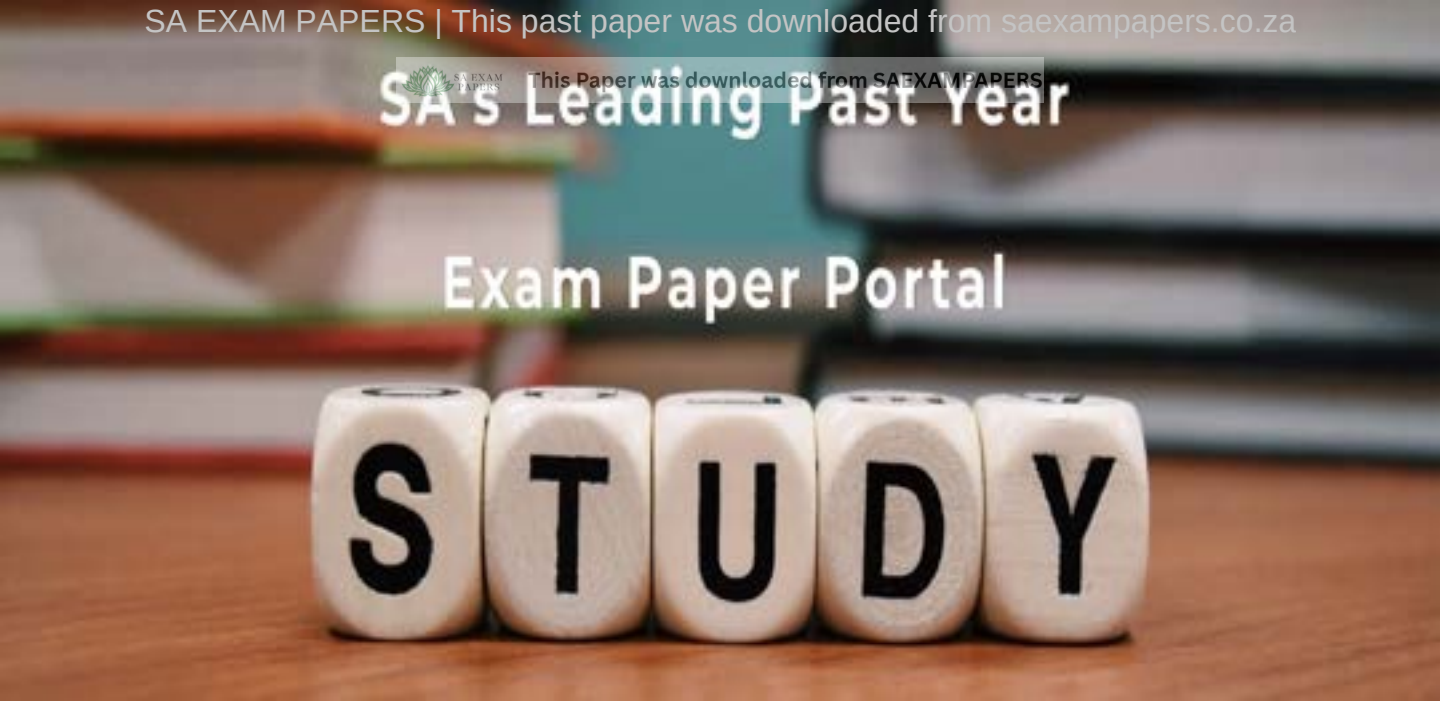


GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

# JUNE EXAMINATION
# GRADE 12

# 2026

## TECHNICAL SCIENCES

## (PAPER 1)

**TECHNICAL SCIENCES P1**

C2101E

**TIME:** 3 hours

**MARKS:** 150

**14 pages + 2 data sheets**

X05

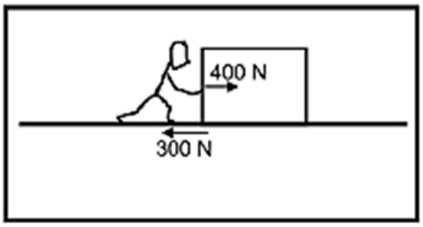
## INSTRUCTIONS AND INFORMATION

1. This question paper consists of ELEVEN questions. Answer ALL the questions in the ANSWER BOOK.
2. Number the answers correctly according to the numbering system used in this question paper.
3. Leave ONE line open between subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
4. You may use a non-programmable calculator.
5. You may use appropriate mathematical instruments.
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.

## 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, e.g. 1.11 E.

1.1 A boy applies a force of 400 N to a crate and pushes the crate as shown below. The frictional force acting on the crate is 300 N. The crate accelerates at 0,2 $m \cdot s^{-2}$ in the direction of the applied force.




According to Newton's Third Law of Motion, the magnitude of the reaction force exerted by the crate on the boy is:

A 20 N
B 100 N
C 400 N
D 700 N (2)

1.2 A passenger who is not wearing a seatbelt, hits the windscreen of a car in a head-on-collision. This is an illustration of:

A Newton's First Law of Motion
B Newton's Second Law of Motion
C Momentum
D Impulse (2)

1.3 A ball of mass *m* strikes a wall at right angles with speed *v*. If it bounces off the wall with the same speed, the magnitude of the change in its momentum is:

A 0
B mv
C 2mv
D $mv^2$ (2)

1.4 The correct SI unit for impulse is:

A $kg \cdot m \cdot s^{-1}$
B N·s
C $kg \cdot m \cdot s^{-2}$
D $N \cdot s^{-1}$ (2)

1.5 Consider the two diagrams below where the critical angle is 50° for both diagrams.

**Diagram A**

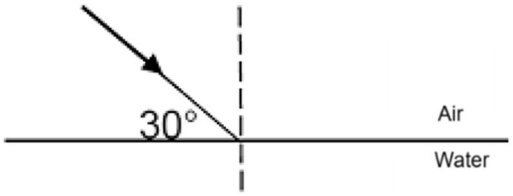
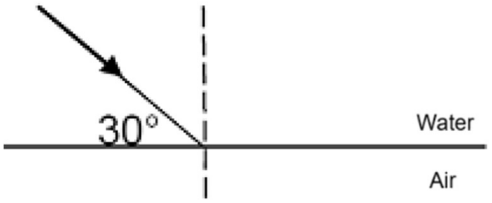



**Diagram B**




Which of the following statements regarding diagrams **A** and **B** is TRUE for total internal reflection to occur?

A The angle of incidence is greater than the critical angle in diagram **A** than in diagram **B**, and water is denser than air.
B The angle of incidence is greater than the critical angle in diagram **B** than in diagram **A** and air is denser than water.
C The angle of incidence is smaller than the critical angle in diagram **A** than in diagram **B**, and air is denser than water.
D The angle of incidence is greater than the critical angle in diagram **B** than in diagram **A** and water is denser than air. (2)

1.6 Which statement about concave and convex lenses is CORRECT?

A A concave lens always converges light rays to a point.
B A convex lens is thicker at the edges and thinner in the middle.
C A concave lens always produces a virtual, upright, and diminished image.
D A convex lens can never produce a real image. (2)

1.7 Good sunglasses mainly protect our eyes from harmful …

A microwaves.
B ultraviolet rays.
C gamma rays.
D infrared rays. (2)

1.8 Which of the following units is the same as Pa?

A $N \cdot m$
B $N \cdot m^{2}$
C $N \cdot m^{-2}$
D $N \cdot m^{-1}$ (2)

1.9 When a racing car brakes heavily to come to a halt, into what form of energy is its kinetic energy transformed?

A Potential energy
B Kinetic energy
C Elastic energy
D Internal energy (2)

1.10 A mechanic uses a hydraulic lift to raise a car. When the mechanic applies a small force on the narrow piston, the car (resting on the wider piston) is lifted upwards.

Which of the following statements correctly explains why the car can be lifted?

A The fluid transfers pressure equally in all directions, so the pressure applied on the narrow piston is transmitted to the wider piston.
B The fluid increases the force as it moves from the narrow piston to the wider piston without maintaining the same pressure.
C The pressure applied on the fluid is only concentrated under the narrow piston where the force is applied.
D The fluid reduces the pressure on the wider piston to balance the small force applied on the narrow piston. (2)

**[20]**

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

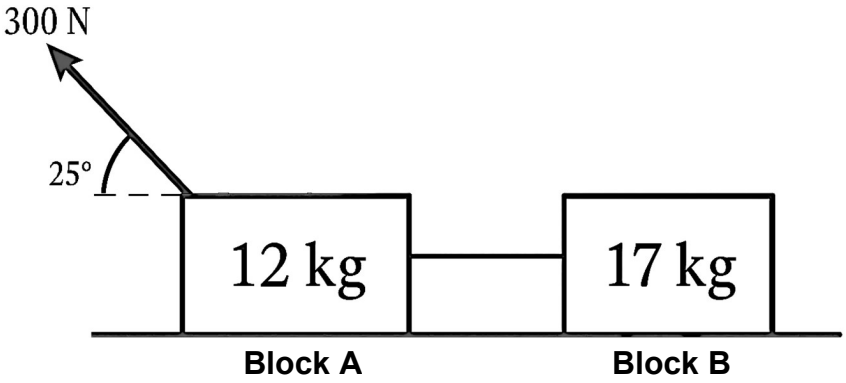
Select the correct term/phrase from COLUMN B that matches a description in COLUMN A. Write only the letter (A – M) next to the question numbers (2.1 to 2.10) in the ANSWER BOOK, e.g. 2.11 N.

| COLUMN A | | COLUMN B | |
|---|---|---|---|
| 2.1 | Inertia | A | does not regain its original shape and size when the deforming force is removed |
| 2.2 | Perfect plastic body | B | deals with the mechanical properties of fluids |
| 2.3 | Refraction | C | property of the fluid to oppose relative motion between the two adjacent layers |
| 2.4 | Isolated system | D | the force parallel to the surface that opposes the motion of an object |
| 2.5 | Focal length | E | a disturbance that transfers energy through matter or space |
| 2.6 | Wave | F | the net external force acting on the system is zero |
| 2.7 | Hydraulics | G | the change in direction of a wave upon striking the interface between two materials |
| 2.8 | Frictional force | H | the bending of light when it passes from one medium to another |
| 2.9 | Electromagnetic wave | I | the property of a body to resist any change in its state of motion or rest |
| 2.10 | Viscosity | J | the distance between the focal point and the centre of the lens |
| | | K | regains its original shape and size when the deforming force is removed |
| | | L | a straight line perpendicular to the surface of the lens |
| | | M | a changing magnetic and electric field mutually perpendicular to each other and the direction of propagation of the wave |

(10 x 1) **[10]**

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

Two wooden blocks, connected with an inelastic string, are pulled on a frictionless surface as indicated in the diagram below.




3.1 Define the term *normal force*. (2)

3.2 Draw a free-body diagram of ALL the forces acting on block **A**. (4)

3.3 Calculate the tension experienced by the string. (6)

3.4 The string between the two wooden blocks breaks. What will happen to the acceleration of block **B**? Write down only INCREASE, DECREASE or REMAINS THE SAME. (1)

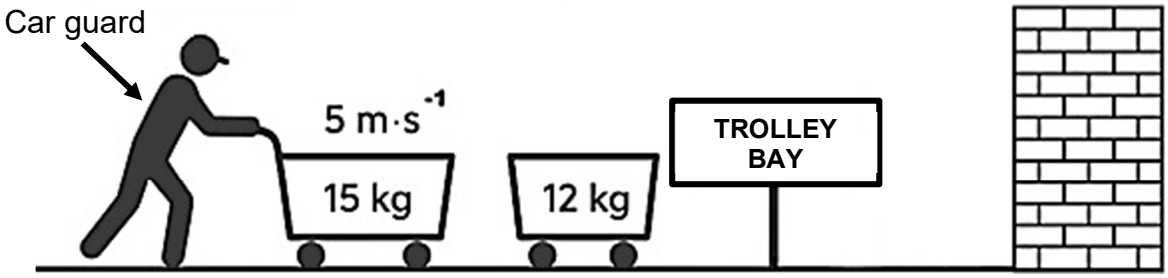
3.5 Explain the answer to QUESTION 3.4. (2)

3.6 Name and state the law that was used in the explanation of QUESTION 3.5. (3)

**[18]**

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

A car guard pushes a trolley with a mass of 15 kg at a velocity of 5 m·s$^{-1}$ into a stationary trolley with a mass of 12 kg. After the collision, both trolleys move forward together towards the trolley bay.




4.1 Define the term *momentum*. (2)

4.2 Calculate the:

4.2.1 Initial momentum of the trolleys before the collision (4)

4.2.2 Velocity of the trolleys on their way towards the trolley bay (3)

4.3 The car guard claims the trolley collision is inelastic. Use calculations to prove that his statement is correct. (5)

The two trolleys collide with the wall at the trolley bay and rebound with a velocity of 1,75 m·s$^{-1}$. The trolleys remain in contact with the wall for 0,3 s.

4.4 Define the term *impulse*. (2)

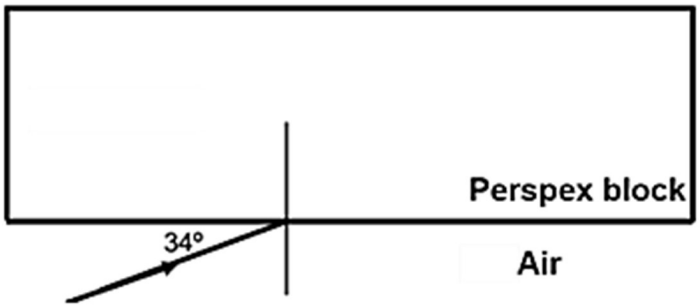
4.5 Calculate the impulse with which the trolleys collide with the wall. (3)

4.6 Calculate the force that is exerted by the wall on the trolleys. (4)

**[23]**

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

The diagram below shows a ray of light that moves from air into a transparent rectangular Perspex block.

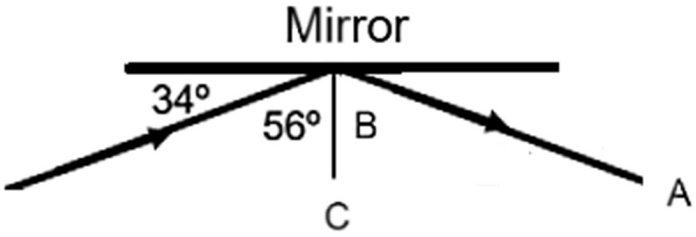



5.1 Define the term *refraction*. (2)

5.2 Redraw the diagram in your ANSWER BOOK. Complete the diagram by indicating the path of the light ray as it enters and exits the Perspex block. Ensure that the diagram is fully-labelled. (NOTE: The diagram does not need to be drawn to scale.) (6)

5.3 Write down the value for the angle of incidence. (1)

The Perspex block above is replaced with a mirror and the following observation is made:




5.4 State the law observed in the above diagram. (2)

5.5 Refer to the diagram above and identify the following:

5.5.1 **A** (1)

5.5.2 **B** (1)

5.5.3 **C** (1)

5.6 Name TWO properties of an image as observed in the above diagram. (2)

**[16]**

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

The frequency and corresponding energy of electromagnetic waves are given in the table below.

| WAVE | FREQUENCY (HZ) | ENERGY (J) |
|---|---|---|
| **A** | $2 \times 10^{9}$ | $1{,}33 \times 10^{-24}$ |
| **B** | $4 \times 10^{12}$ | $2{,}65 \times 10^{-21}$ |
| **C** | **X** | $2{,}32 \times 10^{-18}$ |
| **D** | $1{,}8 \times 10^{18}$ | $1{,}19 \times 10^{-15}$ |
| **E** | $7{,}5 \times 10^{19}$ | $4{,}97 \times 10^{-14}$ |

6.1 Define the term *photon*. (2)

6.2 Calculate the frequency of wave **C**. (3)

6.3 What is the relationship between frequency and energy? (2)

6.4 Which wave has the highest wavelength? Explain the answer with reference to the information in the table. (2)

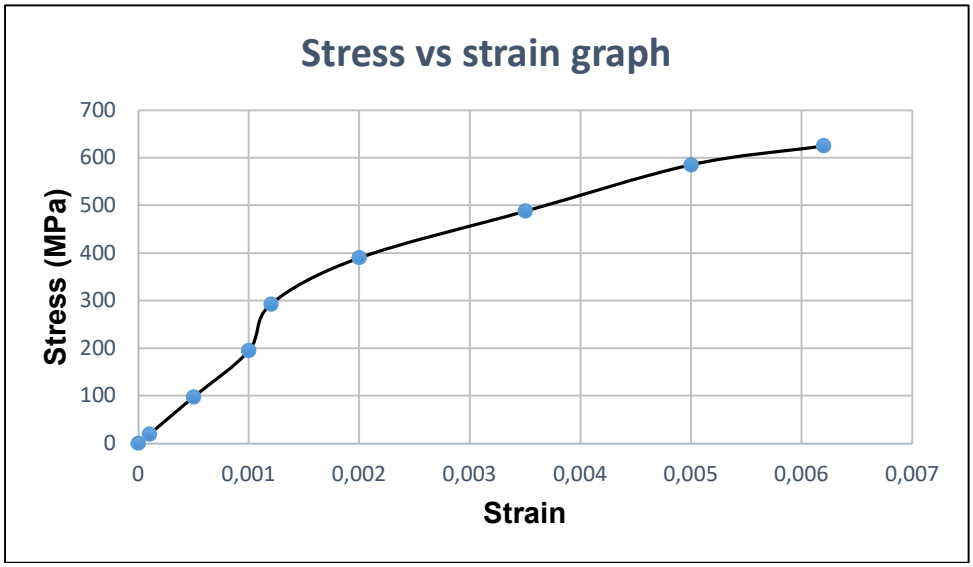
6.5 Wave **B** is identified as infrared. Which wave could be identified as x-rays? Choose between wave **D** and **E**. Give a reason for the choice. (2)

**[11]**

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

An iron rod of unknown diameter was subjected to increasing mass pieces being placed upon it to investigate how stress and strain relate up to the point of fracture. The following table and graph represent the data collected during the experiment.

| MASS (Kg) | STRESS (MPa) |
|---|---|
| 100 | 19,5 |
| 500 | 97,6 |
| 1 000 | 195,1 |
| 1 500 | 292,7 |
| 2 000 | 390,2 |
| 2 500 | 487,8 |
| 3 000 | 625,0 |
| 3 200 | 625,0 |




7.1 Write down an investigative question for this experiment. (2)

7.2 Define the term *elasticity*. (2)

7.3 Explain the difference between the *elastic* and *plastic* regions of a material. (2)

7.4 From the graph, determine the maximum stress that the iron rod can withstand while remaining in the elastic region. (2)

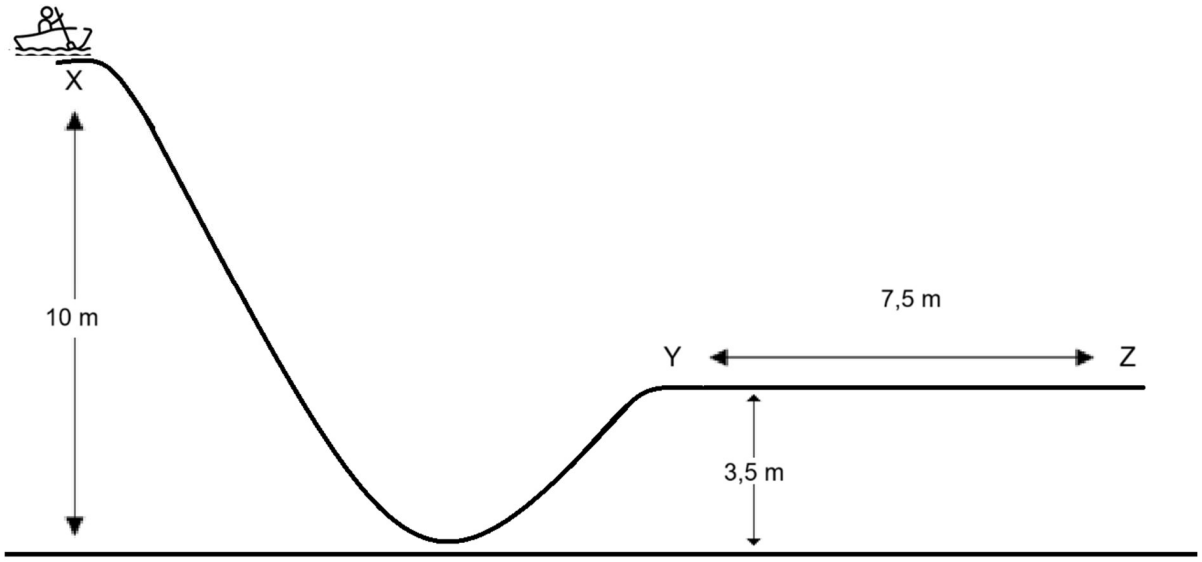
7.5 Calculate the diameter of the iron rod if the stress is 195,1 MPa. (5)

7.6 Draw a conclusion from this experiment. (2)

**[15]**

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

The diagram below shows part of a water slide at an amusement park. A rider and the inflatable boat have a combined mass of 75 kg. At the top of the slide, at point **X**, the rider is at a vertical height of 10 m above the ground and moves the inflatable boat with a velocity of 6 m·s$^{-1}$. The rider descends the slide and then rises to a vertical height of 3,5 m at point **Y**. Ignore the effects of friction.




8.1 Define the term *kinetic energy*. (2)

8.2 Calculate the velocity with which the rider reaches point **Y**. (5)

A force of 2 000 N is applied to the inflatable boat from point **Y** to reach the end of the water slide at point **Z**, which is 7,5 m from point **Y**.

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

8.4 Calculate the work done on the inflatable boat between points **Y** and **Z**. (3)

8.5 If the inflatable boat takes 2 minutes to reach point **Z** from point **Y**, determine the power, in horsepower, of the motor used to apply the force of 2 000 N. (4)

**[16]**

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

A deep-sea diver dives at Sodwana Bay in search of specific fish species. Upon reaching a depth of 107 m, the diver notices a possible rare species and descends another 25 m to take a closer look.

9.1 Name ONE factor that affects fluid pressure in a liquid. (1)

9.2 Calculate the pressure on the diver at the depth of the rare fish species if the sea water's density is 1 025 $kg \cdot m^{-3}$. (3)

9.3 Will the pressure which the diver experiences INCREASE, DECREASE or REMAIN THE SAME, if the diver moves back to his original depth before spotting the rare fish species? Explain your answer. (3)
**[7]**

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

A student investigates the viscosity of various motor oils at a workshop. Equal volumes of three oils (Oil A, Oil B, and Oil C) are placed in identical vertical glass tubes. A steel ball bearing is released from rest at the top of each tube, and the time taken for the ball to fall 0,50 m is measured. The results are summarised in the table below.

| Oil | Time (s) |
|---|---|
| A | 4,2 |
| B | 2,8 |
| C | 1,5 |

10.1 Which oil has the highest viscosity? Explain the answer. (2)

10.2 How will the viscosity of the various oils be affected if the temperature increases? (1)

10.3 Explain why South Africa makes use of multigrade oil in vehicles rather than monograde oil. (2)
**[5]**

**QUESTION 11 (Start on a new page.)**

A hydraulic press consists of two pistons. The smaller piston has a diameter of 40 cm and the larger piston has a diameter of 200 cm. A force of 150 N is applied to the smaller piston.

11.1 Calculate the pressure exerted by the smaller piston. (3)

11.2 If the larger piston can lift a car of mass 1 350 kg, state whether the hydraulic press will be able to lift the car. Show the answer with calculations. (4)

11.3 Name TWO other applications in which the above-mentioned law can be used. (2)
**[9]**

**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 | $9,8\ m{\cdot}s^{-2}$ |
| Permittivity of free space<br>*Permittiwiteit van vry ruimte* | $\varepsilon_o$ | $8,85 \times 10^{-12}\ F.m^{-1}$ |
| Speed of light in a vacuum<br>*Spoed van lig in 'n vakuum* | c | $3,0 \times 10^{8}\ m.s^{-1}$ |
| Planck's constant<br>*Planck se konstante* | h | $6,63 \times 10^{-34}\ J.s$ |

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

**FORCE/*KRAG***

| | |
|---|---|
| $F_{net} = ma$ | $p = mv$ |
| $f_{smax} = \mu_s N$ | $f_k = \mu_k N$ |
| $F_{net}\Delta t = \Delta p$<br>$\Delta p = mv_f - mv_i$ | $F_g = mg$ |

**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* $E_k = \frac{1}{2}mv^2$ | $P = \frac{W}{\Delta t}$ |
| $P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$ | $M_E = E_k + E_p$ |

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

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

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

| | |
|---|---|
| $v = f\lambda$ and/*en* $c = f\lambda$ | $T = \frac{1}{f}$ |
| $E = hf$ or/*of* $E = \frac{hc}{\lambda}$ | |