GRADE 11

PHYSICAL SCIENCES (PHYSICS AND CHEMISTRY)

JUNE 2016

MARKS: 150

TIME: 3 HOURS

**This question paper consists of 13 pages, 3 data sheets
and 1 graph sheet.**

INSTRUCTIONS AND INFORMATION

1. Write your name and grade in the ANSWER BOOK.

2. This question paper consists of TEN questions. Answer QUESTION 10.3 on the attached GRAPH PAPER. Answer ALL the other 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 between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.

6. Write neatly and legibly.

7. Show ALL formulae and substitutions in ALL calculations.

8. You may use a non-programmable calculator.

9. You may use appropriate mathematical instruments.

10. Round off your final numerical answers to a minimum of TWO decimal places.

11. You are advised to use the attached DATA SHEETS.

12. Give brief motivations, discussions, et cetera where required.

QUESTION 1

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 your ANSWER BOOK, for example 1.11 D.

1.1 Which ONE of the following pairs contains a vector and a scalar quantity?

    A   Speed and distance

    B   Velocity and acceleration

   C   Mass and displacement

    D   Power and time   (2)

1.2 The diagram below shows a crate on a rough horizontal surface with a force F_A acting on it at point **O**.
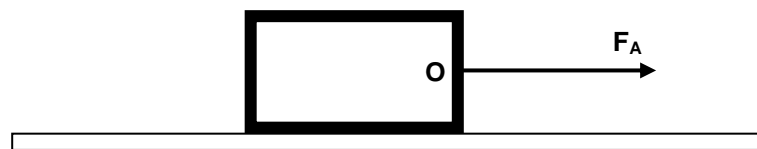
    Which ONE of the following statements about frictional forces is TRUE?

    A   The static frictional force is always equal to the kinetic frictional force.

    B   A frictional force acts in the opposite direction as the normal force.

    C   A frictional force exists only when the object is in motion.

    D   A frictional force always opposes the motion or attempted motion.   (2)

1.3 If the net force acting on a object is ZERO, the object will …

    A   experience a constant increase in velocity.

    B   accelerate in the direction of the largest force.

    C   move at constant velocity or remain at rest.

   D   experience a constant decrease in velocity.   (2)

1.4 A car of mass *m* accelerates up a rough incline at a constant acceleration *a* under the influence of an applied force F_A. The incline makes an angle θ with the horizontal. The coefficient of kinetic friction between the surface and the wheels of the car is μ_k.
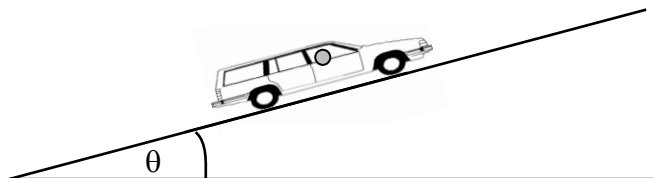
The magnitude of the frictional force acting on the car, can be calculated as …

A $F_A - \mu_k mg \cos\theta$.

B $\mu_k mg \sin\theta - F_A$.

C $\mu_k mg \sin\theta$.

D $\mu_k mg \cos\theta$. (2)

1.5 The diagram below shows two forces F_1 and F_2 of magnitudes 30 N and 40 N respectively, acting on a crate at point **O** as shown below.
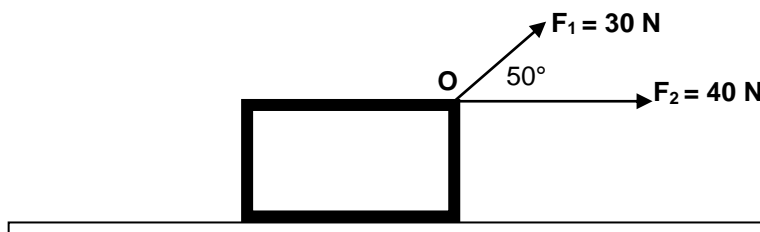
How will the magnitude of the components of F_1 and the resultant force change if the angle is reduced to 30°?

	Horizontal component of F_1	Vertical component of F_1	Resultant of F_1 and F_2
A	decreases	increases	increases
B	increases	decreases	increases
C	increases	decreases	decreases
D	increases	increases	decreases

(2)

1.6 Which ONE of the following best describes the bond formed between an
H$^+$ ion and a NH_3 molecule?

A Covalent bond

B Dative covalent bond

C Ionic bond

D Hydrogen bond (2)

1.7 Which ONE of the following best explains why real gases liquefy?

A Real gases can exist at very low temperatures.

B The volume of the molecules of real gases is not zero.

C There are forces of repulsion between molecules of real gases.

D There are forces of attraction between molecules of real gases. (2)

1.8 A certain mass of an ideal gas is heated and the corresponding changes
in pressure (p), volume (V), and temperature (T) are recorded.

Which ONE of the following graphs shows the correct relationship
between p, V and T?
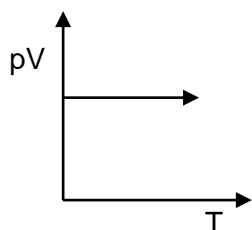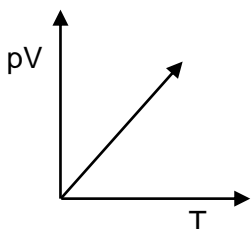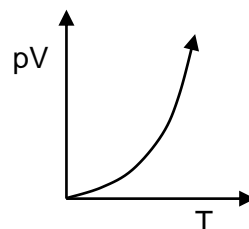
(2)

1.9 The boiling points of three compounds are shown in the table below.

Compound	Boiling point (°C)
H_2O	100
H_2S	-61
H_2Se	-42

Which ONE of the following statements is TRUE?

A H_2Se has the lowest boiling point because it has the smallest molecular mass.
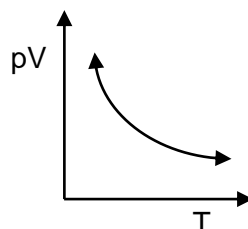
B H_2O has the highest boiling point because of the hydrogen bonding between the molecules.

C H_2Se has a lower boiling point than H_2O because it has the strongest intermolecular forces.

D H_2O has the highest boiling point because it has the largest molecular size. (2)

1.10 A ray of light bends away from the normal when passing from glass into ice.

Which ONE of the following statements is TRUE?

The refractive index of …

A glass is greater than that of ice.

B ice is greater than that of a glass.

C glass is equal to that of ice.

D glass is comparable to that of ice. (2)

[20]

QUESTION 2

The diagram below (not drawn to scale) shows four forces acting at a fixed point *O*.
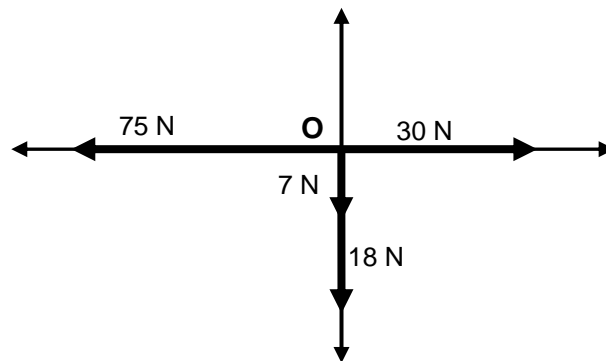
2.1   Define the term *resultant*.   (2)

2.2   Calculate the magnitude and direction of the resultant of the:

       2.2.1   Two horizontal forces   (2)

       2.2.2   Two vertical forces   (2)

2.3   Determine by means of an accurate scale drawing the magnitude and the
        direction of the resultant force of the forces calculated in QUESTION 2.2.1
        and 2.2.2.
        Use a scale of 10 mm = 10 N   (6)
                                                                              [12]

QUESTION 3

Thabiso pulls a 10 kg block, attached to a 5 kg block by a light, inextensible string
of negligible mass, with a force of 50 N at an angle of 30° with the horizontal as
shown below. The 10 kg block experiences a kinetic frictional force of 20 N. The
coefficient of kinetic friction between the surface and the 5 kg block is 0,2.
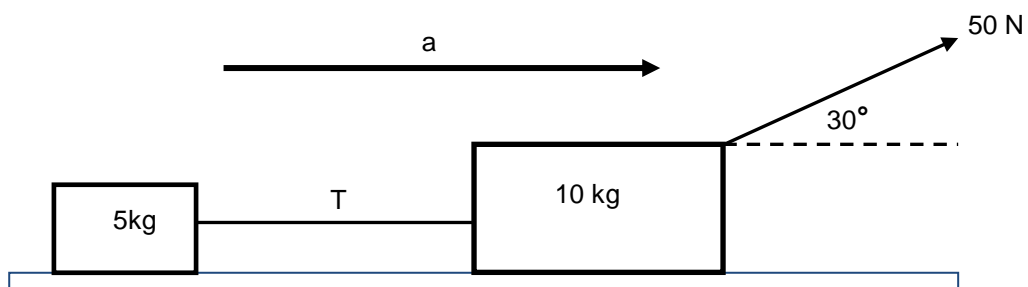
3.1   State *Newton's Second Law of Motion* in words.   (3)

3.2   Draw a labelled free body diagram showing all the forces acting on the
        10 kg block.

        Note: No components of forces may be used in the diagram.   (5)

3.3   Calculate the magnitude of the:

3.3.1   Normal force exerted on the 10 kg block   (4)

3.3.2   Acceleration of the blocks   (7)

3.3.3   Tension in the string   (2)

3.4   How will the magnitude of the normal force calculated in QUESTION 3.3.1 be affected if the angle between the applied force and the horizontal decreases? Choose from INCREASES, DECREASES or REMAINS THE SAME. Explain your answer.   (3)

3.5   Use Physics principles to explain why it is very dangerous when children are not secured in a child's car seat when travelling by car.   (3)

[27]

QUESTION 4

A satellite of mass 500 kg orbit the earth as shown in the diagram below. The earth exerts a force of 250 N on the satellite.
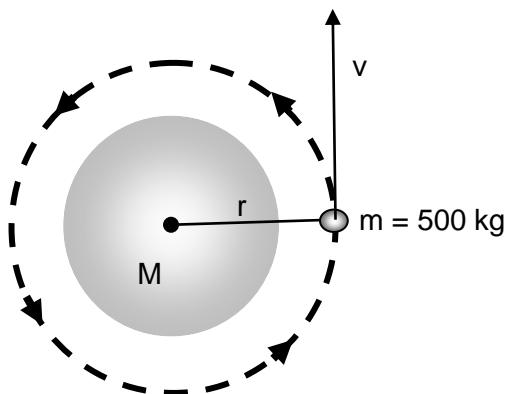
4.1   State *Newton's Law of Universal Gravitation* in words.   (3)

4.2   A learner argues that the Earth exerts a bigger force on the satellite because it has a larger mass.

        NAME and STATE the law that you can use to clarify the learner's misconception.   (3)

4.3   Calculate the distance of the satellite above the surface of the earth.   (5)

[11]

QUESTION 5

The diagram below shows light travelling from air into a transparent rectangular perspex block.
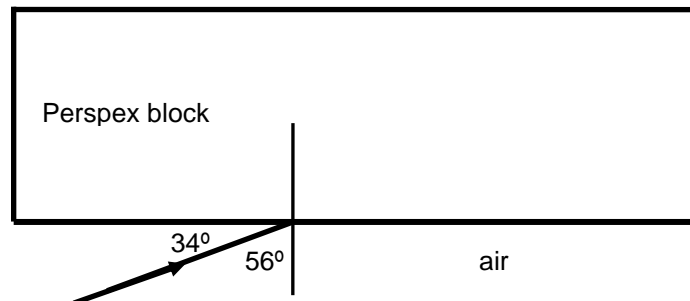
5.1 State *Snell's Law in words.*

See last page for additional information for question 5.2. (2)

5.2 Calculate the refractive index of the Perspex block. (3)

5.3 Redraw the above diagram in your ANSWER BOOK. Complete the diagram showing the path of the light ray as it enters and leaves the Perspex block. Fully label the diagram. (The diagram does not need to be drawn to scale.) (6)

5.4 If the refractive index of water and Perspex are 1,33 and 1,5 respectively, how will the speed of light in water compare to that in Perspex? Choose from GREATER THAN, SMALLER THAN OR EQUAL TO. Explain the answer. (4)

5.5 Calculate the speed of light in glass if the refractive index of glass is 1,52. (4)

[19]

QUESTION 6

A learner investigates the change in broadness of the central bright band in a diffraction pattern when light passes through single slits of different widths. She uses monochromatic violet light of wavelength 4×10^{-7} m. The apparatus is set up as shown in the diagram below.
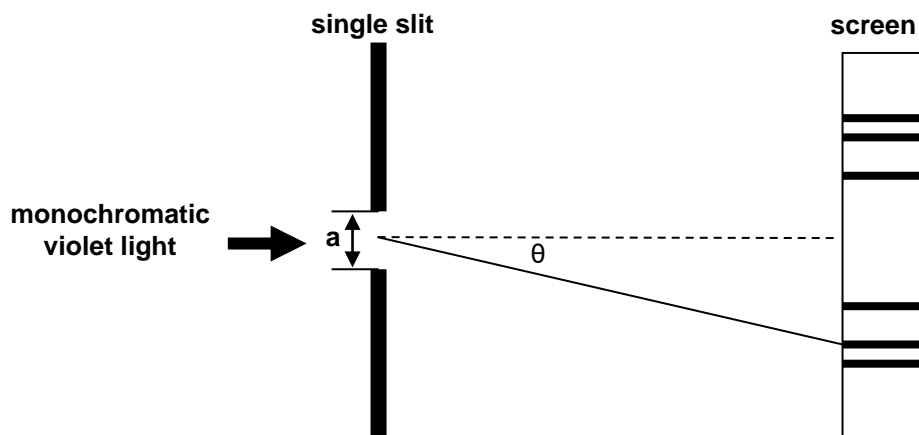
6.1   Define the term *diffraction*.   (2)

6.2   What nature of light is demonstrated by diffraction?   (1)

6.3   Write down the investigative question for this investigation.   (2)

6.4   Write down TWO variables that are kept constant during this investigation. (2)

6.5   Describe the diffraction pattern that will be observed on the screen.   (2)

6.6   The learner now uses a NARROWER slit.

         How will the broadness of the central bright band change? Choose from INCREASES, DECREASES or REMAINS THE SAME. Give a reason for the answer.   (2)

[11]

QUESTION 7

The potential energy graph represents the formation of a chemical bond.
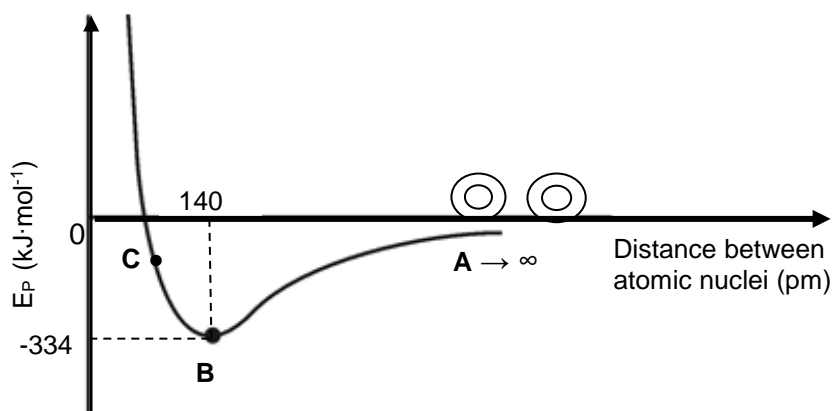
7.1 Explain why the potential energy of the system decreases as shown in the graph. (2)

7.2 At which point, **A** or **B**:

7.2.1 Are the atoms the furthest apart?
Give a reason for the answer by referring to the potential energy. (2)

7.2.2 Is the molecule formed?
Give a reason for the answer. (2)

7.3 From the above graph, write down the value and unit of the:

7.3.1 Bond length (1)

7.3.2 Bonding energy (1)

7.4 Explain the change in energy from point **B** to point **C** on the graph. (2)
[10]

QUESTION 8

8.1   Define the term *molecule*.   (2)

8.2   Write down the type of chemical bond between particles in:

       8.2.1 HF   (1)

       8.2.2 CaF_2 (1)

8.3   Is the bond in the HF molecule POLAR or NON-POLAR? Support your
       answer with a relevant calculation.   (3)

8.4   Use the VSEPR theory to predict the geometrical shape of the following
       molecules:

       8.4.1 H_2O (1)

       8.4.2 BF_3 (1)

       8.4.3 PF_5 (1)

       8.4.4 CH_4 (1)
                                                                                         [11]

QUESTION 9

The boiling points of three compounds (**A, B** and **C**) are shown in the table below.

	Compounds	Boiling point (°C)
A	CH_4	-161,5
B	HCℓ	-85,1
C	H_2O	100

9.1.   Define the term *boiling point*.   (2)

9.2   Identify the type of intermolecular force in compound **A.**   (1)

9.3   Refer to the type of intermolecular forces and energy to explain the
       difference in boiling point between compound **B** and compound **C**.   (4)

9.4   What is the relationship between vapour pressure and boiling point?   (1)

9.5   Which compound, **A** or **B**, has the highest vapour pressure? Explain the
       answer by referring to intermolecular forces and energy.   (3)
                                                                                         [11]

QUESTION 10

During an experiment to investigate the relationship between volume and pressure of a given mass of oxygen gas at constant temperature, the following results were obtained.

Pressure (kPa)	Volume (m³)	$\dfrac{1}{\text{volume}}$ (m⁻³)
50	0,40	a
100	0,20	b
150	0,133	7,5
200	0,10	10

10.1 Name the gas law that is investigated. (1)

10.2 Two values of $\dfrac{1}{\text{volume}}$ in the table above, (a) and (b) was not calculated.

   Calculate these values. (1)

10.3 ON THE ATTACHED GRAPH SHEET, draw a graph of pressure against $\dfrac{1}{\text{volume}}$. Label the axes, plot the points and draw the line of best fit.

   Use the following scale: x axis: 10 blocks = 2 m⁻³
   y axis: 10 blocks = 50 kPa (5)

10.4 Write down a mathematical expression for the relationship between pressure and volume at constant temperature as illustrated in the graph. (1)

10.5 Use the graph to determine the volume of the gas at 160 kPa. (2)

10.6 Calculate the temperature (in °C) of the oxygen gas if there was exactly 173,8 g of oxygen gas. (6)

10.7 Explain how the gradient of the graph will change at higher temperatures. (2)

[18]

GRAND TOTAL: 150

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·s^{-2}
Gravitational constant Swaartekragkonstante	G	$6,67 \times 10^{-11}$ N·m^2·kg^{-2}
Coulomb's constant Coulomb se konstante	k	$9,0 \times 10^9$ N·m^2·C^{-2}
Speed of light in a vacuum Spoed van lig in 'n vakuum	c	$3,0 \times 10^8$ m·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 Earth *Massa van Aarde*	M	$5,98 \times 10^{24}$ kg
Radius of Earth *Radius van Aarde*	R_E	$6,38 \times 10^6$ m

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/BEWEGING

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

FORCE / *KRAG*

$F_{net} = ma$	$w = mg$
$F = \dfrac{Gm_1 m_2}{r^2}$	$f_{s(max)} = \mu_s N$
$f_k = \mu_k N$	

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

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

DATA FOR PHYSICAL SCIENCES GRADE 11
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
VRAESTEL 2 (CHEMIE)

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

NAME / *NAAM*	SYMBOL / *SIMBOOL*	VALUE / *WAARDE*
Molar gas volume at STP Molêre gasvolume by STD	V_m	$22,4\ dm^3 \cdot mol^{-1}$
Standard pressure Standaarddruk	p^{θ}	$1,013 \times 10^5\ Pa$
Standard temperature Standaardtemperatuur	T^{θ}	$273\ K$
Molar gas constant Molêre gaskonstante	R	$8,31\ J \cdot K^{-1} \cdot mol^{-1}$

TABLE 2: FORMULAE / *TABEL 2: FORMULES*

$\dfrac{p_1 V_1}{T_1} = \dfrac{p_2 V_2}{T_2}$	$pV = nRT$
$n = \dfrac{m}{M}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

KEY/*SLEUTEL*

Atomic number
Atoomgetal

29
1,9 **Cu**
63,5

Electronegativity
Elektronegatiwiteit

Symbol
Simbool

Approximate relative atomic mass
Benaderde relatiewe atoommassa

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
2,1 **1 H** 1																	2 **He** 4
1,0 **3 Li** 7	1,5 **4 Be** 9											2,0 **5 B** 11	2,5 **6 C** 12	3,0 **7 N** 14	3,5 **8 O** 16	4,0 **9 F** 19	**10 Ne** 20
0,9 **11 Na** 23	1,2 **12 Mg** 24											1,5 **13 Aℓ** 27	1,8 **14 Si** 28	2,1 **15 P** 31	2,5 **16 S** 32	3,0 **17 Cℓ** 35,5	**18 Ar** 40
0,8 **19 K** 39	1,0 **20 Ca** 40	1,3 **21 Sc** 45	1,5 **22 Ti** 48	1,6 **23 V** 51	1,6 **24 Cr** 52	1,5 **25 Mn** 55	1,8 **26 Fe** 56	1,8 **27 Co** 59	1,8 **28 Ni** 59	1,9 **29 Cu** 63,5	1,6 **30 Zn** 65	1,6 **31 Ga** 70	1,8 **32 Ge** 73	2,0 **33 As** 75	2,4 **34 Se** 79	2,8 **35 Br** 80	**36 Kr** 84
0,8 **37 Rb** 86	1,0 **38 Sr** 88	1,2 **39 Y** 89	1,4 **40 Zr** 91	**41 Nb** 92	1,8 **42 Mo** 96	1,9 **43 Tc**	2,2 **44 Ru** 101	2,2 **45 Rh** 103	2,2 **46 Pd** 106	1,9 **47 Ag** 108	1,7 **48 Cd** 112	1,7 **49 In** 115	1,8 **50 Sn** 119	1,9 **51 Sb** 122	2,1 **52 Te** 128	2,5 **53 I** 127	**54 Xe** 131
0,7 **55 Cs** 133	0,9 **56 Ba** 137	**57 La** 139	1,6 **72 Hf** 179	**73 Ta** 181	**74 W** 184	**75 Re** 186	**76 Os** 190	**77 Ir** 192	**78 Pt** 195	**79 Au** 197	**80 Hg** 201	1,8 **81 Tℓ** 204	1,8 **82 Pb** 207	1,9 **83 Bi** 209	2,0 **84 Po**	2,5 **85 At**	**86 Rn**
0,7 **87 Fr**	0,9 **88 Ra** 226	**89 Ac**															

58 Ce 140	59 Pr 141	60 Nd 144	61 Pm	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175
90 Th 232	91 Pa	92 U 238	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

NAME:	
CLASS:	

QUESTION 10.3

Submit this GRAPH SHEET with the ANSWER BOOK.

Pressure (kPa)	Volume (m³)	$\dfrac{1}{volume}$ (m⁻³)
50	0,40	a
100	0,20	b
150	0,133	7,5
200	0,10	10
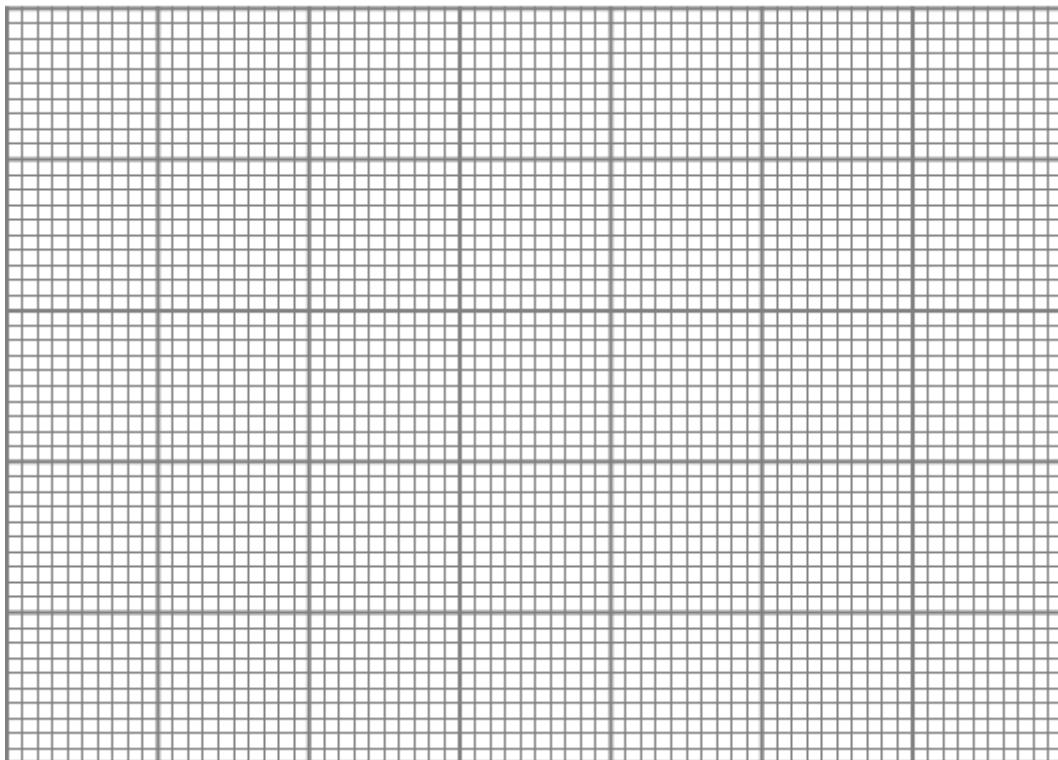
PHYSICAL SCIENCES JUNE 2016 EXAM ERRATA 1

GRADE 11 JUNE 2016 EXAM

5.2 Calculate the refractive index of the Perspex block. The angle of refraction is 35° and the refractive index of air is 1. (3)

FISIESE WETENSKAPPE JUNIE-EKSAMEN ERRATA 1

GRAAD 11 JUNIE 2016 EKSAMEN

5.2 Bereken die brekingsindeks van die perspeksblok. Die brekingshoek is 35° en die brekingsindeks van lug is 1. (3)