education

Department of Education
FREE STATE PROVINCE

EXAMINATION

GRADE 11

PHYSICAL SCIENCES (PHYSICS AND CHEMISTRY)

JUNE 2017

MARKS: 150

TIME: 3 HOURS

This paper consists of 12 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 TEN (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 necessary.

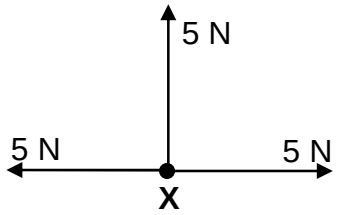
11. Give brief motivations, discussions, et cetera where required.

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 only the letter A, B, C or D next to the question number (1.1 – 1.10) in your ANSWER BOOK.

1.1 Three forces, each with a magnitude of 5 N, act on object **X** as shown below.



The equilibrant of all the forces acting on object **X** is …

A zero.

B 5 N to the left.

C 5 N upwards.

D 5 N downwards. (2)

1.2 Newton's first law of motion states that …

A the net force acting on a body depends on its mass and acceleration.

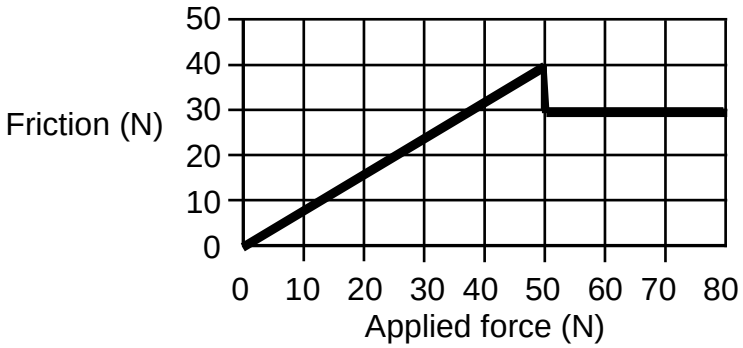
B the change in velocity of a body is constant if a constant force acts on it.

C the velocity of a body remains constant unless a resultant force acts upon it.

D for every force there is an equal, but opposite reaction force. (2)

1.3 A box with a weight of 100 N rests on a horizontal floor. A horizontal force is applied to the box and increased until the box starts to move. Use the information on the graph to determine the coefficient of static friction.

Graph of friction versus applied force



A $\frac{40-30}{40}$

B $\frac{30}{100}$

C $\frac{40}{100}$

D $\frac{40-20}{50-25}$ (2)

1.4 A loaded elevator with worn cables has a total mass of 2 000 kg. The cables can withstand a maximum tension of 24 000 N. What would be the maximum upward acceleration, in $m \cdot s^{-2}$, if the cables of the elevator are not to break?

A	B	C	D
$a=\frac{2000}{24000}$	$a=\frac{24000-2000x9,8}{2000}$	$a=\frac{24000}{2000}$	$a=\frac{24000+2000x9,8}{2000}$

(2)

1.5 If the same elevator, as in QUESTION 1.4, is operating on the moon where g = 1,62 $m \cdot s^{-2}$, what would be the maximum upward acceleration, in $m \cdot s^{-2}$, if the cables of the elevator are not to break?

A	B	C	D
$a=\frac{2000x1,62}{24000}$	$a=\frac{24000}{2000x1,62}$	$a=\frac{24000-2000x1,62}{2000}$	$a=\frac{24000+2000x1,62}{2000}$

(2)

1.6 Which one of the following phenomena provides the most conclusive evidence for the wave nature of light?

A Diffraction

B Reflection

C Refraction

D Interference (2)

1.7 Which one of the following molecules is non-polar, but have polar interatomic covalent bonds?

A $NC\ell_3$

B CH_4

C $C\ell_2$

D H_2O (2)

1.8 The boiling point of HF is much higher than the boiling point of HCℓ, because the hydrogen bonds between the …

A HF molecules are stronger than the hydrogen bonds between the HCℓ molecules.

B HCℓ molecules are stronger than the hydrogen bonds between the HF molecules.

C HF molecules are stronger than the dipole-dipole forces between the HCℓ molecules.

D HCℓ molecules are stronger than the dipole-dipole forces between the HF molecules. (2)

1.9 When the kelvin temperature of an ideal gas in a closed, non-expandable container is doubled, the gas pressure exerted on the inside walls of the container will be …

A half.

B double.

C 4 times less.

D 4 times more. (2)

1.10 Which one of the following gases occupies the smallest volume at STP?

A 4 g of helium

B 32 g of oxygen

C 14 g of nitrogen

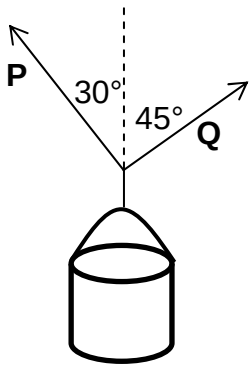
D 34 g of ammonia (2)
[20]

QUESTION 2

The grade 11 learners learn that there is more than one way to determine the resultant of two vectors. One way is the COMPONENT METHOD. They want to use THIS METHOD to find the resultant of the forces acting on a bucket by the ropes from which the bucket is suspended. The bucket is stationary.

2.1 Define the term *resultant*. (2)

2.2 The tension in rope **P** is 130 N at 30° to the vertical and the tension in **Q** is 91,92 N at 45° to the vertical.



Calculate the MAGNITUDE of the:

2.2.1 Horizontal components of **P** and **Q** respectively (4)

2.2.2 Vertical components of **P** and **Q** respectively (4)

2.2.3 Resultant of the horizontal components (1)

2.2.4 Resultant of the vertical components (1)

2.2.5 Resultant of the forces exerted by **P** and **Q** on the bucket (1)

2.3 Determine the MASS of the bucket. (3)
[16]

QUESTION 3

Naledi finds out that the normal force that acts on an object can differ depending on the situation it is placed in. She finds a wheelchair with a mass of 18 kg and decides to use it in different situations. She starts with the wheelchair on a horizontal surface.

3.1 Define *normal force*. (2)

3.2 Draw a free-body diagram, with labels, of all the forces acting on the wheelchair in the vertical plane when it is STATIONARY on the horizontal surface. (2)

3.3 Calculate the magnitude of the normal force on the wheelchair when it is stationary on the horizontal surface. (3)

3.4 How would the normal force, calculated in QUESTION 3.3, differ in the following situations? Write down only INCREASE, DECREASE or STAY THE SAME.

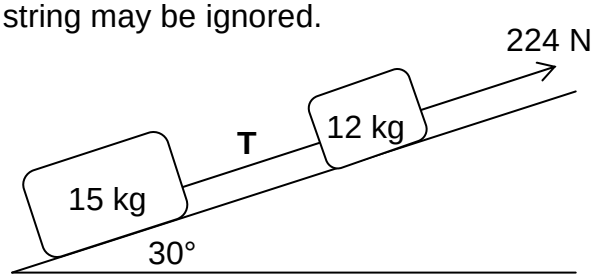
3.4.1 She pushes down on the wheelchair with a force of 100 N at an angle of 20° to the horizontal. (2)

3.4.2 She pulls the wheelchair with a force of 100 N at an angle of 20° to the horizontal. (2)

3.4.3 The wheelchair is stationary on an INCLINE of 30°. (2)
[13]

QUESTION 4

Two blocks with masses of 15 kg and 12 kg are connected by a light, inelastic string. They are pulled up an inclined plane by a force with a magnitude of 224 N. The incline makes an angle of 30° with the horizontal. The coefficient of kinetic friction for the 12 kg block is 0,11 and the frictional force experienced by the 15 kg block is 26,5 N. The mass of the string may be ignored.



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

4.2 Draw a free-body diagram showing ALL the forces acting on the 12 kg block. (5)

4.3 Calculate the magnitude of the:

4.3.1 Acceleration of the system (Write down separate equations for the two moving objects using Newton's second law of motion and then calculate the acceleration.) (8)

4.3.2 Tension in the string (2)

[18]

QUESTION 5

5.1 Give one word for the following:

5.1.1 The reaction force of the force that your book exerts on the desk. (1)

5.1.2 The resistance of an object to any change in its state of motion. (1)

5.1.3 The sensation experienced when all contact forces are removed, i.e. no external objects touches one's body. (1)

5.2 An astronaut stands on the surface of a planet, which has a radius of $2,6 \times 10^6$ m. The astronaut drops an object and it accelerates at 3,2 $m \cdot s^{-2}$. Ignore the effect of friction.

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

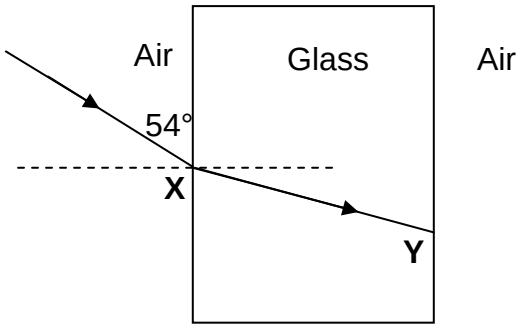
5.2.2 Determine the mass of the planet. (4)

5.2.3 Calculate the magnitude of the weight of an 18 kg mass, which is on the surface of this planet. (3)

[13]

QUESTION 6

6.1 Light travels from air through a window pane into a class room as shown below. The light travels from **X** to **Y** in the glass.



6.1.1 Define *refraction*. (3)

6.1.2 Calculate the angle of refraction at **X** if the refractive indices of air and glass are 1 and 1,52 respectively. (4)

6.1.3 What is the magnitude of the angle of incidence at **Y**? (1)

6.1.4 Would the light be reflected or refracted at **Y** if the critical angle of glass is 42°? Explain your answer. (2)

6.2 Optical fibres are very thin, flexible tubes made of special glass or transparent plastic.

6.2.1 Give ONE practical application of optical fibres. (1)

6.2.2 Which phenomenon takes place inside the optical fibres that enable light to move in them? (1)

6.3 Monochromatic green light is observed through a narrow, single slit.

6.3.1 Describe the pattern that is observed. (3)

6.3.2 Will the diffraction pattern be WIDER, NARROWER or THE SAME if the green light is replaced by yellow light? (1)

6.3.3 Explain your answer to QUESTION 6.3.2. (3)
[19]

QUESTION 7

7.1 Draw the following table in your answer book (allow sufficient space for QUESTION 7.1.1) and use it to compare NH_3 and BF_3 according to the criteria that follow below the table:

	NH_3	**BF_3**
7.1.1		
7.1.2		
7.1.3		
7.1.4		
7.1.5		
7.1.6		

7.1.1 Lewis diagrams (Draw each molecule's Lewis diagram.) (4)

7.1.2 Number of lone pairs (2)

7.1.3 Number of bonding pairs (2)

7.1.4 Polarity of each molecule as a whole (2)

7.1.5 Shape of each molecule (Give the shape of each.) (2)

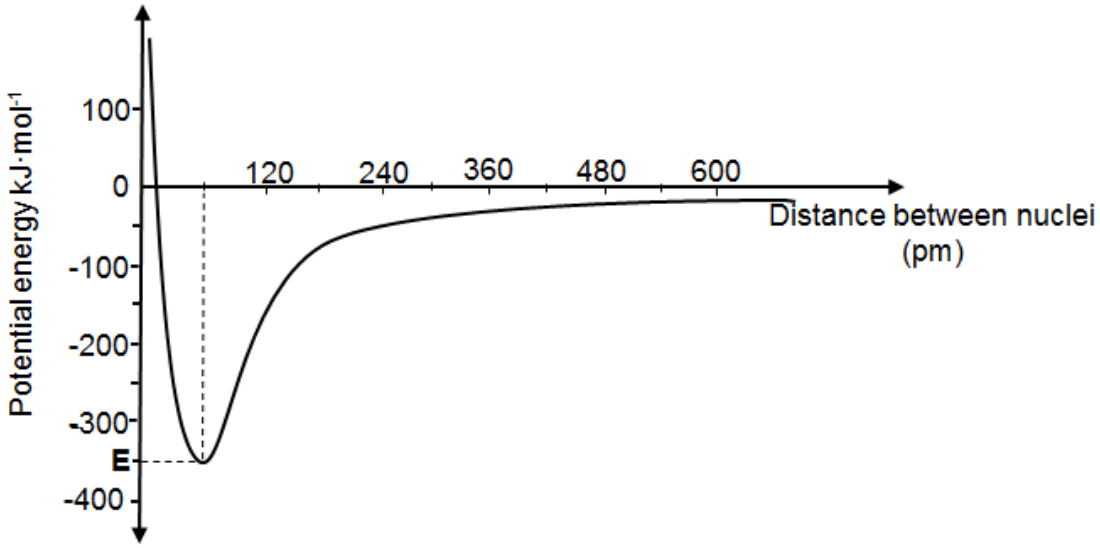
7.2 Explain the type of bond that forms between magnesium and oxygen using:

7.2.1 Electronegativity (3)

7.2.2 Lewis diagrams (3)
[18]

QUESTION 8

The following graph shows the change in potential energy as two atoms approach each other to bond.



8.1 Give a name for the:

8.1.1 Average distance between the nuclei of two bonded atoms (1)

8.1.2 Potential energy at **E** (1)

8.2 Question was withdrawn
~~What is the overall nature of the mutual forces the atoms exert on each other after they have bonded? Write down ATTRACTIVE or REPULSIVE and EXPLAIN your answer.~~ ~~(3)~~

8.3 Why does the potential energy have a negative value? (2)

8.4 Does the potential energy of the system INCREASE, DECREASE or REMAIN THE SAME if the atoms are less than 60 pm from each other? (1)

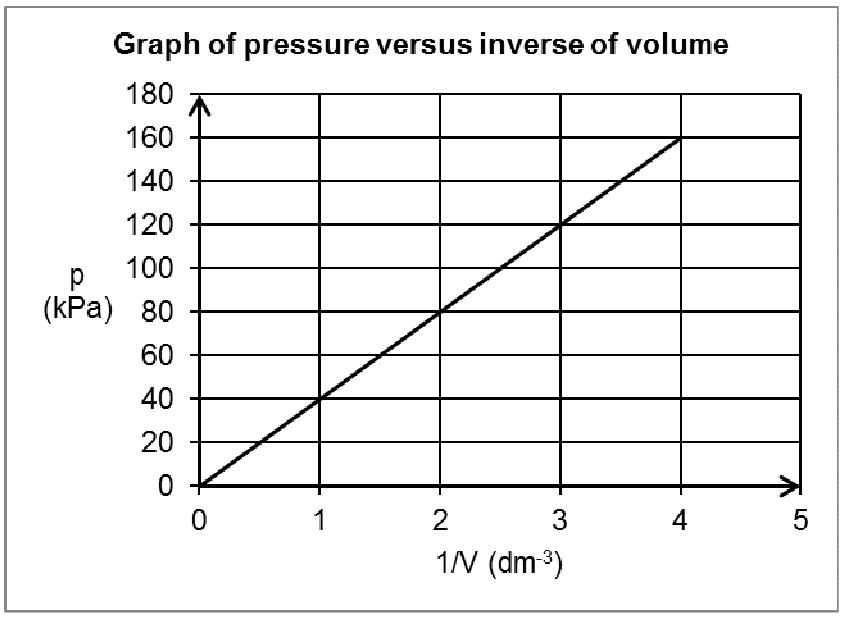
[5] ~~**[8]**~~

QUESTION 9

Ideal gases have simple equations which describe the relationship among *p*, *V* and *T*. There are basically four laws that explain this behaviour.

9.1 Write down Charles' law in words. (2)

9.2 The following graph was obtained in an experiment to investigate the relationship between the pressure and volume of an enclosed gas at constant temperature.



Use the graph to determine the:

9.2.1 Pressure of the gas, in kPa, when the volume is 0,25 dm^3 (2)

9.2.2 Volume of the gas, in dm^3, when the pressure is 80 kPa (2)

9.2.3 Gradient of the graph (3)

9.3 How would the gradient, calculated in QUESTION 9.2.3, be influenced if the experiment was done at a LOWER temperature? Write only INCREASE, DECREASE or STAY THE SAME. (1)

9.4 Give the name of the law that is illustrated by the graph and write down the relationship in symbols. (2)
[12]

QUESTION 10

10.1 A tank attached to an air compressor contains 3 360 cm^3 of oxygen gas (O_2) at a temperature of 30°C and pressure of 400 kPa.

10.1.1 Calculate the mass of oxygen gas in the tank. (7)

10.1.2 Explain, by using the kinetic molecular theory, what happens inside the tank if the temperature increases. (4)

10.2 Under which conditions do real gases deviate from the ideal gas behaviour? (2)
[13]

GRAND TOTAL: 147 ~~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 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 Po	2,5 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

KEY/SLEUTEL