education

Department:
Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATION - 2005

PHYSICAL SCIENCE P1
PHYSICS

STANDARD GRADE

OCTOBER/NOVEMBER 2005

Marks: 150

2 Hours

This question paper consists of 14 pages and 2 data sheets.

GENERAL INSTRUCTIONS

1. Write your **examination number** (and **centre number** if applicable) in the appropriate spaces on the answer book.
2. Answer **ALL** the questions.
3. Non-programmable calculators may be used.
4. Appropriate mathematical instruments may be used.
5. A data sheet is attached for your use.
6. NOTE! The following circuit diagram symbols are used in this paper:

   Resistor :  instead of /\/\/\/

   Bulb :  instead of 
7. Marks may be forfeited if instructions are not followed.

QUESTION 1

INSTRUCTIONS

1. Answer this question on the specially printed **ANSWER SHEET.** [NOTE: The answer sheet may either be a separate sheet provided as part of your question paper, or printed as part of the answer book.] Write your **EXAMINATION NUMBER** (and **centre number** if applicable) in the appropriate spaces if a separate answer sheet is used**.**

2. Four possible answers, indicated by A, B, C and D, are supplied with each question. Each question has only ONE correct answer. Choose only that answer, which in your opinion, is the correct or best one and mark the appropriate block on the ANSWER SHEET with a cross (X).

3. Do not make any other marks on the answer sheet. Any calculations or writing that may be necessary when answering this question should be done in the answer book and must be deleted clearly by means of a diagonal line drawn across the page.

4. If more than one block is marked, no marks will be awarded for that answer.

PLACE THE COMPLETED ANSWER SHEET INSIDE THE FRONT COVER OF YOUR ANSWER BOOK, IF A SEPARATE ANSWER SHEET HAS BEEN USED.

EXAMPLE

QUESTION: The SI unit of time is ...

A t.
B h.
C s.
D m.

ANSWER:

A	B	C	D

[NOTE: This layout may vary, depending on the type of answer sheet used by the province.]

QUESTION 1

1.1 Which one of the following pairs consists of two vector quantities?

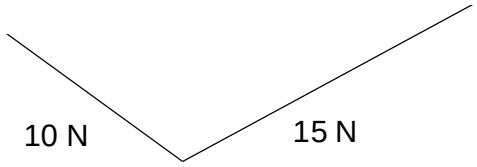
A time, acceleration

B velocity, displacement

C electric field strength, charge

D momentum, kinetic energy. (3)

1.2 Two forces, 10 N and 15 N, act at an angle at the same point.



Which one of the following **CANNOT** be the resultant of these two forces?

A 2 N

B 5 N

C 8 N

D 20 N. (3)

1.3 A trolley moves across a horizontal, frictionless floor at constant acceleration. The following ticker-tape was obtained.

The average velocity between points L and M is equal to ...

A the velocity at half the time interval between L and M.

B the velocity at half the distance between L and M.

C half of the velocity at M.

D $\frac{\text{the velocity at M} - \text{the velocity at L}}{2}$. (3)

1.4 A car travels at **constant velocity** on a frictionless surface. Which one of the following physical quantities **increases** in magnitude during this motion?

A Resultant force

B Kinetic energy

C Momentum

D Displacement. (3)

1.5 The symbol **v** represents the final velocity of an object, **a** is the non-zero acceleration and the time of motion is **t**. Which one of the following expressions **CANNOT** be used to determine the displacement of the object, if it accelerates from rest?

A $\frac{vt}{2}$

B $\frac{v^2}{2a}$

C vt

D $\frac{at^2}{2}$. (3)

1.6 On the surface of the earth, Azeez has a weight **F**. What would be the force that the earth exerts on Azeez if he is in a space shuttle, orbiting the earth at a distance from the centre of the earth, equal to three times the radius of the earth?

A $\frac{1}{3}\mathbf{F}$

B $\frac{1}{4}\mathbf{F}$

C $\frac{1}{9}\mathbf{F}$

D $\frac{1}{16}\mathbf{F}$. (3)

1.7 A log of wood is attached to a cart by means of a light, inelastic rope. A horse pulls the cart along a rough, horizontal road with an applied force **F**. The total system accelerates initially with an acceleration of magnitude **a** (Figure 1). The forces acting on the **cart**, during the acceleration, are indicated in Figure 2.

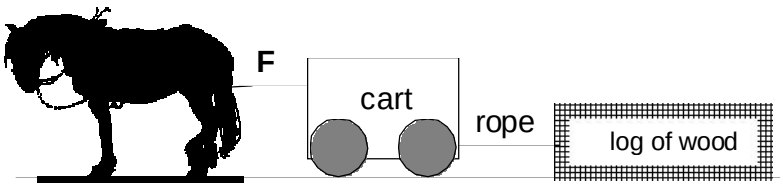


Figure 1

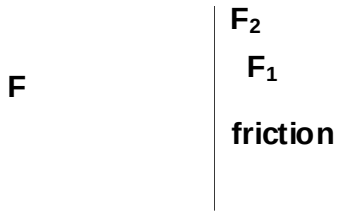


Figure 2

Which one of the following combinations would be the most appropriate labels for $\mathbf{F_1}$ and $\mathbf{F_2}$?

	$\mathbf{F_1}$	$\mathbf{F_2}$
A	Force of log on cart	Reaction force of earth on cart
B	Force of log on cart	Force of road on cart
C	Force of rope on cart	Reaction force of earth on cart
D	Force of rope on cart	Force of road on cart

(3)

1.8 The physical quantity **force**, expressed in base units is …

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

B $kg.m.s^{-2}$.

C $kg.m^2.s^{-3}$.

D $kg.m^2.s^{-2}$. (3)

1.9 An object, moving at a constant speed, has momentum **p** and kinetic energy $\mathbf{E_k}$. Which one of the following combinations is correct if the speed of the object is doubled?

	Momentum	**Kinetic energy**
A	2**p**	2$\mathbf{E_k}$
B	2**p**	4$\mathbf{E_k}$
C	**p**	2$\mathbf{E_k}$
D	**p**	4$\mathbf{E_k}$

(3)

1.10 The distance between the centres of two identical, charged spheres is **r**. Which one of the following changes will **double** the force that one charged sphere exerts on the other?

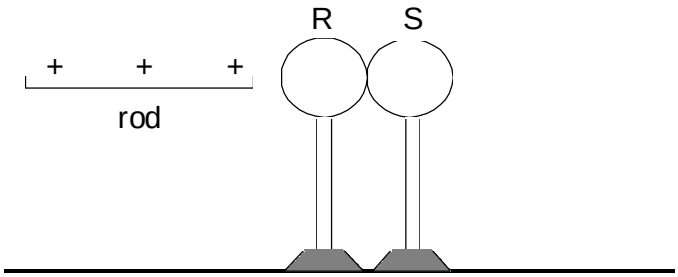
A Double the distance to **2r**

B Reduce the distance to $\frac{\mathbf{r}}{\mathbf{2}}$

C Double the charge on each sphere

D Double the charge on one sphere only. (3)

1.11 Two neutral metal balls, R and S, each on an insulated stand, are in contact with each other. A positively charged rod is held near R without touching it, as shown below.



Ball S is then moved away from R and the rod is removed thereafter. What would be the nature of the charges on R and S?

	Charge on R	**Charge on S**
A	neutral	neutral
B	negative	neutral
C	negative	positive
D	positive	negative

(3)

1.12 Two heaters are connected to an extend-a-plug adapter and operate correctly. When a third heater is connected to the same plug, a circuit breaker cuts off the electricity supply to the plug. Which one of the following statements best explains this situation?

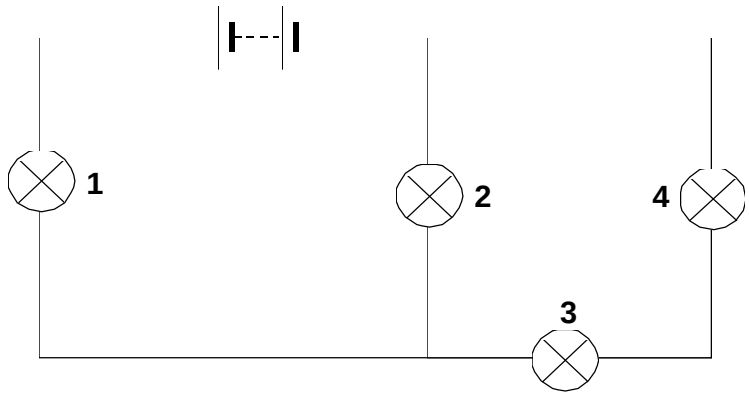
A The potential difference across the circuit becomes too large.

B The effective resistance increases and therefore the rate at which energy is transferred, is too large.

C The effective resistance decreases and therefore the current becomes too large.

D The potential difference cannot change and because there is not enough current, the energy supply is then cut off. (3)

1.13 In the circuit represented below, the four bulbs are identical.



Which one of the following pairs of bulbs has equal brightness?

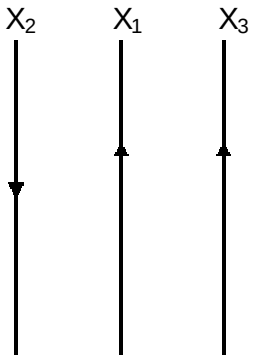
A 2 and 4

B 3 and 4

C 1 and 3

D 1 and 2. (3)

1.14 X_1, X_2 and X_3 are three parallel conductors in the same plane, carrying electrical currents in the directions shown.



Which one of the following statements is **true** about the magnetic force which X_1 exerts on X_2 and X_3?

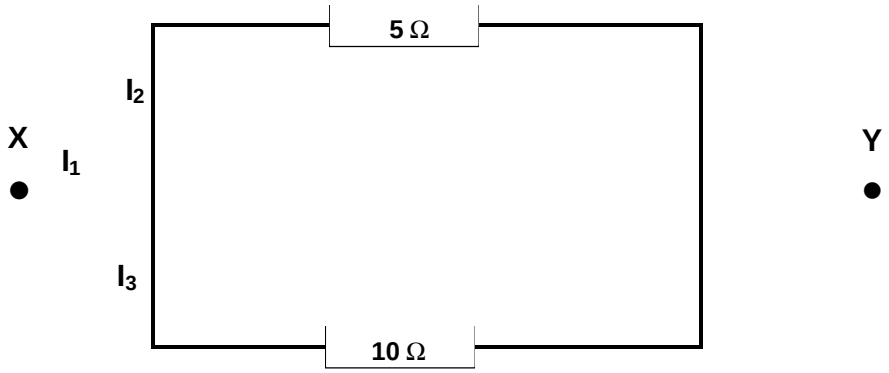
A X_1 attracts both X_2 and X_3.

B X_1 attracts X_2 and repels X_3.

C X_1 repels X_2 and attracts X_3.

D X_1 repels both X_2 and X_3. (3)

1.15 In the circuit represented below, a potential difference is applied across XY. The current I_1 at X divides into I_2 and I_3.



Which one of the following equations is **true** for the current I_2?

A $I_2 = I_1 \times \frac{15}{50}$

B $I_2 = I_1 \times \frac{5}{15}$

C $I_2 = I_1 \times \frac{5}{10}$

D $I_2 = I_1 \times \frac{10}{15}$ (3)

[15 x 3 = 45]

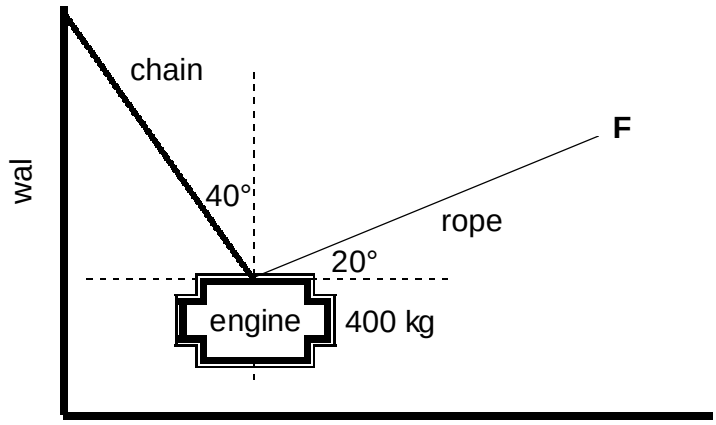
ANSWER QUESTIONS 2 TO 9 IN THE ANSWER BOOK.

INSTRUCTIONS

1. Start each question on a **NEW PAGE** in the ANSWER BOOK.
2. Leave a line between subsections, for example 2.1 and 2.2.
3. Show ALL formulae, as well as the calculations, including substitutions.
4. Number the answers exactly as the questions are numbered.

QUESTION 2 **[START ON A NEW PAGE]**

In a workshop, one end of a chain is attached to a wall and the other end to an engine, mass 400 kg. A rope is also attached to the engine at the same point, and a force is applied in order to lift the engine. To keep the engine at rest in the position shown, a force, **F**, must be applied to the rope. The angles that the chain and rope then form with the vertical and horizontal are indicated below.



2.1 What is the resultant force on the engine when force **F** is applied so that the engine is stationary? (2)

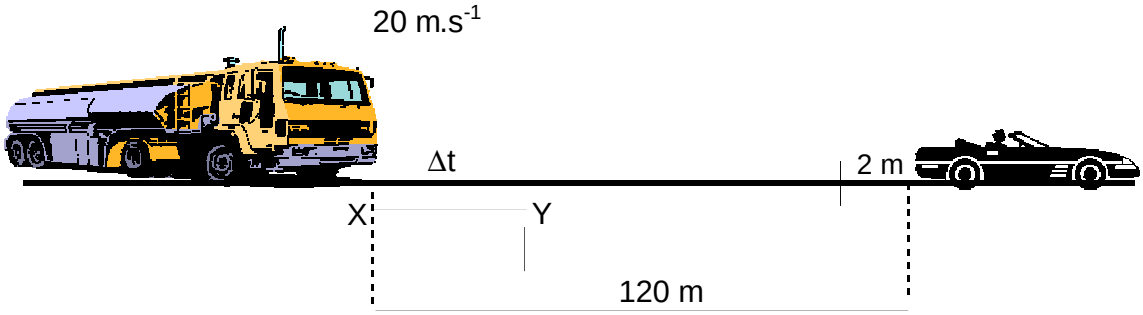
2.2 Draw a labelled force diagram of all the forces acting on the engine. Clearly indicate any two angles. (4)

2.3 Determine, either by construction (1 cm represents 400 N) or by calculation (include a rough triangle of forces), the magnitude of force **F** needed to keep the engine stationary. (6)

[12]

QUESTION 3 [START ON A NEW PAGE]

A truck is moving forward at a constant speed of 20 $m.s^{-1}$ on a horizontal road. At point X the driver sees a stationary car 120 m ahead. At point Y, after travelling at a constant speed for time Δt, the driver applies the brakes and the magnitude of the acceleration of the truck is then 2,5 $m.s^{-2}$.



3.1 Define, in words, **acceleration**. (2)

3.2 Calculate how far the truck travels, after the brakes have been applied at point Y, until it stops. (5)

3.3 When the truck actually stops, it is 2 m from the car.
Calculate the distance XY travelled by the truck, during the time Δt. (2)

3.4 Determine the time Δt. (4)

[13]

QUESTION 4 [START ON A NEW PAGE]

Henry Cavendish, an English scientist, used the gravitational force which one sphere exerts on another to determine the value of the Universal Gravitational Constant, G.

4.1 State, in words, **Newton's Law of Universal Gravitation**. (4)

4.2 In a typical experiment, the force which a sphere, mass 1,2 kg, exerts on another sphere, mass 0,5 kg, is found to be equal to 4,2 x 10^{-10} N when the centres of the two spheres are at a distance of 30 cm.

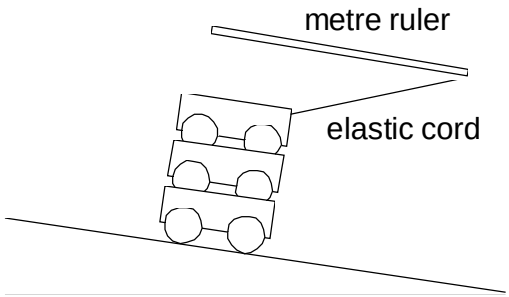
Using the given data, calculate the value of the Universal Gravitational Constant, G. (5)

[9]

QUESTION 5 [START ON A NEW PAGE]

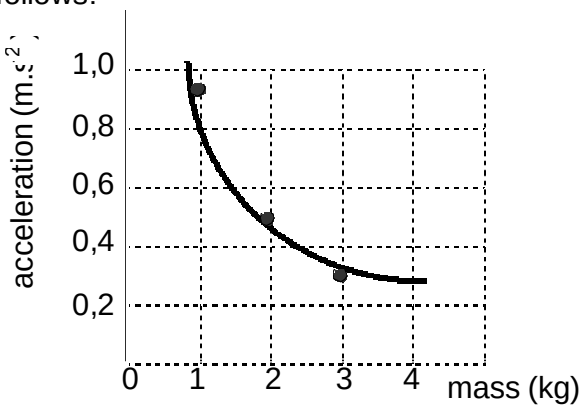
Learners at a school were required to achieve the following outcome: *Learners should be able to use graphical methods to determine how the acceleration of an object, to which a constant force is applied, varies with changing mass.*

In order to do this, Keshev conducted the following experiment. He first accelerated one, then two and lastly three identical trolleys, mass 1 kg each, down a friction-compensated track, as shown. Keshev used a metre ruler and an elastic cord, stretched to the same length and at the same angle for each of the three situations, in order to maintain the constant force.



His results and the graph he drew, were as follows:

Mass of trolleys (kg)	Acceleration ($m.s^{-2}$)
1	0,96
2	0,49
3	0,31



In order to obtain a relationship between acceleration and mass, it is necessary to plot a graph which produces a **straight line** tendency.

5.1 Calculate the values for the reciprocal (inverse) of mass. Draw and label the new system of axes with acceleration, **a**, on the dependent (Y-) axis and the reciprocal of mass ($\frac{1}{m}$) on the independent (X-) axis. Then plot the 3 points and sketch the graph. (5)

5.2 State the relationship between the acceleration, **a**, and the mass, **m**. (2)

5.3 Determine the gradient of the graph sketched in Question 5.1 above. (3)

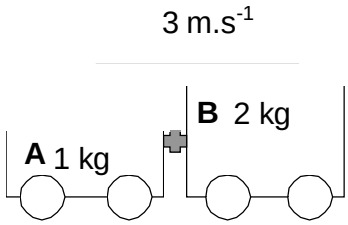
5.4 What physical quantity does the gradient calculated in Question 5.3, represent? (2)

5.5 State, in words, **Newton's Second Law of Motion.** (3)

[15]

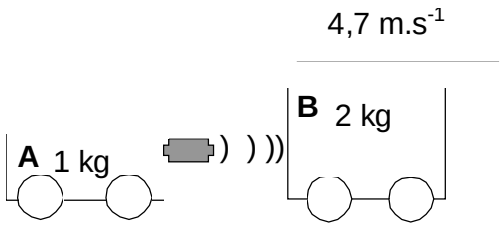
QUESTION 6 **[START ON A NEW PAGE]**

A combination of trolley A (fitted with a spring) of mass 1 kg, and trolley B of mass 2 kg, moves to the right at 3 $m.s^{-1}$ along a frictionless, horizontal surface. The spring is kept compressed between the two trolleys.



BEFORE

While the combination of the two trolleys is moving at 3 $m.s^{-1}$, the spring is released and when it has expanded completely, the 2 kg trolley is then moving to the right at 4,7 $m.s^{-1}$ as shown below.



AFTER

6.1 State, in words, the principle of **conservation of linear momentum**. (3)

6.2 Calculate the magnitude and direction of the velocity of the 1 kg trolley immediately after the spring has expanded completely. (7)

[10]

QUESTION 7 [START ON A NEW PAGE]

Consider the equation **W** = **F** x **s** *which could be used to calculate the work done on an object.*

7.1 Is **work** a vector or a scalar quantity? (2)

7.2 A crane is used to lift a crate, mass 1 500 kg, through a height of 8 m at a constant velocity. Calculate the work done by the crane on the crate in lifting the crate against the gravitational force. (4)

7.3 Does **F** represent the **applied** force or the **resultant** force in the formula given above? (2)

Now consider the equation $\mathbf{W} = \mathbf{F} \times \mathbf{s} = \Delta \mathbf{E_k}$ *which could also be used to calculate the work done on an object.*

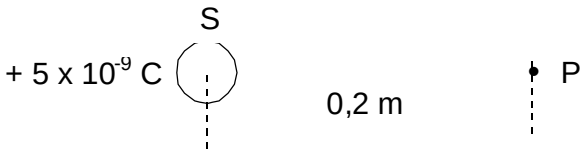
7.4 A toy car, mass 200 g, enters a horizontal, carpeted section of a floor at a velocity of 2 $m.s^{-1}$. It travels along in a straight line and leaves the carpeted section at 0,5 $m.s^{-1}$. Calculate the work done by the carpet in slowing the car down. (5)

7.5 The force the carpet exerts on the toy car in order to slow it down, is both the applied force AND the resultant force. Explain. (2)

[15]

QUESTION 8 [START ON A NEW PAGE]

S is a small, positively-charged sphere carrying a charge of + 5 x 10^{-9} C. Consider a point P at a distance of 0,2 m from the centre of S.



8.1 Draw the electric field pattern around S. (3)

8.2 Calculate the magnitude and direction of the electric field strength at P due to the charge on S. (5)

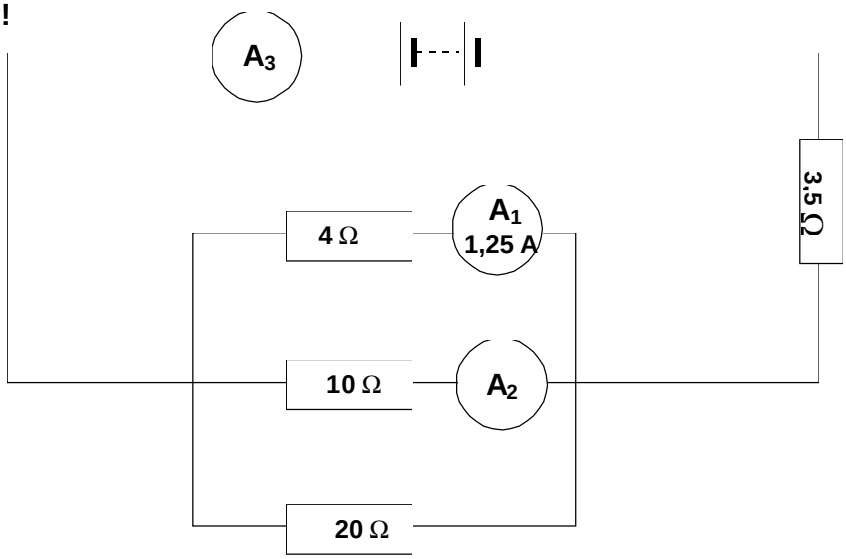
8.3 A small point charge, placed at P, experiences a repelling force of 3,375 X 10^{-5} N. Calculate the magnitude of the charge at P and state whether it is positive or negative. (5)

[13]

QUESTION 9 **[START ON A NEW PAGE]**

In the circuit represented below, the emf of the battery is unknown and its internal resistance is negligible. When three resistors, 4 Ω, 10 Ω and 20 Ω respectively, are connected in parallel, ammeter A_1 has a reading of 1,25 A.

Error!



9.1 Show by calculation that the potential difference across the 4 Ω resistor is 5,0 V. (3)

9.2 Calculate the reading on ammeter A_2. (3)

9.3 Calculate the effective resistance of the three resistors connected in parallel. (5)

9.4 Calculate the reading on ammeter A_3. (3)

9.5 Calculate the emf of the battery. (4)

[18]

TOTAL QUESTION 1 : 45
TOTAL QUESTIONS 2– 9 : 105
GRAND TOTAL : 150

DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

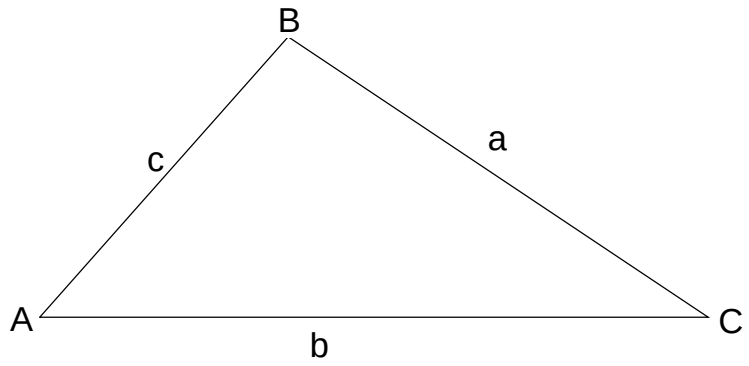
DATA FOR PHYSICAL SCIENCE
PAPER I (PHYSICS)

GEGEWENS VIR NATUUR- EN SKEIKUNDE
VRAESTEL I (FISIKA)

TABLE 1: PHYSICAL CONSTANTS
TABEL 1: FISIESE KONSTANTE

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity Swaartekragversnelling	g	$10\ m.s^{-2}$
Gravitational constant Swaartekragkonstante	G	$6,7 \times 10^{-11}\ N.m^2.kg^{-2}$
Charge on electron Lading van elektron	e^-	$-1,6 \times 10^{-19}\ C$

MATHEMATICAL AIDS/WISKUNDIGE HULPMIDDELS



$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

$$c^2 = a^2 + b^2 - 2ab\cos C$$

TABLE 2: FORMULAE
TABEL 2: FORMULES

MOTION/BEWEGING

$v = u + at$	$s = ut + \frac{1}{2}at^2$
$v^2 = u^2 + 2as$	$s = \left(\frac{u+v}{2}\right)t$

FORCE/KRAG

$F_{res} = ma$	$p = mv$
$F = \frac{Gm_1m_2}{r^2}$	$F\Delta t = \Delta p = mv - mu$

WORK, ENERGY AND POWER/ARBEID, ENERGIE EN DRYWING

$W = Fs$	$E_p = mgh$
$P = \frac{W}{t}$	$E_k = \frac{1}{2}mv^2$

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9 \times 10^9\ N.m^2.C^{-2})$	$V = \frac{W}{Q}$
$E = \frac{F}{q}$	$W = QEs$
$E = \frac{kQ}{r^2}$ $(k = 9 \times 10^9\ N.m^2.C^{-2})$	$E = \frac{V}{d}$

CURRENT ELECTRICITY/STROOMELEKTRISITEIT

$Q = It$	emf/emk $= I(R + r)$
$R = r_1 + r_2 + r_3 + \ldots$	$F = \frac{kI_1I_2l}{d}$ $(k = 2 \times 10^{-7}\ N.A^{-2})$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots$ $R = \frac{V}{I}$	$W = VIt = I^2Rt = \frac{V^2t}{R}$ $P = VI = I^2R = \frac{V^2}{R}$

ANSWER SHEET/ANTWOORDBLAD

Examination number **Eksamennommer**													

DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION/SENIORSERTIFIKAAT-EKSAMEN

PHYSICAL SCIENCE STANDARD GRADE FIRST PAPER (PHYSICS)/
NATUUR- EN SKEIKUNDE STANDAARDGRAAD EERSTE VRAESTEL (FISIKA)

1.1	A	B	C	D
1.2	A	B	C	D
1.3	A	B	C	D
1.4	A	B	C	D
1.5	A	B	C	D
1.6	A	B	C	D
1.7	A	B	C	D
1.8	A	B	C	D
1.9	A	B	C	D
1.10	A	B	C	D
1.11	A	B	C	D
1.12	A	B	C	D
1.13	A	B	C	D
1.14	A	B	C	D
1.15	A	B	C	D

For the use of the marker Vir die gebruik van die nasiener	
Marks obtained Punte behaal	
Marker's initials Nasiener se paraaf	
Marker's number Nasiener se nommer	