education

Department:
Education
REPUBLIC OF SOUTH AFRICA

SENIOR CERTIFICATE EXAMINATION - 2006

PHYSICAL SCIENCE P1 : PHYSICS

STANDARD GRADE

FEBRUARY/MARCH 2006

304-2/1 E

Marks: 150

2 Hours

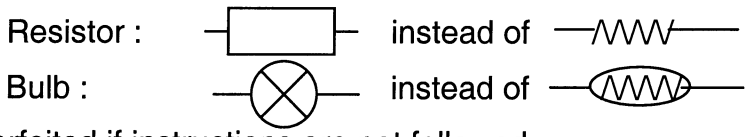
This question paper consists of 16 pages and 2 data sheets.

304 2 1E SG

X05

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.



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.

EXAMPLE

QUESTION: The SI unit of time is ...

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

ANSWER:

A	B	C	D

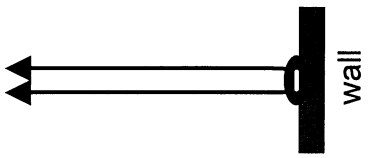
[NOTE: This layout may vary, depending on the type of answer sheet used by the province.]

QUESTION 1

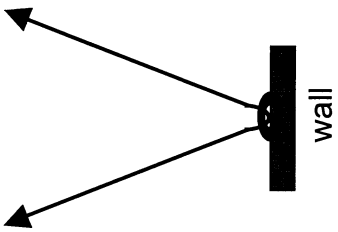
1.1 Two boys want to break a strong rope. They consider four options and in three of these the rope is fixed to the wall at different angles. In the other situation they pull at opposite ends of the rope. Which one of the following arrangements would be the best to break the rope? The boys each apply the same magnitude of force in all four situations.

A

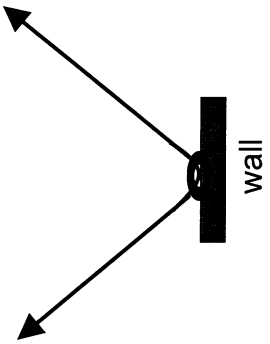
B



C

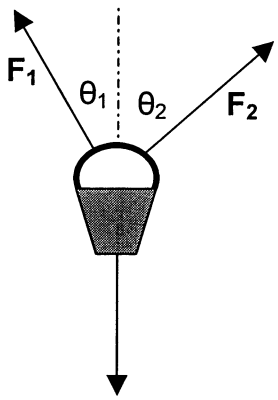


D



(3)

1.2 A bucket of water is held **at rest** (in equilibrium) between Jack and Jill. The magnitude of the force that Jack exerts on the bucket is $\mathbf{F_1}$ and the force makes an angle θ_1 with the vertical. The magnitude of the force that Jill exerts on the bucket is $\mathbf{F_2}$ and that force makes an angle θ_2 with the vertical.



If θ_1 is **smaller** than θ_2, which one of the following statements concerning the magnitudes of the forces is **true**?

A $\mathbf{F_1} + \mathbf{F_2}$ = weight of the bucket, but $\mathbf{F_1}$ and $\mathbf{F_2}$ are not known

B $\mathbf{F_1} = \mathbf{F_2}$

C $\mathbf{F_1} < \mathbf{F_2}$

D $\mathbf{F_1} > \mathbf{F_2}$ (3)

1.3 In an experiment to determine the acceleration of a trolley, the following ticker-tapes were obtained using the same ticker timer. Which one of the ticker-tapes represents uniform acceleration of the trolley? Tapes are not drawn to scale.

A

. 660 mm . 540 mm . 420 mm . 300 mm .

B

. 1 140 mm . 660 mm . 420 mm . 300 mm .

C

. 760 mm . 580 mm . 420 mm . 280 mm.

D

. 2 400 mm . 1 200 mm . 600 mm . 300 mm .

(3)

1.4 An object rests on a horizontal, frictionless surface. When a force, **F**, is applied to it, it attains a velocity **v** in a time **t** (Figure 1).

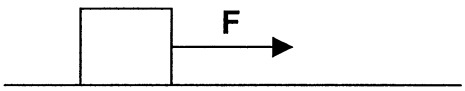


Figure 1

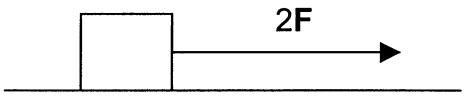


Figure 2

The same object is again at rest on the same surface, but this time the applied force is increased to 2**F** (Figure 2). The velocity attained by the object, in the same time, **t**, will be …

A **v**.

B $\sqrt{2}\,\mathbf{v}$.

C 2**v**.

D 4**v**. (3)

1.5 The gravitational force that the earth exerts on a satellite is **F**. If the distance between the satellite and the centre of the earth is doubled, the gravitational force that the earth exerts on the satellite will be equal to …

A $\frac{1}{4}\mathbf{F}$.

B $\frac{1}{2}\mathbf{F}$.

C 2**F**.

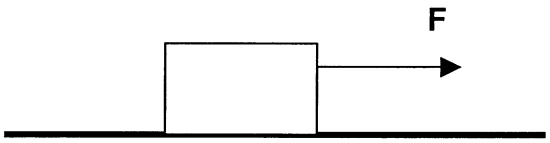
D 4**F**. (3)

1.6 A 4 kg mass falls at a **terminal velocity**. Which one of the following combinations, concerning the air resistance and the resultant force, is correct?

	Magnitude and direction of air resistance	**Magnitude of resultant force**
A	40 N down	40 N
B	40 N down	0 N
C	40 N up	40 N
D	40 N up	0 N

(3)

1.7 A block, being pulled by a force and moving to the right on a rough, horizontal surface, is slowing down.

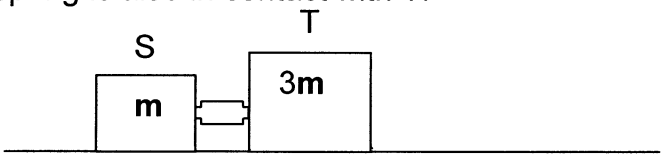


The directions of the resultant force and the acceleration are ...

	Direction of resultant force	**Direction of acceleration**
A	to the right	to the left
B	to the right	to the right
C	to the left	to the right
D	to the left	to the left

(3)

1.8 A combination of two blocks, S (fitted with a spring device) and T, is at rest on a horizontal, frictionless surface. The masses of S and T are **m** and 3 **m** respectively. The compressed spring is also in contact with T.



Which one of the following equations is the correct comparison between the magnitudes of the momenta of T and S, after the spring has been released, and has expanded completely?

A $\mathbf{p}_T = \mathbf{p}_S$

B $\mathbf{p}_T = 3\mathbf{p}_S$

C $\mathbf{p}_T = \frac{3}{4}\mathbf{p}_S$

D $\mathbf{p}_T = \frac{1}{3}\mathbf{p}_S$. (3)

1.9 A trolley, R, of mass **m** is moving horizontally to the right at a constant velocity with kinetic energy $\mathbf{E_k}$. If another trolley, S, also of mass **m** is dropped vertically on top of trolley R, while trolley R is still moving, the new kinetic energy of the combination will be …

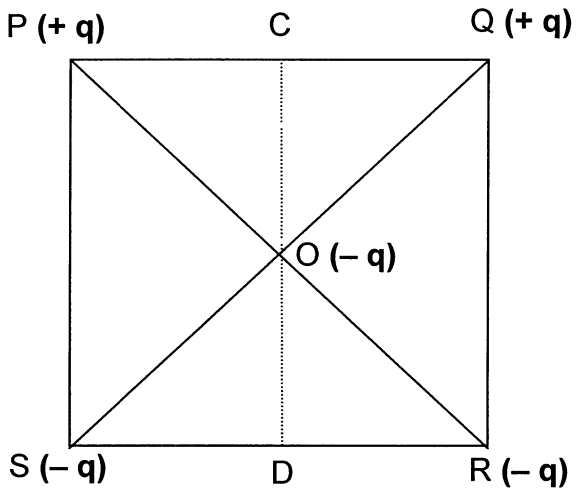
A $2\mathbf{E_k}$.

B $\sqrt{2}\ \mathbf{E_k}$.

C $\frac{1}{2}\mathbf{E_k}$.

D $\frac{1}{4}\mathbf{E_k}$. (3)

1.10 Five point charges, of magnitudes of either **+ q** or **– q**, are stationary at the four corners and at the centre of a square PQRS as shown in the diagram below.



The **direction** of the resultant electrostatic force, experienced by the charge at O, the point of intersection of the diagonals of the square, is …

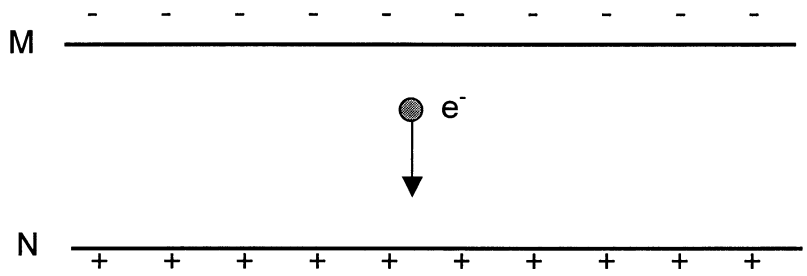
A OP.

B OQ.

C OC.

D OD. (3)

1.11 An electron moves from a negatively charged plate M towards a positively charged plate N. The plates are parallel to each other.

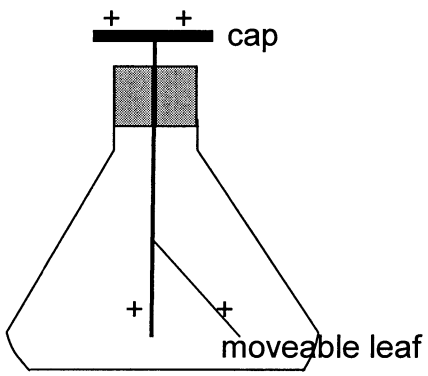


Which one of the following combinations relating to the magnitude of the electrical force **F** exerted on the electron and the velocity **v** of the electron, is correct?

	Magnitude of the electrical force on the electron (F)	**Velocity of the electron (v)**
A	increases	increases
B	remains constant	increases
C	decreases	decreases
D	remains constant	decreases

(3)

1.12 A gold-leaf electroscope, with one moveable leaf, has a positive charge.



Which one of the following actions shall definitely cause the moveable leaf to rise to a higher position and then remain there?

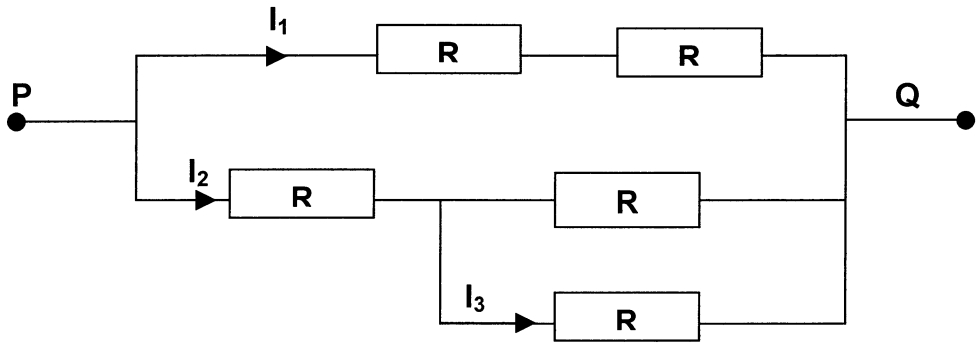
A Bringing a positively charged rod near the cap and then removing the rod.

B Bringing a negatively charged rod near the cap and then removing the rod.

C Touching the cap with a positively charged conducting sphere and then removing it.

D Touching the cap with a negatively charged conducting sphere and then removing it. (3)

1.13 A section of a circuit represented below, shows a network of four identical resistors, each of resistance **R**.



I_1, I_2 and I_3 are currents in the different branches as shown in the diagram. Which one of the following statements is true of these currents?

A $I_1 > I_2$ and $I_2 < I_3$

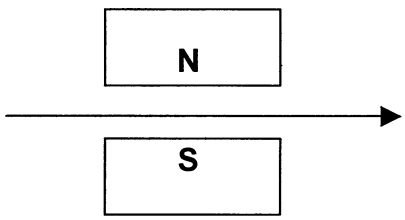
B $I_1 > I_2 > I_3$

C $I_2 > I_1 > I_3$

D $I_1 = I_2$ and $I_2 > I_3$.

(3)

1.14 A conducting wire, carrying conventional current in the direction as indicated in the diagram below, is placed between the two opposite poles of a magnet as shown below. "N" is the north pole while "S" is the south pole.



Which one of the following combinations correctly represents the type of force acting on the conductor and the direction of the force experienced by the conductor?

	Type of force	Direction of force
A	magnetic	out of the plane of the paper
B	magnetic	into the plane of the paper
C	electric	into the plane of the paper
D	electric	out of the plane of the paper

(3)

1.15 An electric kettle and heater are both connected in parallel to a 220 V power supply. If the kettle is marked 220 V; 1 kW and the heater 220 V; 3 kW, the resistance of the heater is …

A one third of the resistance of that of the kettle.

B the same as the resistance of that of the kettle.

C three times the resistance of that of the kettle.

D nine times the resistance of that of the kettle. (3)

[15 x 3 = 45]

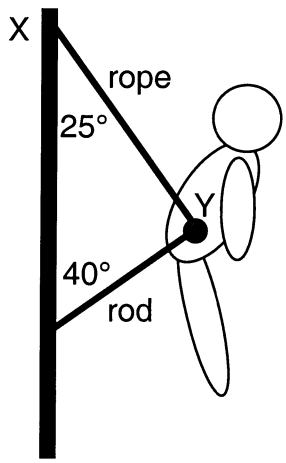
ANSWER QUESTIONS 2 TO 8 IN THE ANSWER BOOK.

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 all calculations, including substitutions.
4. Number the answers exactly as the questions are numbered.

QUESTION 2 [START ON A NEW PAGE]

During a mountain climbing exercise, Sandra, mass 60 kg, is suspended from an inelastic piece of nylon rope, fixed to a vertical cliff at X. A light, strong rod is fixed to her middle and she pushes the rod against the cliff so that she can hang freely as shown.



All the forces act through point Y.

2.1 State, in words, the **triangle rule for forces in equilibrium**. (3)

2.2 Draw a labelled diagram of all the forces (not as a triangle of forces) acting on her at point Y. Also indicate at least two angles. (4)

2.3 Determine, either by accurate scale drawing (1 cm represents 50 N) or by means of a calculation (include a rough, labelled diagram), the **magnitude** of the force which the rope exerts at point X if the angle the rope makes with the cliff equals 25°. Indicate at least 2 angles. The angle which the rod makes with the cliff is 40°. (6)
[13]

QUESTION 3 [START ON A NEW PAGE]

Four runners competed in a 100 m race. The race was run along a straight, horizontal track. The table shows the time taken by each runner to complete the race.

Runner	Time (s)
Jackie	13,5
Anusha	12,9
Unathi	13,1
Mariam	13,6

3.1 Which runner won the race? (1)

3.2 Explain, in words, your choice in question 3.1. (2)

Unathi accelerated uniformly from the starting line for 4,0 s, after which she maintained her maximum, constant velocity up to the finish line.

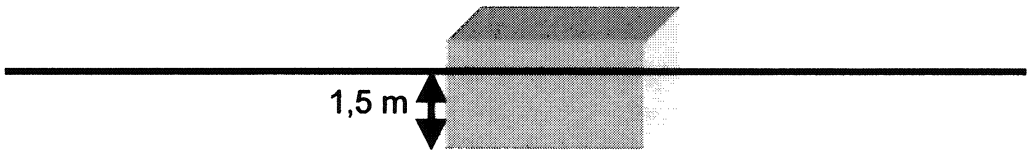
3.3 Define, in words, **acceleration**. (2)

3.4 Calculate the magnitude of Unathi's acceleration if she covered 18 m during the first 4,0 s of her race. (5)

3.5 Calculate the magnitude of the velocity with which Unathi finished the race. (5)
[15]

QUESTION 4 [START ON A NEW PAGE]

A crane in the East London harbour lifts a crate, mass 300 kg, from the deck of a ship. It moves the crate horizontally above the surface of the water and stops. While the crate hangs above the water, the cable holding the crate snaps. The crate, height 2 m, which is completely sealed so that no water can seep in, strikes the water at 21 $m.s^{-1}$ and penetrates (sinks into) the water to a depth of 1,5 m before rising again and coming to a stop.



4.1 Determine the magnitude of the average acceleration of the crate from the moment it strikes the water until it reaches its maximum depth of 1,5 m. (5)

4.2 Draw a labelled force diagram of the vertical forces acting on the crate from the moment it penetrates the water until it reaches the maximum depth. (3)

4.3 Calculate the magnitude of the average force that the **water exerts on the crate** to bring it to a stop. (6)

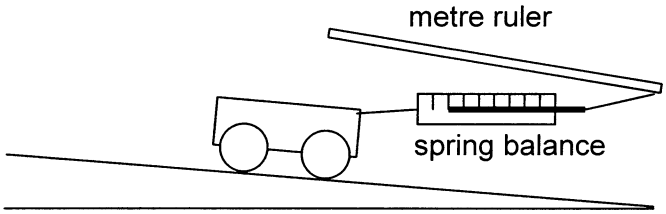
4.4 Determine the **change in the kinetic energy** of the crate while it is descending into the water to its lowest point (maximum depth) of 1,5 m. (4)

[18]

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 a trolley, of constant mass, varies with resultant force.*

In order to do this, Sonali and Shastra attach a metre ruler and a spring balance, calibrated in newton (N), to the front end of a trolley, which is placed on a friction compensated track as shown below. The spring balance is firstly stretched to 2 N and Sonali runs alongside the trolley to keep the resultant force constant. The experiment is then repeated with resultant forces of 4 N and 6 N respectively.



Their results were as follows:

Resultant force (F) (N)	Acceleration (a) ($m.s^{-2}$)
2	0,2
4	0,4
6	0,6

5.1 Draw and label a system of axes with the resultant force, **F**, on the X-axis (independent axis) and the acceleration, **a**, on the Y-axis (dependent axis). Plot the points and draw the graph. (4)

5.2 State, in words, the relationship between acceleration, **a**, and the resultant force, **F**. (2)

5.3 The gradient of the graph drawn in question 5.1 represents the inverse of the mass $\left(\frac{1}{m}\right)$. Use the graph to calculate the mass of the trolley. (4)

5.4 State, in words, **Newton's Second Law of Motion.** (3)
[13]

QUESTION 6 [START ON A NEW PAGE]

Two boys are standing on a trolley, which is moving to the right at 2 $m.s^{-1}$. Peter has a mass of 70 kg and John a mass of 60 kg. The total mass of the trolley and both boys is 160 kg (Figure 1).

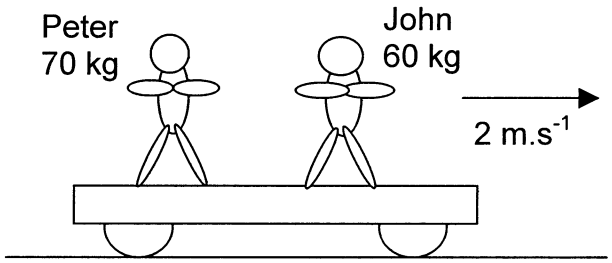


Figure 1

John jumps off the trolley, in the direction of the motion of the trolley, at a velocity of 2,5 $m.s^{-1}$ relative to the ground (Figure 2). An observer sees that he lands on the ground and falls forward.

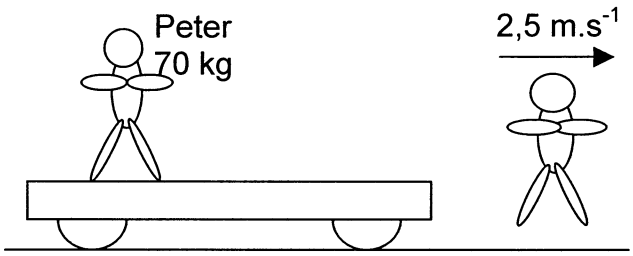


Figure 2

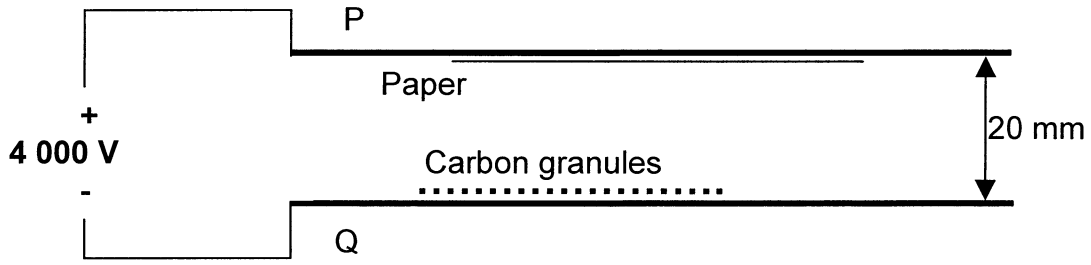
6.1 Name and state, in words, the law of Physics which explains why he probably falls forward after landing on the ground. (4)

6.2 Calculate the **magnitude and direction** of the velocity of the combination of Peter and the trolley immediately after John has jumped off. (7)

6.3 Name and state, in words, the principle used in answering question 6.2. (4)
[15]

QUESTION 7 [START ON A NEW PAGE]

Fingerprints on paper can be made visible by sprinkling minute carbon granules on the paper using an electric field produced by two charged metal plates, P and Q. The diagram below shows the principle of such a machine. Carbon granules are kept on Q and the paper with the fingerprints is attached to P.



A potential difference of 4 000 V is applied across P and Q, kept at a distance of 20 mm from one another. Plate P is positive. One carbon granule carries a negative charge of 8×10^{-19} C.

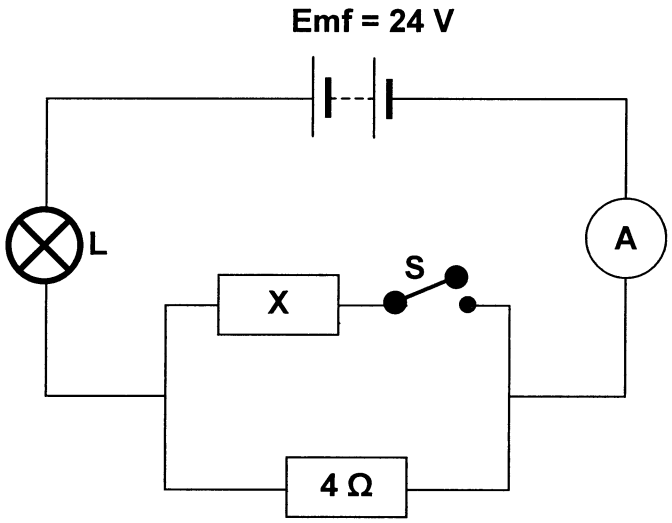
7.1 Draw a diagram to represent the electric field pattern between P and Q. (4)

7.2 Calculate the number of excess electrons on each granule of carbon. (3)

7.3 Calculate the work done by the field in moving a granule from Q to P. (4)
[11]

QUESTION 8 [START ON A NEW PAGE]

In the circuit represented below, the battery has an emf of 24 V. Its internal resistance is negligible and the resistance of resistor **X** is unknown.



8.1 State, in words, **Ohm's law**. (3)

*When switch **S is open**, ammeter A has a reading of 1,5 A.*

8.2 Calculate the potential difference across the 4 Ω resistor**.** (4)

8.3 Calculate the resistance of lamp L. (4)

*When switch **S is closed**, ammeter A has a reading of 1,6 A.*

8.4 Calculate the effective resistance of the circuit. (3)

8.5 Calculate the effective resistance of the parallel combination. (2)

8.6 Calculate the resistance of resistor **X**. (4)
[20]

TOTAL QUESTION 1 : 45
TOTAL QUESTIONS 2- 8 : 105
GRAND TOTAL : 150

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DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

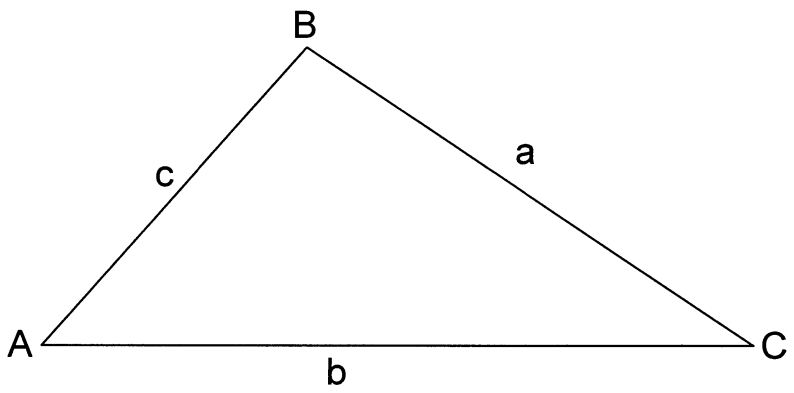
DATA FOR PHYSICAL SCIENCE
PAPER I (PHYSICS)

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 $= I(R + r)$
$R = r_1 + r_2 + r_3 + \ldots$	$F = \frac{kI_1I_2\ell}{d}$ $(k = 2 \times 10^{-7}\ N.A^{-2})$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots$	$W = VIt = I^2Rt = \frac{V^2t}{R}$
$R = \frac{V}{I}$	$P = VI = I^2R = \frac{V^2}{R}$

ANSWER SHEET/ANTWOORDBLAD

Examination number **Eksamennommer**													

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SENIOR CERTIFICATE EXAMINATION/SENIORSERTIFIKAAT-EKSAMEN

PHYSICAL SCIENCE STANDARD GRADE FIRST PAPER (PHYSICS)/
NATUUR- EN SKEIKUNDE STANDAARD GRAAD 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	