GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PROVINCIAL EXAMINATION

JUNE 2017

GRADE 11

PHYSICAL SCIENCES
PAPER 1

(PHYSICS)

TIME: 3 hours

MARKS: 150

14 pages + 2 information sheets + 1 answer sheet

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INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space in the ANSWER BOOK.
2. This question paper consists of NINE questions. Answer ALL questions in the ANSWER BOOK except for Question 4.3 which has to be answered on the ANSWER SHEET attached to this question paper. Write your name in the appropriate space on the ANSWER SHEET.
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 between two sub-questions, for example between Question 2.1 and Question 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached data sheets.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round-off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief substantiations, discussions, et cetera where required.
12. Write neatly and legibly.

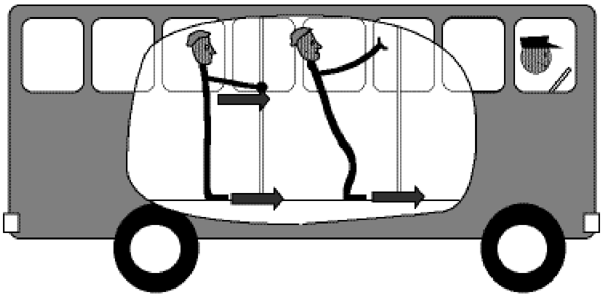
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A – D) next to the question number (1.1 – 1.10) in the ANSWER BOOK, for example 1.11 E.

1.1 Which ONE of the following is an example of a non-contact force?

A Frictional force
B Gravitational force
C Tension force
D Normal force (2)

1.2 As a bus pulls away from the curb, the standing passengers move backwards as a result of one of Newton's Law's. Which law?



A Newton's First Law
B Newton's Second Law
C Newton's Third Law
D Newton's Law of Universal Gravity (2)

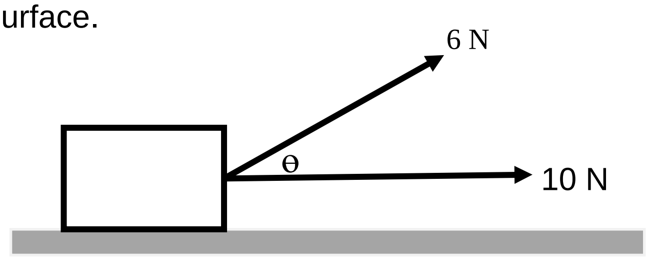
1.3 The critical angle between air and water is 49°. This indicates that the angle of refraction is ...

A 35°.
B 49°.
C 55°.
D 90°. (2)

1.4 An endoscope is used by doctors to examine a patient internally. The principle on which the endoscope operates is ...

A diffraction.
B refraction.
C total internal reflection.
D absorption. (2)

1.5 Two forces of magnitude 10 N and 6 N act on a box. The box rests on a horizontal frictionless surface.



What must the angle θ, between the two forces, be to give a maximum resultant for the two forces?

A 0°
B 60°
C 120°
D 180° (2)

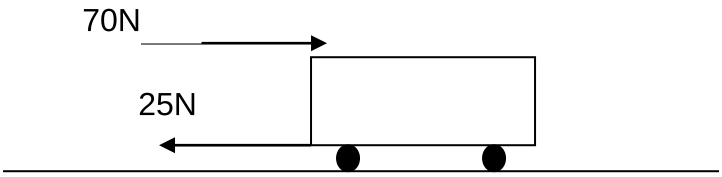
1.6 An object is dropped from a height of 1 km above the Earth. If air resistance is ignored, the acceleration of the object is **only** dependent on the …

A mass of the object.
B distance from the centre of the earth.
C rotation speed of the earth.
D mass of the earth. (2)

1.7 A satellite experiences a gravitational force of magnitude **F** on the surface of the Earth. The radius of the Earth is **R**. The satellite now circles the Earth at an unknown height above the surface of the Earth and experiences a gravitational force of magnitude $^{1}/_{16}$ F. This unknown height is ...

A R.
B 2 R.
C 3 R.
D 4 R. (2)

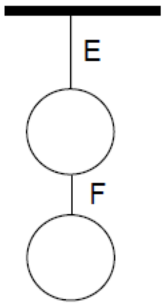
1.8 A woman pushes a trolley in a supermarket with a horizontal force of 70 N. During the motion, a frictional force of 25 N acts on the trolley.



The magnitude of the force exerted by the trolley on the woman is ...

A 45 N.
B 25 N.
C 70 N.
D 95 N. (2)

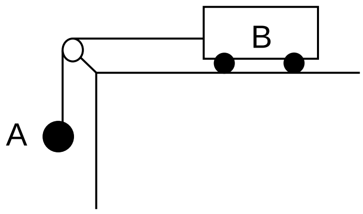
1.9 Two identical chandeliers are suspended from cable **E** attached to the ceiling and cable **F** attached between the chandeliers, as indicated in the diagram below.



Which ONE of the following relationships between the tension, T_E, in cable **E**, and the tension, T_F, in cable **F** is correct?

A $T_E > T_F$
B $T_E < T_F$
C $T_E = T_F \neq 0$ N
D $T_E = T_F = 0$ N (2)

1.10 A frictionless trolley of mass **B** is accelerated to the left by the effect of gravity acting on mass **A**. A light, inelastic string linking **A** to **B** passes over a frictionless pulley. The acceleration of the system can be halved by ...

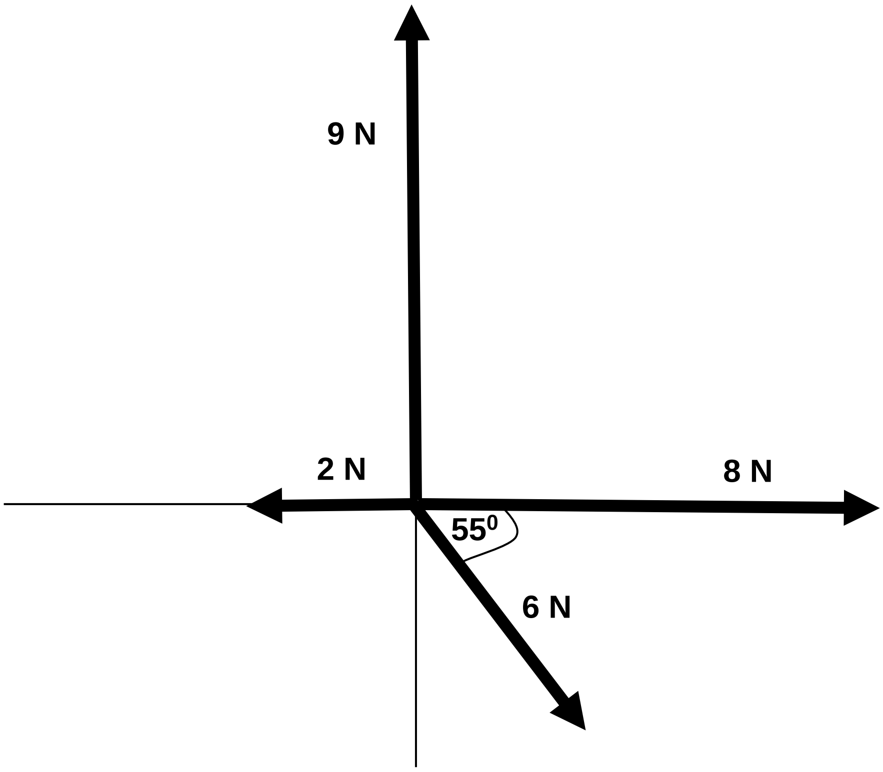


A doubling the mass of the trolley to 2B.
B halving the mass of A to $^A/_2$.
C halving the suspended mass to $^A/_2$ and increasing the mass of B by $^A/_2$.
D doubling the mass of the trolley, **B** and halving the mass of **A**. (2)

(10x2) **[20]**

QUESTION 2 (START ON A NEW PAGE.)

The diagram below shows FOUR forces of 9 N, 8 N, 6 N and 2 N acting on an object on the same plane.



2.1 Define the term *Resultant / Net Force*. (2)

2.2 Calculate

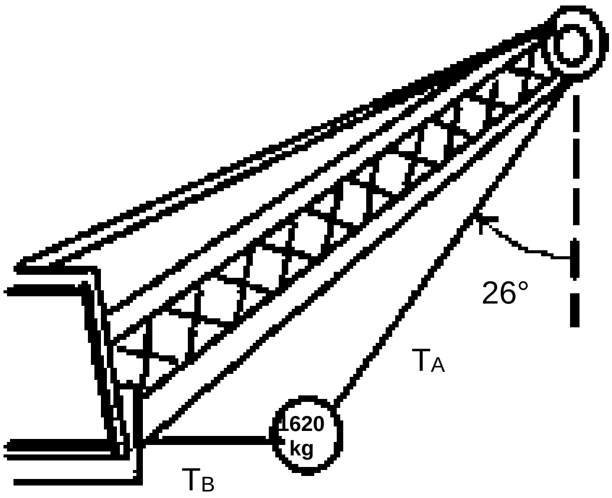
2.2.1 the magnitude of the resultant of ALL the forces acting on the object. (7)

2.2.2 the direction of the resultant force. (3)

[12]

QUESTION 3 (START ON A NEW PAGE.)

A large wrecking ball is held in place by two light steel cables. The mass, m, of the wrecking ball is 1620 kg.



3.1 Explain the concept *Forces in Equilibrium*. (2)

3.2 Draw a triangle of forces in equilibrium and indicate at least one angle. (4)

3.3 Calculate

3.3.1 the magnitude of the tension T_A in the cable that makes an angle of 26° with the vertical. (3)

3.3.2 the magnitude of the tension T_B in the horizontal cable. (3)

[12]

QUESTION 4 (START ON A NEW PAGE.)

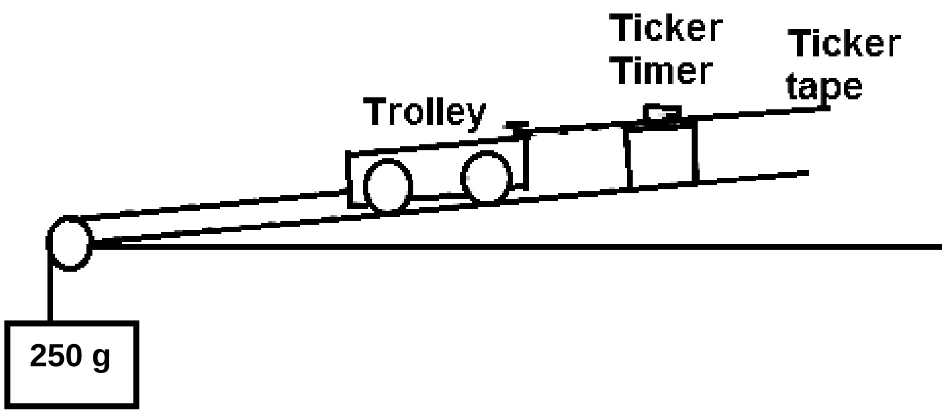
Overloading of motor vehicles is one of the many causes of road accidents on our country's roads. A Physical Sciences class investigated the relationship between force, mass and acceleration. Different groups investigated different relationships of the formula: $F_{net} = m \times a$

One group of learners did the investigation below.

These learners used the following apparatus in their investigation:

- Four trolleys
- A ticker timer
- Four lengths of ticker tape
- A ramp (Runway)
- A non-elastic string
- A pulley
- A 250 g mass piece

They set up the apparatus as shown below:



The runway was inclined to compensate for friction. The mass piece accelerated the trolley down the incline. The incline was kept constant for the duration of the experiment. The mass was increased by stacking the trolleys one on top of the other after each reading. After analysis of the four ticker tapes, the following results were recorded:

FORCE (N)	Mass (Trolley Units)	ACCELERATION ($m.s^{-2}$)	$\frac{1}{\text{MASS}}$
2,5	1	4,4	
2,5	2	2,8	
2,5	3	2,3	
2,5	4	1,9	

4.1 Identify

4.1.1 the dependent variable,

4.1.2 the independent variable and

4.1.3 the controlled variable. (3)

4.2 Formulate an investigative question for this investigation. (2)

4.3 On page 17, complete the table and draw a graph on the ANSWER SHEET. (4)

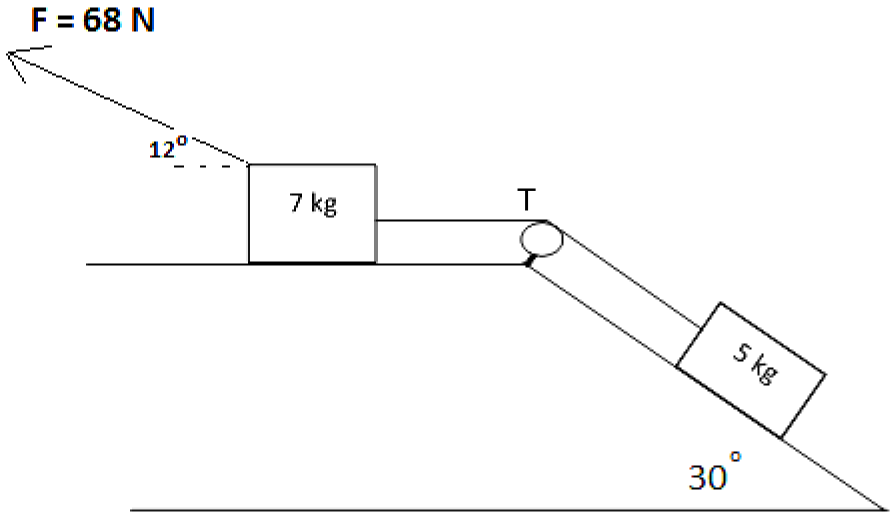
4.4 Draw a conclusion from the graph. (2)

4.5 Give a possible reason why the first point does NOT lie on the line. (2)

4.6 Use your conclusion in QUESTION 4.4 to explain to motorists why overloading is dangerous. (2)
[15]

QUESTION 5 (START ON A NEW PAGE.)

Two blocks of masses 7 kg and 5 kg respectively are connected by a light inextensible string that runs over a light frictionless pulley as shown in the diagram below. The 7 kg block is pulled to the left with a force of 68 N at an angle of 12° to the horizontal .The 7 kg block experiences a frictional force of 6 N. The coefficient of kinetic friction between the 5 kg block and the surface of the inclined plane is 0,18.



5.1 Define the term *Normal Force*. (2)

5.2 Draw a labelled, free-body diagram to indicate ALL the forces acting on the 5 kg object. (4)

5.3 Distinguish between *static* friction and *kinetic* friction. (4)

5.4 Calculate

5.4.1 the frictional force acting between the 5 kg block and the surface of the inclined plane. (4)

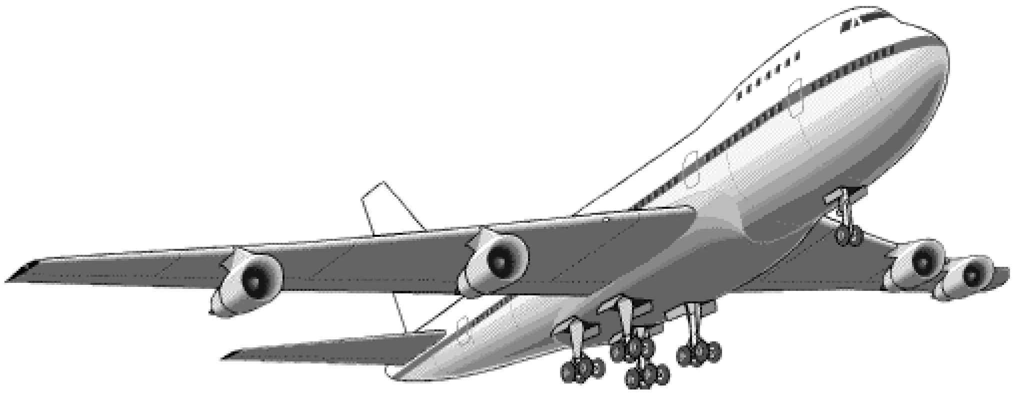
5.4.2 the acceleration of the 7 kg block. (7)

5.4.3 the magnitude of the tension T in the string between the blocks. (3)

[24]

QUESTION 6 (START ON A NEW PAGE.)

Passenger plane accidents are becoming very common. In one recent accident, an Airbus, with a mass of 30 000 kg was last seen on the radar at a height of 3 500 m above the Earth's surface before crashing into the sea. It is not yet clear what caused the crash, but some reports allegedly say that the plane exploded before hitting the water's surface in the sea.



6.1 Name and state the law that explains the force with which the Earth and the plane interact at a height of 3 500 m above the Earth's surface. (3)

6.2 How does the magnitude of the force experienced by the plane compare to the force experienced by the Earth due to this plane? Only answer: GREATER THAN, EQUAL TO or LESS THAN. (2)

6.3 Explain why the plane can be seen moving towards the Earth and not vice-versa. (2)

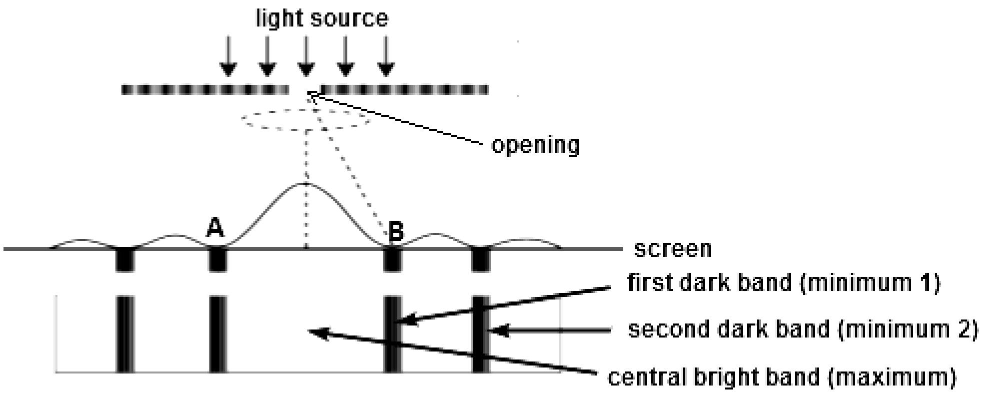
6.4 Calculate the force exerted by the Earth on the plane at a height of 3 500 m. (5)

6.5 With what factor will the force of impact (**F**) that the plane experiences on the surface of the water change, if the plane had to crash on a different planet, with double the mass of the Earth, and the total distance a third of that on Earth? Show calculations. (3)

[15]

QUESTION 7 (START ON A NEW PAGE.)

When a monochromatic red light is shone through a narrow slit, the following pattern is observed on the screen.



7.1 Name the phenomenon that is observed on the screen. (2)

7.2 Name and state the principle used to explain the phenomenon in your answer to Question 7.1. (4)

7.3 Describe the pattern observed on the screen. (3)

7.4 Give the term that explains the formation of the dark bands on the screen. (2)

7.5 What effect would each of the following changes have on the width of the central colour band labelled (A – B) if ...

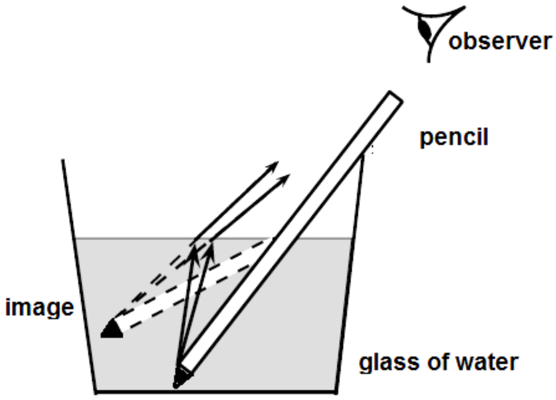
7.5.1 the slit opening is decreased? Only answer INCREASE, DECREASE or REMAIN THE SAME and explain your answer. (3)

7.5.2 the red light is replaced with blue light? Only answer INCREASE, DECREASE or REMAIN THE SAME and explain your answer. (3)

[17]

QUESTION 8 (START ON A NEW PAGE.)

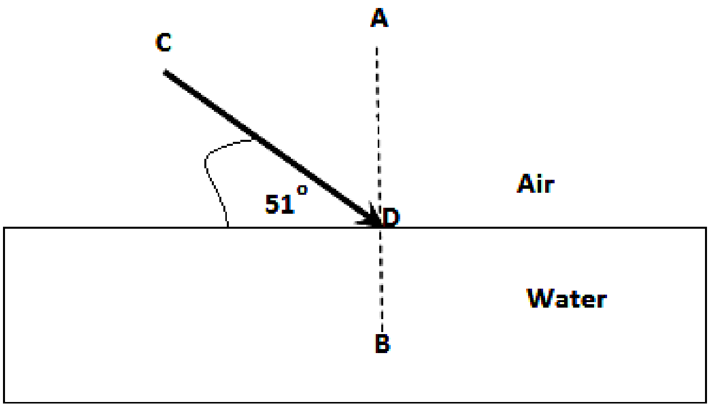
8.1 Study the following picture of a pencil in a glass of water and answer the questions that follow.



8.1.1 Name the phenomenon as seen in the picture. (2)

8.1.2 Explain why the pencil will look as if it is bent at the surface of the water. (3)

8.2 Consider the following diagram of the light ray (c) striking an interface between air and water. The angle that the light ray makes with the surface of the water is 51°, as shown in the diagram.



$n_{air} = 1{,}00$

$n_{water} = 1{,}33$

8.2.1 Name the line AB. (2)

8.2.2 Calculate the angle of refraction for the light ray when it travels from air to water. (4)

8.2.3 In your ANSWER BOOK, redraw the sketch above and show the path of the light ray as it moves from air to water and emerges into the air again. (4)

8.3 What happens to the speed of light as the light moves from AIR to WATER? Write only INCREASES, DECREASES or REMAINS THE SAME. (2)

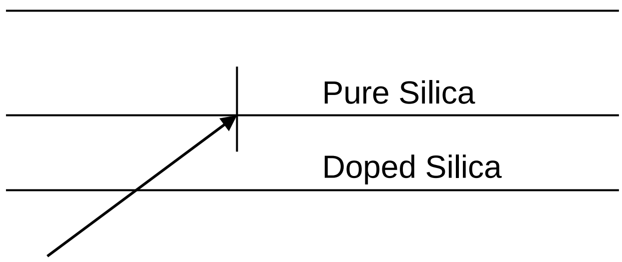
8.4 Explain your answer to Question 8.3. (2)
[19]

QUESTION 9 (START ON A NEW PAGE.)

9.1 Give TWO conditions for total internal reflection to occur. (4)

9.2 Define the term *critical angle of a medium*. (2)

9.3 Doped silica has a very high refractive index (n = 1,45). The diagram shows a thin layer of pure silica deposited on doped silica.



Calculate

9.3.1 the critical angle of the doped silica – pure silica boundary. The pure silica has a refractive index of n =1,40. (4)

9.3.2 the speed of the light in the doped silica. (4)

9.4 Why do telecommunication companies prefer optical fibre cables to copper cables? (2)
[16]

TOTAL: 150

END

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 1 (PHYSICS)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 1 (FISIKA)

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

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Acceleration due to gravity *Swaartekragversnelling*	g	$9{,}8\ m\cdot s^{-2}$
Gravitational constant *Swaartekragkonstante*	G	$6{,}67 \times 10^{-11}\ N\cdot m^2\cdot kg^{-2}$
Radius of Earth *Straal van Aarde*	R_E	$6{,}38 \times 10^{6}\ m$
Coulomb's constant *Coulomb se konstante*	K	$9{,}0 \times 10^{9}\ N\cdot m^2\cdot C^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3{,}0 \times 10^{8}\ m\cdot s^{-1}$
Charge on electron *Lading op elektron*	e	$-1{,}6 \times 10^{-19}\ C$
Electron mass *Elektronmassa*	m_e	$9{,}11 \times 10^{-31}\ kg$
Mass of the earth *Massa van die Aarde*	M	$5{,}98 \times 10^{24}\ kg$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

$F_{net} = ma$	$w = mg$
$F = \frac{Gm_1m_2}{r^2}$	$\mu_s = \frac{f_{s(max\ /\ maks)}}{N}$
$\mu_k = \frac{f_k}{N}$	

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

$v = f\lambda$	$T = \frac{1}{f}$
$n_i \sin\theta_i = n_r \sin\theta_r$	$n = \frac{c}{v}$

ELECTROSTATICS/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$E = \frac{F}{q}$
$E = \frac{kQ}{r^2}$ $(k = 9{,}0 \times 10^9\ N{\cdot}m^2{\cdot}C^{-2})$	$V = \frac{W}{Q}$

ELECTROMAGNETISM/*ELEKTROMAGNETISME*

$\varepsilon = -N\frac{\Delta\Phi}{\Delta t}$	$\Phi = BA\cos\theta$

CURRENT ELECTRICITY/*STROOMELEKTRISITEIT*

$I = \frac{Q}{\Delta t}$	$R = \frac{V}{I}$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + ...$	$R = r_1 + r_2 + r_3 + ...$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

QUESTION 4.3

NAME OF LEARNER:

____

____

FORCE (N)	Mass (Trolley Units)	ACCELERATION ($m.s^{-2}$)	$\frac{1}{MASS}$
2,5	1	4,4	
2.5	2	2.8	
2,5	3	2,3	
2,5	4	1,9