Province of the
EASTERN CAPE
EDUCATION

# NATIONAL SENIOR CERTIFICATE

## GRADE 12

## JUNE 2023

# TECHNICAL SCIENCES P1 (DEAF)

**MARKS:** **150**

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

This paper has 17 pages and 3 data sheets.

**INSTRUCTIONS AND INFORMATION**

**Read** the **instructions**. **Answer** the **questions**.

1. This **question paper** has **TEN questions**.
   **Answer ALL** the **questions** in the **ANSWER BOOK**.

2. Start **EACH question** on a **NEW page** in the ANSWER BOOK.

3. **Number** the **answers** the **same** as the **numbers** in the **question paper**.

4. You may use a non-programmable calculator.

5. Leave **ONE line between questions**, e.g. between QUESTION 2.1 and QUESTION 2.2.

6. **Use** the attached **DATA SHEETS**.

7. **Show** ALL **formulae** and **substitutions** in ALL calculations.

8. **Round off** your **answers** to a minimum of **TWO decimal places**.

9. Some **questions** will **ask** you to **explain** your **answer**.
   Write **short explanations**.

10. Write **neatly**.
    Your **work** must be **easy** to **read**.

## QUESTION 1: MULTIPLE-CHOICE QUESTIONS

**Choose** the **answer**.
**Write only** the **letter** (A–D) **next** to the **question numbers** (1.1 to 1.10), e.g. 1.11 D.

1.1 A **car experiences** a **constant net force** of **500 N** as it **moves towards** the **west**.
The **rate** at which the **momentum** of the **car changes** during its **motion** is …

A equal to the impulse of the car.

B equal to 500 N.

C greater than the net force

D less than 500 N (2)

1.2 **Newton's First Law of Motion implies**(says) that an **object** will **continue moving** at **constant velocity as long as** the …

A sum of all forces acting on the object is zero.

B net force experienced by the object is greater than zero.

C net force experienced by the object is less than zero.

D sum of all the forces acting on the object is greater than zero but less than one. (2)

1.3 **One** of the **properties** of **action-reaction pairs** is that **…**

A they have the same magnitude.

B they act towards the same direction.

C their net force is always zero.

D they act on the same object. (2)

1.4 A **learner drops** his **book** from his **desk** to the **floor**. The **mechanical energy** at the **top** of the **desk**, **from where** the **book** was **dropped** will be …

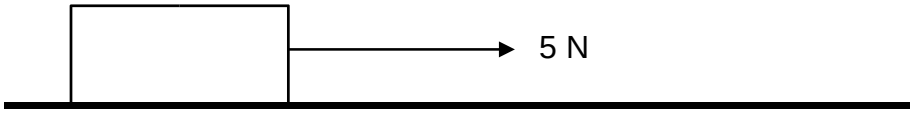
A equal to zero.

B equal to kinetic energy.

C equal to the gravitational potential energy.

D None of the above. (2)

1.5 An **object moves** with a **constant velocity** along a **rough surface** when a **horizontal force** of **5 N acts on it.**




The **magnitude** of the **kinetic frictional force** is …

A equal to 0.

B equal to 5 N.

C greater than 5 N.

D less than or equal to 5 N. (2)

1.6 Which **term** best **describes** a **force** that is **equal**, and **opposite** to the **deforming force**?

A Strain

B Stress

C Applied Force

D Restoring Force (2)

1.7 A **bricklayer** wants to **displace** an **object** through a **horizontal distance** of **5 m**. He **applies** a **force** of **10 N**, but the object **remains at rest.** **Work done** by the **bricklayer on** the **object (in Joule) is** …

A 0.

B 5.

C 10.

D 50. (2)

1.8 **Which** ONE of the **statements represents(show) Pascal's law**?

A The area is inversely proportional to the pressure in it, if the temperature remains constant.

B The pressure exerted at any point of a continuous liquid at equilibrium, is transmitted equally in all directions.

C The pressure is directly proportional to the volume if the temperature remains constant.

D Volume is inversely proportional to the pressure on it if the temperature remains constant. (2)

1.9 **Strain** is **defined** as the …

A force acting per unit area.

B internal restoring force per unit area.

C force that changes the shape of an object.

D ratio of change in dimension to the original dimension. (2)

1.10 The **pressure** at a **point** in a **liquid** DOES NOT **depend** on the ...

A area.

B depth.

C density.

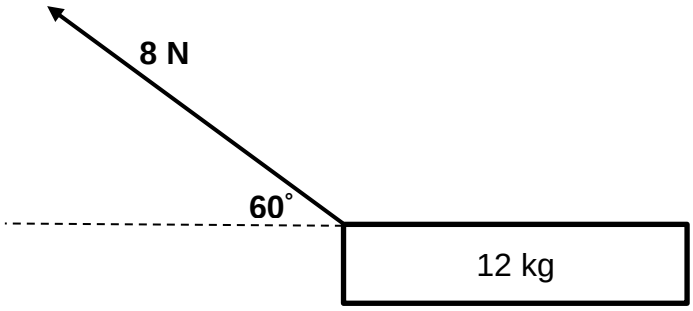
D gravitational acceleration. (2)

**[20]**

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

**Diagram:**
A **learner** is **pulling** a **block** of **mass 12 kg** at a **force** of **8 N left**
It is at an **angle** of **60°** to the **horizonta**l.
The **block experiences** a **frictional force** of **0,3 N parallel** to the **surface**.
It is **shown** in the **diagram** below.




2.1 **Define** the term ***acceleration***. (2)

2.2 **Use** the **diagram**. **Answer** the **questions**.

2.2.1 **Calculate** the **magnitude** and the **direction** of the **net force**. (5)

2.2.2 **Calculate** the **magnitude** of the **acceleration** of the **block**. (3)

2.2.3 **Write** down the **NAME** of the **law** that can be **used** to **explain** the **movement** of the **block**. (2)

2.2.4 **State** the **law identified** in QUESTION 2.2.3 in **words**. (2)

2.2.5 **Draw** a **free-body diagram** of all the **forces acting** on the **block**. (4)

2.3 **Another block** of **same mass** is **placed** on top of the **block A**.
It is **pulled** at the **same angle**.
**How** will the following **be influenced** by the **increase** of **mass**?

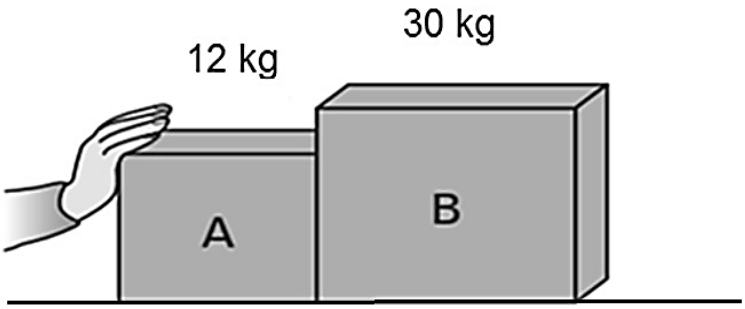
**State** only, I**NCREASES**, **DECREASES** or **REMAINS THE SAME**.

2.3.1 Frictional force (1)

2.3.2 Acceleration (1)
**[20]**

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

Crate **A** and crate **B**, of **different masses**, are **placed next** to **each other on** a **horizontal rough surface.**
A **hand pushing crate A causes both crates** to **accelerate** at **2,3 m.s$^{-2}$** to the **right**.
Crate **B experiences** a **frictional force** of 25,3 N.



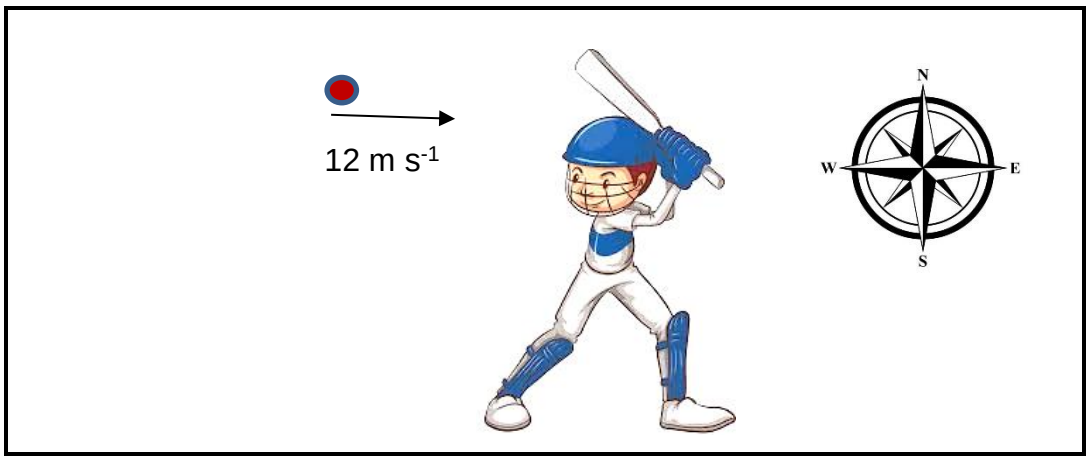

3.1 **Give Newton's Third Law of Motion** in words. (2)

3.2 **Calculate** the **force exerted$_{(applied)}$** by crate **B** on crate **A**. (6)
**[8]**

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

4.1 **Diagram**:
A **cricket ball**, of **mass 175 g**, is **thrown directly** towards a **batsman** at a **horizontal velocity** of **12 m·s$^{-1}$ east**.
It is **hit back** in the **opposite direction with** a **velocity of 30 m·s$^{-1}$ west**.
The **ball** is **in contact** with the **bat** for a period of **0,05 s**.




4.1.1 **Give** the **definition** of the term ***impulse*** in words. (2)

4.1.2 **Calculate** the **change** in the **momentum** of the **ball** in **magnitude** and **direction**. (5)

4.1.3 **Calculate** the **magnitude** of the **force exerted$_{(applied)}$** by the **bat** on the **ball**. (3)

4.1.4 Modern **cars use crumple zones** on the **front** and the **sides as** a **safety measure**.
It is to **reduce injuries during** a **collision**.
**Explain,** by using the **concept** of **impuls**e, **how crumple zones reduce injuries**. (4)

4.2 Block **X**, of **mass 2 kg**, **slides** at **3 m·s$^{-1}$** to the **right** and **collides** with a **stationary block Y**, of mass 3,5 kg.
Block **X rebound**s at a **velocity** of **1 m·s$^{-1}$** to the **left**.

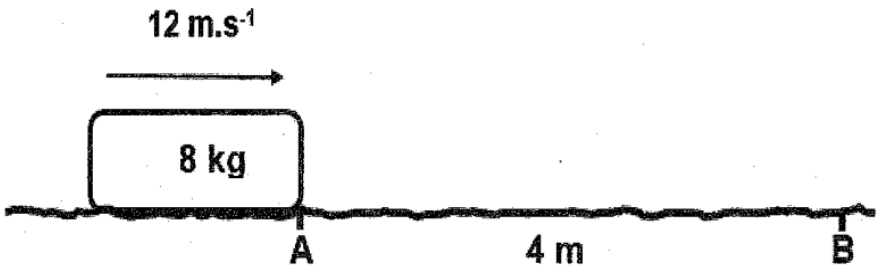
4.2.1 **Write** down the **principle of conservation** of **linear momentum**. (2)

4.2.2 **Calculate** the **velocity** of block **Y after** the **collision**. (5)
**[21]**

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

**Diagram**
A **block** of **mass 8 kg moves** to the **right** over a **rough horizontal surface** from point **A** to point **B**.
Point **B** is **situated 4 m** away **from** point **A** as **shown** in the diagram below.
The c**oefficient** of **friction** ($\mu_k$) **between** the **block** and the **surface AB** is 0,14.




5.1 **Define** the term ***work done***. (2)

5.2 **Calculate**:

5.2.1 The **magnitude** of the **kinetic frictional force on** the **block** while **moving** from point **A** to point **B** (3)

5.2.2 The **work done** by the **kinetic frictional force** from point **A** to point **B** (3)

5.3 **What** would the **work done** by **gravitational force** be **equal to**? (1)

5.4 The **amount of work done by** a **truck** of **mass 3 000 kg moving** on a **horizontal road** in 30 s, is 480 000 J.

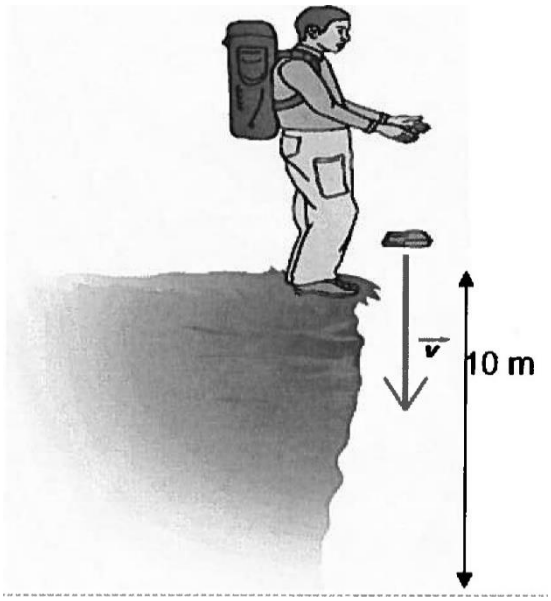
5.4.1 **Define** the term ***power*.** (2)

5.4.2 **Calculate** the **power** of the **truck** in **horsepower**. (5)
**[16]**

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

**Diagram**
A **hiker** is **standing** on **top** of a **cliff**.
The **hiker drops** a **parcel** with a **mass** of **8 kg.**
It is **10 m above** the **ground**.




6.1 **State** the **principle of Conservation of Mechanical Energy** in words. (2)

6.2 **Calculate** the **total mechanical energy** of the **parcel** at the **top** of the **cliff**. (4)

6.3 **Another hiker**, at the **bottom** of the **cliff, picks** up the **parcel** and walks **0,5 m** on a **horizontal surface** with it.

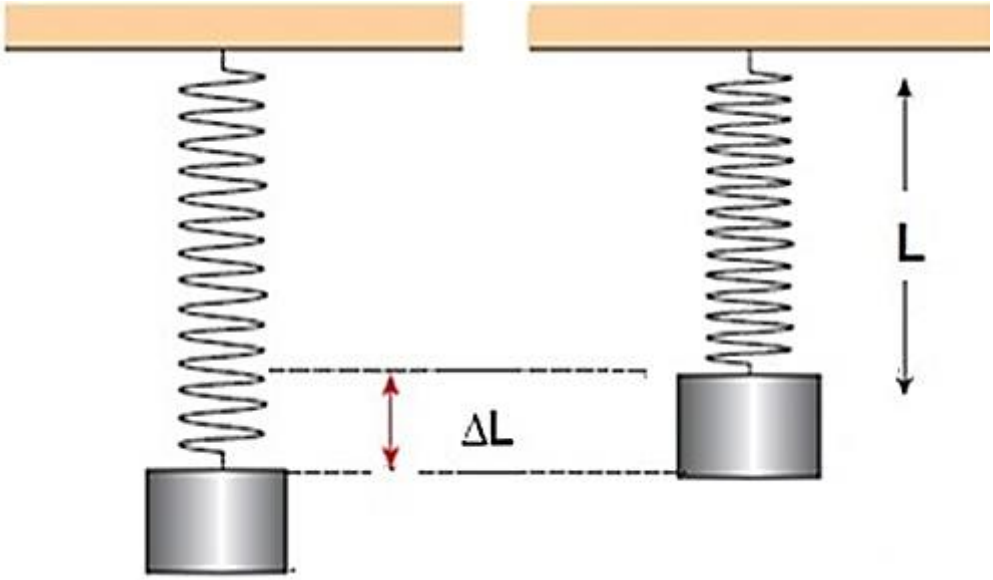
6.3.1 **Is** there **work done on** the **parcel after** the **second hiker** has **walked 0,5 m with it**? Answer YES or NO. (1)

6.3.2 **Explai**n your **answer** to **QUESTION 6.3.**1. (2)
**[9]**

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

**Diagram**
A **compressive force causes internal stress** of **1 MPa**.
It is **in** a **SPRING made** of an **unknown metal**.
The resistance area of the round SPRING is $2 \times 10^{-3}\ m^2$.
Its **original length** is **50 mm**.
The **force causes** the **round SPRING** to **increase** by **$1 \times 10^{-3}$ mm**.




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

7.2 **State *Hooke's Law*** in words. (2)

7.3 **Calculate** the:

7.3.1 ***Force*** that **causes** the **SPRING** to **stretch** (4)

7.3.2 ***Strain*** in the **metal** caused by the **force** (3)

7.3.3 ***Elasticity modulus*** for this **metal** (3)
**[14]**

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

**Table:**
The **table below** shows **different types** of **motor oils** and their **gradings**, used in different **temperature regions**, in different **seasons**.

| Motor Oil | Type of Oil | Grading |
|---|---|---|
| A | Low viscosity | 5W-30 |
| B | High viscosity | 5W-40 |

8.1 **Define** the term ***viscosity***. (2)

8.2 **What** does **5W-30 represent**(show) on the **label** of a **motor oil container**(can)? (2)

8.3 Use the **information** given in the **table**.
**Choose** which **motor oil** (**A** or **B**) will be **suitable** for **use** in **summer** as **compared** to **winter**. (2)

8.4 **Explain** your **answer** to QUESTION 8.3 above in terms of **viscosity** and **temperature**. (2)

8.5 **Distinguish**(explain difference) between *single/mono-grade* and *multi-grade motor oils*. (4)
**[12]**

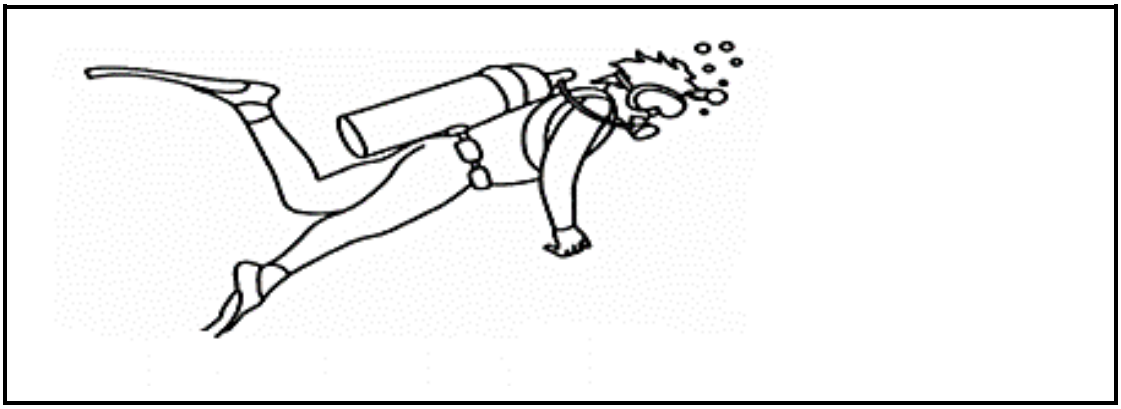
 

**QUESTION 9 (Start on a new page.)**

9.1 **Explain** the term ***hydraulics*** in words**.** (2)

9.2 Write down **TWO applications** of **hydraulic systems**. (2)

9.3 In the diagram below, a **diver** is seen **swimming under water**.
The **pressure acting** on the **diver's forehead** is 1,2 x $10^5$ Pa.
The **surface area** at the **back** of his **head** is 8,4 x $10^{-3}$ $m^2$**.**

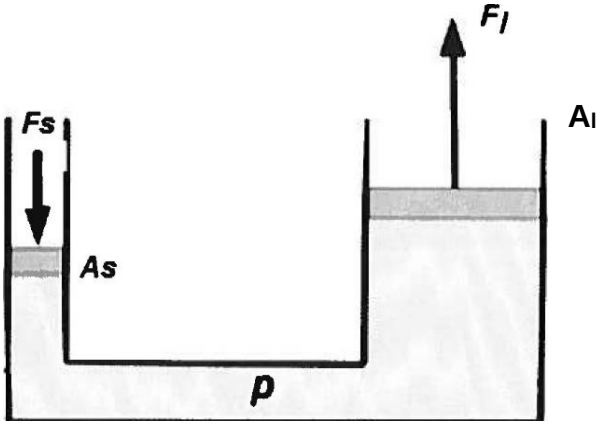


9.3.1 **Define** the term ***pressure*** in words. (2)

9.3.2 **Calculate** the **magnitude** of the **force** that acts on the **diver's head**. (3)

9.3.3 **State** the **direction** of the **force** of the **water acting** on the **diver**. (1)

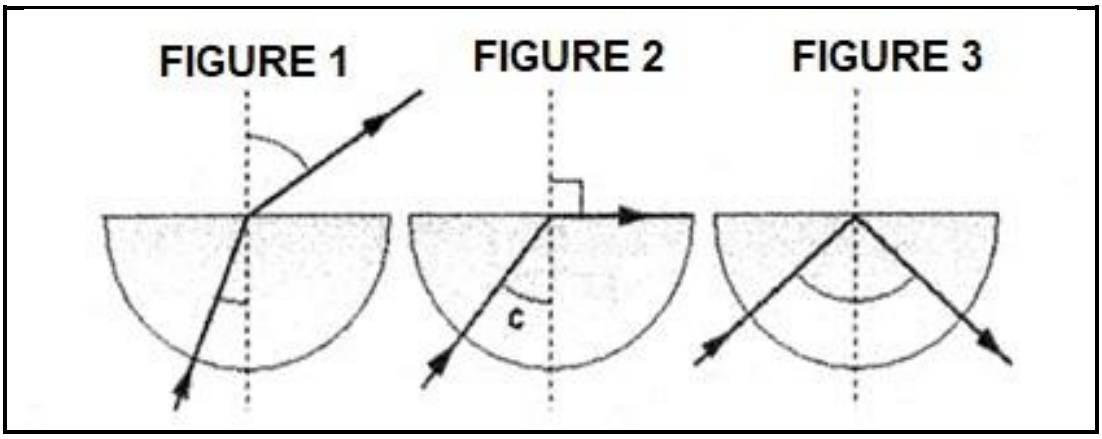
9.4 **Diagram:**
The diagram below shows a **simple hydraulic system** that is **used** to **lift cars**.
The **force applied** by **$F_S$** is 130 N downwards.
The **surface area** of **$A_S$** is 0,002 $m^2$.
The **surface area** of **$A_I$** is 0,025 $m^2$.




**Calculate** the force **$F_I$** due to **pressure exerted** by force **Fs**. (3)
**[13]**

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

10.1 **Diagram:**
**Light moves** through a **semi-circular glass prism** as shown below.




10.1.1 Give **ONE word** that **describes** the **phenomenon** taking **place** in **FIGURE 1**. (1)

10.1.2 **Give** the **name** of **angle C** in **FIGURE 2**. (1)

10.1.3 **Identify** the **phenomenon** taking place in **FIGURE 3**. (1)

10.1.4 **Give TWO conditions** for the **phenomenon** in **FIGURE 3**. (2)

10.1.5 **List THREE applications** where the **phenomenon** in **FIGURE 3** is **used** in **optical equipment**. (3)

10.2 A **radio station broadcasts** an **FM radio signal** at **99,5 MHz**.

10.2.1 **Convert**(change) 99,5 MHz to Hz. (2)

10.2.2 **Calculate** the **wavelength** of this **radio signal**. (3)

10.2.3 The **frequency** of **another radio station** is 108 MHz.

Is the wavelength SHORTER THAN, the SAME AS or LONGER THAN the one **calculated** in QUESTION 10.2.2?

Give a **reason** for your **answer**. (4)
**[17]**

**TOTAL: 150**

# 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·s |
| Coulomb's constant<br>*Coulomb se konstante* | k | $9,0 \times 10^{9}$ $N \cdot m^{2} \cdot C^{-2}$ |
| Charge on electron<br>*Lading op elektron* | -e | $-1,6 \times 10^{-19}$ C |
| Electron mass<br>*Elektronmassa* | $m_e$ | $9,11 \times 10^{-31}$ kg |

### 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>$\Delta p = mv_f - mv_i$ | $F_g = mg$ |
| Torque $= F \times r_{\perp}$ | $MA = \frac{L}{E} = \frac{e}{l}$ |

### 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* $W_{net} = \Delta E_k$<br>$\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$ |
| $W_{nc} = \Delta K + \Delta U$ or/*of* $W_{nc} = \Delta E_k + \Delta E_p$ | $P = \frac{W}{\Delta t}$ |
| $P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$ | $M_E = E_k + E_p$ |

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

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

## ELECTROSTATICS/*ELEKTROSTATIKA*

| | |
|---|---|
| $F = \frac{kQ_1Q_2}{r^2}$ | $E = \frac{kQ}{r^2}$ |
| $Q = \frac{Q_1 + Q_2}{2}$ | $E = \frac{F}{q}$ |
| $n = \frac{Q}{e}$ or/*of* $n = \frac{Q}{q_e}$ | $E = \frac{V}{d}$ |
| $C = \frac{Q}{V}$ | $C = \frac{\varepsilon_o A}{d}$ |

## 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*

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