education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

PROVINCIAL ASSESSMENT

GRADE 12

TECHNICAL SCIENCES P1
JUNE 2024

MARKS: 150

TIME: 3 hours

This question paper consists of 13 pages and 2 data sheets.

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INSTRUCTIONS AND INFORMATION

1. Write your name on the ANSWER SHEET.
2. This question paper consists of EIGHT (8) questions.
3. Answer ALL the questions in the ANSWER SHEET.
4. Start EACH question on a NEW page in the ANSWER SHEET.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
7. You may use a non-programmable calculator.
8. You may use appropriate mathematical instruments.
9. You are advised to use the attached DATA SHEET.
10. Show ALL formulae and substitutions in ALL calculations.
11. Round off your FINAL numerical answers to a minimum of TWO decimal places.
12. Give brief motivations, discussions, etc. where required.
13. 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 question numbers (1.1 to 1.10) in the ANSWER SHEET, for example 1.11 D.

1.1 The perpendicular force exerted by a surface on an object that lies on that surface.

A Weight

B Frictional force

C Resultant force

D Normal force (2)

1.2 If an object moves at a constant velocity, the …

A object will remain at rest.

B net force will be zero.

C acceleration will decrease.

D net force will decrease. (2)

1.3 1 N is equivalent to …

A 1 $kg \cdot m \cdot s^{-1}$.

B 9,8 $kg \cdot m^{-1} \cdot s^{-2}$.

C 1 $kg \cdot m \cdot s^{-2}$.

D 9,8 $kg \cdot m^{-1} \cdot s^{-1}$. (2)

1.4 The product of the net force acting on an object and the time the net force acts on the object.

A Momentum

B Impulse

C Work done

D Net force (2)

1.5 When a force is applied on the brake system of a motor vehicle, the linear momentum of the motor vehicle will …

A increase.

B decrease.

C remain the same.

D none of the above. (2)

1.6 The energy an object has due to its position above the ground.

A Gravitational potential energy

B Sound energy

C Kinetic energy

D Elastic energy (2)

1.7 Which ONE of the following is NOT an example of a perfect elastic body?

A Quartz fiber guitar string

B Elastic rubber band

C Phosphorus bronze in a spring

D Soft metal like copper (2)

1.8 The SI-unit for pressure is Pascal. 1 Pa is equivalent to …

A 1 $N.m^{-2}$

B 1 $kg.m.s^{-1}$

C 1 bar

D 1 torr (2)

1.9 A changing magnetic and electric field mutually perpendicular to each other and the direction of propagation of the wave.

A Reflection

B Refraction

C Electromagnetic wave

D Longitudinal wave (2)

1.10 When a ray of light travels from an optical less dense medium to an optical denser medium, the ray of light will bend …

A towards the normal and increase its speed.

B away from the normal and decrease its speed.

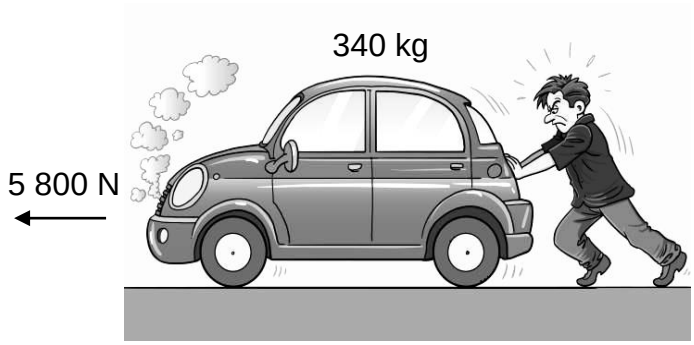
C towards the normal and decreases its speed.

D away from the normal and increase its speed. (2)

[20]

QUESTION 2 (Start on a new page.)

2.1 A man is pushing his motor vehicle with a mass of 340 kg to the filling station on a rough, leveled road. He applies a force of 5 800 N to the left, as indicated on the diagram below.



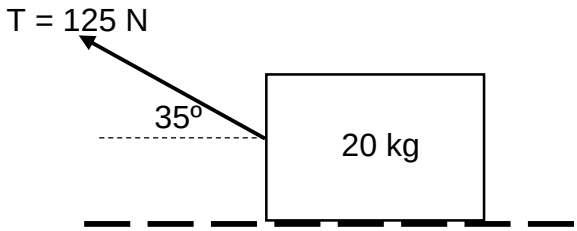
2.1.1 Define the term *frictional force* in words. (2)

2.1.2 Draw a labelled free-body diagram of ALL the forces acting on the motor vehicle. (4)

2.1.3 Calculate the kinetic frictional force that the motor vehicle will experience if the kinetic coefficient is equal to 0,833. (4)

2.1.4 Use the answer in QUESTION 2.1.3 and explain if the man will be able to move his motor vehicle. (2)

2.2 A box with a mass of 20 kg is being pulled with a rope over a frictionless horizontal surface with a force, **T**, of 125 N at an angle of 35º with the horizontal, as indicated in the diagram below.



2.2.1 Define the term *tension*. (2)

2.2.2 Calculate the magnitude and direction of the net force experienced on the box. (3)
[17]

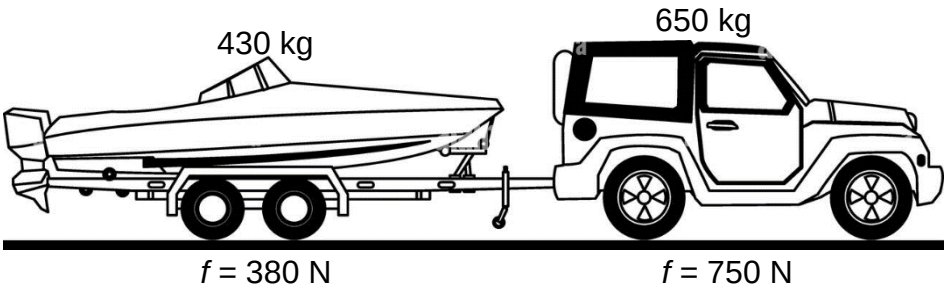
QUESTION 3 (Start on a new page.)

3.1 A book with a mass of 730 g is resting on a table.

3.1.1 Define the term *inertia*. (2)

3.1.2 NAME and STATE the physics law in words that will explain why the book will remain at rest. (3)

3.2 A Jeep is pulling a boat-trailer with an in-extensible string, as shown in the diagram below. The mass of the Jeep is 650 kg while the mass of the boat-trailer is 430 kg. Frictional forces experienced by the Jeep and boat-trailer are 750 N and 380 N respectively, while the engine of the Jeep exerts a force of 4 750 N forwards.



3.2.1 State *Newton's Second Law of Motion* in words. (2)

3.2.2 Draw a labelled free-body diagram of ALL the forces acting on the boat-trailer. (4)

3.2.3 Calculate the magnitude and direction of the acceleration of the system. (5)

3.2.4 Determine the magnitude of the tension in the string between the Jeep and boat-trailer. (3)
[19]

QUESTION 4 (Start on a new page.)

4.1 A rubber ball with a mass of 175 g falls downwards with a velocity of 12 $m.s^{-1}$. It hits the ground and bounces back upwards at a velocity of 10 $m.s^{-1}$.

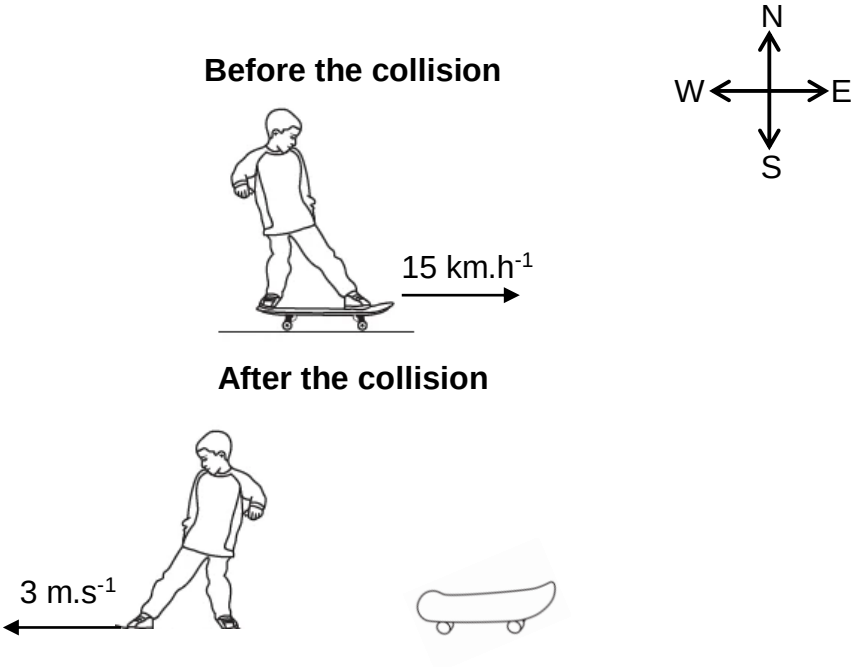
4.1.1 Define the term *impulse*. (2)

4.1.2 Calculate the impulse of the rubber ball. (4)

4.1.3 Determine the force exerted on the rubber ball, if the contact time between the rubber ball and the ground was 0,3 seconds. (3)

4.1.4 If the contact time between the rubber ball and the ground increase, what will happen to the force exerted on the rubber ball? Only write down INCREASE, DECREASE or REMAIN THE SAME. (1)

4.2 A boy with a mass of 60 kg stands on a moving skateboard with a mass of 5 kg, moving eastwards at a velocity of 15 $km.h^{-1}$ on a straight FRICTIONLESS surface. The boy jumps off the skateboard and moves westwards at a velocity of 3 $m.s^{-1}$ when he lands on the ground as shown in the diagram below.



4.2.1 State the *Principle of conservation of Linear Momentum* in words. (2)

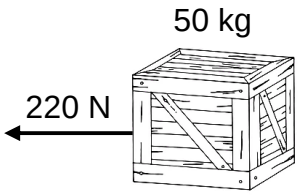
4.2.2 Calculate the magnitude and direction of the skateboard's velocity after the collision. (4)

4.2.3 Determine, by means of calculation, if the above collision is elastic or inelastic. (7)

[23]

QUESTION 5 (Start on a new page.)

5.1 A 220 N force is applied horizontally to the left on a box with a mass of 50 kg on a rough horizontal surface, as shown in the diagram below. The box moves 10 m to the left. The kinetic friction between the surface and the box is 40 N.



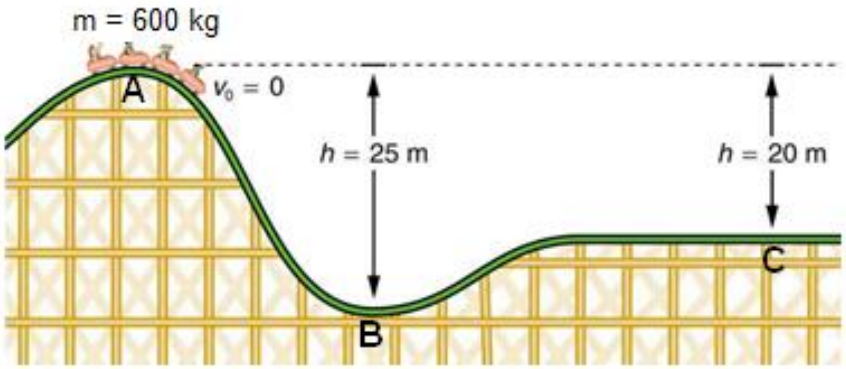
5.1.1 Define the term *work done.* (2)

Calculate the:

5.1.2 Magnitude and direction of the net force exerted on the box (4)

5.1.3 Work done by the net force on the box (3)

5.2 Study the diagram below and answer the questions that follow.



5.2.1 State the *Principle of conservation of Mechanical Energy* in words. (2)

Calculate the:

5.2.2 Gravitational potential energy of the roller coaster at point **A** (3)

5.2.3 Velocity of the roller coaster at point **C** (4)

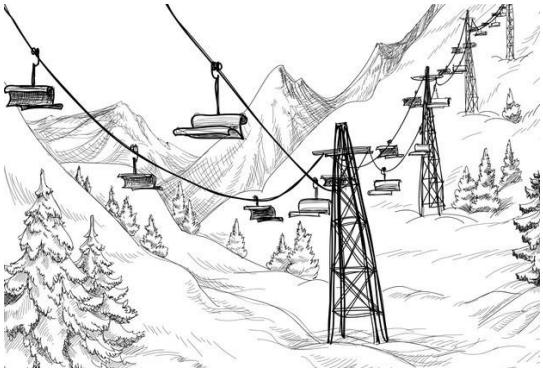
5.3 An electric pump of 10 hp is used to pump water from a borehole that is 10 m deep.

5.3.1 Define the term *power*. (2)

5.3.2 Determine the mass of water pumped from the borehole in 1 minute. (6)
[26]

QUESTION 6 (Start on a new page)

Suspension cables are used to carry cable cars at ski resorts. A cable is 3 km long that can be stretched by 18 m and has a radius of 5,6 cm. The maximum tension a cable can withstand is 3×10^6 N.



6.1 State *Young's modulus of elasticity* in words. (2)

Calculate the:

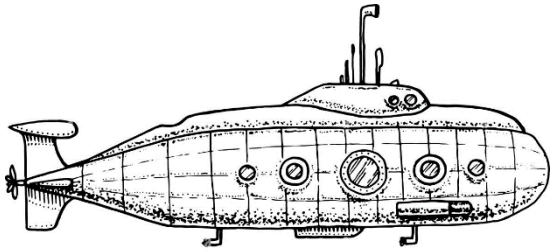
6.2 Stress experienced by the cable (4)

6.3 Strain caused by the force (3)

6.4 Modulus of elasticity (3)
[12]

QUESTION 7 (Start on a new page.)

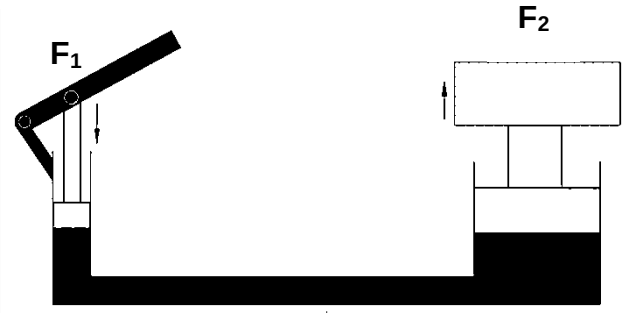
7.1 A submarine has crew members and divers on board and is at a depth of 120 m below sea level.



7.1.1 Define the term *thrust.* (2)

7.1.2 Calculate the fluid pressure on the submarine in the ocean if the density of ocean water is 1 025 kg.m^{-3}. (3)

7.2 Hydraulic systems can be found in everything from cars to industrial machinery. On a ship a hydraulic system is used to move heavy cargo. A force, $\mathbf{F_1}$, of 50 N is applied on an input piston of a hydraulic system with an area of 2 x 10^{-2} m^2. The area of the load at $\mathbf{F_2}$, that needs to be lifted is 5,5 m^2.



7.2.1 State *Pascal's law* in words. (2)

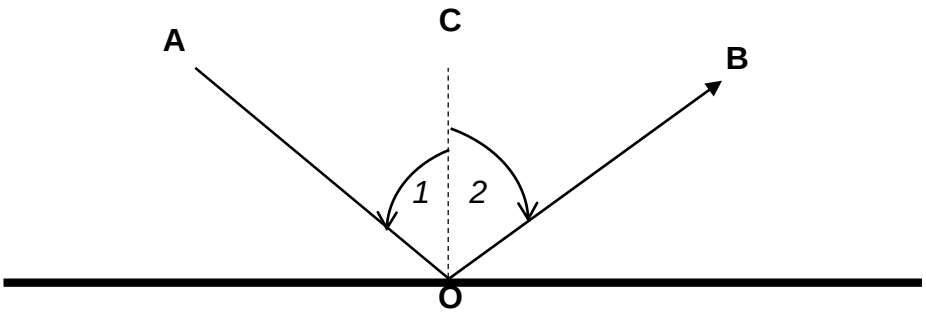
7.2.2 Calculate the load ($\mathbf{F_2}$) that needs to be lifted. (4)

7.2.3 Explain how temperature will affect the viscosity of the fluid in a hydraulic system. (2)

7.2.4 Give TWO examples of hydraulic systems in technology. (2)
[15]

QUESTION 8 (Start on a new page.)

8.1 A light ray strikes a reflective smooth surface at an angle of 45° with the surface and reflects off the surface, as shown in the diagram below.



8.1.1 Define the term *reflection*. (2)

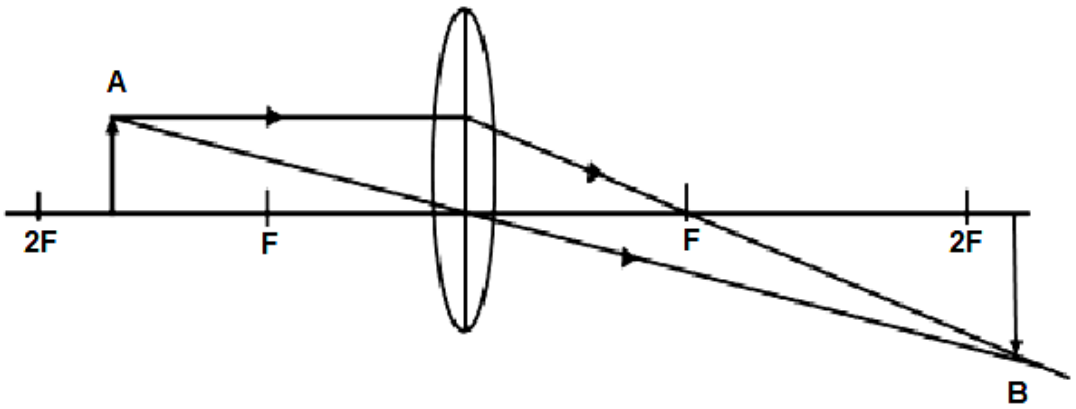
8.1.2 Give the relationship between angel **1** and angle **2**. (1)

Provide labels for:

8.1.3 Light ray **AO** (1)

8.1.4 Line **C** (1)

8.2 The ray diagram below shows an image at point **A** of an object placed between **F** and **2F** of a lens.

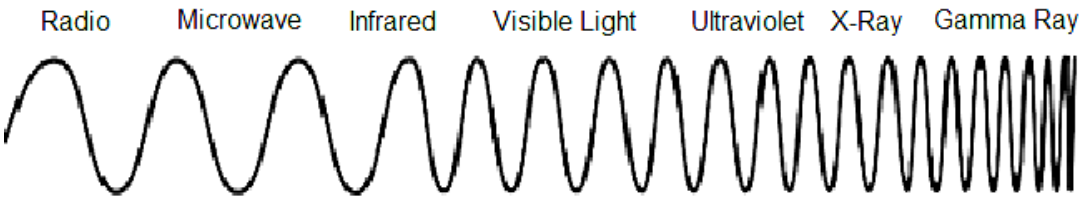


8.2.1 Define the term *refraction*. (2)

8.2.2 Name the type of lens used in the diagram. (1)

8.2.3 What is the nature of the image that will form at point **B**? (1)

8.3 Study the diagram of the electromagnetic spectrum below and answer the questions that follow.



8.3.1 Define the term *wave*. (2)

8.3.2 Which EM-wave will travel at the highest speed? Give a reason for your answer referring to the ENERGY of the wave. (2)

8.3.3 Give TWO uses of the EM-wave in QUESTION 8.3.2. (2)

8.4 An X-ray wave has a wavelength of $1,72 \times 10^{-11}$ m and a frequency of $5,24 \times 10^{17}$ Hz in a vacuum.

8.4.1 Calculate the speed of the X-ray wave. (3)
[18]

TOTAL: 150

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DATA SHEET FOR TECHNICAL SCIENCES GRADE 12: PAPER 1
GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12 VRAESTEL 1

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

NAME/*NAAM*	SYMBOL/*SYMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaarteekragversnelling*	g	9,8 $m \cdot s^{-2}$
The permittivity of free space *Permittiwiteit van vrye ruimte*	ε_0	8,85 x 10^{-12} $F \cdot m^{-1}$
Planck's constant *Planck se konstante*	h	6,63 x 10^{-34} $J \cdot s$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3 x 10^{8} $m \cdot s^{-1}$

TABLE 2: FORMULAE/*TABLE 2: FORMULES*

FORCE/*KRAG*

$F_{net} = ma$	$Fg = mg$ or/*of* $w = mg$
$f_s = \mu_s N$ $f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$a = \frac{\Delta v}{\Delta t}$	$v = \frac{\Delta x}{\Delta t}$

MOMENTUM

$p = mv$	
$F_{net}\,\Delta t = \Delta p$	$\Delta p = mv_f - mv_i$

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

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

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

ELECTROSTATICS/*ELEKTROSTATIKA*

$C = \frac{\varepsilon_0 A}{d}$	$C = \frac{Q}{V}$

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

$R = \frac{V}{I}$	$R_S = R_1 + R_2$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$
$W = VQ$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ELECTROMAGNETISM/*ELEKTROMAGMETISME*

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

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

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

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