GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

JUNE EXAMINATION
GRADE 12

2023

TECHNICAL SCIENCES

(PAPER 1)

TIME: 3 hours

MARKS: 150

11 pages and 2 data sheets

INSTRUCTIONS AND INFORMATION

1. Write your name in the ANSWER BOOK.
2. This question paper consists of EIGHT questions. Answer ALL the questions.
3. Start the answer to EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line open between two sub-questions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. Use the DATA SHEETS that are attached.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round-off your FINAL numerical answers to a maximum of TWO decimal places, where necessary.
11. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A – D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK.

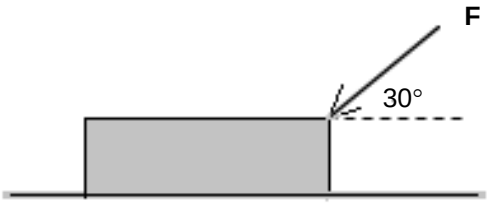
1.1 Linear momentum can be described as …

A a scalar quantity.
B a vector always in the direction of the friction force.
C a scalar quantity in the same direction as the acceleration of the object.
D a vector quantity in the same direction as the velocity of the object. (2)

1.2 The change in momentum after a collision will always be equal to …

A the mass of the cars.
B the kinetic energy.
C the product of the F_{net} and the time of impact (Δt).
D the mechanical energy and kinetic energy. (2)

1.3 A force **F** is applied to an object at an angle of 30° downwards, as shown in the diagram. The angle of the applied force **F** is increased to 55°.



How will this change affect the vertical component of the force, the weight and the normal force? Choose the correct answer from the options below.

	FRICTION	VERTICAL COMPONENT	WEIGHT
A	increases	decreases	remains the same
B	increases	decreases	increases
C	decreases	increases	remains the same
D	decreases	decreases	decreases

(2)

1.4 An object was thrown into the air, it slows down and stops at the top. It then turns around and falls back to the ground. The acceleration at the top is:

A 0 $m \cdot s^{-2}$
B 9,8 $m \cdot s^{-2}$ downward
C 0 $m \cdot s^{-2}$ downward
D It depends on how fast the object was thrown. (2)

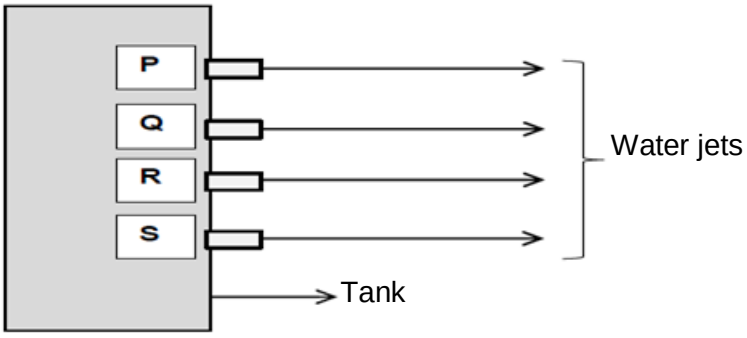
1.5 Strain is defined as …

A the division of the load by the smallest cross-sectional area of the test specimen.
B the ratio of change in dimension to the original dimension.
C the amount of stress that a material can absorb without exceeding its breaking stress.
D a measurement of the deformation produced by the application of an external force. (2)

1.6 With an increase of temperature the viscocity …

A of gases decreases.
B of liquids increases.
C of liquids decreases.
D depends on the surface area of the liquid. (2)

1.7 The diagram below shows a water tank with water jets at different heights. At which point will the pressure be the lowest?



A S
B Q
C R
D P (2)

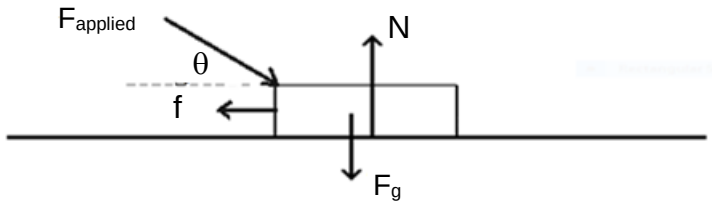
1.8 Which of the following about the properties of light is correct?

A Light can only be reflected.
B Light travels at a maximum speed of 3 x 10 $m \cdot s^{-1}$.
C Light does not have photons.
D Light is a type of transverse wave. (2)

1.9 Frequency is defined as …

A the time taken to complete a single disturbance.
B the distance between two consecutive points that are in phase.
C the number of complete pulses per second.
D the number of disturbances that occur in a medium. (2)

1.10 A boy is pushing an object to the left along a straight horizontal surface without lifting it. All the forces acting on the object are shown in the force diagram below. The object accelerates to the right.



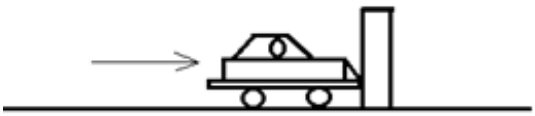
Which of the following forces acts positively on the object?

A N
B Fg
C Fx
D Fy (2)

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QUESTION 2 (Start on a new page.)

2.1 The drawing below shows a car as it hits a wall. The car was travelling at a velocity of 120 km.h^{-1}. The front passenger was not wearing a safety belt.



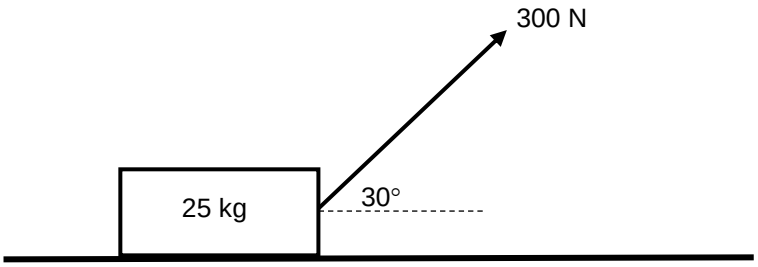
2.1.1 Name and state Newton's Law in words, which can be used to explain what happened to the passenger. (3)

2.1.2 The driver of the car was wearing a safety belt during the collision.

Use your knowledge of impulse and time to explain how the air bag can save the driver's life. (3)

2.1.3 Convert the car's velocity into m·s^{-1}. (3)

2.2 A force of 300 N acts on a 25 kg block as shown below. A constant friction force of 4 N acts on the block.



2.2.1 State Newton's second law in words. (2)

2.2.2 Draw a labelled, free-body diagram showing all forces acting on the block. (4)

2.3 A learner pulls a block, labelled **block A**, with a weight of 50,69 N by applying a force of 20 N. The block accelerates at 1,67 $m \cdot s^{-2}$ to the right as shown in the diagram below.



2.3.1 The earth pushes the block up with the same force that the block pushes downward onto the earth. Name and give the definition of Newton's law that applies here. (3)

2.3.2 Calculate the mass of the block. (3)

2.3.3 Determine the net force acting on the block. (3)

2.3.4 Determine the friction for the system. (3)

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QUESTION 3 (Start on a new page.)



Car **A** (mass = 2 200 kg) which is travelling at a velocity of 14 $m \cdot s^{-1}$ in an easterly direction loses control and crashes head-on into an oncoming car, car **B** (mass = 1 200 kg), which is travelling at a velocity of 40 $m \cdot s^{-1}$ in a westerly direction. The two cars become stuck with the impact and continue to move together.

3.1 During a collision, sound and heat are released. What type of collision is described here? (1)

3.2 Give the definition of the principle that is used to calculate the velocity of the wreckage after the collision. (2)

3.3 Calculate the velocity of the wreckage after the collision. (4)

3.4 A learner states that it is less dangerous to be in a heavier car during a collision than it is to be in a light car. Answer the following questions relating to this statement.

3.4.1 How will the change in momentum of car **A** compare to that of car **B**? (2)

3.4.2 Use the principles of Physics to explain why the statement made by the learner could be correct. (3)

3.5 Driving a car with a mass of 2 000 kg moving at 10 $m \cdot s^{-1}$, the driver collides with a wall and comes to rest against the wall. The collision happens for 0,1s. The car does not have airbags. Calculate the net force that the wall exerts on the car and driver. (5)

3.6 Ball **A** with a mass of 20 g rolls towards the right at 3 $m \cdot s^{-1}$. Ball **B** with a mass of 50 g rolls to the left at 1 $m \cdot s^{-1}$. The two balls collide. After the collision the velocity of ball **A** is 2,5 $m \cdot s^{-1}$ to the left.

3.6.1 Calculate the velocity and direction of ball **B** after the collision. (4)

3.6.2 Determine, with the aid of calculations, whether the collision was elastic or inelastic. Show ALL calculations. (6)

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QUESTION 4 (Start on a new page.)

A scientist creates a small cellphone lift to help old people who drop their phones to lift the phone from the floor. The lift can lift a phone with a mass of 300 g, to a height of 80 cm above the floor. The lift applies a force of 15 N to lift the cellphone. Ignore the effects of friction.

4.1 Define the term *work*. (2)

4.2 Calculate the work done by gravitational force on the cellphone. (3)

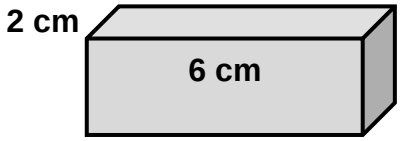
4.3 Define the term *power*. (2)

4.4 If it took the lift 4 s to lift the cellphone to the height of 80 cm above the floor, calculate the power used by the lift. (4)

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

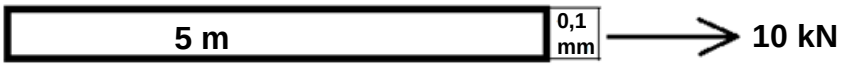
[13]

QUESTION 5 (Start on a new page.)



5.1 Forces are applied at the rectangular block which is made of an elastic material. These forces are not applied to the block simultaneously. Calculate the stress experienced by the surface at the top of the block, when a force of 0,05 N is applied at that surface. (5)

5.2 A rod bar has a diameter of 50 mm and length of 5 m. It is stretched with a force of 10 kN and is extended by 0,1mm.



5.2.1 Define the term *strain*. (2)

5.2.2 Calculate the stress experienced by the rod. (8)

5.2.3 Calculate the strain experienced by the rod. (3)

5.3 State Hooke's Law in words. (2)

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QUESTION 6 (Start on a new page.)

6.1 What does SAE stand for as found on motor oil bottles? (1)

6.2 Explain how temperature affects the viscosity of motor oil. (2)

6.3 Explain ONE advantage and ONE disadvantage of a low-viscosity motor oil for a motor engine. (2)

6.4 Explain the difference between *monograde* and *multigrade* oils. (2)

6.5 Interpret the meaning of the grading 15W40 SAE of engine oil. (2)

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QUESTION 7 (Start on a new page.)

7.1 7.1.1 State Pascal's Law. (2)

7.1.2 Dam walls are thicker at the bottom than at the top. Is the pressure of water at the bottom GREATER THAN, LESS THAN or EQUAL TO the pressure of water at the top? Explain your answer. (3)

7.1.3 If you dive deeper into a dam until your ears hurt, will it help to go sideways? Give a law that you applied. (2)

7.2 In a car lift used at service stations, compressed air exerts a force on a small piston of a circular cross section with a radius of 5,0 cm. This pressure is transmitted by an incompressible liquid to a second piston with a radius 15,0 cm.

What force must the compressed air exert on the small piston to lift a car weighing 13 300 N? (5)
[12]

QUESTION 8 (Start on a new page.)

8.1 We use lenses in everyday life, for example, as reading glasses. Some people can see far away objects well and others can only see objects that are close by.

8.1.1 Describe the vision of a far-sighted person without reading glasses. (2)

8.1.2 Name the type of lens used in the reading glasses of a far-sighted person. (1)

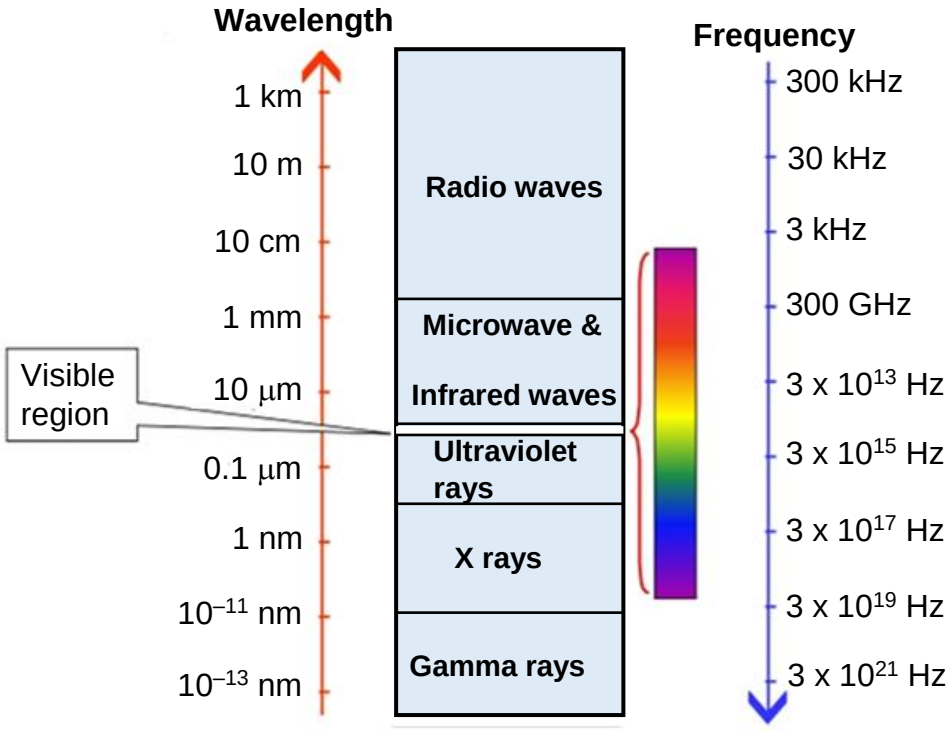
8.2 An object is placed on the 2F of a convex lens.

8.2.1 Define the term *dispersion of light.* (2)

8.2.2 Draw a labelled ray diagram to indicate the position of the image that will form. (4)

8.2.3 List TWO properties of the image. (2)

8.3 The following diagram shows the wavelengths and frequencies of different types of electromagnetic radiation. Consider the diagram and answer the questions that follow.



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

8.3.2 What is the relationship between the frequency and wavelength of a wave? (1)

8.4 A photon of light has a wavelength of 3 nm. Calculate the frequency of the photon. (3)

8.5 List any FIVE colours in white light. (5)

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TOTAL: 150

DATA FOR TECHNICAL SCIENCES GRADE 12
JUNE EXAMINATION

GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
JUNIE EKSAMEN

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	$3,0 \times 10^{8}$ $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}$ $J \cdot s$
Standard pressure *Standaarddruk*	p°	$1,01 \times 10^{5}$ Pa
Standard temperature *Standaardtemperatuur*	T°	273 K
Permittivity of free space *Permittiwiteit van vrye spasie*	ε_O	$8,85 \times 10^{-12}$ $F \cdot m^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

FORCE/*KRAG*

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

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* $E_k = \frac{1}{2}mv^2$	$\Delta K = K_f - K_i$ or/*of* $\Delta E_k = E_{kf} - E_{ki}$
$M_E = E_k + E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemiddeld} = Fv_{gemiddeld}$	

ELASTICITY, VISCOSITY & HYDRAULICS
ELASTISITEIT, VISKOSITEIT & HIDROULIKA

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

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

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

ELECTROSTATICS/*ELEKTROSTATIKA*

$C = \frac{\kappa \varepsilon_o A}{d}$ and/*en* $C = \frac{\varepsilon_o A}{d}$	$E = \frac{V}{d}$
$C = \frac{Q}{V}$	

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

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

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

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