GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PROVINCIAL EXAMINATION

JUNE 2016

GRADE 11

PHYSICAL SCIENCES
PHYSICS
(PAPER 1)

TIME: 180 minutes (3 hours)

MARKS: 150

15 pages + 2 data sheets and 1 answer sheet

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INSTRUCTIONS AND INFORMATION

1. Write your name in your ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL questions in the ANSWER BOOK except Question 8.2 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 the answer to each question on a NEW page in the ANSWER BOOK.
4. Number the answers according to the numbering system used in this question paper.
5. Leave ONE open 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 motivations, 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 1.3 D.

1.1 Which ONE of the following forces always acts perpendicular to the surface on which a body is placed?

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

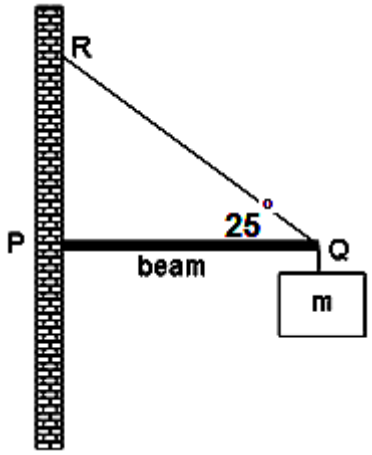
1.2 A vector of magnitude 5 N is added to a vector of magnitude 6 N. The magnitude of the resultant will always be between ...

A 1 and 6.
B 4 and 6.
C 1 and 11.
D 4 and 11. (2)

1.3 Which of the following combinations are both vectors?

A Displacement and time
B Acceleration and velocity
C Energy and mass
D Force and work (2)

1.4 In the diagram below, one end, P, of a rigid beam PQ is fixed to the wall. An inelastic rope, is fixed to the wall at R and is tied to the other end Q, of Beam PQ, such that the beam is horizontal. An object of mass **m** is suspended with an inelastic rope from point Q. Beam PQ exerts a force of 560 N at Point Q on Rope RQ. Ignore the masses of the ropes and the beam.



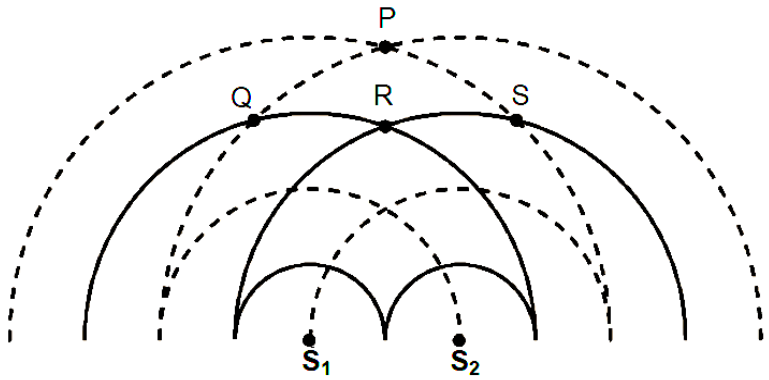
Which one of the following is the mass of Object M?

A 236,67 kg
B 507,53 kg
C 26,65 kg
D 83,26 kg (2)

1.5 An object attracts another with a gravitational force ***F***. If the distance between the centres of the two objects is now decreased to a **third (⅓)** of the original distance, the force of attraction that the one object would exert on the other would become ...

A $\frac{1}{9}$ F
B ⅓ F
C 3 F
D 9 F (2)

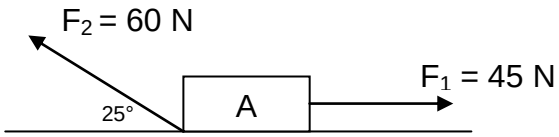
1.6 The diagram below shows waves in phase generated by two coherent sources, S_1 and S_2. The solid lines represent CRESTS and the broken (dashed) lines represent TROUGHS.



Constructive interference occurs at Points ...

A Q and R.
B Q and P.
C P and R.
D R and S. (2)

1.7 Object A is at rest on a frictionless horizontal plane as indicated in the diagram below.



If the forces act on the object as shown in the diagram, the object will ...

A accelerate to the right.
B accelerate to the left.
C move at a constant velocity to the right.
D move at a constant velocity to the left. (2)

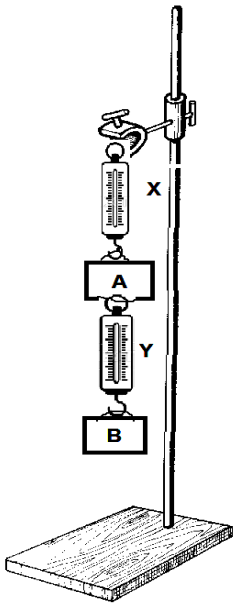
1.8 The mass of a person on earth is 75 kg. His weight and mass on the moon, with a gravitational acceleration of 1,67 $m.s^{-2}$, will be:

	Mass on the moon in kg	Weight on the moon in N
A	75	125,25
B	44,91	150
C	125,25	75
D	75	44,91

(2)

1.9 Two objects are hanging from a retort stand. The mass of Object A is 420 g and the mass of Object B is 530 g. What will be the reading on the Spring Balance Y?

A 9,31 N
B 4,12 N
C 5,19 N
D 10 N



(2)

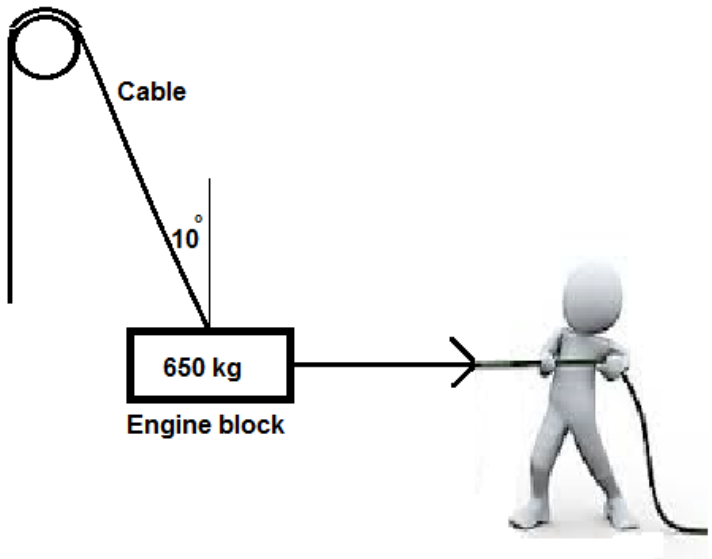
1.10 The driver of a car places a figurine on the dashboard in front of him. After a while he finds that it slides towards him. This happens because ...

A the car is moving forward at a constant speed.
B the car is accelerating forwards.
C the car is accelerating backwards.
D the car is moving backwards at a constant velocity. (2)

[20]

QUESTION 2: (Start on a new page.)

An engine block with a total mass of 650 kg, is suspended by a cable over a frictionless pulley. A learner pulls a rope, attached to the engine block, horizontally to the right so that the cable forms an angle of 10° with the vertical. It is then kept in this position.



2.1 Explain the concept of *Forces in Equilibrium*. (2)

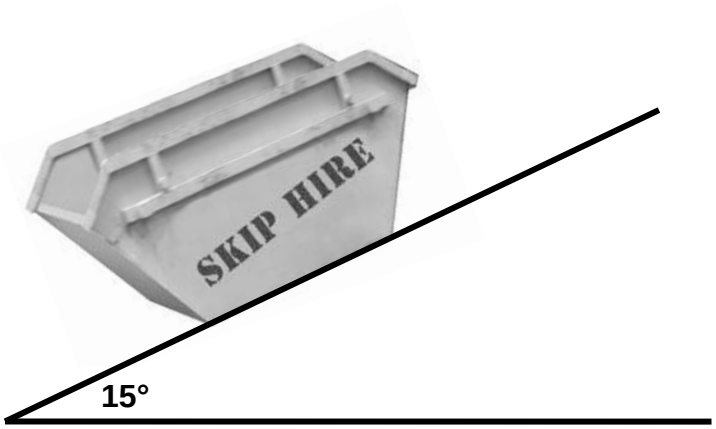
2.2 Draw a labelled, free-body vector diagram showing ALL the forces acting on the engine block. Indicate the magnitude of at least ONE angle. (4)

2.3 Calculate the magnitude of the tension in the cable. (3)

2.4 The cable can withstand a maximum tension of 7 000 N. The engine block is now pulled further to the right so that the angle of the cable with the vertical is 32°. Determine whether or not the cable will snap. (4)
[13]

QUESTION 3: (Start on a new page.)

A learner and her family live on a hill. They are remodelling their house so they have hired a rubbish skip to hold the building rubble, because they do not want to pollute the environment. The stationary skip has a mass of 320 kg and the road forms an angle of 15° with the horizontal.



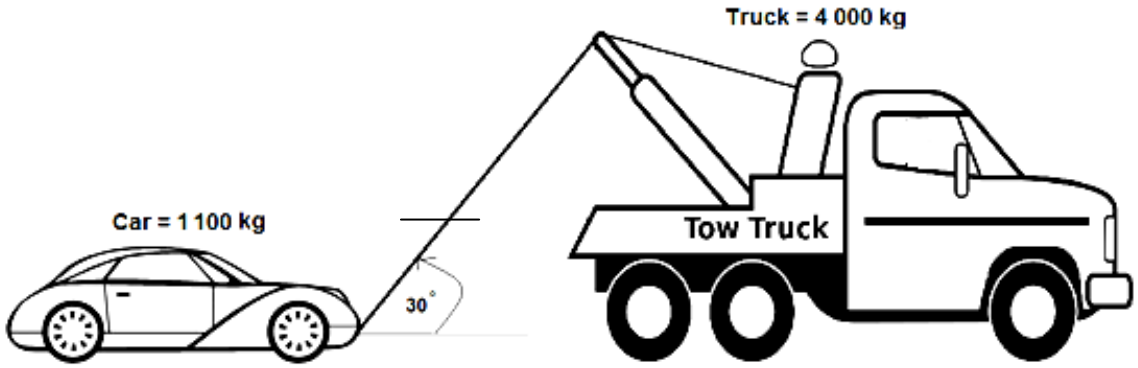
3.1 Define *frictional force*. (2)

3.2 Calculate the force of static friction exerted on the skip. (4)

3.3 Calculate the co-efficient of friction between the skip and the road. (4)
[10]

QUESTION 4: (Start on a new page.)

A breakdown truck, pulls a small car, using a light inelastic rope as shown in the diagram. **The inelastic rope forms an angle of 30°** with the **horizontal**.



The two vehicles move from rest on a straight, horizontal road to the right. The mass of the car is 1 100 kg and the mass of the breakdown truck is 4 000 kg. The truck's engine applies a force of 18 000 N. A frictional force of 1 617 N is working on the car and a frictional force of 5 880 N on the breakdown truck.

4.1 Define Newton's Second Law of motion, in words. (2)

4.2 Draw a labelled, free-body diagram of all the forces working on the car. (4)

4.3 Calculate the acceleration of the car. (6)

4.4 Calculate the magnitude of the tension T in the rope. (3)

4.5 Using equations of motion, calculate the distance that the car will travel in 6 s. (3)

4.6 After a while the breakdown truck and the car travel at a **constant velocity**. The rope now exerts a horizontal force of 1 617 N on the car. Calculate the normal force of the road on the car. (4)

4.7 Define Newton's First Law of motion, in words. (2)

4.8 Towing with a rope can be dangerous. Refer to Newton's laws of motion to explain this. (2)

4.9 If the force of horizontal tension in the rope, from the car on the truck is 1 617 N, what is the horizontal force of the truck on the car? Explain with reference to the relevant scientific principles. (2)

[28]

QUESTION 5: (Start on a new page.)

A block of mass 4 kg on a rough horizontal surface is connected to another block of mass 1,2 kg by means of a light inextensible string. The string that connects the two blocks is hanging over a frictionless pulley as shown in the diagram below.



The 4 kg block experiences a constant kinetic friction of 2,5 N when a force of 25 N is applied horizontally. Ignore the effects of air friction.

5.1 Calculate the magnitude of the acceleration of the blocks. (6)

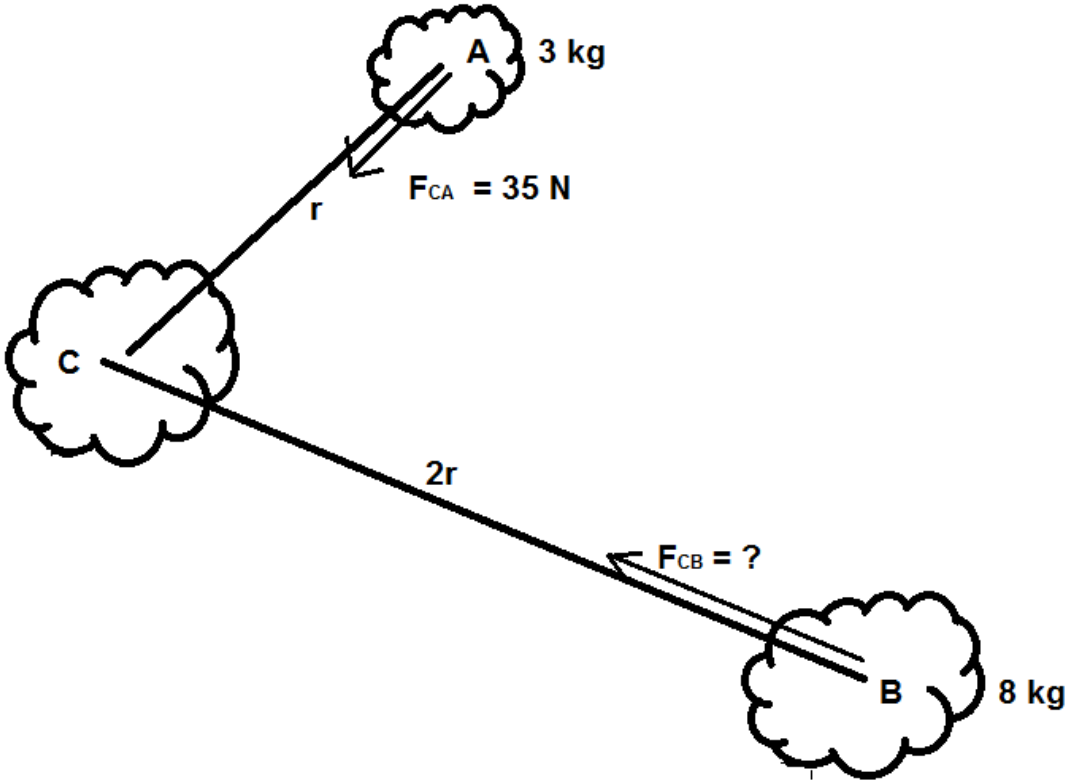
5.2 Calculate the co-efficient of kinetic friction on the 4 kg block for this surface. (3)

5.3 State Newton's Third Law of motion, in words. (2)

5.4 Identify ONE action-reaction pair working on the 4 kg block. (2)
[13]

QUESTION 6: (Start on a new page.)

Three objects A, B and C are moving through space at right angles to each other. The mass of A is 3 kg and the mass of B is 8 kg. The distance between C and A is r and the distance between C and B is 2r. F_{CA} is 35 N.



6.1 Define Newton's Law of Universal Gravitation, in words. (2)

6.2 Calculate the force between C and B. (6)

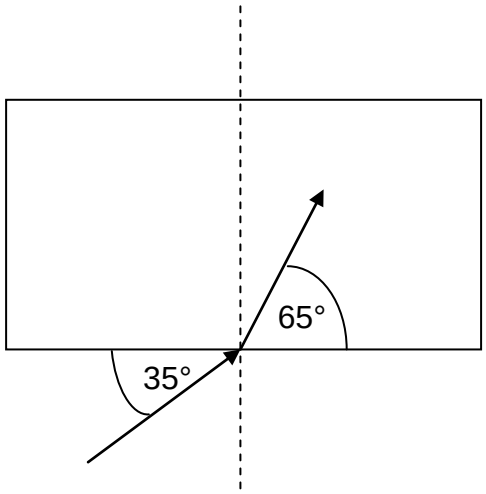
6.3 Show how F_{CB} will change if the radius CB is halved and the mass of B is doubled. (2)

6.4 Prove that $g = \frac{Gm}{r^2}$ (3)

[13]

QUESTION 7: (Start on a new page.)

A light beam travels from the air into a transparent rectangular glass prism as shown below.



7.1 Define *refraction*. (2)

7.2 Write down the value of the angle of incidence. (2)

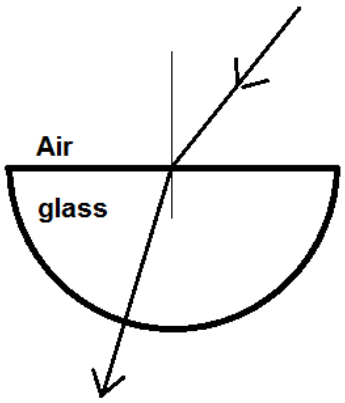
7.3 Write down the value of the angle of refraction. (1)

7.4 Redraw and complete the above diagram (NOT drawn to scale) to show the emergent ray on the second surface. (2)

7.5 In which medium (air or glass) will the speed of light be faster? Explain your answer. (2)
[9]

QUESTION 8: (Start on a new page.)

In an experiment to verify Snell's Law, a Grade 11 class measured the angle of incidence (θ_i) and the angle of refraction (θ_r) for a ray of light entering a semi-circular glass prism.



θ_i	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**
Sin θ_i						
θ_r	**13°**	**19°**	**26°**	**30°**	**35,5°**	**39°**
Sin θ_r						

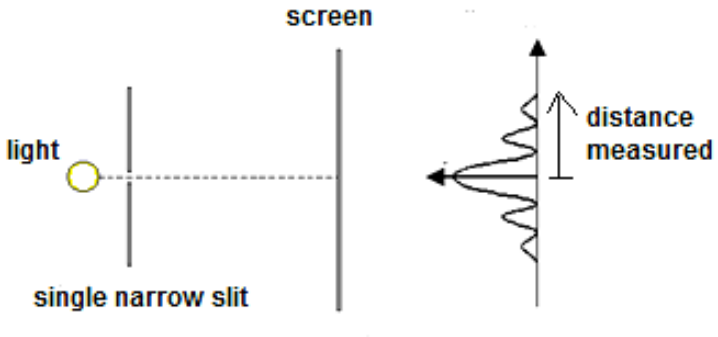
8.1 Give the formula for Snell's Law. (2)

8.2 Complete the table in the ANSWER SHEET and plot a graph of Sin θ_i (on y-axis) vs Sin θ_r (on x-axis) on the graph provided. (8)

8.3 Use the graph to calculate the refractive index of the glass prism. (4)
[14]

QUESTION 9: (Start on a new page.)

The relationship between the wavelength and the diffraction of light is investigated. Monochromatic light of wavelength 650 nm is passed through a single slit at a fixed distance from a screen. The pattern on the screen is investigated.



9.1 Describe and explain the pattern that you will see on the screen. (3)

9.2 Define the term *monochromatic light.* (2)

During a practical investigation a learner used red light with a wavelength of 650 nm and then he used blue light with a wavelength of 475 nm.

9.3 For this investigation:

9.3.1 Identify the independent variable. (1)

9.3.2 Identify the dependent variable. (1)

9.3.3 Identify the two controlled variables. (2)

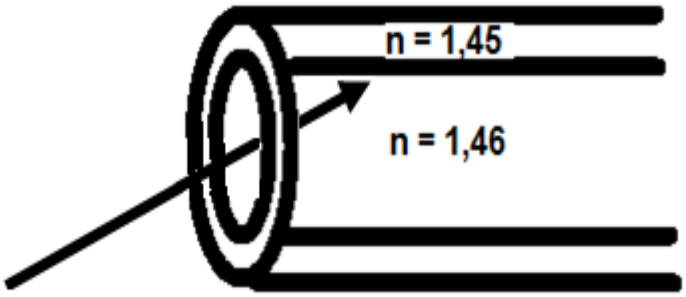
9.3.4 Write an investigative question for this experiment. (3)

9.3.5 Explain which wavelength of light will experience the most diffraction. (2)

[14]

QUESTION 10: (Start on a new page.)

Telkom is continuously installing fibre optic cables to improve data transfers. They make use of an optical fibre with a core, having a refractive index of 1,46 and a cladding with a refractive index of 1,45.



10.1 Define the term *critical angle*. (2)

10.2 Calculate the critical angle for this core-cladding interface. (4)

10.3 What will happen to the ray **R** when the angle of incidence is increased to 86°? (2)

10.4 Name the phenomenon that will occur in Question 10.3. (2)

10.5 Explain the requirements for the phenomenon in Question 10.3 to be able to take place. (4)

10.6 Name a medical instrument that makes use of the phenomenon in Question 10.3. (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 x 10^{-11} $N \cdot m^2 \cdot kg^{-2}$
Radius of Earth *Straal van Aarde*	R_E	6,38 x 10^6 m
Coulomb's constant *Coulomb se konstante*	K	9,0 x 10^9 $N \cdot m^2 \cdot C^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	3,0 x 10^8 $m \cdot s^{-1}$
Charge on electron *Lading op elektron*	e	-1,6 x 10^{-19} C
Electron mass *Elektronmassa*	m_e	9,11 x 10^{-31} kg
Mass of the earth *Massa van die Aarde*	M	5,98 x 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*

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

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*

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

ANSWER SHEET

NAME OF LEARNER:_____

QUESTION 8.2

θ_i	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**
Sin θ_i						
θ_r	**13°**	**19°**	**26°**	**30°**	**35,5°**	**39°**
Sin θ_r						

