



Province of the  
**EASTERN CAPE**  
EDUCATION



# **NATIONAL SENIOR CERTIFICATE**

**GRADE 12**

**JUNE 2023**

**TECHNICAL SCIENCES P1  
(DEAF)**

**MARKS: 150**

**TIME: 3 hours**



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This paper has 17 pages and 3 data sheets.

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**INSTRUCTIONS AND INFORMATION**

**Read the instructions. Answer the questions.**

1. This **question paper** has **TEN questions**.  
**Answer ALL the questions** in the **ANSWER BOOK**.
2. Start **EACH question** on a **NEW page** in the ANSWER BOOK.
3. **Number the answers the same** as the **numbers** in the **question paper**.
4. You may use a non-programmable calculator.
5. Leave **ONE line between questions**, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. **Use** the attached **DATA SHEETS**.
7. **Show ALL formulae and substitutions** in ALL calculations.
8. **Round off your answers** to a minimum of **TWO decimal places**.
9. Some **questions** will **ask** you to **explain** your **answer**.  
Write **short explanations**.
10. Write **neatly**.  
Your **work** must be **easy to read**.

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

**Choose the answer.**

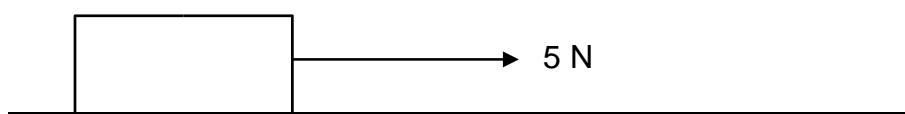
**Write only the letter (A–D) next to the question numbers (1.1 to 1.10), e.g. 1.11 D.**

- 1.1 A car experiences a constant net force of 500 N as it moves towards the west.  
The rate at which the momentum of the car changes during its motion is ...
- A equal to the impulse of the car.  
B equal to 500 N.  
C greater than the net force  
D less than 500 N (2)
- 1.2 Newton's First Law of Motion implies<sub>(says)</sub> that an object will continue moving at constant velocity as long as the ...
- A sum of all forces acting on the object is zero.  
B net force experienced by the object is greater than zero.  
C net force experienced by the object is less than zero.  
D sum of all the forces acting on the object is greater than zero but less than one. (2)
- 1.3 One of the properties of action-reaction pairs is that ...
- A they have the same magnitude.  
B they act towards the same direction.  
C their net force is always zero.  
D they act on the same object. (2)

- 1.4 A learner drops his book from his desk to the floor. The mechanical energy at the top of the desk, from where the book was dropped will be ...

- A equal to zero.
- B equal to kinetic energy.
- C equal to the gravitational potential energy.
- D None of the above. (2)

- 1.5 An object moves with a constant velocity along a rough surface when a horizontal force of 5 N acts on it.



The magnitude of the kinetic frictional force is ...

- A equal to 0.
  - B equal to 5 N.
  - C greater than 5 N.
  - D less than or equal to 5 N. (2)
- 1.6 Which term best describes a force that is equal, and opposite to the deforming force?
- A Strain
  - B Stress
  - C Applied Force
  - D Restoring Force (2)

- 1.7 A **bricklayer** wants to **displace** an **object** through a **horizontal distance** of **5 m**. He **applies** a **force** of **10 N**, but the object **remains at rest**.  
**Work done** by the **bricklayer** on the **object** (in **Joule**) is ...
- A 0.
- B 5.
- C 10.
- D 50. (2)
- 1.8 Which ONE of the **statements** represents<sub>(show)</sub> **Pascal's law**?
- A The area is inversely proportional to the pressure in it, if the temperature remains constant.
- B The pressure exerted at any point of a continuous liquid at equilibrium, is transmitted equally in all directions.
- C The pressure is directly proportional to the volume if the temperature remains constant.
- D Volume is inversely proportional to the pressure on it if the temperature remains constant. (2)
- 1.9 **Strain** is **defined** as the ...
- A force acting per unit area.
- B internal restoring force per unit area.
- C force that changes the shape of an object.
- D ratio of change in dimension to the original dimension. (2)
- 1.10 The **pressure** at a **point** in a **liquid** DOES NOT **depend** on the ...
- A area.
- B depth.
- C density.
- D gravitational acceleration. (2)

**[20]**

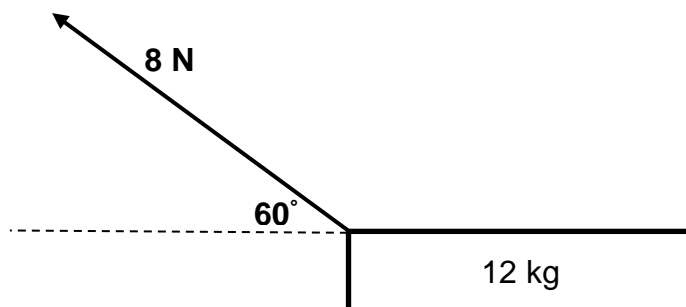
**QUESTION 2 (Start on a new page.)****Diagram:**

A learner is pulling a block of mass 12 kg at a force of 8 N left

It is at an angle of  $60^\circ$  to the horizontal.

The block experiences a frictional force of 0,3 N parallel to the surface.

It is shown in the diagram below.



2.1 Define the term **acceleration**. (2)

2.2 Use the diagram. Answer the questions.

2.2.1 Calculate the magnitude and the direction of the net force. (5)

2.2.2 Calculate the magnitude of the acceleration of the block. (3)

2.2.3 Write down the NAME of the law that can be used to explain the movement of the block. (2)

2.2.4 State the law identified in QUESTION 2.2.3 in words. (2)

2.2.5 Draw a free-body diagram of all the forces acting on the block. (4)

2.3 Another block of same mass is placed on top of the block A.

It is pulled at the same angle.

How will the following be influenced by the increase of mass?

State only, INCREASES, DECREASES or REMAINS THE SAME.

2.3.1 Frictional force (1)

2.3.2 Acceleration (1)

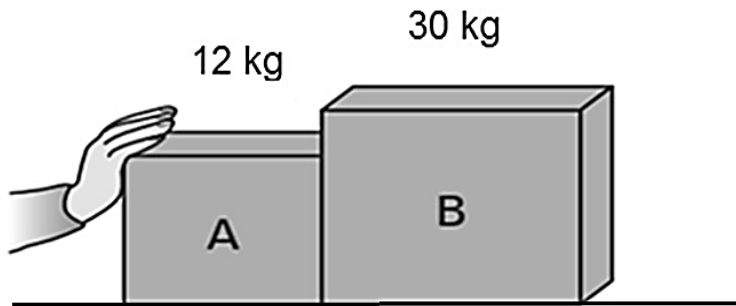
**[20]**

**QUESTION 3 (Start on a new page.)**

Crate **A** and crate **B**, of **different masses**, are **placed next to each other on a horizontal rough surface**.

A hand **pushing crate A** causes **both crates** to **accelerate** at  $2,3 \text{ m.s}^{-2}$  to the **right**.

Crate **B** experiences a **frictional force** of  $25,3 \text{ N}$ .



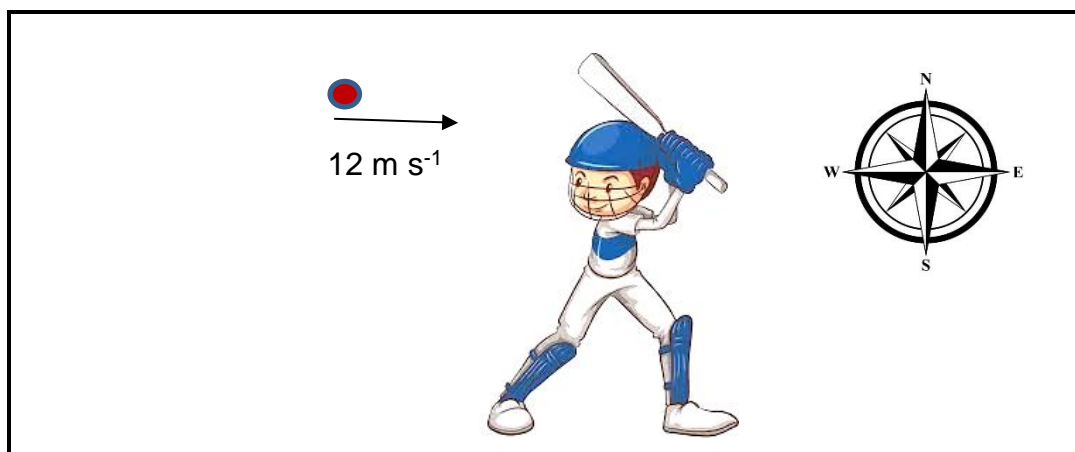
- 3.1 Give Newton's Third Law of Motion in words. (2)
- 3.2 Calculate the force exerted<sub>(applied)</sub> by crate **B** on crate **A**. (6)
- [8]**

**QUESTION 4 (Start on a new page.)****4.1 Diagram:**

A cricket ball, of mass 175 g, is thrown directly towards a batsman at a horizontal velocity of  $12 \text{ m}\cdot\text{s}^{-1}$  east.

It is hit back in the opposite direction with a velocity of  $30 \text{ m}\cdot\text{s}^{-1}$  west.

The ball is in contact with the bat for a period of 0,05 s.



4.1.1 Give the **definition** of the term **impulse** in words. (2)

4.1.2 Calculate the **change** in the **momentum** of the **ball** in **magnitude** and **direction**. (5)

4.1.3 Calculate the **magnitude** of the **force exerted**<sub>(applied)</sub> by the **bat** on the **ball**. (3)

4.1.4 Modern **cars use crumple zones** on the **front** and the **sides as a safety measure**.  
It is to **reduce injuries during a collision**.  
**Explain**, by using the **concept of impulse**, **how crumple zones reduce injuries**. (4)

4.2 Block X, of mass 2 kg, slides at  $3 \text{ m}\cdot\text{s}^{-1}$  to the **right** and **collides** with a **stationary block Y**, of mass 3,5 kg.

Block X **rebounds** at a **velocity** of  $1 \text{ m}\cdot\text{s}^{-1}$  to the **left**.

4.2.1 Write down the **principle of conservation of linear momentum**. (2)

4.2.2 Calculate the **velocity** of block Y **after the collision**. (5)

[21]

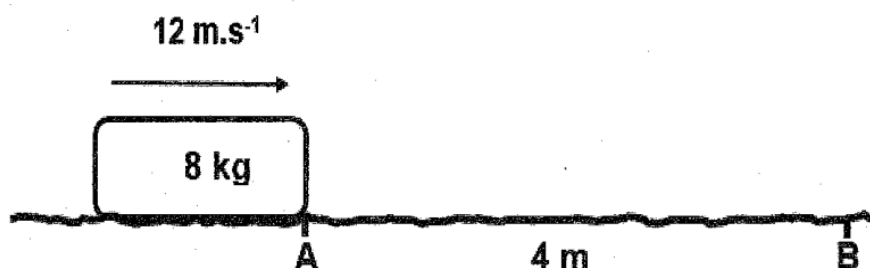


**QUESTION 5 (Start on a new page.)****Diagram**

A **block** of mass **8 kg** moves to the **right** over a **rough horizontal surface** from point **A** to point **B**.

Point **B** is **situated 4 m** away from point **A** as **shown** in the diagram below.

The **coefficient of friction** ( $\mu_k$ ) **between the block and the surface AB** is 0,14.



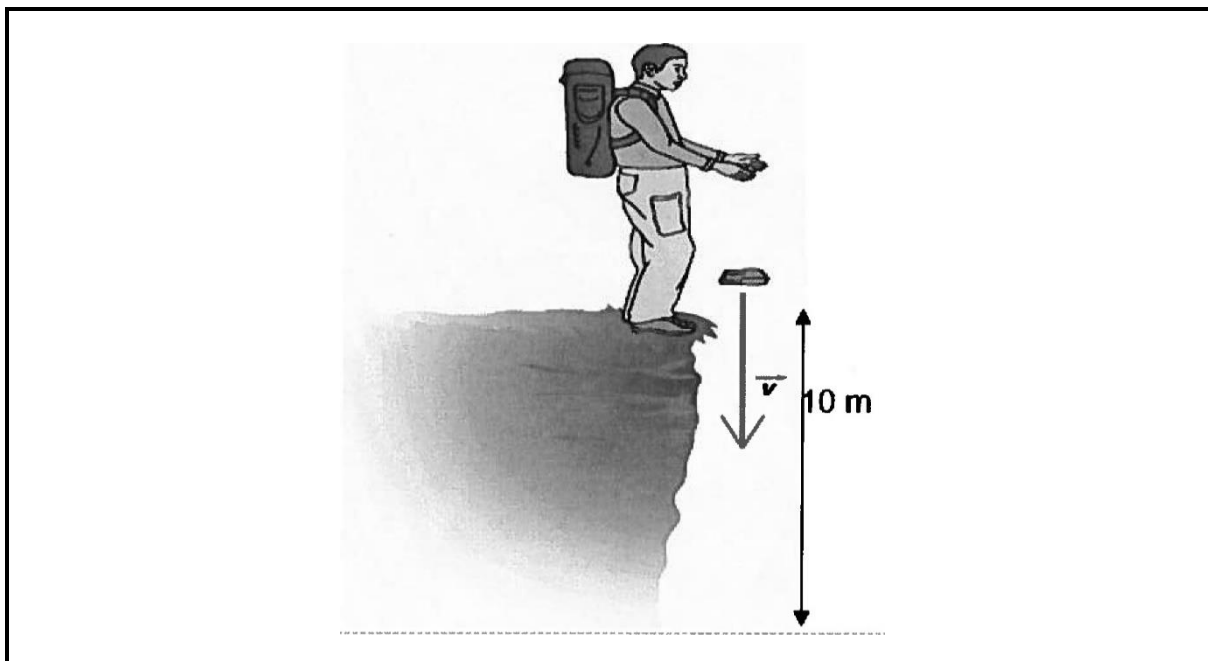
- 5.1 Define the term **work done**. (2)
- 5.2 Calculate:
- 5.2.1 The **magnitude** of the **kinetic frictional force** on the **block** while **moving** from point **A** to point **B** (3)
- 5.2.2 The **work done** by the **kinetic frictional force** from point **A** to point **B** (3)
- 5.3 What would the **work done** by **gravitational force** be equal to? (1)
- 5.4 The **amount of work done** by a **truck** of **mass 3 000 kg** moving on a **horizontal road** in 30 s, is 480 000 J.
- 5.4.1 Define the term **power**. (2)
- 5.4.2 Calculate the **power** of the **truck** in **horsepower**. (5)
- [16]

**QUESTION 6 (Start on a new page.)****Diagram**

A **hiker** is **standing** on **top** of a **cliff**.

The **hiker** **drops** a **parcel** with a **mass** of **8 kg**.

It is **10 m** **above** the **ground**.



- 6.1 **State** the **principle of Conservation of Mechanical Energy** in words. (2)
- 6.2 **Calculate** the **total mechanical energy** of the **parcel** at the **top** of the **cliff**. (4)
- 6.3 **Another hiker**, at the **bottom** of the **cliff**, **picks** up the **parcel** and walks **0,5 m** on a **horizontal surface** with it.
- 6.3.1 **Is** there **work done on** the **parcel** **after** the **second hiker** has **walked 0,5 m with it**? Answer YES or NO. (1)
- 6.3.2 **Explain** your **answer** to **QUESTION 6.3.1**. (2)

**[9]**

**QUESTION 7 (Start on a new page.)****Diagram**

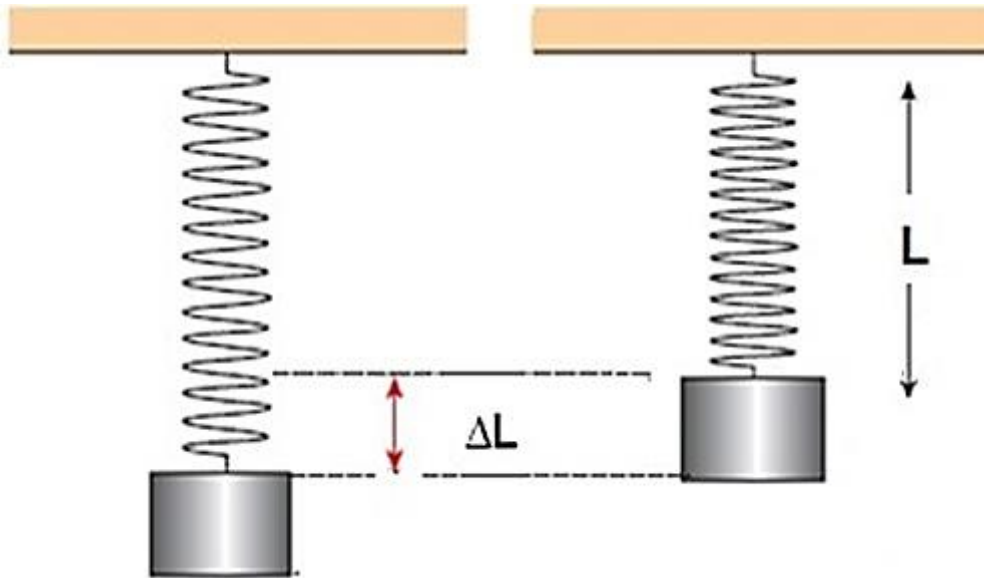
A **compressive force** causes internal stress of 1 MPa.

It is in a **SPRING** made of an **unknown metal**.

The resistance area of the round **SPRING** is  $2 \times 10^{-3} \text{ m}^2$ .

Its **original length** is 50 mm.

The **force** causes the round **SPRING** to increase by  $1 \times 10^{-3} \text{ mm}$ .



- 7.1 Define the term **strain** in words. (2)
- 7.2 State **Hooke's Law** in words. (2)
- 7.3 Calculate the:
- 7.3.1 **Force** that causes the **SPRING** to stretch (4)
- 7.3.2 **Strain** in the **metal** caused by the **force** (3)
- 7.3.3 **Elasticity modulus** for this **metal** (3)

**[14]**

**QUESTION 8 (Start on a new page.)****Table:**

The **table below** shows **different types** of **motor oils** and their **gradings**, used in different **temperature regions**, in different **seasons**.

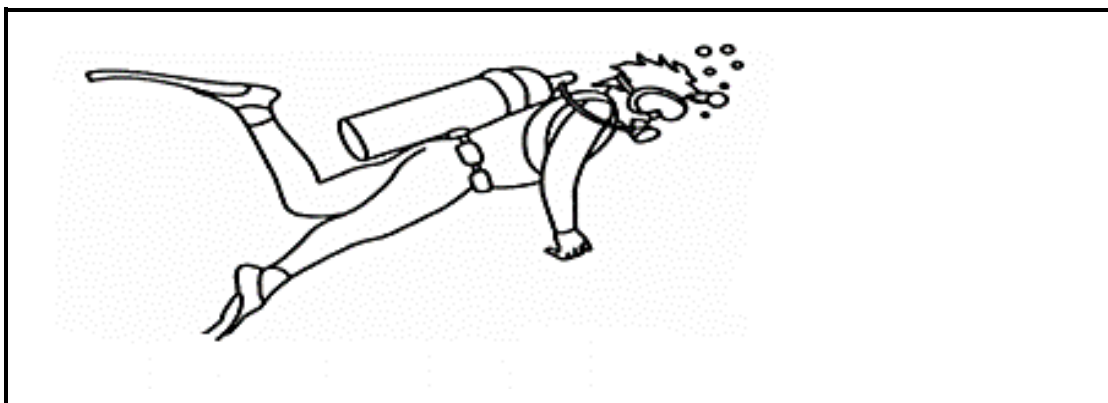
Motor Oil	Type of Oil	Grading
A	Low viscosity	5W-30
B	High viscosity	5W-40

- 8.1 **Define** the term **viscosity**. (2)
- 8.2 **What** does **5W-30** represent<sub>(show)</sub> on the **label** of a **motor oil container**<sub>(can)</sub>? (2)
- 8.3 Use the **information** given in the **table**.  
**Choose** which **motor oil (A or B)** will be **suitable** for **use** in **summer** as compared to **winter**. (2)
- 8.4 **Explain** your **answer** to QUESTION 8.3 above in terms of **viscosity** and **temperature**. (2)
- 8.5 **Distinguish**<sub>(explain difference)</sub> between *single/mono-grade* and *multi-grade motor oils*. (4)

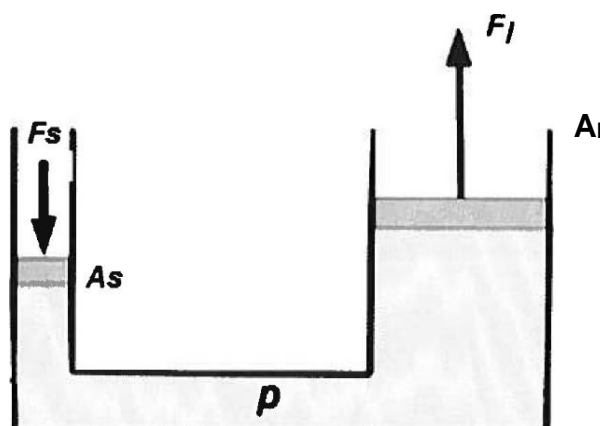
**[12]**

**QUESTION 9 (Start on a new page.)**

- 9.1 Explain the term **hydraulics** in words. (2)
- 9.2 Write down **TWO applications** of hydraulic systems. (2)
- 9.3 In the diagram below, a **diver** is seen **swimming under water**.  
The **pressure acting** on the **diver's forehead** is  $1,2 \times 10^5 \text{ Pa}$ .  
The **surface area** at the **back** of his **head** is  $8,4 \times 10^{-3} \text{ m}^2$ .



- 9.3.1 Define the term **pressure** in words. (2)
- 9.3.2 Calculate the **magnitude** of the **force** that acts on the **diver's head**. (3)
- 9.3.3 State the **direction** of the **force** of the **water acting** on the **diver**. (1)
- 9.4 **Diagram:**  
The diagram below shows a **simple hydraulic system** that is **used to lift cars**.  
The **force applied** by  $F_s$  is 130 N downwards.  
The **surface area** of  $A_s$  is  $0,002 \text{ m}^2$ .  
The **surface area** of  $A_l$  is  $0,025 \text{ m}^2$ .

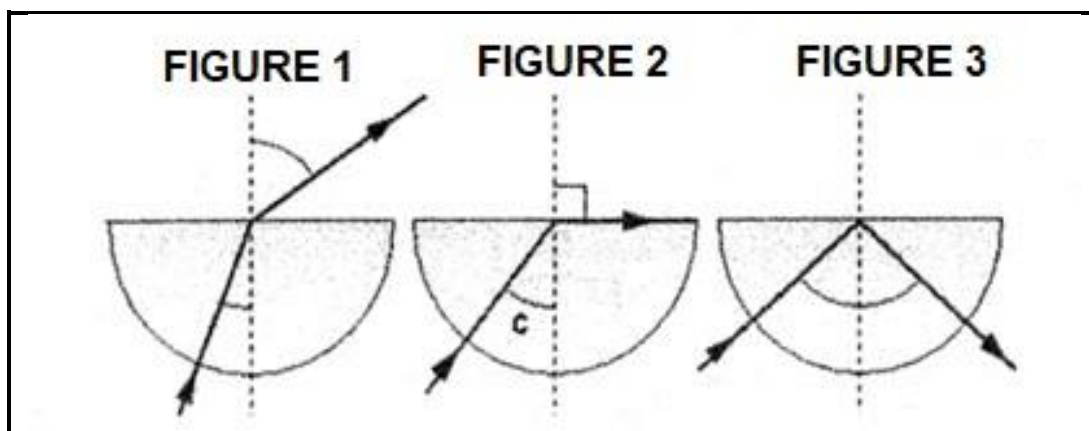


**Calculate** the force  $F_l$  due to **pressure exerted** by force  $F_s$ .

(3)  
[13]

**QUESTION 10 (Start on a new page.)****10.1 Diagram:**

**Light moves** through a **semi-circular glass prism** as shown below.



10.1.1 Give **ONE** word that **describes** the **phenomenon** taking place in **FIGURE 1**. (1)

10.1.2 Give the **name** of **angle C** in **FIGURE 2**. (1)

10.1.3 **Identify** the **phenomenon** taking place in **FIGURE 3**. (1)

10.1.4 Give **TWO** **conditions** for the **phenomenon** in **FIGURE 3**. (2)

10.1.5 List **THREE** **applications** where the **phenomenon** in **FIGURE 3** is used in **optical equipment**. (3)

10.2 A **radio station** broadcasts an **FM radio signal** at **99,5 MHz**.

10.2.1 **Convert**<sub>(change)</sub> 99,5 MHz to Hz. (2)

10.2.2 **Calculate** the **wavelength** of this **radio signal**. (3)

10.2.3 The **frequency** of **another radio station** is 108 MHz.

Is the wavelength **SHORTER THAN**, the **SAME AS** or **LONGER THAN** the one **calculated** in QUESTION 10.2.2?

Give a **reason** for your **answer**. (4)

**[17]**

**TOTAL: 150**

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

**TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIIESE KONSTANTES**

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	9,8 m·s <sup>-2</sup>
Speed of light in a vacuum <i>Spoed van lig in 'n vakuum</i>	c	3,0 x 10 <sup>8</sup> m·s <sup>-1</sup>
Planck's constant <i>Planck se konstante</i>	h	6,63 x 10 <sup>-34</sup> J·s
Coulomb's constant <i>Coulomb se konstante</i>	k	9,0 x 10 <sup>9</sup> N·m <sup>2</sup> ·C <sup>-2</sup>
Charge on electron <i>Lading op elektron</i>	-e	-1,6 x 10 <sup>-19</sup> C
Electron mass <i>Elektronmassa</i>	m <sub>e</sub>	9,11 x 10 <sup>-31</sup> kg

**TABLE 2: FORMULAE/TABEL 2: FORMULES****FORCE/KRAG**

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

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

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

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

**ELECTROSTATICS/ELEKTROSTATIKA**

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$Q = \frac{Q_1 + Q_2}{2}$	$E = \frac{F}{q}$
$n = \frac{Q}{e} \quad \text{or/of} \quad n = \frac{Q}{q_e}$	$E = \frac{V}{d}$
$C = \frac{Q}{V}$	$C = \frac{\varepsilon_0 A}{d}$

**CURRENT ELECTRICITY/STROOMELEKTRISITEIT**

$R = \frac{V}{I}$	$\text{emf/emk } (\mathcal{E}) = I(R + r)$
$R_s = R_1 + R_2 + \dots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$	$q = I \Delta t$
$W = VQ$ $W = VI \Delta t$ $W = I^2 R \Delta t$ $W = \frac{V^2 \Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2 R$ $P = \frac{V^2}{R}$



**ELECTROMAGNETISM/ELEKTROMAGNETISME**

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





