education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

PROVINCIAL ASSESSMENT

GRADE 12

PHYSICAL SCIENCES: PHYSICS P1

JUNE 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 14 pages and 3 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name on the ANSWER BOOK.
2. This question paper consists of 10 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 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. Show ALL formulae and substitutions in ALL calculations.
9. Round off your final numerical answers to a minimum of TWO decimal places.
10. Give brief motivations, discussions, etc. where required.
11. You are advised to use the attached DATA SHEETS.
12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. 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 E.

1.1 Which ONE of the following situations best describes the concept of inertia?

A A bicycle comes to a stop when brakes are applied.

B A soccer ball that remains still until kicked.

C A child runs into a wall and falls backward.

D A satellite orbiting the earth. (2)

1.2 Which ONE of the following statements is true regarding Newton’s second law?

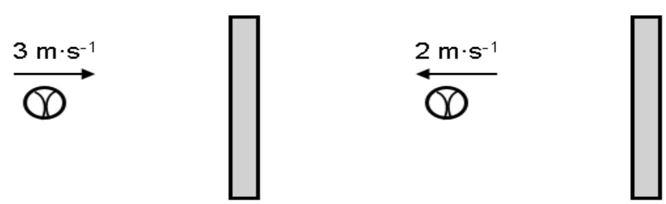
A It applies only to objects at rest.

B It describes how velocity is affected by mass and force.

C It indicates that the force and acceleration are inversely proportional.

D It quantifies how the net force acting on an object affects its motion. (2)

1.3 A ball has a mass of 0,30 kg. It moves horizontally with a velocity of 3.0 $m.s^{-1}$ in the direction shown. The ball hits a wall and rebounds with a horizontal velocity of 2.0 $m.s^{-1}$.



What is the change in momentum of the ball?

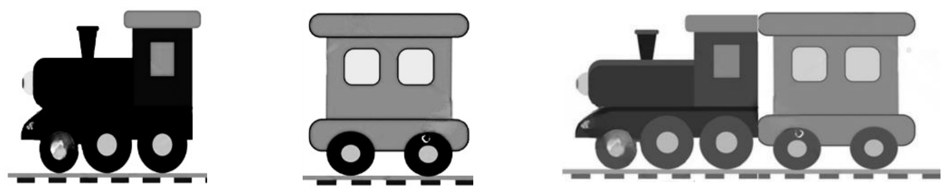
A 0.3 $kg.m.s^{-1}$ left

B 1.5 $kg.m.s^{-1}$ right

C 1.5 $kg.m.s^{-1}$ left

D 5.0 $kg.m.s^{-1}$ right (2)

1.4 A toy train with the mass of 75 g moving backward at a constant speed, on a horizontal track, collides with a stationary toy cart with the mass of 50 g and moves together as shown in the diagram below.



How will the impulse on the toy train compare to the impulse of the toy cart during collision?

A Equal to, but in the opposite direction.

B More than, but in the opposite direction.

C Equal to, but in the same direction.

D More than, but in the same direction. (2)

1.5 A ball is thrown vertically upwards at initial velocity of $\mathbf{V_i}$ and acceleration **a** till it reaches its maximum height **y**, it returns to the thrower's hand with a final velocity of $\mathbf{V_f}$. The quantities $\mathbf{V_i}$, $\mathbf{V_f}$, **a** and **y** are related by expression:

$$\mathbf{V_f^2 = V_i^2 + 2ay}$$

UPWARDS motion is taken as POSITIVE.

Which ONE of the following conditions apply to the formula?

A	**a** is negative	$\mathbf{V_i}$ is positive and $\mathbf{V_f}$ is negative
B	**a** is positive	$\mathbf{V_i}$ is negative and $\mathbf{V_f}$ is negative
C	**a** is negative	$\mathbf{V_i}$ is positive and $\mathbf{V_f}$ is positive
D	**a** is negative	$\mathbf{V_i}$ is negative and $\mathbf{V_f}$ is negative

(2)

1.6 Which ONE of the following physical quantities is equal to the product of the force and average velocity?

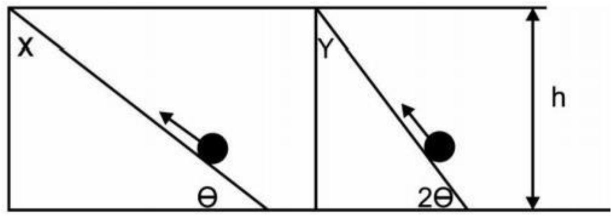
A Average acceleration

B Work

C Average power

D Energy (2)

1.7 Two boys are pulling two identical objects at the same CONSTANT SPEED up two different inclines, **X** and **Y**, with different gradients, but equal height. Ignore the effect of friction.



The magnitude of the force exerted by each of the boys, parallel to the incline, and the work done by the gravitational force of each can be compared as follows:

	MAGNITUDE OF FORCE	WORK DONE BY GRAVITATIONAL FORCE
A	Fx < Fy	Wx > Wy
B	Fx > Fy	Wx > Wy
C	Fx < Fy	Wx = Wy
D	Fx > Fy	Wx = Wy

(2)

1.8 A train is moving towards a stationary listener. The train sounds its horn. What are the correct changes in frequency and wavelength as heard by the listener?

	Frequency	Wavelength
A	Higher	Shorter
B	Higher	Longer
C	Lower	Shorter
D	Lower	Longer

(2)

1.9 A team of hunters are researching about the movement of lions in the forest. They plan to calculate the speed of a lion using Doppler effect. The lion roars while moving towards the hunters who are in stationary car.

Which ONE of the following equations will be used by the hunters to calculate the speed of the lion?

A	B
$f_L = 1 + \frac{V_L}{V_S} f_S$	$f_L = \frac{V_L}{V + V_s} f_S$
C	D
$f_L = \frac{V + V_L}{V} f_S$	$f_L = \frac{V}{V - V_s} f_S$

(2)

1.10 A source of sound with frequency of 1 000 Hz is moving with a constant velocity of 20 $m.s^{-1}$ towards a stationery listener.

The ratio of frequency observed by stationary listener to the frequency of the source is ... (Speed of sound is 340 $m.s^{-1}$).

A 17 **:** 16

B 16 **:** 17

C 1 **:** 1

D 17 **:** 18 (2)

[20]

QUESTION 2 (Start on a new page.)

A bakkie with a mass of 900 kg, pulls a trailer with a mass of 150 kg, over a level road in a westerly direction as shown in the diagram below. The engine of the bakkie exerts a force of 8 000 N. The frictional force on the bakkie is 1 800 N and that on the trailer is 300 N.

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

2.2 Draw a labelled free-body diagram for all the forces on the bakkie. (5)

2.3 Calculate the acceleration that the system experiences. (5)

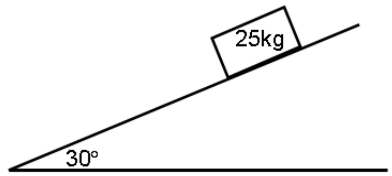
2.4 The mass of the trailer is now decreased.

How will this change the *net force* and the *acceleration* of the system?

Choose from INCREASE, DECREASE or REMAINS THE SAME. (2)
[14]

QUESTION 3 (Start on a new page.)

A crate with a mass of 25 kg is at REST on an inclined plane that forms an angle of 30° to the horizontal.



3.1 Define the term *frictional force*. (2)

3.2 Draw a labelled force diagram of all the forces acting on crate. (3)

3.3 Calculate the component of the weight of the crate parallel to the plane. (3)

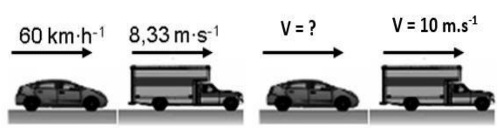
3.4 Suppose the coefficient of static friction between the surfaces of the crate and the slope is 0,6. Determine the angle of inclination that results in a maximum static friction force. (2)

3.5 How does an increase in the angle of incline affect the frictional force acting on the crate? (3)

[13]

QUESTION 4 (Start on a new page.)

A car with a mass of 650 kg travels at a velocity of 60 km.h^{-1} on a straight horizontal road and crashes the back of a truck with a mass of 1 000 kg that is travelling in the same direction at 8,33 m.s^{-1}. Immediately after the collision, the truck travels at 10 m.s^{-1} in the original direction of motion. (Ignore the effect of friction.)



4.1 State the *principle of conservation of linear momentum*. (2)

4.2 Calculate:

4.2.1 The speed of the car immediately after the collision. (5)

4.2.2 The total kinetic energy of the system both before and after the collision and conclude whether the collision is elastic or inelastic. (6)

4.3 During collision, the car and the truck exert forces on each other.

Name and state Newton's Law of Motion that relates the magnitudes of forces that the car and the truck exert on each other. (3)

[16]

QUESTION 5 (Start on a new page.)

The picture below shows a basketball player that shoots a 650 g basketball. The net force acting on the ball increases linearly from 0 N to 22 N during the first 0,15 s while it is in contact with his hand. During the next 0,25 s the net force decreases linearly to 0 N.

5.1 Define the term *impulse*. (2)

5.2 Draw a graph of net force acting on the ball as a function of time. (2)

5.3 Use the graph in QUESTION 5.2 to calculate:

5.3.1 The magnitude of impulse provided to the basketball. (3)

5.3.2 The speed of basketball when it leaves the hand of the shooter. (4)

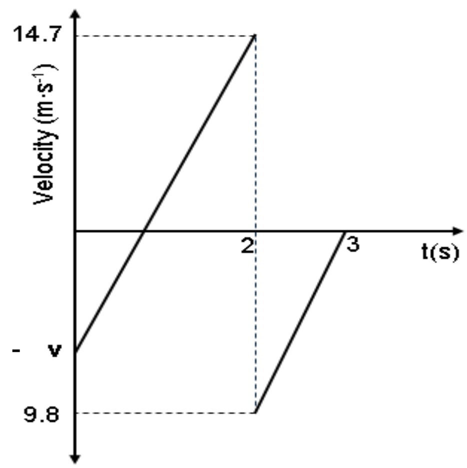
5.4 How would the ball's speed be affected if the same impulse was provided to a ball with less mass? Write only INCREASE, DECREASE or REMAINS THE SAME. (1)

5.5 Give a reason for the answer in question 5.4. (2)

[14]

QUESTION 6 (Start on a new page.)

The following velocity-time graph below shows the motion of a ball that is thrown upwards. It reaches a maximum height, falls back to the ground and then bounces up again.



6.1 What sign (POSITIVE or NEGATIVE) was chosen for the upwards motion? (1)

6.2 Calculate:

6.2.1 The slope of the graph between $t = 2$ s and $t = 3$ s. (3)

6.2.2 Which physical quantity does the slope in 6.2.1 represent? (2)

6.3 Use the graph to determine the velocity at which:

6.3.1 The ball was thrown upwards. (3)

6.3.2 The ball hit the ground. (2)

6.3.3 The ball left the ground after it bounced. (2)

6.4 Describe the position of the ball at:

6.4.1 t = 0,5 s (1)

6.4.2 t = 1 s (1)

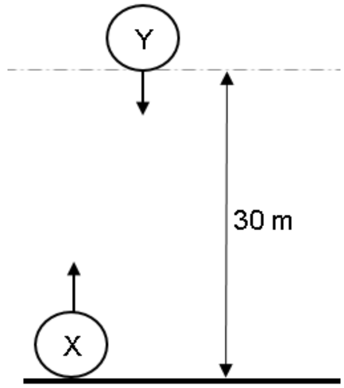
6.4.3 t = 3 s (1)

6.5 WITHOUT THE USE OF ANY EQUATION OF MOTION, determine the height above the ground from which the ball was initially thrown. (4)

[20]

QUESTION 7 (Start on a new page.)

Ball **X** is thrown vertically upwards. At the same time ball **Y** was dropped downwards from a height of 30 m above the ground.



7.1 Define the term *Projectile*. (2)

7.2 What will the velocity of ball **X** at its maximum height be? (1)

7.3 At what velocity must **X** be thrown to reach a maximum height of 30 m above the ground? (4)

7.4 Calculate the time that it will take for the two balls to pass each other? (7)

7.5 On the same set of axes, draw the position-time graphs for the motion of ball **X** and ball **Y**.

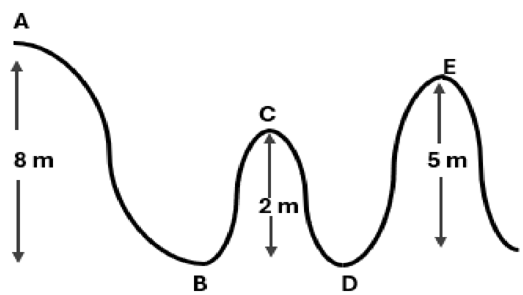
Clearly indicate the following on the graph:

- For ball **Y**, from the moment it was dropped until it reached the ground.
- For ball **X**, from the moment it was projected till it reached the maximum height.
- Use the ground as zero position.
- Label the graphs **X** and **Y**. (3)

[17]

QUESTION 8 (Start on a new page.)

At Gold Reef City Park, a train toy of mass 120 kg travels without propulsion along a track as shown in the diagram below. It starts from rest at point **A** and travels past points **B** and **C**. Section **ABC** is FRICTIONLESS. The train continues to point **D** and then up to point **E**.



8.1 State the *principle of conservation of mechanical energy*. (2)

8.2 Calculate the speed of the toy train as it moves past point **C**. (4)

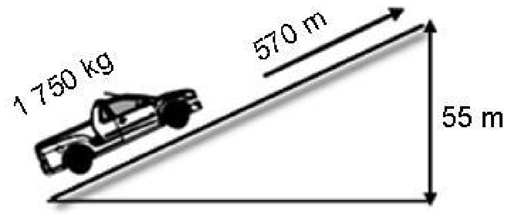
8.3 At point **C** the toy train's velocity is 10,84 $m.s^{-1}$. Going through the ROUGH section **CDE** its speed decreased by 90% by the time it reaches point **E**.

Calculate the amount of heat generated during this part of the ride due to friction between the track and the wheels of the train. (4)

[10]

QUESTION 9 (Start on a new page.)

A loaded bakkie travels up a slope as indicated below. The total mass of the bakkie and the load is 1 750 kg. It is driven at a CONSTANT VELOCITY of 20 m·s^{-1} and travels for 570 m up to the top of the slope, 55 m above the ground level.



The work done by friction is 5,84 x 10^{6} J.

9.1 Define the term *non-conservative force.* (2)

9.2 Calculate the applied force by the engine of the bakkie, as it is moving up the incline. (5)

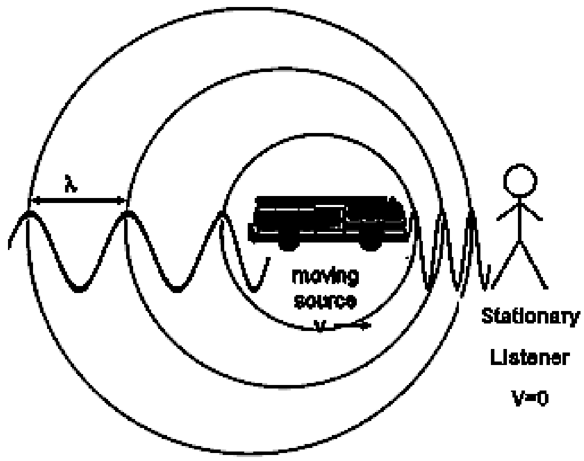
9.3 What was the net force on the bakkie at a point halfway up the slope? (1)

9.4 In another scenario the empty bakkie, with a mass of 1100 kg, travels down the slope and accelerates from 20 m.s^{-1} at the top of the slope, to 25 m.s^{-1}, at the bottom of the slope. The average frictional force is 6,44 x 10^{3} N.

Calculate the work done by the engine while the bakkie is accelerating. (5)
[13]

QUESTION 10 (Start on a new page.)

A fire engine travelling at constant velocity of 30 $m.s^{-1}$ approaches a stationary listener with its siren emitting a frequency of 458 Hz. The listener hears a change in pitch as the train approaches him, passes him and moves away from him.



10.1 Name the phenomenon that explains the change in pitch heard by the listener. (1)

10.2 Calculate the frequency of the sound that the listener hears while the fire engine is approaching him. Use the speed of sound in air as 340 $m.s^{-1}$. (4)

10.3 How will the frequency heard by the listener change as the fire engine passes and moves away from the listener?

Write down only INCREASE, DECREASE or REMAINS THE SAME. (1)

10.4 How will the frequency heard by the fire engine driver compare to that of sound waves emitted by the fire engine siren? Write only GREATER THAN, EQUALS TO or LESS THAN.

Give a reason for the answer. (2)

10.5 Mention THREE practical applications for the above mentioned phenomenon across different fields. (3)

10.6 How does the above mentioned phenomenon provide evidence for the expansion of the universe? (2)
[13]

TOTAL: 150

DATA FOR PHYSICALSCIENCES GRADE 12
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 1 (FISIKA)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9,8\ m \cdot s^{-2}$
Universal gravitational constant *Universele gravitasiekonstante*	G	$6,67 \times 10^{-11}\ N \cdot m^2 \cdot kg^{-2}$
Radius of the Earth *Radius van die Aarde*	R_E	$6,38 \times 10^6\ m$
Mass of the Earth *Massa van die Aarde*	M_E	$5,98 \times 10^{24}\ kg$
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*

MOTION/*BEWEGING*

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$ or/*of* $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$ or/*of* $v_f^2 = v_i^2 + 2a\Delta y$	$\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ or/*of* $\Delta y = \left(\frac{v_i + v_f}{2}\right)\Delta t$

FORCE/*KRAG*

$F_{net} = ma$	$p = mv$
$f_s^{max} = \mu_s N$	$f_k = \mu_k N$
$F_{net}\Delta t = \Delta p$ $\Delta p = mv_f - mv_i$	$w = mg$
$F = G\frac{m_1m_2}{d^2}$ or/*of* $F = G\frac{m_1m_2}{r^2}$	$g = G\frac{M}{d^2}$ or/*of* $g = G\frac{M}{r^2}$

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* $W_{nc} = \Delta E_k + \Delta E_p$	$P = \frac{W}{\Delta t}$
$P_{ave} = Fv_{ave}$ / $P_{gemid} = Fv_{gemid}$	

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

$v = f\lambda$	$T = \frac{1}{f}$
$f_L = \frac{v \pm v_L}{v \pm v_s}f_s$ or/*of* $f_L = \frac{v \pm v_L}{v \pm v_b}f_b$	$E = hf$ or/*of* $E = \frac{hc}{\lambda}$
$E = W_0 + E_{k(max)}$ or/*of* $E = W_0 + K_{max}$ where $E = hf$ and $W_0 = hf_0$ and $E_{k(max)} = \frac{1}{2}mv_{max}^2$ or $K_{max} = \frac{1}{2}mv_{max}^2$	
$E = W_0 + E_{k(maks)}$ *of* $E = W_0 + K_{maks}$ *waar* $E = hf$ *en* $W_0 = hf_0$ *en* $E_{k(maks)} = \frac{1}{2}mv_{maks}^2$ *of* $K_{maks} = \frac{1}{2}mv_{maks}^2$	

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{kQ}{r^2}$
$V = \frac{W}{q}$	$E = \frac{F}{q}$
$n = \frac{Q}{e}$ *or/of* $n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

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

ALTERNATING CURRENT/*WISSELSTROOM*

$I_{rms} = \frac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \frac{I_{maks}}{\sqrt{2}}$ $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \frac{V_{maks}}{\sqrt{2}}$	$P_{ave} = V_{rms}I_{rms}$ / $P_{gemiddeld} = V_{wgk}I_{wgk}$ $P_{ave} = I_{rms}^2R$ / $P_{gemiddeld} = I_{wgk}^2R$ $P_{ave} = \frac{V_{rms}^2}{R}$ / $P_{gemiddeld} = \frac{V_{wgk}^2}{R}$