Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Department van Onderwys
Porafensie Ya Kapa Botjhabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2025

TECHNICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

This question paper consists of 17 pages, including 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. 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. You may use a non-programmable calculator.
5. LEAVE ONE line between sub questions, for example between QUESTION 2.1 and QUESTION 2.2.
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 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, for example 1.11 D.

1.1 Newton's First Law of Motion implies that an object will continue moving at constant velocity as long as the …

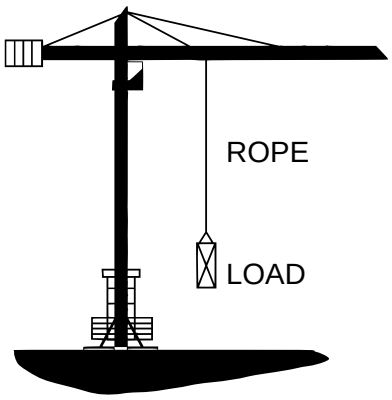
A sum of all the forces acting on the object is greater than zero but less than one.

B net force experienced by the object is less than zero.

C net force experienced by the object is greater than zero.

D sum of all forces acting on the object is zero. (2)

1.2 A crane lifts a 50 kg load with a rope at a constant velocity. What is the tension (force) in the rope? Ignore air friction.



A 500 N, upwards

B 500 N, downwards

C 490 N, upwards

D 490 N, downwards (2)

1.3 The law of conservation of momentum implies that … after the collision.

A the kinetic energy before the collision is equal to the kinetic energy

B in an isolated system the kinetic energy before collision is equal to the kinetic energy

C in an isolated system the total linear momentum before the collision is equal to the total linear momentum

D both objects will be at rest (2)

1.4 A ball with mass **m** strikes a wall with speed **v**. Assume that the collision is elastic. If the ball bounces back with the same speed **v,** the magnitude of the change in momentum will be ...

A 2 **mv** in the opposite direction.

B **mv** in the opposite direction.

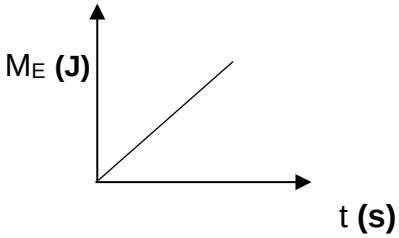
C 2 **mv** in the original direction.

D **mv** in the original direction. (2)

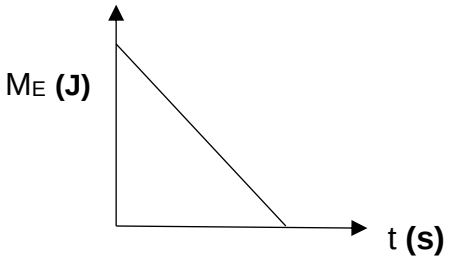
1.5 A ball is dropped and falls vertically downwards. (Ignore air resistance)

Which ONE of the following graphs is CORRECT about mechanical energy ($\mathbf{M_E}$) of the ball versus time (**t**)?

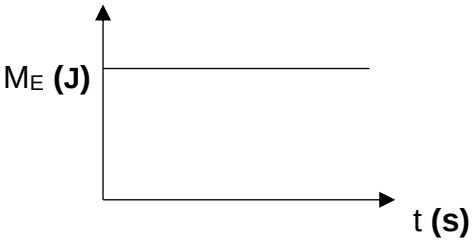
A



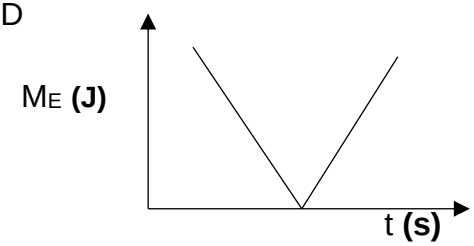
B



C



D



(2)

1.6 Which ONE of the following explains best why walls of dams are built THICKER at the bottom than at the top.

A Liquid pressure decreases with an increase in depth.

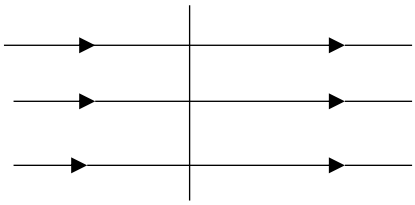
B Liquid pressure increases with an increase in depth.

C Density of a liquid decreases with an increase in depth.

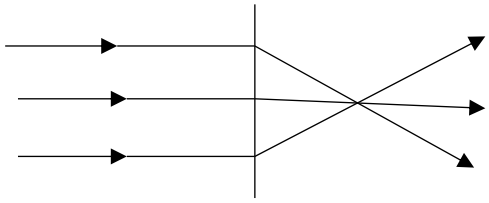
D Density of a liquid increases with an increase in depth. (2)

1.7 Parallel rays of light strike a concave lens. Which ONE of the diagrams below shows what happens to the rays when they strike the lens?

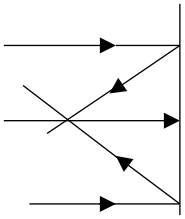
A



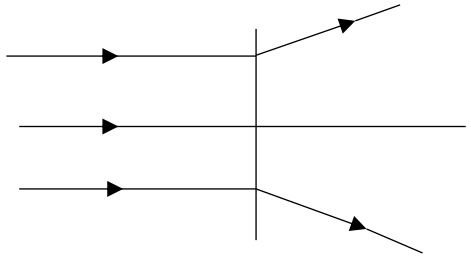
B



C



D



(2)

1.8 A light ray passes from glass to air. The angle of incidence is 40˚ and the critical angle of the glass-air surface is 42˚.

Which ONE of the following is CORRECT about the path of the light ray?

The light ray will undergo …

A refraction towards the normal.

B refraction away from the normal.

C total internal reflection.

D neither reflection nor refraction. (2)

1.9 The unit of the electromotive force (emf) is …

A Newton.

B Watt.

C Joule.

D Volt. (2)

1.10 An electrical machine that uses a commutator (split-ring) and converts mechanical energy to electrical energy is called …

A DC generator.

B AC Motor.

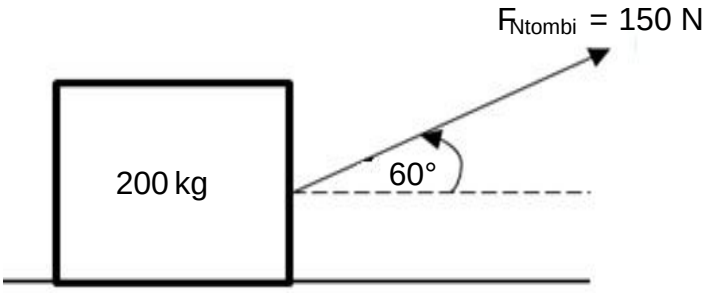
C AC generator.

D DC motor. (2)

[20]

QUESTION 2 (Start on a new page.)

A toolbox containing workshop equipment with a mass of 200 kg rests on horizontal rough surface. Ntombi pulls the toolbox with a force of 150 N at an angle of 60° to the horizontal using a rope, as shown in the diagram below. The box is not moving as she is pulling it.

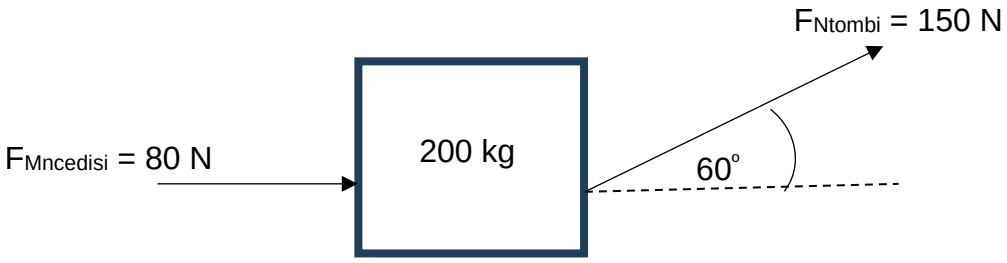


2.1 Draw a free-body diagram to show ALL the forces acting on the toolbox. (4)

2.2 Name and define the law in Science that can be used to explain why the toolbox is not moving. (3)

2.3 Use the law in QUESTION 2.2 to explain why the toolbox is not moving. (2)

2.4 After some time, Ntombi ask for help from Mncedisi who pushes the toolbox from behind with a force of 80 N and the toolbox starts moving in the direction in which Ntombi is pulling.



2.4.1 Define *tension force* and give an example of such a force in the diagram above. (3)

2.4.2 How will the frictional force on the toolbox be affected by Ntombi's applied force? Write only INCREASES, DECREASES or REMAINS CONSTANT. (2)

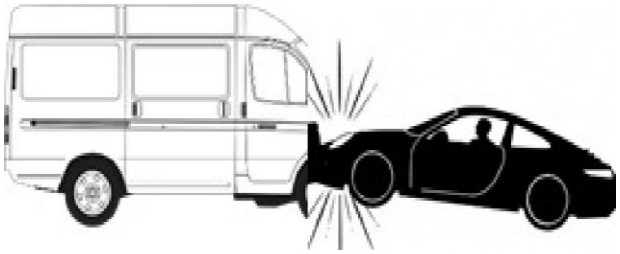
2.4.3 Draw a free-body diagram to show ALL the horizontal forces acting on the toolbox and its contents. (3)

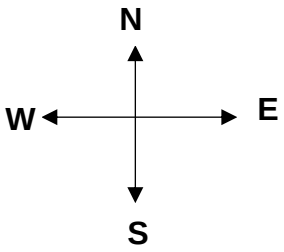
2.4.4 If the net force acting on the toolbox and its contents is 105 N, calculate the coefficient of kinetic friction between the surface and the toolbox. (6)

[23]

QUESTION 3 (Start on a new page.)

A minibus taxi of mass 1 500 kg moving towards the eastern direction is travelling at 120 km.h^{-1}. The minibus taxi collides head-on with a car of mass 1 100 kg travelling in the opposite direction at 16,67 m.s^{-1}.





3.1 Define *momentum*. (2)

3.2 What is the velocity, in m.s^{-1}, of the minibus before the collision takes place? (2)

3.3 Calculate the initial momentum of the car. (3)

3.4 After the collision, the minibus continues to move towards the east at 20,3 m.s^{-1} and the car moves backwards at 5,32 m.s^{-1}. Assume system is isolated.

3.4.1 Explain what is meant by *isolated system*. (2)

3.4.2 Use a calculation to determine whether the collision was elastic or inelastic. (5)

3.5 A motorbike with a mass of 1 150 kg crashes into a tree with a velocity of 15 m.s^{-1} as shown in the diagram below. The motorbike experiences a constant net force of 57 500 N before it comes to rest.

3.5.1 What is the relationship between the net force experienced by the motorbike and the contact time during the crash? (2)

3.5.2 How does the impulse experienced by the motorbike compare to its change in momentum? Write only SMALLER THAN, GREATER THAN or EQUAL TO. (1)

3.5.3 Modern vehicles are equipped with airbags. Explain, using impulse, how this would reduce the extent of the injuries to occupants. (3)

3.5.4 Calculate the contact time during the crash of the motorbike. (4)

[24]

QUESTION 4 (Start on a new page.)

4.1 A construction worker, working on the roof of a building, drops his hammer with of mass 0,55 kg, from a height of 8 m above the ground. Assume that the system is isolated.

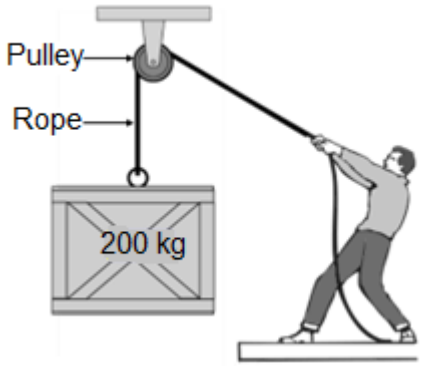
4.1.1 State the *principle of conservation of mechanical energy* in words. (2)

4.1.2 Calculate the mechanical energy of the hammer at 8 m above the ground. (3)

4.1.3 Calculate the magnitude of the velocity of the hammer at a height of 3,5 m above the ground. (5)

4.1.4 Without using calculations, write down the magnitude of the hammer's kinetic energy at which it hits the ground. Give a reason for the answer. (3)

4.2 The diagram below shows a man using a rope on a frictionless pulley to lift a 200 kg box at a constant velocity of 4 $m \cdot s^{-1}$.



4.2.1 Calculate the magnitude of the force exerted by the rope on the box. (2)

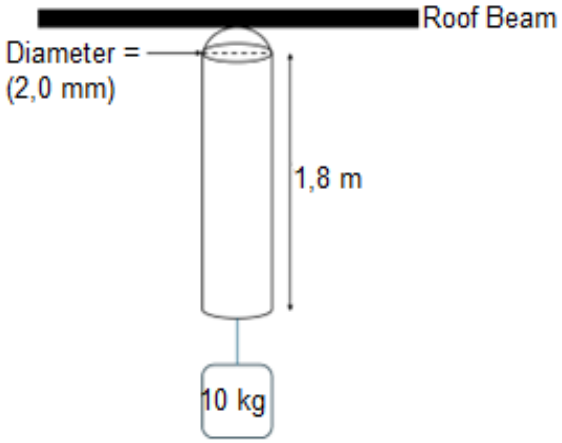
4.2.2 Calculate the work done by the man to lift the box at a height of 3 m. (4)

4.2.3 Calculate the power output, in watt, needed to lift the box at a height of 3 m. (3)

[22]

QUESTION 5 (Start on a new page.)

A cylindrical steel wire, length 1,8 m and 2,0 mm diameter, is connected by an inextensible material to a roof beam. A 10 kg block is attached to the bottom end of the wire and this causes the wire to stretch by 3×10^{-4} m.



5.1 Define the term *deforming force*. (2)

5.2 Calculate the stress on the steel wire. (4)

5.3 Calculate the strain on the steel wire. (3)

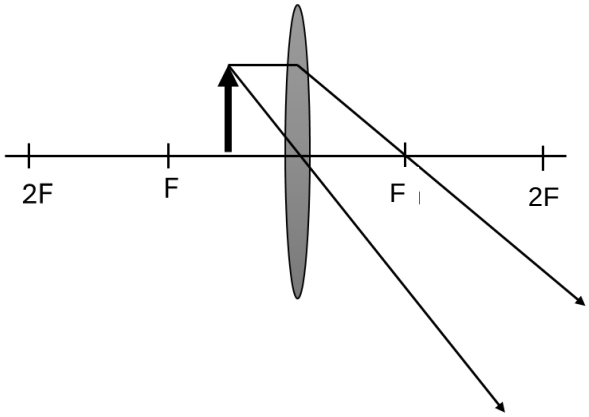
5.4 Define a *perfectly elastic* body and give ONE example. (3)
[12]

QUESTION 6 (Start on a new page.)

6.1 Study the diagrams below that illustrate a phenomenon of light.

DIAGRAM 1

DIAGRAM 2



6.1.1 Name the phenomenon illustrated by DIAGRAM 1. (1)

6.1.2 Define the phenomenon mentioned in QUESTION 6.1.1. (2)

6.2 The following questions refer to DIAGRAM 2.

6.2.1 At what position will the image be formed in DIAGRAM 2? (1)

6.2.2 Mention THREE (3) characteristics of the image formed in QUESTION 6.2.1. (3)

6.2.3 Name TWO (2) applications of the type of lens in DIAGRAM 2. (2)

6.3 The object is now moved to **F**.

6.3.1 At what position will the image be formed? (1)

6.3.2 Explain the answer to QUESTION 6.3.1. (2)

[12]

QUESTION 7 (Start on a new page.)

7.1 An X-ray has an energy of 1,989 x 10^{-17} J.

7.1.1 Define *electromagnetic wave*. (2)

7.1.2 Calculate the wavelength of the X-ray. (4)

7.1.3 Name TWO uses of X-rays. (2)

[8]

QUESTION 8 (Start on a new page.)

8.1 A capacitor has two plates with an unknown total surface area. The separation distance between the plates is 0,02 m and the dielectric medium used is air.

8.1.1 Define the term *capacitance.* (2)

8.1.2 Write the SI unit for capacitance in words. (1)

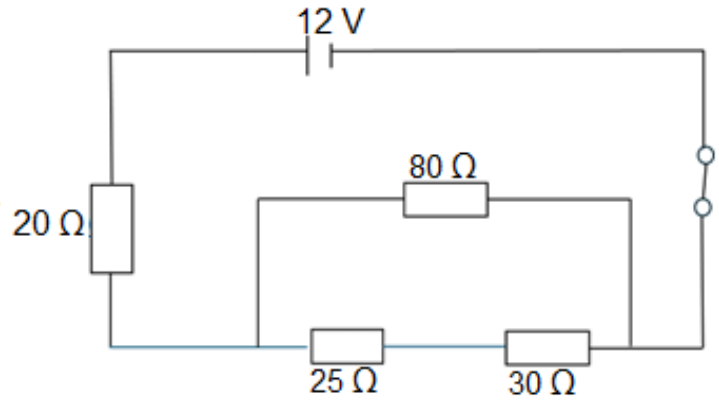
8.1.3 Calculate the total surface area of the metal plates if the capacitance of the capacitor is 100×10^{-6} F. (3)

8.2 The capacitance of a capacitor may be increased or decreased by changing any or all of the factors affecting capacitance.

Mention how any of the THREE (3) factors affecting capacitance may be changed to increase the capacitance of a capacitor. (3)
[9]

QUESTION 9 (Start on a new page.)

Four resistors are connected to a battery with a terminal potential difference of 12 V as shown in the diagram below. Study the circuit diagram and answer the questions that follow.



9.1 State *Ohm's Law* in words. (2)

9.2 Calculate the total current in the circuit. (4)

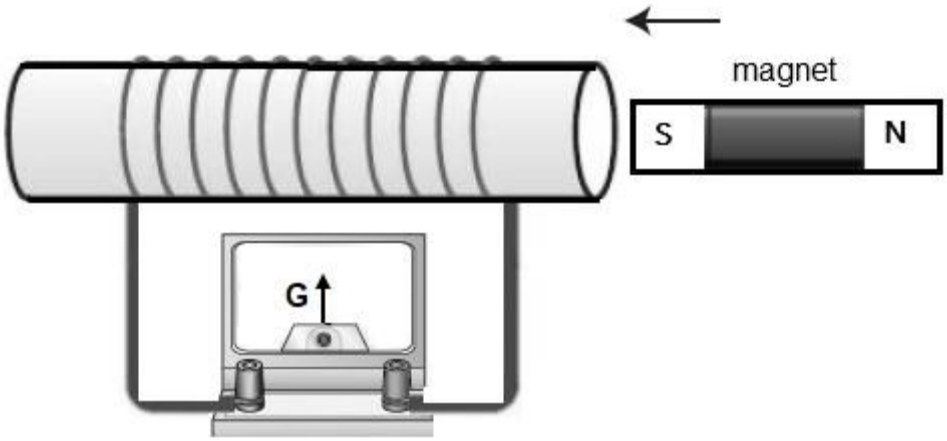
9.3 If the current flows for two minutes, calculate the heat produced by the 20 Ω resistor. (4)

9.4 The average usage of a 1 500 W kettle is 7,5 minutes per day for a 30 day month. Calculate the monthly cost if the municipal tariff is R3,20 per kilowatt hour. (4)

[14]

QUESTION 10 (Start on a new page.)

Two Physical Science learners set up an experiment, to investigate electromagnetic induction using a bar magnet and a cylindrical coil as indicated in the diagram below. An electromotive force was generated by moving the bar magnet in and out of the coil.



10.1 Name the law used to describe this phenomenon. (1)

10.2 State the law mentioned in QUESTION 10.1 in words. (2)

10.3 Suppose the cylindrical coil has 11 turns and the generated electromotive force (emf) of 20 V in 0,5 s.

Calculate the change in magnetic flux. (3)
[6]

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	$3,0 \times 10^{8}$ $m \cdot s^{-1}$
Planck's constant *Planck se konstante*	h	$6,63 \times 10^{-34}$ $J \cdot s$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}$ kg
Permittivity of free space *Permittiwiteit van vrye ruimte*	$\varepsilon_\circ$	$8,85 \times 10^{-12}$ $F.m^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_{s\,max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$F_g = mg$
$MA = \frac{L}{E} = \frac{e}{l}$	

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* $E_k = \frac{1}{2}mv^2$	$W_{net} = F_{net}\Delta x\cos\theta$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	$P = \frac{W}{\Delta t}$
	$M_E = E_k + E_p$

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

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

ELECTROSTATICS / *ELEKTROSTATIKA*

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

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

$R = \frac{V}{I}$	emf/*emk* (ε)= I(R + r)
$R_s = R_1 + R_2 + ...$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + ...$	$q = I\ \Delta t$
W = VQ W = VIΔt W = I^{2}RΔt W = $\frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ P = VI P = I^2R $P = \frac{V^2}{R}$

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

Δϕ = BA	ε = - 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 = fλ	T = $\frac{1}{f}$
E = hf or E = h.$\frac{c}{\lambda}$	