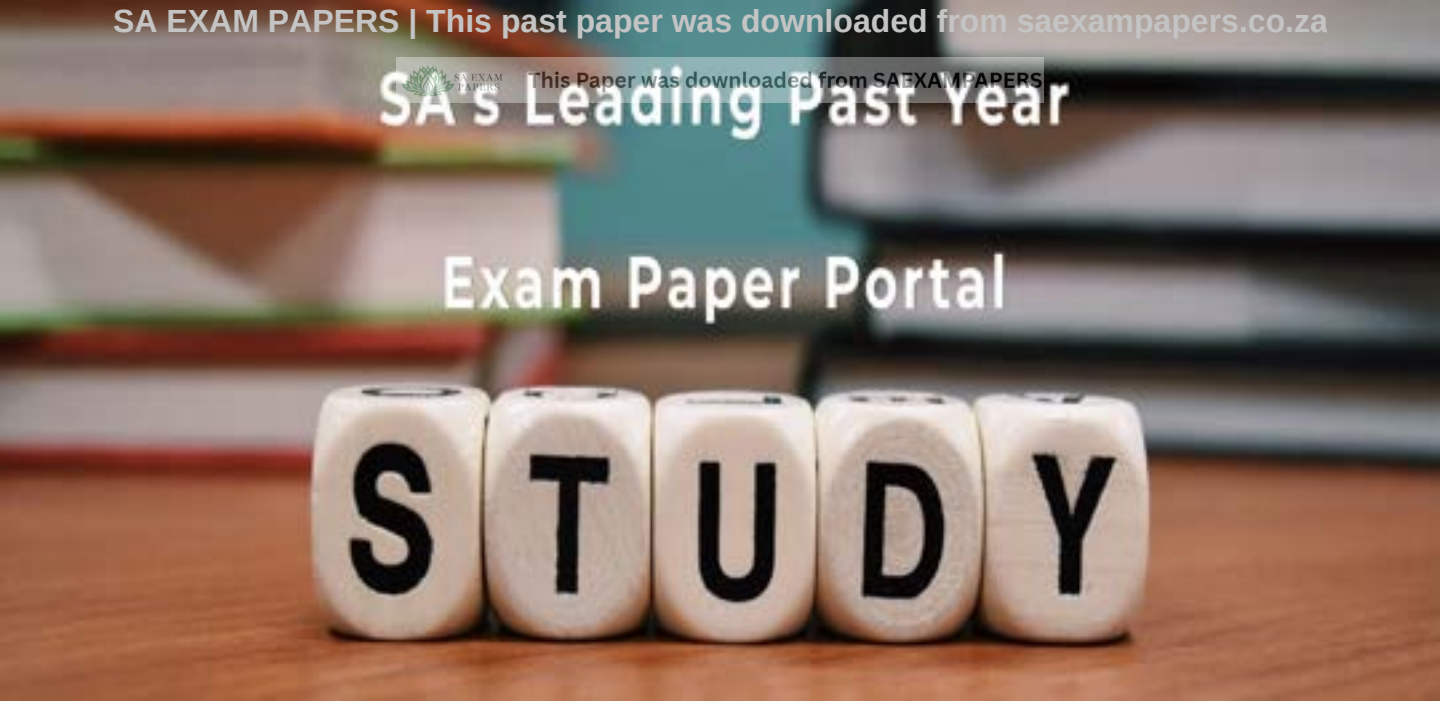


education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

PROVINCIAL ASSESSMENT

GRADE 12

TECHNICAL SCIENCES P1

JUNE 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 15 pages and 2 data sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of SEVEN 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 correctly according to the numbering system used in this question paper.
4. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
5. You may use a non-programmable calculator.
6. You may use appropriate mathematical instruments.
7. You are advised to use the attached DATA SHEETS.
8. Show ALL formulae and substitutions in ALL calculations.
9. Round off your FINAL numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, etc. where required.
11. 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 D.

1.1 … depends on the mass of the body.

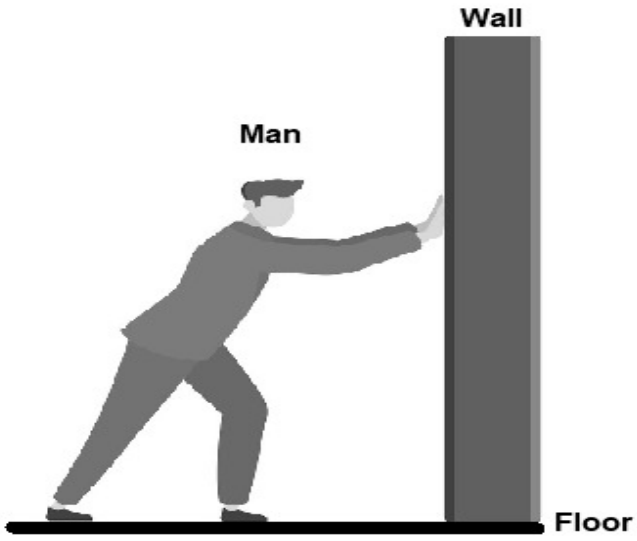
A Speed of an object

B Inertia of a body

C Acceleration of the body

D Velocity of the object (2)

1.2 A man weighing 705,6 N is standing on the floor, pushing against the wall with a force of 25 N to the right, as shown in the diagram below.



Which ONE is the CORRECT magnitude and direction that the wall exerts on the man?

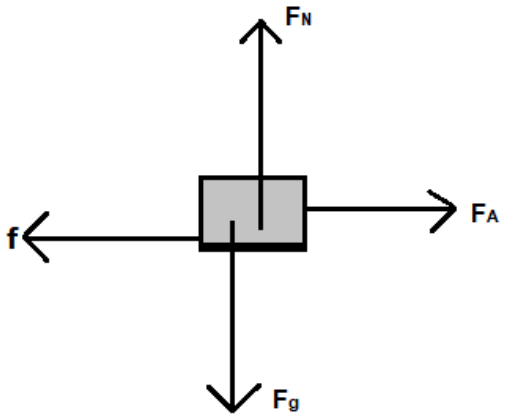
A 25 N to the left

B 705,6 N to the right

C 25 N to the right

D 705,6 N to the left (2)

1.3 Force **F_A** is applied to pull a box to the right across a rough horizontal surface at a CONSTANT velocity **v**. The force diagram below shows the forces acting on the block whilst moving across the surface.



Which ONE of the following represents the CORRECT relationship between the magnitudes of the horizontal forces?

A $F_A > f$

B $F_N = F_g$

C $F_A < f$

D $F_A = f$ (2)

1.4 Momentum is known as the …

A scalar quantity with a direction opposite to that of the velocity of the object.

B product of mass and acceleration.

C product of an object's mass and its velocity.

D vector quantity with a direction opposite to that of the velocity of the object. (2)

1.5 Which value of θ will result in negative work done?

A 180°

B 90°

C 45°

D 0° (2)

1.6 A ball is dropped vertically downwards from a height **h**, ignore the effect of air resistance, which physical quantity is increasing?

A Mechanical energy

B Kinetic energy

C Gravitational potential energy

D Height (2)

1.7 Pascal (Pa) is equivalent to …

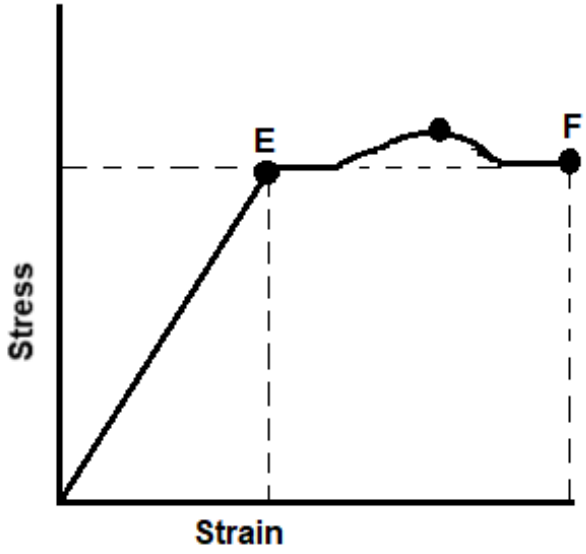
A N.m

B $N.m^2$

C $N.m^{-1}$

D $N.m^{-2}$ (2)

1.8 The graph below shows a relationship between the stress and strain **E** and **F** respectively.



Which ONE of the following is CORRECT for point **E** and **F**?

	POINT E	POINT F
A	Fracture	Elastic limit
B	Plastic region	Elastic region
C	Elastic limit	Fracture
D	Elastic region	Plastic region

(2)

1.9 What happens to the speed of light when the light is moving from a more denser to a less dense medium?

A speed of light decreases

B speed of light increases

C speed of light remains the same

D speed of light deviates (2)

1.10 When a light wave with a single frequency strikes an object, a number of things could happen. Which ONE of the following is INCORRECT about what could happen to the light?

A It can change colour.

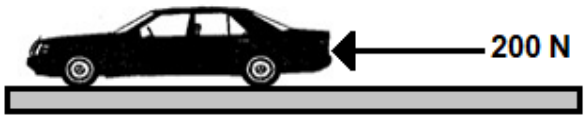
B It can be reflected.

C It can be refracted.

D It can be absorbed. (2)
[20]

QUESTION 2 (Start on a new page.)

2.1 Angie is pushing a car on a FRICTIONLESS horizontal surface. The mass of the car is 400 kg and is pushed with a horizontal force of 200 N to the left, as shown in the diagram below.



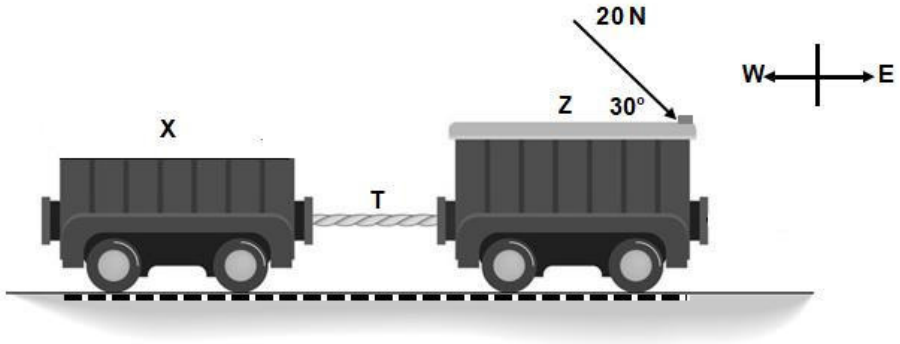
2.1.1 Name TWO vertical forces which are acting on the car. (2)

2.1.2 Calculate the net forces acting on the car. (3)

2.1.3 Define the term *acceleration*. (2)

2.1.4 Calculate the acceleration of the car. (4)

2.2 A force of 20 N is applied at an angle of 30° to the horizontal on trolley **Z** with a mass 10 kg which is connected to trolley **X**, with an unknown mass, by a light inextensible string. Trolley **Z** experiences a frictional force of 6 N whilst trolley **X** experiences a frictional force 2 N.



The two trollies accelerate to the east at 2 $m.s^{-2}$.

2.2.1 Define the term *mass*. (2)

2.2.2 Draw a labelled free-body diagram showing ALL the forces acting on trolley **Z**. (5)

Calculate the:

2.2.3 tension in the string between trolley **X** and **Z** (4)

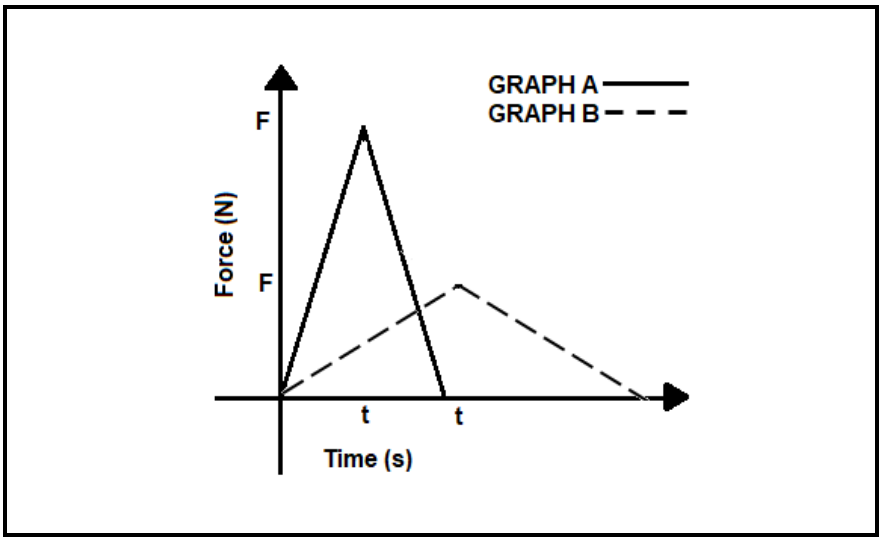
2.2.4 mass of trolley **X** (4)

2.3 State the law you used to calculate QUESTION 2.2.3 and 2.2.4. (2)

[28]

QUESTION 3 (Start on a new page.)

3.1 Two cars one WITH and one WITHOUT an airbag each with a mass of 1 500 kg were used in a car factory, to investigate the injuries on drivers. Graphs **A** and **B** below represent their results obtained from the investigation, as shown below.
Study the graphs and answer the questions that follow.



3.1.1 Which graph represent the results of a car WITH an airbag? Write down only GRAPH A or GRAPH B. (1)

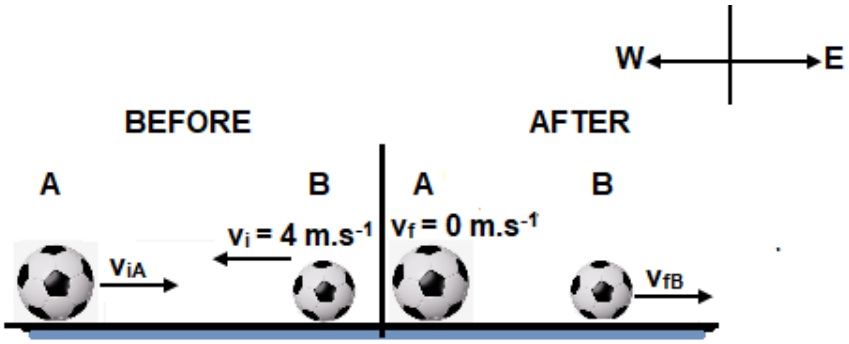
3.1.2 Explain the answer in QUESTION 3.1.1. Refer to the TIME OF CONTACT and NET FORCE. (2)

3.1.3 Define the term *impulse*. (2)

3.1.4 Calculate the magnitude and direction of the impulse, if car **A** exerts an average force of 60 kN to the right for a period of 0,01 s on the driver. (5)

3.1.5 Determine the change in momentum of car **A**. (2)

3.2 Ball **A** with a mass of 10 kg was thrown due east at a velocity of $\mathbf{v_{iA}}$ and collided ELASTICALLY with ball **B** with a mass 2 kg traveling 4 $m.s^{-1}$ in the opposite direction. After the collision, ball **A** become stationery while ball **B** bounces off to the east at a velocity of $\mathbf{v_{fB}}$. Ignore the effect of friction.



3.2.1 Is the system isolated? Write only YES or NO. (1)

3.2.2 Give a reason for your answer in QUESTION 3.2.1. (2)

3.2.3 Define the term *elastic collision* in words. (2)

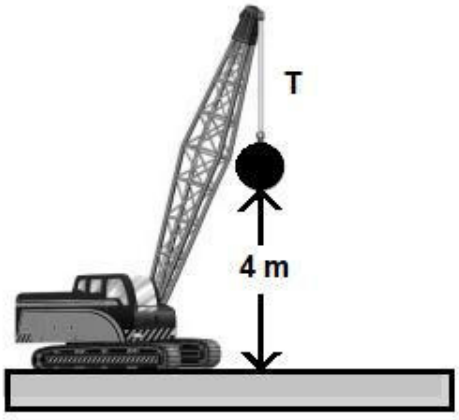
3.2.4 If the total kinetic energy of the system before collision is 36 J, calculate the velocity $\mathbf{v_{fB}}$ of ball **B** after the collision. (3)

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

3.2.6 Calculate the velocity $\mathbf{v_{iA}}$ of ball **A** before the collision. (4)
[26]

QUESTION 4 (Start on a new page.)

The wrecking ball of mass 1,5 $\times 10^3$ kg is hanging from a crane on a cable at a height of 4 m above the ground. The crane lifts the wrecking ball with an applied force of 2 000 N at a power dissipation of 7 200 W.
Ignore the mass of the cable and the effects of air friction.



4.1 Draw a labelled free-body diagram showing ALL the forces acting on the wrecking ball. (2)

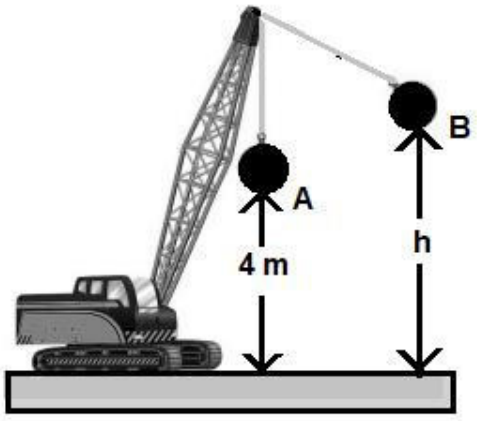
4.2 Define the term *work done*. (2)

Calculate the:

4.3 Work done by crane on the wrecking ball (3)

4.4 Average speed at which the wrecking ball is lifted (4)

The wrecking ball is hanging on the crane at point **A**, a strong wind starts to blow and the ball swing in the direction of point **B**. The crane winds up the wrecking ball, and moves with a speed of 2 $m \cdot s^{-1}$ from point **A**.



The ball reaches a maximum height **h** at point **B** above ground.

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

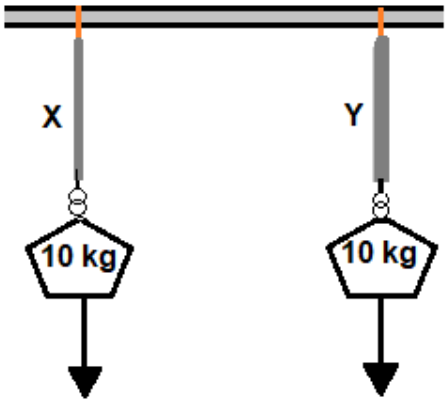
Calculate the:

4.6 Mechanical energy at point **A** (4)

4.7 Height **h** from which the wrecking ball was hanging at **B** (4)
[21]

QUESTION 5 (Start on a new page.)

Grade 12 learners attach two cylindrical rods **X** and **Y** to the beam, which are made from the same metal to investigate the relationship between stress and cross-sectional area. The cross-sectional area of rod **Y** is double the cross-sectional area of rod **X**. The original length of rod **Y** is changed by 15%.



5.1 Define the term *stress*. (2)

5.2 Which rod **X** or **Y** will have the larger stress? Give a reason for your response. (2)

5.3 Calculate the:

5.3.1 Cross sectional area of rod **Y** has a stress of $3,4 \times 10^8$ Pa (3)

5.3.2 Stress in rod **X** (4)

5.4 Define the term *strain*. (2)

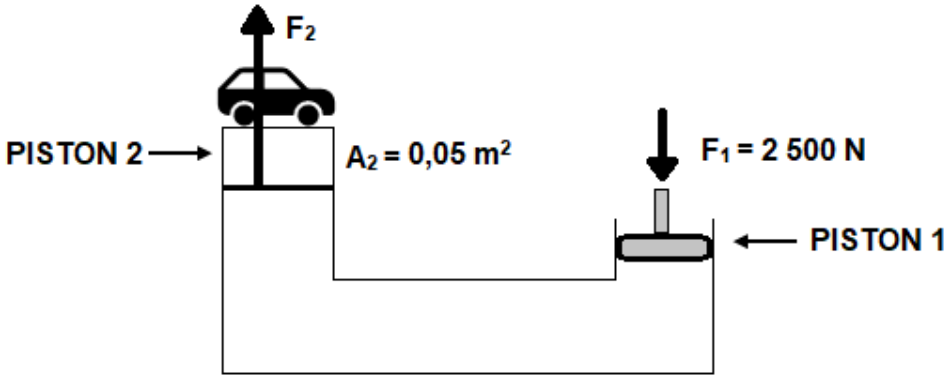
5.5 Determine strain in rod **Y**. (1)

5.6 State *Hooke's law* in words. (2)

5.7 Calculate the modulus of elasticity of rod **Y**. (3)
[19]

QUESTION 6 (Start on a new page.)

6.1 A pressure of 1,25 $\times 10^7$ Pa is applied on piston **1** that has an unknown area. Output force $\mathbf{F_2}$ is applied on piston **2** that has an area of 0,05 m^2. Study the diagram below and the answer the questions that follow.



6.1.1 Write down the magnitude of the pressure applied in piston **2**. (1)

6.1.2 Name and state the principle you would use to explain the answer in QUESTION 6.1.1. (3)

6.1.3 Calculate the output force $\mathbf{F_2}$ that is required to lift the car in piston **2**. (3)

6.1.4 Give ONE reason why liquids are preferred to be used in hydraulics. (1)

6.1.5 List ONE use of hydraulics in technology. (1)

6.2 Viscosities of WATER and OIL were observed by scientist in a laboratory.

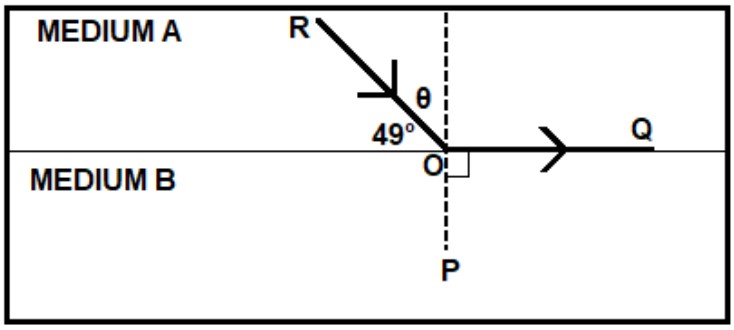
6.2.1 Define the term *viscosity.* (2)

6.2.2 Which liquid will run slower? Write down only WATER or OIL. (1)

6.2.3 Explain your answer in QUESTION 6.2.2. (2)
[14]

QUESTION 7 (Start on a new page.)

7.1 Glass and air were used as mediums. When light ray **RO** is shown from medium **A** to medium **B** at an incidence angle θ, it is refracted such that the angle of refraction is 90°.
Study the diagram below to answer the questions that follow.



7.1.1 Define the term *refraction*. (2)

7.1.2 Which medium will be air? Write down only MEDIUM A or MEDIUM B. (1)

7.1.3 Write down the size of incidence angle θ (in degrees). (2)

7.1.4 What is the name of incidence angle calculated in QUESTION 7.1.3? (1)

Medium **A** is now replaced with a vacuum, which is medium **C** such that the angle θ is now decreased.

7.1.5 What will be observed in the new path of ray **OQ**? Write down only THE LIGHT RAY WILL BEND TOWARDS THE NORMAL or THE LIGHT RAY BEND AWAY FROM THE NORMAL. (2)

7.1.6 Explain your answer in QUESTION 7.1.5. (1)

7.2 Define the term *electromagnetic wave.* (2)

7.3 Identify the TYPE of electromagnetic wave that is applicable to the function from the table below.

VISIBLE LIGHT	GAMMA RAY

7.3.1 For eyesight (1)

7.3.2 For treatment of cancer (1)

7.4 Given that the frequency of a radio wave is 300 GHz.

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

7.4.2 Calculate the energy of the photon. (3)

7.4.3 Calculate the wavelength of the photon. (4)
[22]

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 *Swaartekragversnelling*	g	$9,8\ m{\cdot}s^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3\times10^{8}\ m.s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63\times10^{-34}\ J.s$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\,\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$F_g = mg$

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

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

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

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

$v = f \lambda$	$T = \frac{1}{f}$
$E = hf$ or/*of* $E = h\frac{c}{\lambda}$	