Province of the
EASTERN CAPE
EDUCATION

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

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2025

TECHNICAL SCIENCES P1

MARKS: **150**

TIME: **3 hours**

JTSCE1

This question paper consists of 14 pages, including 2 data sheets.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. Write your FULL NAME and SURNAME in the appropriate spaces on the ANSWER SHEET.
2. Answer ALL the questions in the ANSWER BOOK.
3. You may use a non-programmable calculators.
4. You may use appropriate mathematical instruments.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Show ALL formulae and substitutions in ALL calculations.
7. Round off your FINAL numerical answers to a minimum of TWO decimal places.
8. Give brief motivations, discussions et cetera where required.
9. You are advised to use the attached DATA SHEETS.
10. 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 your ANSWER BOOK, for example 1.11 D.

1.1 The diagram below shows a stationary brick of mass 1 kg on a frictionless floor. The brick remains stationary when $\mathbf{F_1}$ and $\mathbf{F_2}$ are simultaneously applied to the brick.

Which ONE of the following statements is CORRECT?

A $F_1 = F_2$

B $F_1 = \frac{1}{2} F_2$

C $F_1 = 2 F_2$

D $F_1 < F_2$ (2)

1.2 Which ONE of the following is always in the same direction as the acceleration of a body?

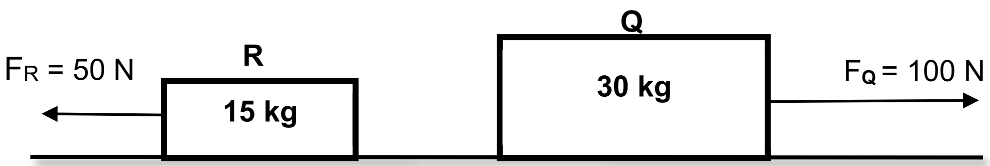
A Velocity

B Rate of change of momentum

C Momentum

D Work done (2)

1.3 Two boxes **R** and **Q** of masses 15 kg and 30 kg respectively, rest on a frictionless horizontal surface. These boxes are then pulled with forces F_R = 50 N and F_Q = 100 N and they move to the direction of the applied forces.



How does the inertia of box **R** compare to the inertia of box **Q**?

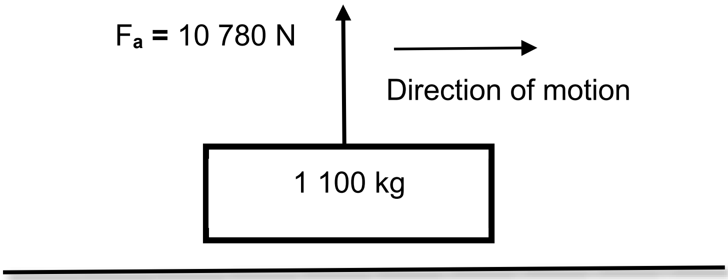
A Inertia of box **R** = Inertia of box **Q**

B Inertia of box **R** > Inertia of box **Q**

C Inertia of box **R** < Inertia of box **Q**

D Inertia of box **R** = 2 x Inertia of box **Q** (2)

1.4 A crane is moving a box to the right while it applies an upward force of 10 780 N over a height of 0,9 m. The mass of the box is 1 100 kg, as shown in the diagram below.



The amount of work done on the box by the applied force is …

A 9 702 J.

B 1 100 J.

C 0 J.

D 10 789 J. (2)

1.5 Consider the following statements regarding fluid pressure:

(i) Fluid pressure is directly proportional to the depth
(ii) Fluid pressure is independent of the size of shape of the container
(iii) Fluid pressure is inversely proportional to the density of the fluid

Which ONE of the following options is CORRECT regarding fluid pressure?

A (ii) and (iii)

B (i) and (iii)

C (i), (ii) and (iii)

D (i) and (ii) (2)

1.6 The CORRECT definition for power is:

A The ratio of work done over a certain period of time.

B No work is done when a force acts at right angles to the direction of motion.

C The ability to do work.

D The rate at which work is done. (2)

1.7 The minimum force that can be applied on a body so that the body regains its original form completely on removal of the force, is elastic limit.

Which of the following word(s) is used INCORRECTLY in the above statement?

A removal

B minimum

C elastic limit

D original form (2)

1.8 40 GPa is equal to …

A 4×10^{15} Pa.

B 40×10^{6} Pa.

C 4×10^{8} Pa.

D 40×10^{9} Pa. (2)

1.9 The equivalent unit to N·s is …

A $kg\ m.s^{-2}$

B $m.s^{-2}$

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

D $m.s^{-1}$ (2)

1.10 Optical fibers are based on the phenomenon of …

A diffraction.

B dispersion.

C interference.

D total internal reflection. (2)

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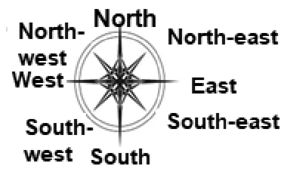
QUESTION 2

2.1 The diagram below shows a 12 kg box moving at constant velocity to the east while three forces F_1, F_2 and F_3 are simultaneously exerted on it.

The surface is frictionless.

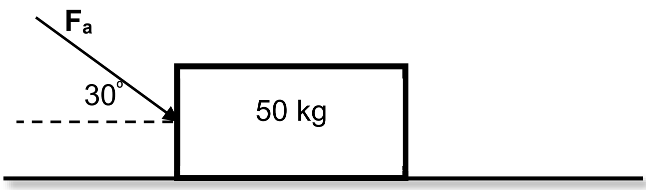


2.1.1 State Newton's First Law of Motion in words. (2)

2.1.2 What is the magnitude of the acceleration of the box? (1)

2.1.3 Calculate the magnitude of the F_2 if Newton's First Law is obeyed. (3)

2.2 A force (F_a) with a magnitude of 280 N is applied to push a block of mass 50 kg across a rough horizontal surface at an angle of 30° with the horizontal, as shown in the diagram below.



The coefficient of kinetic friction (μ_k) is 0,24.

2.2.1 Draw a labelled free-body diagram showing ALL the forces acting on the block. (4)

2.2.2 Calculate the magnitude of the kinetic frictional force experienced by the block. (4)

2.2.3 When the angle between the applied force and the horizontal is increased, the kinetic frictional force will decrease.

Is the above statement TRUE or FALSE? (2)

2.2.4 Calculate the acceleration of the block. (4)

2.2.5 The same block of 50 kg now experiences a pulling force that has been halved. If everything else remains the same, how will it affect the magnitude of the normal force?

Write only INCREASE, DECREASE or REMAINS THE SAME. (2)

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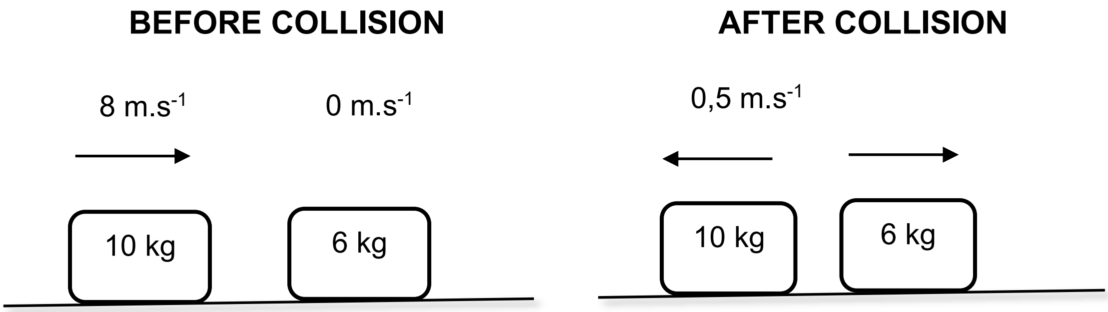
QUESTION 3

3.1 A 10 kg block moving due east with a velocity of 8 $m.s^{-1}$, and collides with a stationary 6 kg block.

Immediately after the collision, the 10 kg block moves due west with a velocity of 0,50 $m.s^{-1}$ and the 6 kg block move with a constant velocity due east, as shown in the diagram below.

The collision is inelastic.



3.1.1 Define the term *momentum.* (2)

3.1.2 Is momentum conserved in the above system? Yes or No. (1)

3.1.3 Calculate the velocity of the 6 kg block after collision. (4)

3.1.4 Name and state the law used in the calculation in QUESTION 3.1.3 above. (3)

3.2 A cricket ball of mass 0,29 kg is thrown to a batsman at a velocity of 24,69 $m.s^{-1}$. The batsman hits the ball back towards the bowler at a velocity of 15,70 $m.s^{-1}$.

3.2.1 Define the term *impulse.* (2)

3.2.2 What can be said about the relationship of the impulse and the velocity of the ball as it returns towards the bowler? Are these quantities DIRECTLY PROPORTIONAL or INVERSELY PROPORTIONAL towards each other? (2)

3.2.3 The net force exerted by the ball on the bat decreases when the time of contact between the ball and the bat increases. Give a reason why this occurs. (2)

3.2.4 Calculate the net force exerted by the bat on the ball when the contact time between the bat and the ball is 0,007 s. (4)

3.2.5 What is the magnitude and direction of the net force exerted by the ball on the bat? (2)

3.2.6 Name and state the law used to answer QUESTION 3.2.5. (3)

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QUESTION 4

4.1 A handyman is painting the roof of a house. As he is painting, he accidentally bumps the paint container with a mass of 5 kg at a height of 4 m above the ground. Assume that the system is isolated.

4.1.1 Define the term *kinetic energy.* (2)

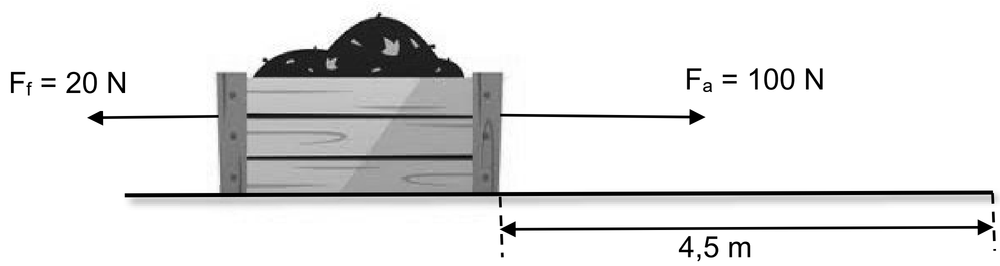
4.1.2 State the principle of conservation of mechanical energy in words. (2)

4.1.3 Calculate the mechanical energy of the paint container at a height of 4 m above the ground. (3)

4.1.4 Calculate the velocity of the paint container at a height of 2 m above the ground. (4)

4.1.5 Give the magnitude of the paint container's kinetic energy just before it hits the ground, without calculation. Give a reason for your answer. (3)

4.2 A gardener applies a force of 100 N to pull a crate with soil over a distance of 4,5 m. The total mass of the crate with soil is 60 kg.



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

4.2.2 Calculate the amount of work done by friction. (3)

4.2.3 If the size of the angle between the applied force and the direction of motion is 90˚, what will be the value for work done on the crate. (2)

4.2.4 Calculate the net work done on the crate and its contents. (4)

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QUESTION 5

5.1 Explain what a *perfect elastic body* is. (2)

5.2 Define the term *stress.* (2)

5.3 The table below shows data of stress versus strain for Substance **A** and Substance **B**.

SUBSTANCE A		SUBSTANCE B	
Strain (x 10^{-2})	**Stress (x 10^{9})**	**Strain (x 10^{-2})**	**Stress (x 10^{9})**
1	1,8	1,1	3,78
2	3,6	1,9	7,02
3	5,4	3	10,44
4	7,2		

Answer the following questions using the above table of results.

5.3.1 Write down the relationship between stress and strain. (2)

5.3.2 Name the law that states the above relationship between stress and strain. (1)

5.3.3 Which ONE of the substances has the highest modulus of elasticity? Motivate your answer by means of calculations. (5)

5.4 The viscosity of three different substances at 25 °C are given in the table below.

SUBSTANCES	VISCOSITY (Pa.s)
Vinegar	8,9 x 10^{-4}
Ethanol	10,4 x 10^{-4}
Motor oil SAE 10	650 x 10^{-4}

5.4.1 Define *viscosity.* (2)

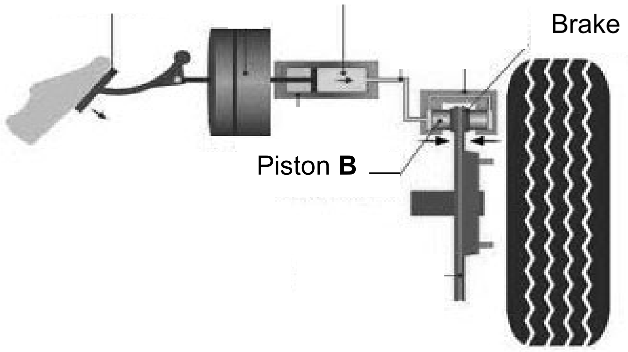
5.4.2 Which ONE of the above substances flows the fastest? Explain your answer. (2)

5.4.3 How does the increase in temperature affect the viscosity? (2)

5.5 A system of hydraulic brakes has the following measurements:

- Area of piston **A** is 142 x 10^{-6} m^2
- Area of piston **B** is 253,50 x 10^{-6} m^2

The force that is applied on the brake pedal is 882,50 N.



5.5.1 State Pascal's Law in words. (2)

5.5.2 Calculate the force exerted by piston **B** on the brake pad. (4)

5.5.3 What would happen to the pressure on the brake if the area of piston **B** is increased? Write down only INCREASES, DECREASES or REMAIN THE SAME. (1)

5.5.4 Write down TWO uses of hydraulic systems other than hydraulic brakes. (2)

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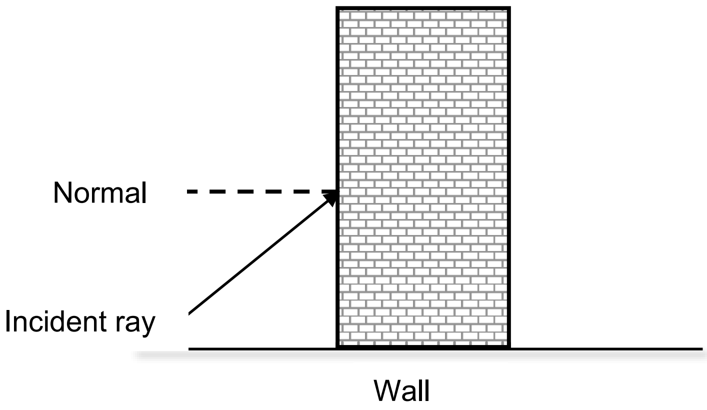
QUESTION 6

A ray of light can undergo both reflection and refraction.

6.1 Define the term *reflection of light.* (2)

6.2 A light ray strikes the wall at an angle.



Redraw the above diagram and complete the diagram by showing the reflection of the light ray to the wall. Label ALL light rays and angles. (3)

6.3 The refractive index of four media **A**, **B**, **C** and **D** are given in the table below.

Medium	**A**	**B**	**C**	**D**
Refractive index	1,00	1,33	1,52	2,42

6.3.1 Define the term *refractive index.* (2)

6.3.2 Through which medium will light travel the fastest? (2)

6.3.3 Medium **A** is the most optically dense in the above table. State whether this statement is TRUE or FALSE. Give a reason for your answer. (3)

6.3.4 If the light ray exits medium **C** into medium **D**, will it refract TOWARDS or AWAY from the normal? Give a reason for your answer. (3)

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QUESTION 7

7.1 A light ray is used to determine the position and size of the image formed by a convex lens.

7.1.1 For which position of the object does a convex lens form a virtual and erect image? (2)

7.1.2 An object with size of 5 mm is placed, 14 mm in front of the convex lens. The lens has a focal length of 10 mm. Draw a ray diagram according to scale to show how the image is formed. (8)

7.1.3 Use the ray diagram to determine the position, size and nature of the image. (3)

7.2 Give THREE applications where convex lenses are used. (3)

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TOTAL: 150

DATA FOR TECHNICAL SCIENCES GRADE 12
PAPER 1

GEGEWENS VIR TEGNIESE WETENSKAPPE GRAAD 12
VRAESTEL 1

TABLE 1/*TABEL 1*

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	$6,63 \times 10^{-34}\ J\cdot s$
Coulomb's constant *Coulomb se konstante*	k	$9,0 \times 10^{9}\ N\cdot m^{2}\cdot C^{-2}$
Charge on electron *Lading op elektron*	-e	$-1,6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9,11 \times 10^{-31}\ kg$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$F_g = mg$
Torque = $F \times r_{\perp}$	$MA = \frac{L}{E} = \frac{e}{I}$

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

Speed/*Spoed*	$c = f\lambda$
Energy/*Energie*	$E = hf$ or/*of* $E = \frac{hc}{\lambda}$

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

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

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