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Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## SEPTEMBER 2026

# TECHNICAL SCIENCES P1

**MARKS:** **150**

**TIME:** **3 hours**

This question paper consists of 18 pages, including 3 data sheets.

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## INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions in the ANSWER BOOK.
2. Start EACH question on a NEW page in the ANSWER BOOK.
3. Number the answers correctly according to the numbering system used in this question paper.
4. You may use a non-programmable calculator.
5. Leave ONE line between subsections, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You are advised to use the attached DATA SHEETS.
7. Show ALL formulae and substitutions in ALL calculations.
8. Round off your final numerical answers to a minimum of TWO decimal places.
9. Give brief motivations, discussions, etc. where required.
10. Write neatly and legibly.

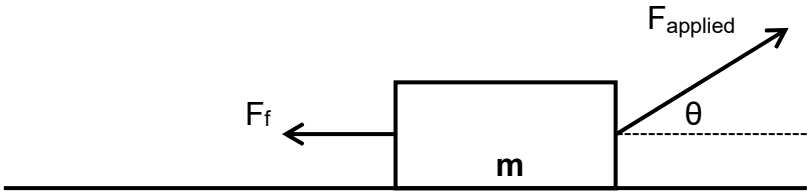
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## QUESTION 1: MULTIPLE-CHOICE QUESTIONS

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 numbers (1.1 to 1.10) in the ANSWER BOOK, for example 1.11 D.

1.1 A block with a certain mass **m** moves towards the right at a constant velocity across a rough horizontal surface, as shown in the diagram below.




The velocity is constant because …

A $F_f = F_{applied}$ and $a = 9{,}8\ m{\cdot}s^{-2}$.

B $F_{applied} < F_f$ and $a = 0\ m{\cdot}s^{-2}$.

C $F_{applied} \sin\theta = F_f$ and $a = 9{,}8\ m{\cdot}s^{-2}$.

D $F_{applied} \cos\theta = F_f$ and $a = 0\ m{\cdot}s^{-2}$. (2)

1.2 Newton's Third Law of Motion refers to action-reaction pairs of forces. Which ONE of the following statements is INCORRECT for the action-reaction pairs in the picture below?




A They act along the same line.

B Both forces act on the hammer simultaneously.

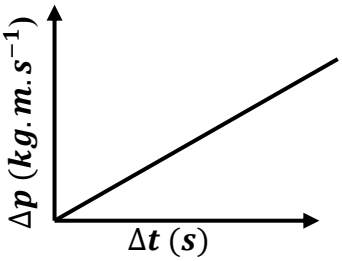
C These forces act on the hammer and the nail simultaneously.

D These forces act in opposite directions. (2)



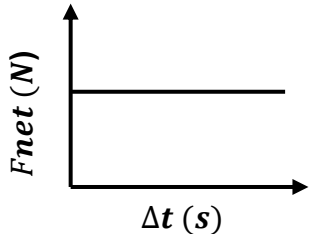
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1.3 The graph below represents the relationship between a change in momentum (Δp) of an object and change in time (Δt).

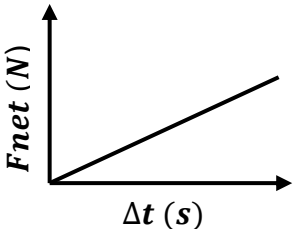



Which ONE of the following graphs represents a corresponding $F_{net}$ versus time graph?

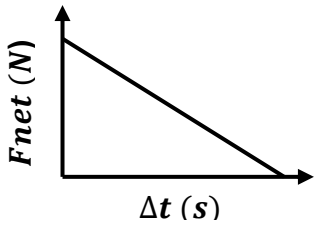
A



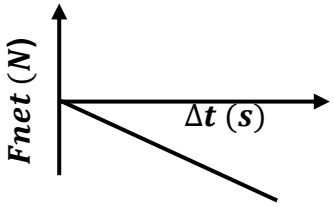

B




C




D




(2)

1.4 Which ONE of the following is CORRECT in relation to work and energy.

A Both are vector quantities.

B Work is vector and energy is scalar.

C SI unit of work is Watt, and SI unit of energy is Joule.

D Both have the same SI unit Joule. (2)



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1.5 Fluid pressure is given by the following equation: P = ρgh, the symbol **ρ** represent:

A Pressure

B Gravitational force

C Density

D Viscosity

1.6 Which ONE of the following statements about work is TRUE?

Work is done when …

A the displacement is in the direction of the force.

B the force is at 90° with the direction of displacement.

C there is no resultant force and the displacement is zero.

D the force is at 90° with the direction of displacement. (2)

1.7 What will happen to the speed of light when a light ray moves from a more optically dense medium to a less optically dense medium.

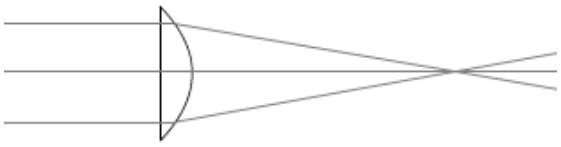
A Decrease

B Increase

C Stay the same

D None of the above-mentioned (2)

1.8 The distance between the centre of the lens and where the rays meet is known as …



A focal length.

B focal point.

C optic axis.

D principal axis. (2)

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1.9 The potential difference across the cell when the circuit is open is called …

A emf.

B power.

C internal resistance.

D voltage. (2)

1.10 Which ONE of the following best describes the function of a step-down transformer?

A Increase voltage

B Increase magnetic flux

C Decrease voltage

D Decrease magnetic flux (2)

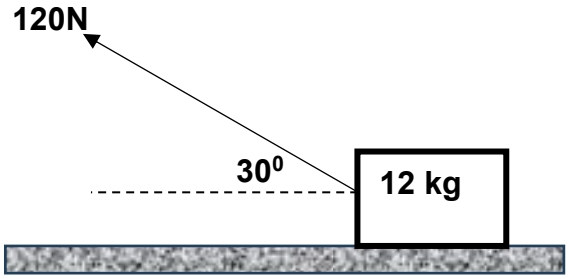
**[20]**



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

A 12 kg object is pulled with a force of 120 N at an angle of 30° across a rough surface, as shown in the diagram below.




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

2.2 Calculate the following:

2.2.1 Vertical component of the 120 N force (2)

2.2.2 Frictional force experienced by the object if the coefficient of kinetic friction ($\mu_k$) between the surface and the object is 0,13 (4)

2.2.3 Acceleration of the object (4)

2.3 How will an increase in the angle between the applied force and the horizontal influence the friction? Write only, **INCREASE, DECREASE** or **STAYS THE SAME.** Motivate your answer. (3)

2.4 A car is pulling a caravan on a rough horizontal surface as indicated in the diagram. (The system is NOT moving at constant velocity.)



2.4.1 State Newton's Third Law of motion in words. (2)

2.4.2 Draw a labelled free-body diagram of ALL the forces acting on the caravan. (4)

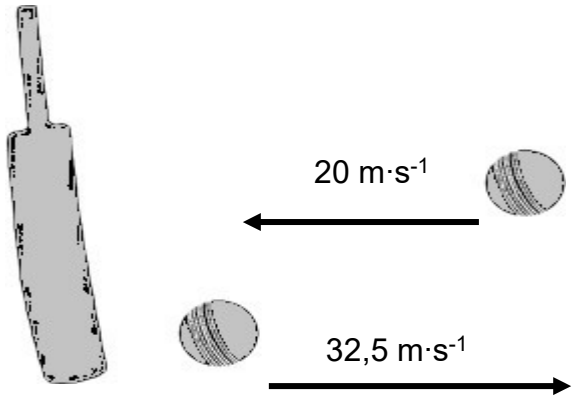
**[21]**

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

An 80 g cricket ball, bowled with a velocity of 20 m·s$^{-1}$, is struck by a cricket bat. The ball leaves the cricket bat with a velocity of 32,5 m·s$^{-1}$ in the opposite direction in a straight line, as shown in the diagram below. The contact time between the cricket bat and the cricket ball is 2 x 10$^{-3}$ s.

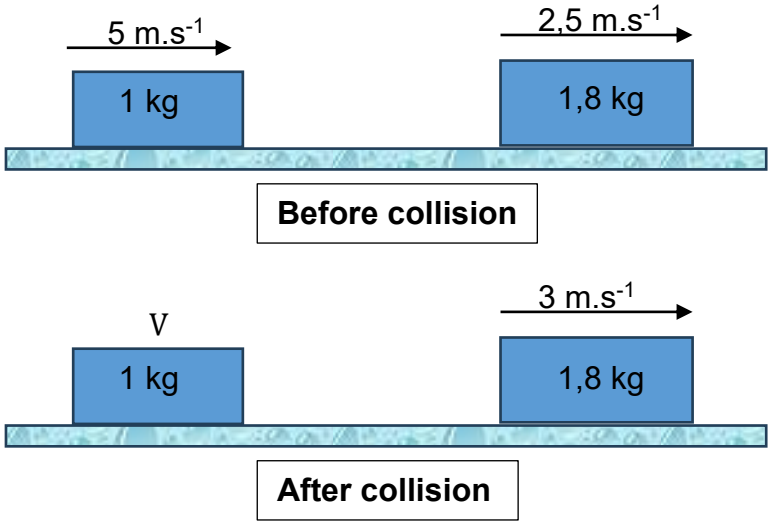



3.1 Define the term *impulse* (2)

3.2 Calculate the impulse of the cricket bat on the ball. (4)

3.3 Calculate the magnitude of the net force exerted on the ball. (3)

3.4 Two blocks are sliding on a frictionless ice surface, as shown in the diagram below.




3.4.1 State the principle of conservation of linear momentum in words. (2)

3.4.2 Calculate the velocity of the 1 kg block after the collision. (4)

3.4.3 Determine, by means of calculations, if the above collision is elastic or inelastic. (5)

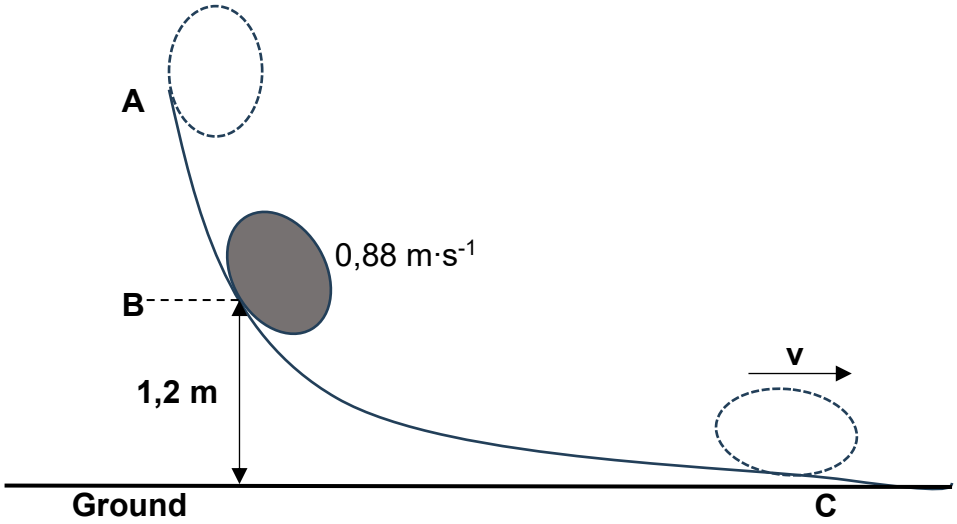
**[20]**

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

4.1 An object of mass 2 kg slides down a frictionless track **ABC**. The object starts from rest at point **A**. It then passes point **B**, which is 1,2 m above the ground, with a speed of 0,88 $m \cdot s^{-1}$. The object reaches point **C**, on the ground, with an unknown speed **v**, as shown in the diagram below.



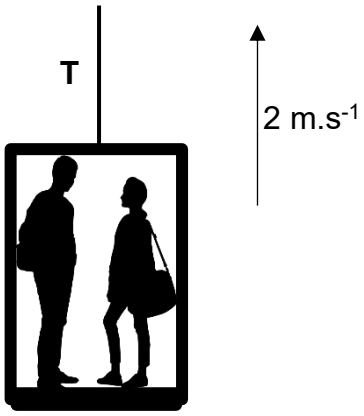

4.1.1 State the principle of conservation of mechanical energy in words. (2)

4.1.2 Determine the gravitational potential energy of the object at point **B**. (3)

4.1.3 Calculate the mechanical energy of the object at point **B**. (4)

4.1.4 Calculate the speed, **v**, with which the object reaches point **C**. (4)

The diagram below shows an elevator that is moving upwards with two people. A motor delivers 43 kW to lift the elevator with the two people at a constant speed of 2 $m \cdot s^{-1}$. Ignore air friction.




4.2 Define the term *power*. (2)

4.3 Calculate the magnitude of the tension, **T**, in the cable. (4)

**[19]**

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

5.1 A force of 16 N is applied to a 3 m long metal wire. The wire stretches by 0,5 mm. The diameter of the metal wire is 2,5 mm.

Calculate:

5.1.1 Stress in the wire (4)

5.1.2 Strain in the wire (3)

5.1.3 Young's modulus of the wire (3)

5.2 A hydraulic jack is used to lift a car weighing 1 278 N. The force applied to the input piston is 26 N. The area of the input piston is $7,855 \times 10^{-5}\ m^2$.

5.2.1 Define *pressure* at a particular point. (2)

5.2.2 Calculate the fluid pressure in the hydraulic system. (3)

5.2.3 Calculate the area of the output piston. (3)

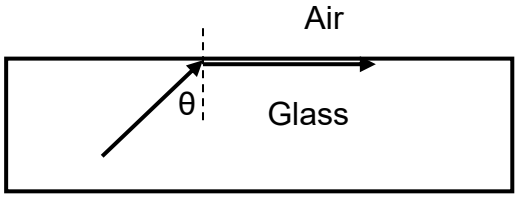
**[18]**

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

6.1 The ray of light moves from glass to air at the interface of the glass and air as shown in the sketch below and forms an angle **θ** in the glass. Study the sketch below and answer the questions that follow.




6.1.1 What name is given to the angle **θ**. (1)

6.1.2 Explain what will happen if angle ***θ*** is increased. (2)

6.1.3 Name ONE condition that is necessary for the phenomenon in QUESTION 6.1.2 to take place. (1)

6.2 An object with a height of 2 cm (upright) is placed 5 cm from the centre of a convex lens while the focal point is 3 cm from the centre of the lens.

6.2.1 Draw and label the image that will be formed from the above scenario. (5)

6.2.2 Name THREE characteristics of the image that is formed. (3)
**[12]**

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

Electromagnetic waves have many uses in our everyday lives. The spectrum below illustrates 5 waves, from radio waves until gamma rays. Study the sketch below and answer the questions that follow.

| Radio waves | Microwaves | Visible light  | X-rays | Gamma rays |
|---|---|---|---|---|

7.1 Define the term *photon* in words. (2)

7.2 Visible light has a maximum frequency of 750 x $10^{14}$ Hz. Calculate the energy of those photons. (3)

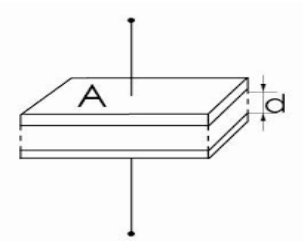
7.3 Name ONE use of X-rays. (1)
**[6]**



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

A capacitor has an area of 0,3 $m^2$ and a distance between the two plates of 0,15 m. There is only air between the two plates.




8.1 Define the term *capacitor* in words. (2)

8.2 Calculate the capacitance of the capacitor. (3)

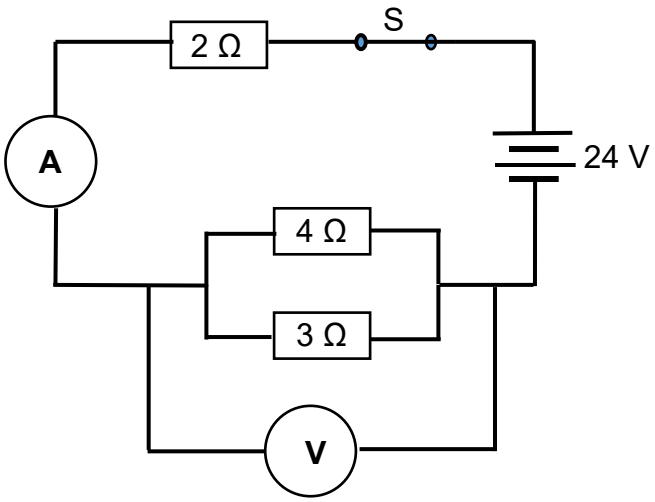
8.3 State THREE ways in which the capacitance of a capacitor can be INCREASED. (3)
**[8]**

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

Three resistors 2 Ω, 3 Ω and 4 Ω are connected to a 24 V battery of negligible internal resistance as shown in the circuit diagram below.




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

9..2 Calculate the:

9.2.1 Total resistance in the circuit (4)

9.2.2 Reading on the ammeter (3)

9.2.3 Reading on the voltmeter (3)

9.3 Define the term *power*. (2)

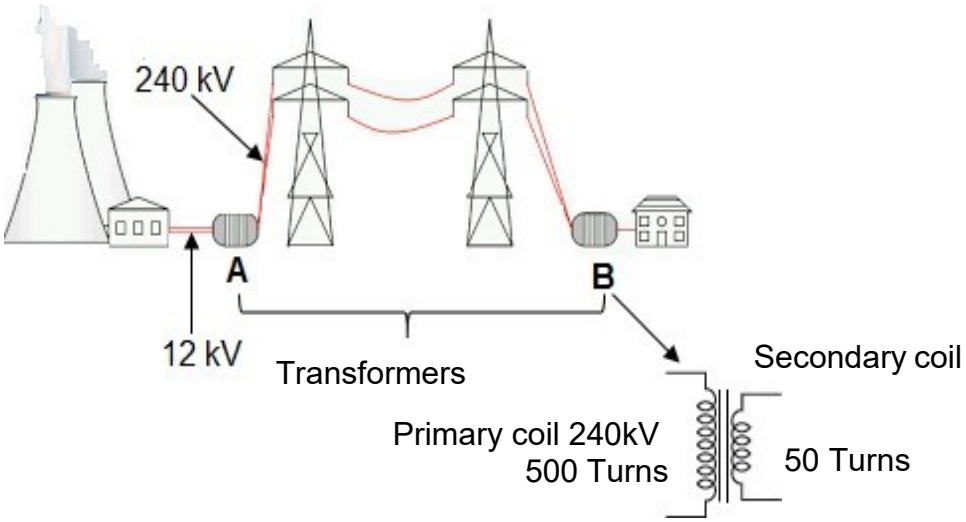
9.4 Calculate the power dissipated by a 2 Ω resistor. (3)
**[17]**



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**QUESTION 10 (Start on a new page.)**

10.1 Study the diagrams below that illustrate the use of a transformer from power plant to substation.

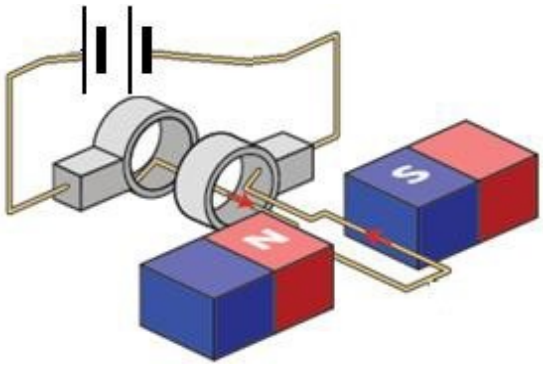



10.1.1 What type of transformer is indicated by letter **A?** (1)

10.1.2 Explain the answer in QUESTION 10.1.1. (2)

10.1.3 Calculate the potential difference on the secondary coil for the transformer indicated by symbol **B**. (3)

10.2 The diagram below illustrates a simple electric motor.




10.2.1 What type of motor is shown in the diagram above? Write down only AC motor or DC motor. (1)

10.2.2 State the energy conversion that is taking place in the diagram above. (2)

**[9]**

**TOTAL: 150**

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# DATA FOR TECHNICAL SCIENCES GRADE 12
# PAPER 1

## *GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12*

## *VRAESTEL 1*

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

| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Acceleration due to gravity<br>*Swaartekragversnelling* | g | 9,8 $m \cdot s^{-2}$ |
| Speed of light in a vacuum<br>*Spoed van lig in 'n vakuum* | c | $3,0 \times 10^{8}$ $m \cdot s^{-1}$ |
| Planck's constant<br>*Planck se konstante* | h | $6,63 \times 10^{-34}$ $J \cdot s$ |
| Electron mass<br>*Elektronmassa* | $m_e$ | $9,11 \times 10^{-31}$ kg |
| Permittivity of free space<br>*Permittiwiteit van vrye ruimte* | $\varepsilon_\circ$ | $8,85 \times 10^{-12}$ $F.m^{-1}$ |

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

### FORCE/*KRAG*

| | |
|---|---|
| $F_{net} = ma$ | $p = mv$ |
| $f_{s\,max} = \mu_s N$ | $f_k = \mu_k N$ |
| $F_{net}\Delta t = \Delta p$<br>$\Delta p = mv_f - mv_i$ | $F_g = mg$ |
| $MA = \frac{L}{E} = \frac{e}{l}$ | |

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## 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* $E_k = \frac{1}{2}mv^2$ | $W_{net} = F_{net}\Delta x\cos\theta$ |
| $P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$ | $P = \frac{W}{\Delta t}$ |
| | $M_E = E_k + E_p$ |

## ELASTICITY, VISCOSITY AND HYDRAULICS/*ELASTISITEIT, VISKOSITEIT EN HIDROULIKA*

| | |
|---|---|
| $\sigma = \frac{F}{A}$ | $\varepsilon = \frac{\Delta \ell}{L}$ |
| $\frac{\sigma}{\varepsilon} = K$ | $\frac{F_1}{A_1} = \frac{F_2}{A_2}$ |
| $P = \frac{F}{A}$ | $P = \rho gh$ |

## ELECTROSTATICS / *ELEKTROSTATIKA*

| | |
|---|---|
| $C = \frac{Q}{V}$ | $C = \frac{\varepsilon_o A}{d}$ |

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## CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

| | |
|---|---|
| $R = \frac{V}{I}$ | emf/*emk* ( $\varepsilon$ )= I(R + r) |
| $R_s = R_1 + R_2 + ...$<br>$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ...$ | $q = I\,\Delta t$ |
| $W = VQ$<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>$P = \frac{V^2}{R}$ |

## ELECTROMAGNETISM/*ELEKTROMAGNETISME*

| | |
|---|---|
| $\Delta\phi = BA$ | $\varepsilon = - N \frac{\Delta\phi}{\Delta t}$ |
| $\frac{V_s}{V_p} = \frac{N_s}{N_p}$ | |

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

| | |
|---|---|
| $v = f\lambda$ | $T = \frac{1}{f}$ |
| $E = hf$ or $E = h.\frac{c}{\lambda}$ | |

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