy car at the end of the 2,0 s. (5)

5.4 Calculate the **magnitude** of the acceleration of the car. (5)

5.5 Calculate the distance travelled by the car during the 2,0 s. (5)
[21]

QUESTION 6 [START ON A NEW PAGE]

Lightning occurs when there is a large difference in electric potential between the ground and the base of the clouds. A particular lightning flash transfers 4,5 C of charge in 5×10^{-3} s.

6.1 If a potential difference of 220 000 V exists between the ground and the clouds, calculate the amount of energy transferred by the charge as the lightning flashes. (4)

6.2 Calculate the current in this lightning flash. (4)
[8]

QUESTION 7 [START ON A NEW PAGE]

A small, metal ball, carrying a charge of $+4 \times 10^{-9}$ C, is placed on an insulated stand.

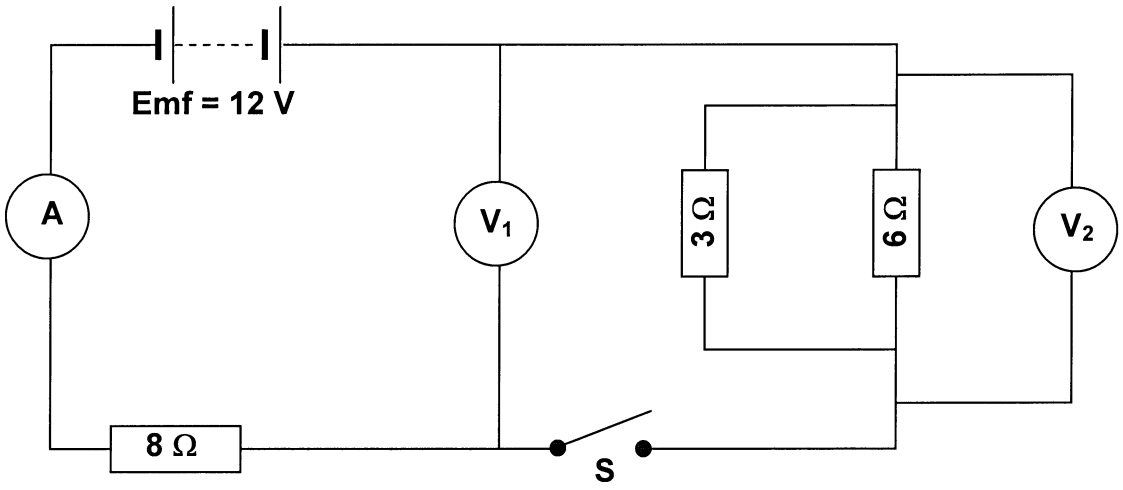
7.1 Draw the electric field pattern around the charge. (3)

7.2 Define, in words, **electric field strength**. (3)

7.3 Calculate the **magnitude** of the electric field strength at a point 0,5 m from the charge. (4)
[10]

QUESTION 8 [START ON A NEW PAGE]

In the circuit represented below, the battery has an emf of 12 V. The resistance of the connecting wires and ammeter can be ignored. The battery has negligible internal resistance.



8.1 State, in words, **Ohm's Law**. (3)

Switch S is open.

8.2 What is the reading on V_1? (2)

8.3 What is the reading on V_2? (2)

Switch S is then closed.

8.4 Calculate the effective resistance of the parallel combination of resistors. (4)

8.5 Calculate the reading on the ammeter. (5)

8.6 Calculate the reading on voltmeter V_2. (3)
[19]

TOTAL QUESTION 1 : 45
TOTAL QUESTIONS 2 – 8 : 105
GRAND TOTAL : 150

DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

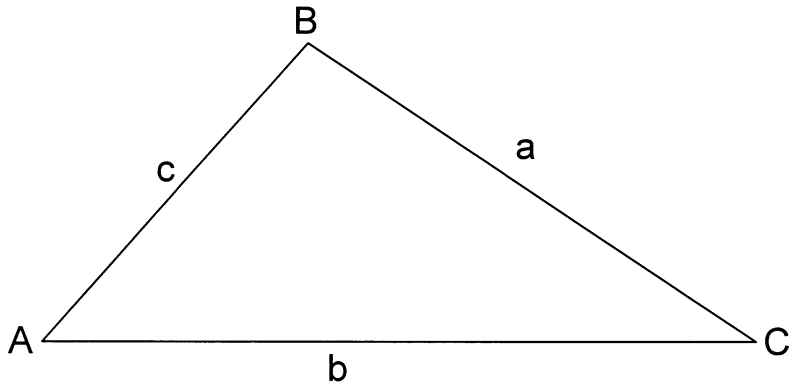
DATA FOR PHYSICAL SCIENCE
PAPER I (PHYSICS)

GEGEWENS VIR NATUUR- EN SKEIKUNDE
VRAESTEL I (FISIKA)

TABLE 1: PHYSICAL CONSTANTS
TABEL 1: FISIESE KONSTANTES

NAME/*NAAM*	**SYMBOL/*SIMBOOL***	**VALUE/*WAARDE***
Acceleration due to gravity *Swaartekragversnelling*	g	$10\ m.s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	$6{,}7 \times 10^{-11}\ N.m^2.kg^{-2}$
Charge on electron *Lading van elektron*	e^-	$-1{,}6 \times 10^{-19}\ C$

MATHEMATICAL AIDS/*WISKUNDIGE HULPMIDDELS*



$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

$$c^2 = a^2 + b^2 - 2ab\cos C$$

TABLE 2: FORMULAE
TABEL 2: FORMULES

MOTION/*BEWEGING*

$v = u + at$	$s = ut + \frac{1}{2}at^2$
$v^2 = u^2 + 2as$	$s = \left(\frac{u+v}{2}\right)t$

FORCE/*KRAG*

$F_{res} = ma$	$p = mv$
$F = \frac{Gm_1m_2}{r^2}$	$F\Delta t = \Delta p = mv - mu$

WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

$W = Fs$	$E_p = mgh$
$P = \frac{W}{t}$	$E_k = \frac{1}{2}mv^2$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9 \times 10^9\ N.m^2.C^{-2})$	$V = \frac{W}{Q}$
$E = \frac{F}{q}$	$W = QEs$
$E = \frac{kQ}{r^2}$ $(k = 9 \times 10^9\ N.m^2.C^{-2})$	$E = \frac{V}{d}$

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

$Q = It$	emf/emk $= I(R + r)$
$R = r_1 + r_2 + r_3 + \ldots$	$F = \frac{kI_1I_2\ell}{d}$ $(k = 2 \times 10^{-7}\ N.A^{-2})$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots$	$W = VIt = I^2Rt = \frac{V^2t}{R}$
$R = \frac{V}{I}$	$P = VI = I^2R = \frac{V^2}{R}$