education

Department of Education
FREE STATE PROVINCE

EXAMINATION

GRADE 11

PHYSICAL SCIENCES

JUNE 2018

MARKS: 150

TIME: 3 HOURS

This paper consists of 11 pages and three information sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name and other applicable information in the appropriate spaces on the ANSWER BOOK.

2. The question paper consists of 10 questions. Answer ALL the 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 sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable pocket 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 where applicable.

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

12. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are given as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write down only the letter A, B, C or D next to the question number (1.1 – 1.10) in your ANSWER BOOK.

1.1 A learner is riding his bicycle when the front wheel hits a pothole. The bicycle stops immediately, but the learner flies over the handlebar. Which one of Newton's laws plays the dominant role that causes the learner to keep on moving forward?

A First law of motion

B Third law of motion

C Second law of motion

D Law of universal gravitation (2)

1.2 Tsholo, while standing in a lift, observes a 10 N mass piece suspended from a spring balance fixed to the roof of the lift. He sees that the reading on the spring balance is LESS than 10 N for a short period.

During this short period, the lift is …

A not moving.

B accelerating upwards.

C accelerating downwards.

D moving at a constant velocity. (2)

1.3 The frictional force acting on a sliding object by the surface in contact with it ...

A depends on air resistance.

B depends on the normal force.

C depends on the area of contact.

D does not depend on the type of surface. (2)

1.4 The gravitational force of the earth on a communication satellite above the earth is *F* when their centres are a distance *r* apart. Which one of the following represents the gravitational force on the satellite if the distance between their centres is changed to $\frac{3}{4}r$?

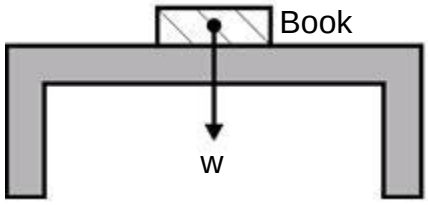
A $\frac{16}{9}F$

B $\frac{4}{3}F$

C $\frac{3}{4}F$

D $\frac{9}{16}F$ (2)

1.5 A book rests on a horizontal table as shown in the following diagram. The force *w* represents the weight of the book.



Which one of the following is part of the action-reaction force pair, according to Newton's third law of motion, of the weight of the book?

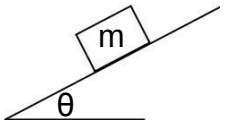
A Force of book on table

B Force of book on Earth

C Force of table on book

D Force of Earth on book (2)

1.6 A block, mass *m*, rests on a slope inclined at an angle θ with the horizontal. Which one of the following expressions represents the magnitude of the frictional force on the block?



A *m*

B *mg*cosθ

C *mg*sinθ

D *mg*tanθ (2)

1.7 What is the shape of aluminium chloride according to the VSEPR theory?

A Trigonal bipyramidal

B Trigonal pyramidal

C Trigonal planar

D Tetrahedral (2)

1.8 What happens to each of the following combinations if the number of bonds between two atoms increases?

	Bond length	**Bond strength**
A	Increase	Increase
B	Decrease	Decrease
C	Unchanged	Increase
D	Decrease	Increase

(2)

1.9 A certain mass of enclosed gas occupies a volume *V* at pressure *p* and temperature *T*. What is the volume of the gas at pressure 2*p* and temperature $\frac{1}{2}T$?

A 4V

B V

C ½V

D ¼V (2)

1.10 Which one of the following is NOT a property of the ideal gas?

A There are no forces of attraction between the molecules.

B The collisions between molecules are entirely elastic.

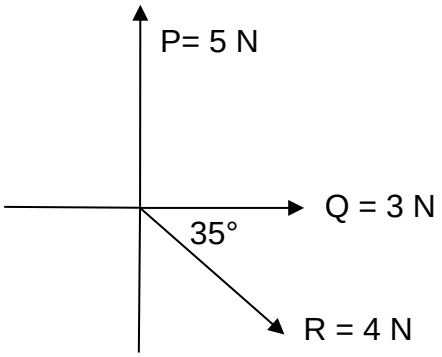
C The volume occupied by the gas is equal to the total volume of the gas molecules.

D The product of the pressure and volume of the gas is constant at a constant temperature. (2)

[20]

QUESTION 2

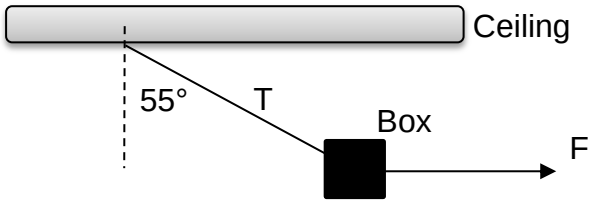
2.1 Three forces, **P**, **Q** and **R**, with magnitudes of 5 N, 3 N and 4 N respectively, are acting on an object in the same Cartesian plane.



2.1.1 Why do we classify a force as a vector? (2)

2.1.2 Calculate the magnitude and direction of the resultant of **P**, **Q** and **R**. Give the direction as an acute angle with respect to the positive x-axis. (7)

2.2 A box, weight 60 N, is suspended from the ceiling by a string. A horizontal force *F* is then applied to the box to keep it in EQUILIBRIUM when the string makes an angle of 55° with the vertical. The tension in the string is *T*.



2.2.1 Explain what is meant if the box is in equilibrium. (2)

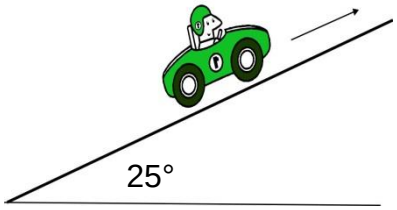
2.2.2 Draw a triangle of the three forces *T*, *F* and *w* by using the tail-to-head method. It is not necessary to construct the triangle. Clearly label the three forces and the 55° angle. (3)

2.2.3 Calculate the magnitudes of *F* and *T*. (4)

[18]

QUESTION 3

A car with a mass of 350 kg is accelerated up along a straight hill by a NET force of 370 N. The net force is parallel to the hill, which makes an angle of 25° with the horizontal. The coefficient of kinetic friction is 0,23.



3.1 Draw a FORCE DIAGRAM, with labels, of all the forces acting on the car. (4)

3.2 Calculate the magnitude of the:

3.2.1 Acceleration of the car (3)

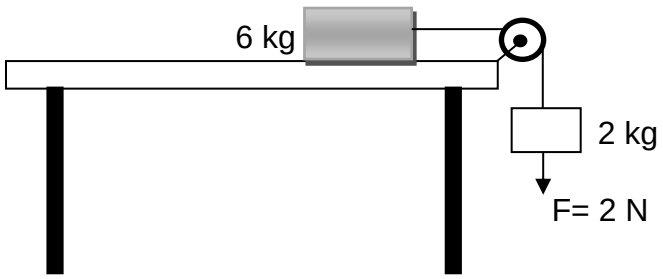
3.2.2 Force of friction on the car (4)

3.2.3 Applied force on the car (4)

[15]

QUESTION 4

A 6 kg block on a horizontal, rough surface is connected to a 2 kg block by a light, inelastic string running over a frictionless pulley. A downward force *F* of 2 N is applied to the 2 kg block as indicated in the diagram below. When the 6 kg block is moving the right, the magnitude of the force of friction on the block is 11,76 N.



4.1 Write down *Newton's second law of motion* in words. (3)

4.2 Calculate the magnitude of the:

4.2.1 Acceleration of the 6 kg block (5)

4.2.2 Tension in the string (2)

4.3 How would it affect the acceleration calculated in QUESTION 4.2.1 if the 6 kg block was placed on a SMOOTH surface? Choose your answer from INCREASE, DECREASE or REMAIN THE SAME. (1)

[11]

QUESTION 5

5.1 A small, hypothetical planet **X** has a mass of $6,5 \times 10^{20}$ kg and a radius of $5,5 \times 10^{5}$ m. Calculate the approximate magnitude of the gravitational force that **X** exerts on a 90 kg rock that lies on the surface of **X**. (4)

5.2 A satellite, mass 250 kg, is in a circular orbit a certain height above the surface of the earth. The earth exerts a gravitational force of $2,4 \times 10^{3}$ N on the satellite to keep it in its orbit.

5.2.1 Write down *Newton's law of universal gravitation* in words. (3)

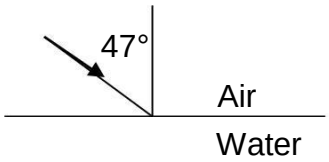
5.2.2 Calculate the height, in km, of the satellite above the surface of the earth. (5)

[12]

QUESTION 6

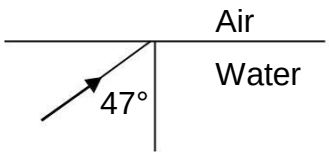
6.1 A light ray strikes an air-water surface at an angle of 47° with respect to the normal. The refractive indices of air and water are 1,00 and 1,33 respectively.

6.1.1 Calculate the angle of refraction when the direction of a light ray is from air to water.



(4)

6.1.2 Calculate the angle of refraction when the direction of a light ray is from water to air.



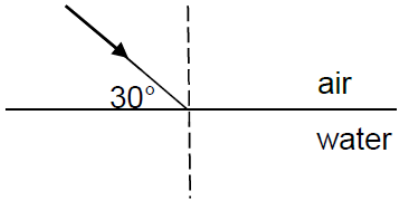
(3)

6.1.3 Calculate the speed of light in water. (3)

6.2 Calculate the critical angle of water when it is in contact with air. (2)

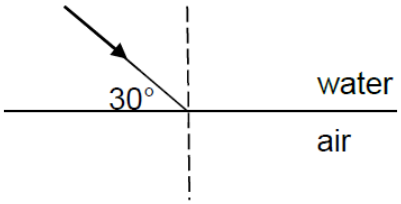
6.3 Redraw the following diagrams in your answer book and complete them.

6.3.1



(2)

6.3.2



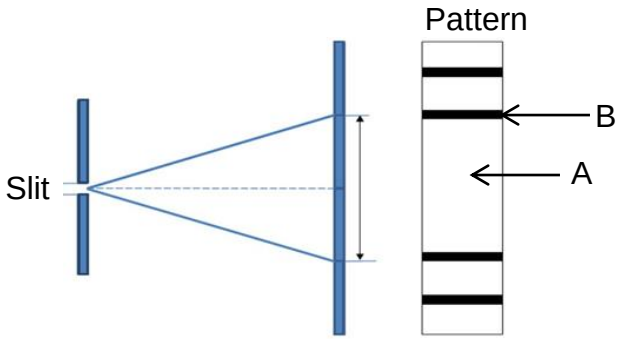
(2)

6.4 Give TWO uses of optical fibre. (2)

[18]

QUESTION 7

Light with a wavelength of 760 nm passes through a slit with a width of 8 x 10^{-6} m and forms a diffraction pattern on a screen as shown in the diagram.



7.1 Write down the *Huygens' principle* in words. (2)

7.2 What is observed on the screen indicated by the letters **A** and **B**? (2)

7.3 Which one of **A** or **B** is the result of constructive interference? (1)

7.4 How will the broadness of the central band be influenced if the following changes are made? Choose your answer from BROADER, NARROWER or STAYS THE SAME.

7.4.1 Light with a wavelength of 900 nm is used. (2)

7.4.2 A narrower slid is used. (2)

7.5 Give a reason for your answer to QUESTION 7.4.1. (2)

[11]

QUESTION 8

8.1 The table below shows molecules and their bond energies measured in kilojoule per mole.

Molecules	Bond energy ($kJ \cdot mol^{-1}$)
F-F	158
Br-Br	193
H-H	436
H-F	565
H-Br	365

8.1.1 Define the term *bond energy*. (2)

8.1.2 Which molecule has the strongest bond? Give a reason for your answer. (2)

8.2 Ammonia (NH_3) is an important chemical in the industry. It is prepared from hydrogen gas (H_2) and nitrogen gas (N_2).

8.2.1 What type of interatomic bond exists in NH_3? (1)

8.2.2 Draw the Lewis structure for an ammonia molecule. (2)

8.2.3 Define the term *electronegativity*. (2)

8.2.4 Is NH_3 polar or non-polar? Explain your answer. (2)

8.2.5 How many lone pairs of electrons are there in one ammonia molecule? (1)

8.2.6 What is the shape of the ammonia molecule? (2)

[14]

QUESTION 9

Consider the following substances with their formulae and approximate boiling points at atmospheric pressure.

Name	Formula	Boiling point (°C)
Iodine	I_2	184
Water	H_2O	100
Ethanol	CH_3CH_2OH	78
Bromine	Br_2	59
Hydrogen bromide	HBr	-67

9.1 Explain the difference in boiling points between the following substances by referring to the relevant intermolecular forces and their influence.

9.1.1 H_2O and HBr (4)

9.1.2 Iodine and bromine (4)

9.2 Can ethanol dissolve in water? Choose from YES or NO. (1)

9.3 Explain your answer to QUESTION 9.2 by referring to intermolecular forces. (3)

9.4 Hydrogen bromide has the highest vapour pressure of the substances in the table.

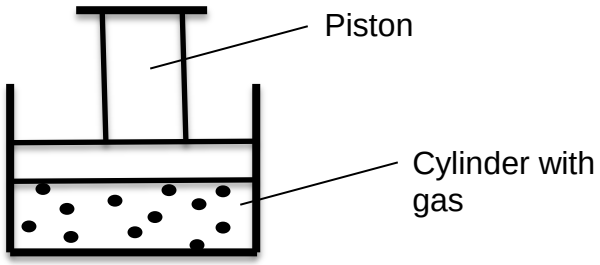
9.4.1 Define the term *vapour pressure*. (2)

9.4.2 Briefly explain why its vapour pressure is the highest. (2)

[16]

QUESTION 10

10.1 The diagram below represents a piston in a cylinder. The piston is able to move up and down.



A gas is trapped in the cylinder at a pressure and temperature of 101,3 kPa and 35°C respectively when the volume is 100 cm^3. Calculate:

10.1.1 How many moles of gas are trapped in the cylinder? (5)

10.1.2 The pressure of the gas when the temperature and volume are 311°C and 200 cm^3 respectively (5)

10.2 Explain, in terms of the kinetic model of gases, how the gas in the cylinder exert pressure. (3)

10.3 Name two conditions where real gases deviate from the ideal gas behaviour. (2)

[15]

GRAND TOTAL: 150

DATA FOR PHYSICAL SCIENCES GRADE 11
(Physics)
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
(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} $N \cdot m^2 \cdot kg^{-2}$
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 Earth *Massa van Aarde*	M	5,98 x 10^{24} kg
Radius of Earth *Radius van Aarde*	r_E	6,38 x 10^6 m

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

MOTION/BEWEGING

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

FORCE / *KRAG*

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

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

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

DATA FOR PHYSICAL SCIENCES GRADE 11
(Chemistry)
GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 11
(Chemie)

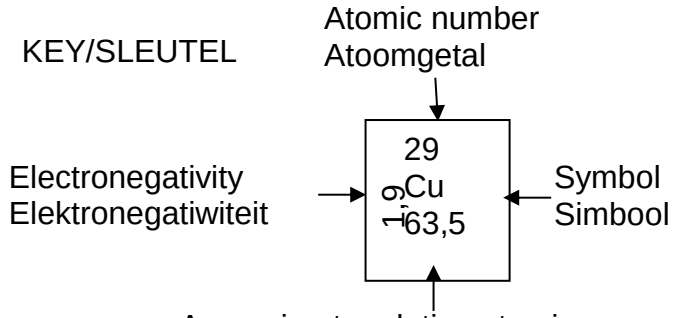
TABLE 1: PHYSICAL CONSTANTS / *TABEL 1: FISIESE KONSTANTES*

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 x 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*

$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$	$pV = nRT$
$n = \frac{m}{M}$	

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



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 H 1																	2 He 4
1,0 Li 7	1,5 Be 9											2,0 B 11	2,5 C 12	3,0 N 14	3,5 O 16	4,0 F 19	10 Ne 20
0,9 Na 23	1,2 Mg 24											1,5 Aℓ 27	1,8 Si 28	2,1 P 31	2,5 S 32	3,0 Cℓ 35,5	18 Ar 40
0,8 K 39	1,0 Ca 40	1,3 Sc 45	1,5 Ti 48	1,6 V 51	1,6 Cr 52	1,5 Mn 55	1,8 Fe 56	1,8 Co 59	1,8 Ni 59	1,9 Cu 63,5	1,6 Zn 65	1,6 Ga 70	1,8 Ge 73	2,0 As 75	2,4 Se 79	2,8 Br 80	36 Kr 84
0,8 Rb 86	1,0 Sr 88	1,2 Y 89	1,4 Zr 91	Nb 92	1,8 Mo 96	1,9 Tc	2,2 Ru 101	2,2 Rh 103	2,2 Pd 106	1,9 Ag 108	1,7 Cd 112	1,7 In 115	1,8 Sn 119	1,9 Sb 122	2,1 Te 128	2,5 I 127	54 Xe 131
0,7 Cs 133	0,9 Ba 137	La 139	1,6 Hf 179	Ta 181	W 184	Re 186	Os 190	Ir 192	Pt 195	Au 197	Hg 201	1,8 Tℓ 204	1,8 Pb 207	1,9 Bi 209	2,0 Po	2,5 At	Rn
0,7 Fr	0,9 Ra 226	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