GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2025

11101

TECHNICAL SCIENCES

(PAPER 1)

TIME: 3 hours

MARKS: 150

14 pages + 3 information sheets

TECHNICAL SCIENCES: Paper 1

11101E

X05

INSTRUCTIONS AND INFORMATION

1. Write your name in the ANSWER BOOK.

2. This question paper consists of ELEVEN questions. Answer ALL the questions in the ANSWER BOOK.

3. Start 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 between two subquestions, 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. You are advised to use the attached INFORMATION SHEETS.

9. Show ALL formulae and substitutions in ALL calculations.

10. Round-off your FINAL numerical answers to a minimum of TWO decimal places.

11. Give brief motivations, discussions, et cetera where required.

12. 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 A trolley, of mass 1,5 kg is travelling at 2 $m \cdot s^{-1}$, collides perpendicularly with a wall and bounces back at 1 $m \cdot s^{-1}$.

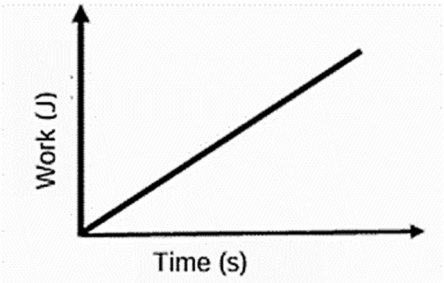
What is the magnitude of the change in velocity (in $m \cdot s^{-1}$) of the trolley?

A 2
B 1
C 3
D 4,5 (2)

1.2 The soles of running shoes reduce the incidence of knee injuries by adding gel and foam to the soles to …

A increase the time of impact with the ground.
B decrease the change in momentum of the athlete's foot.
C reduce the time of impact with the ground.
D increase the force that the ground exerts on the athlete's foot. (2)

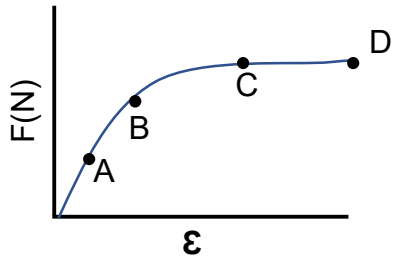
1.3 The graph below represents the relationship between the work done on an object and the time taken for this work to be done.



What does the gradient of the graph represent?

A Momentum
B Kinetic energy
C Potential energy
D Power (2)

1.4 At which position on a force-versus-strain graph does an object reach its elastic limit?



(2)

1.5 Hooke's law gives a relationship between stress and strain. Which of the following is the CORRECT relationship between stress and strain according to Hooke's law?

A Stress is directly proportional to strain within the limit of elasticity.
B Stress is inversely proportional to strain within the limit of elasticity.
C Strain is inversely proportional to the stress that causes it, provided that elasticity is not exceeded.
D Strain is directly proportional to the stress that causes it, even if the limit of elasticity is exceeded. (2)

1.6 The pressure in a liquid at a specific point is dependent on …

A the density of the liquid and the amount of liquid.
B the density of the liquid and the depth under the surface.
C the colour of the liquid and the amount of liquid.
D the density of the liquid and the temperature of the liquid. (2)

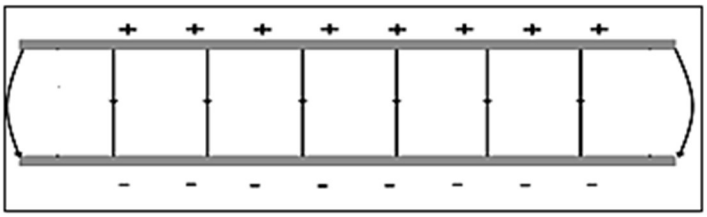
1.7 The speed of a light wave is 2,9 x 10^8 m·s^{-1}. How is the density of the medium through which it moves, compared to a vacuum?

A More dense
B Less dense
C Equally dense
D Impossible to say (2)

1.8 If an object is placed between the focal point and the convex lens, the image formed is …

A smaller, upright and real.
B smaller, inverted and real.
C enlarged, inverted and virtual.
D enlarged, upright and virtual. (2)

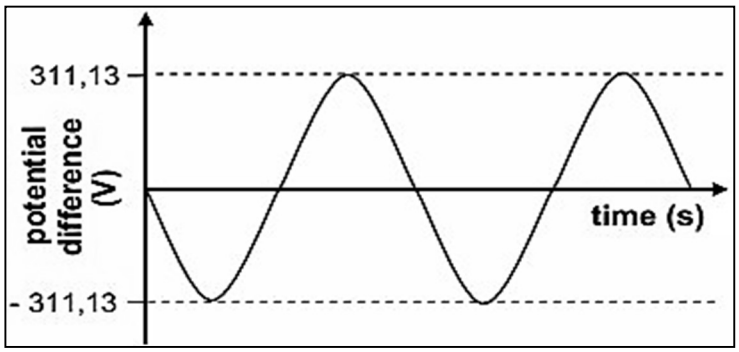
1.9 Two parallel metal plates are connected to oppositely charged terminals to form a capacitor.



If the distance between the plates is halved, which of the following will occur? The total capacitance will …

A be halved.
B increase four fold.
C be doubled.
D decrease four fold. (2)

1.10 The graph below represents the output of a/an:



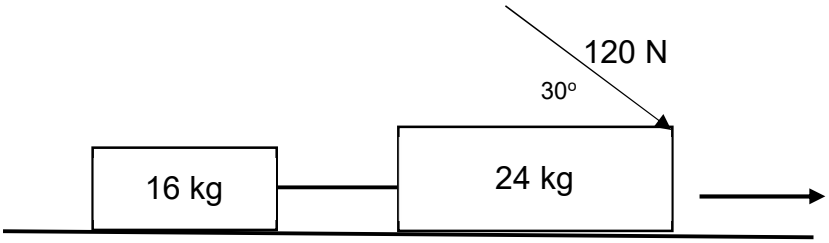
A AC generator
B DC generator
C AC motor
D DC motor (2)

[20]

QUESTION 2 (Start on a new page.)

Learners constructed a push toy using two blocks with masses 16 kg and 24 kg respectively. The push toy was pushed across a rough horizontal surface. The blocks are joined together by a light, inextensible rope with negligible mass. A learner then applies a force of 120 N at an angle of 30° to the right on the 24 kg block using a light rigid rod, causing the toy to move as shown in the diagram below.

The coefficient of kinetic friction (μ_k) between the surface and each block is 0,15.



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

2.2 Draw a labelled, free-body diagram showing ALL the forces acting on the 24 kg block. (5)

2.3 Calculate the magnitude of the kinetic frictional force acting on the 16 kg block. (3)

2.4 Calculate the normal force on the 24 kg block. (3)

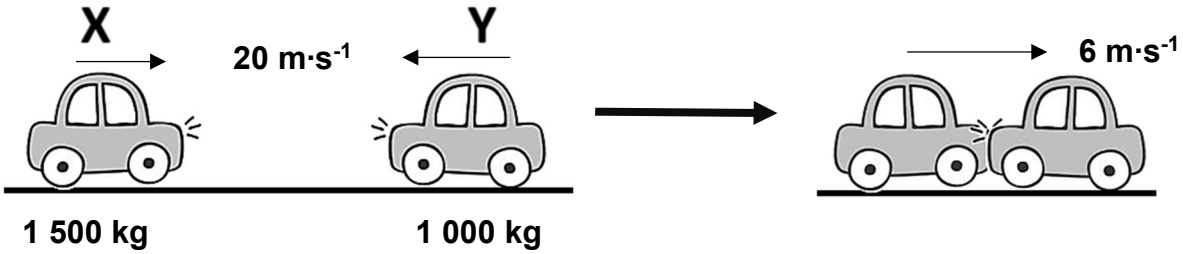
2.5 Calculate the acceleration of the system. (7)

2.6 Determine the tension in the rope during motion. (2)

[22]

QUESTION 3 (Start on a new page.)

Two vehicles, **X** and **Y**, collide head-on and become stuck together after impact. Vehicle **X** has a mass of 1 500 kg and is moving at a velocity of 20 $m \cdot s^{-1}$ east, while vehicle **Y** has a mass of 1 000 kg and is moving west at an unknown velocity, as shown in the diagram below. Ignore any frictional effects before or during the collision.



3.1 Calculate the velocity of vehicle **Y** immediately **BEFORE** the collision. (4)

3.2 Determine whether the collision was ELASTIC or INELASTIC, using appropriate calculations. (4)

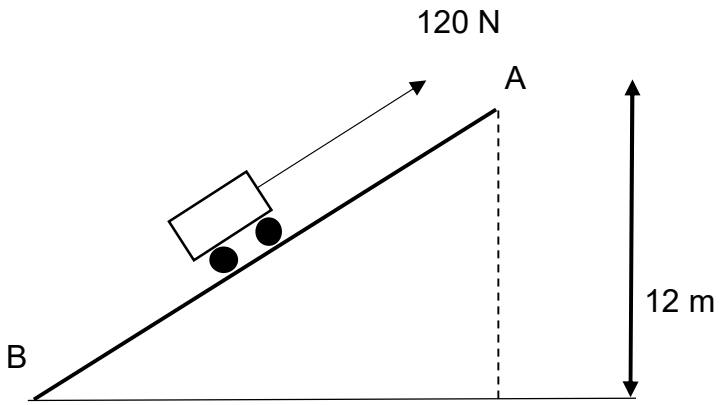
3.3 Explain what is meant by the term *impulse* in Physics. (2)

3.4 Identify which vehicle experienced the larger magnitude of impulse during the collision. (1)

[11]

QUESTION 4 (Start on a new page.)

A trolley of mass 15 kg, filled with bricks of mass 50 kg, is pulled up an incline with a force of 120 N. The trolley and its contents move at a constant velocity of 5 $m \cdot s^{-1}$ up the incline. Ignore the effects of friction.



4.1 Calculate the power generated to pull the trolley and its contents up the incline. (3)

4.2 At point **A**, which is 12 m above the ground, the bricks are offloaded and the trolley is then released. The trolley moves down the inclined plane and reaches point **B**.

4.2.1 At what point will the gravitational potential energy of the trolley be at a maximum? (1)

4.2.2 Calculate the velocity of the trolley when it reaches point **B**. (4)

4.2.3 Name and state the law used to answer QUESTION 4.2.2. (3)

[11]

QUESTION 5 (Start on a new page.)

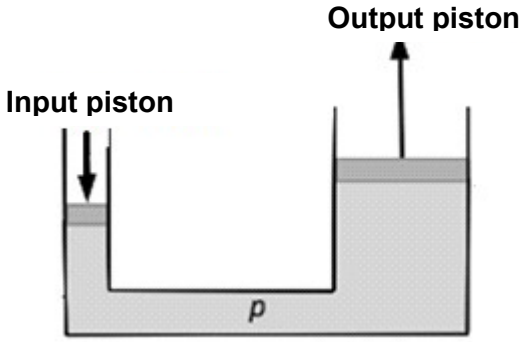
A wire 4 m long with a diameter of 2 mm, is suspended from the roof of a building. A learner wants to test the elastic limit of the wire and hangs a 6 kg mass piece to the wire, causing the wire to stretch by 1,5 mm.



5.1	Define the term *elastic limit*.	(2)
5.2	Calculate the stress on the wire.	(4)
5.3	Calculate the strain on the wire.	(3)
5.4	Calculate Young's modulus for this wire.	(3)
		[12]

QUESTION 6 (Start on a new page.)

The diagram below represents a dentist's chair which is used to lift patients to a suitable height. The dentist presses on the input piston to raise a patient who has a mass of 54 kg. The cross-sectional areas of the input piston and the output piston are 0,03 m^2 and 0,85 m^2 respectively.



6.1 Define *pressure*. (2)

6.2 Calculate the pressure in the output system. (4)

6.3 What will the pressure be in the input system? (1)

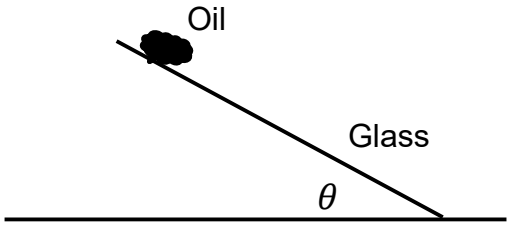
6.4 How much force must the dentist exert in order to lift the patient? (4)

6.5 What would the effect on the output force be if the surface area of the output piston doubles? (2)

[13]

QUESTION 7 (Start on a new page.)

Learners conducted an investigation to compare the viscosity of different motor oils. They set up a clear glass sheet at a fixed angle, as shown in the diagram below. Exactly 5 ml of oil is placed on the top of the glass sheet, and the time is recorded when the oil reaches the bottom of the sheet.



7.1 Two types of car oil, namely SAE10 and SAE60 are tested.

7.1.1 For what does SAE stand? (1)

7.1.2 Explain what SAE grading means. (2)

7.1.3 Which of the two oils would flow faster at room temperature? Explain your answer. (2)

7.2 The glass sheet is now cleaned, and two other types of oil are used, namely 10W60 and 30W60.

7.2.1 What does the term *multi-grade* mean? (1)

7.2.2 For the oil marked 30W60, explain what each of these numbers means, respectively. (3)

7.2.3 Which of these two types of oils would flow faster at 10 °C? Explain your answer. (3)

[12]

QUESTION 8 (Start on a new page.)

8.1 A teacher demonstrates what will happen to a light ray when it moves from an optically less dense medium to a more optically dense medium at a specific angle.

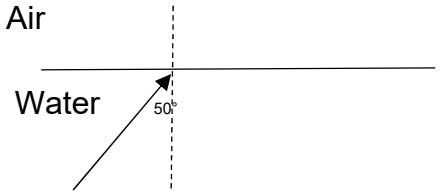
8.1.1 What phenomenon occurs when light transitions from a less optically dense medium to a more optically dense medium at an angle? Choose from: DISPERSION, REFLECTION, or REFRACTION. (1)

8.1.2 Provide an explanation for the phenomenon selected in QUESTION 8.1.1. Refer to the speed and bending of light. (2)

8.2 Define the term *critical angle*. (2)

8.3 List TWO conditions that are required for total internal reflection to occur. (2)

8.4 A ray of light passes from water into air, as shown in the diagram below, where the critical angle is 45°. Draw a labelled diagram showing the path of the light when the angle of incidence is increased to 50°.



(3)

8.5 A beam of white light strikes a triangular prism and separates into its individual colours.

8.5.1 Identify the phenomenon described in the above situation. (1)

8.5.2 Into how many individual colours does white light separate? (1)

8.5.3 Which colour of light has the highest speed when separating into its individual colours? (1)

8.5.4 When entering the prism, how does the wavelength of light change? Choose from: INCREASES, DECREASES, or REMAINS THE SAME. (1)

8.5.5 Explain why the wavelength changes, as described in QUESTION 8.5.4. (3)

[17]

QUESTION 9 (Start on a new page.)

A 1,5 μF capacitor is charged with a charge of 9,5 mC. A switch and a 10 Ω resistor are connected in series to the capacitor.

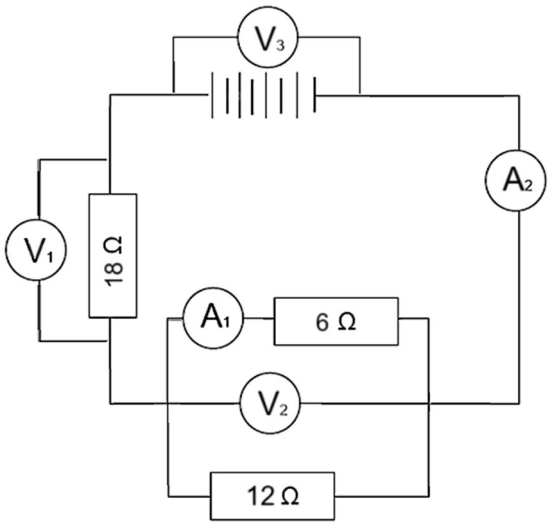
9.1 Define *capacitance of a capacitor*. (2)

9.2 Calculate the potential difference of the capacitor. (4)

[6]

QUESTION 10

The battery in the diagram below has negligible internal resistance. The reading on A_1 is 1,5 A.



10.1 What is the difference between *emf* and *terminal potential difference*. (3)

10.2 Calculate:

10.2.1 The reading on V_2 (3)

10.2.2 The reading on A_2 (3)

10.2.3 The reading on V_1 (2)

10.2.4 The reading on V_3 (2)

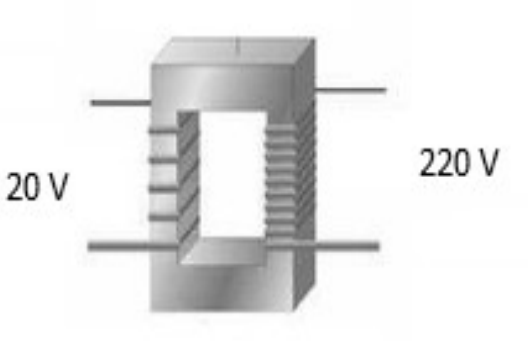
10.2.5 The charge that flows through the 6 Ω resistor in 3 minutes (3)

10.2.6 The energy delivered to the 6 Ω resistor in QUESTION 10.2.5 (3)

[19]

QUESTION 11 (Start on a new page.)

A 20 V light bulb with a current of 3 A and 50 W is connected to a transformer that is 100% effective. The transformer is connected to the main supply of 220 V with 55 windings.



11.1 What type of transformer is used to make the light bulb work? (1)

11.2 Calculate the number of windings for the light bulb in this transformer. (3)

11.3 Calculate the cost if the light bulb glows for 8 hours every evening for 7 nights at R1,10 per unit. (3)
[7]

TOTAL: 150

END

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	3,0 x 10^8 $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	6,63 x 10^{-34} $J \cdot s$
Permittivity of free space *Permatiwiteit van vrye spasie*	ε_o	8,85 $\times 10^{-12}$ $F \cdot m^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

FORCE/*KRAG*

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

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* $\Delta E_k = E_{kf} - E_{ki}$
$P_{av} = Fv_{av}$ / $P_{gemid} = Fv_{gemid}$	$E_M = E_k + E_p$
$P = \frac{W}{\Delta t}$	

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*

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

ELECTRIC CIRCUITS / *ELEKTRIESE STROOMBANE*

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

ELECTROMAGNETISM / *ELEKTROMAGNETISME*

$\Phi = BA$	$\varepsilon = \frac{N\Delta\,\Phi}{\Delta t}$
$\frac{Vs}{Vp} = \frac{Ns}{Np}$	

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

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