education

Department of Education
FREE STATE PROVINCE

JUNE EXAMINATION

GRADE 11

PHYSICAL SCIENCES

JUNE 2025

MARKS: 150

TIME: 3 HOURS

This paper consists of 16 pages and 3 information sheets.

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INSTRUCTIONS AND INFORMATION

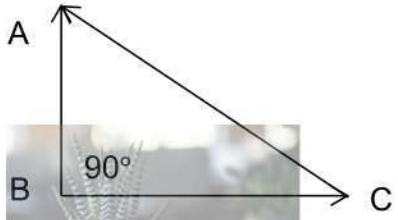
1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 10 questions. Answer ALL questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used 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.

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QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Four options are provided 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 Consider the following vector diagram:



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The vector which represents the resultant of the other two, is …

A AB

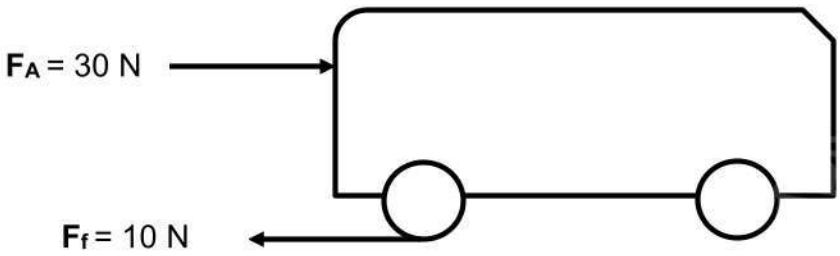
B AC

C CB

D BA

(2)

1.2 A boy is pushing a toy car towards the right with a force, F_A with a magnitude of 30 N. A frictional force, F_f of 10 N acts between the rough surface and the toy as indicated below.

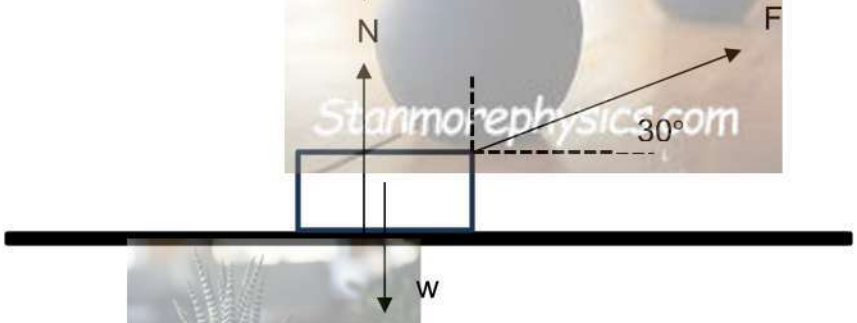


The Newton 3rd Law force acting on the boy by the toy is:

	FORCE	DIRECTION
A	0 N	No direction
B	10 N	To the right
C	20 N	To the right
D	30 N	To the left

(2)

1.3 An object is being pulled towards the right at a CONSTANT VELOCITY by a force **F** acting at an angle of 30° with the horizontal surface. The coefficient of kinetic friction is 0,1.



The magnitude of the frictional force(f_k) is …

A $f_k = 0{,}1(w - F)$

B $f_k = F\cos 30°$

C $f_k = 0{,}1(N - F\sin 30°)$

D $f_k = 0{,}1(F\cos 30°)$ (2)

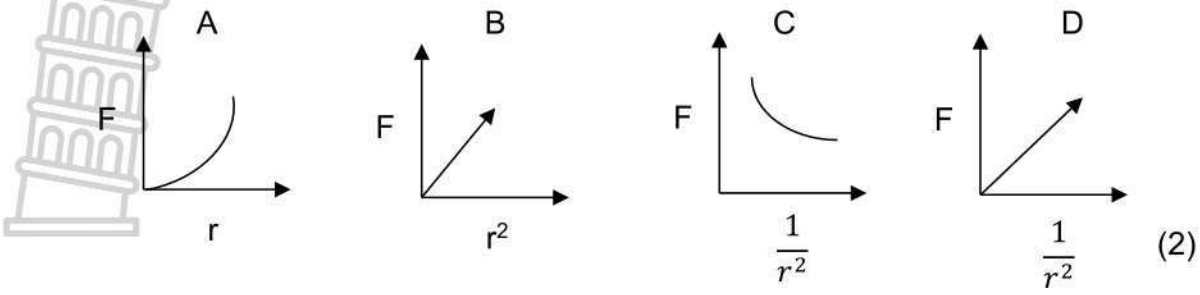
1.4 Two identical stationary charged particles, Q_1 with a charge of +4 nC and Q_2 with a charge of -6 nC, exert a force *F* on each other. The two particles are now allowed to make contact. Afterwards they are taken back to their original positions.

Which combination correctly describes the magnitude and direction of the new force the particles exert on each other compared to the original force?

	MAGNITUDE OF FORCE	DIRECTION OF FORCE
A	Smaller than *F*	Towards each other
B	Smaller than *F*	Away from each other
C	Greater than *F*	Towards each other
D	Greater than *F*	Away from each other

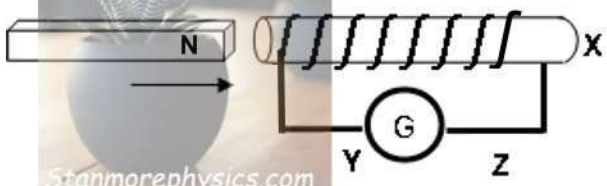
(2)

1.5 Which one of the following graphs correctly shows the relationship between the electrostatic force and distance between two charges in Coulomb's law?



(2)

1.6 In the following sketch the N-pole of a magnet is inserted into a coil.



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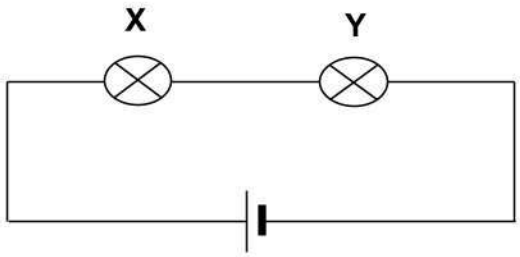
Which combination below is correct for the magnetic pole induced at point **X** and the direction of the induced current through the galvanometer between points **Y** and **Z**?

.

	Magnetic pole at X	**Direction of current through galvanometer**
A	N	Z to Y
B	N	Y to Z
C	S	Z to Y
D	S	Y to Z

(2)

1.7 The diagram below shows two light bulbs, **X** and **Y**, connected in series to a battery with negligible internal resistance.



If bulb **X** glows brighter than bulb **Y**, then the …

A current through bulb **X** is smaller than that through bulb **Y**.

B current through bulb **X** is greater than that through bulb **Y**.

C resistance of bulb **X** is smaller than that of bulb **Y**.

D resistance of bulb **X** is greater than that of bulb **Y**. (2)

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1.8 Electric lamps **A** and **B** are marked: **A**: 100 W; 200 V and **B**: 100 W; 100 V

Which statement is correct regarding the power dissipated by **A** and **B**?

A $P_A = \frac{1}{4} P_B$

B $P_A = P_B$

C $P_A > P_B$

D $P_A = 2P_B$ (2)

1.9 The shape of a CH_4 molecule is:

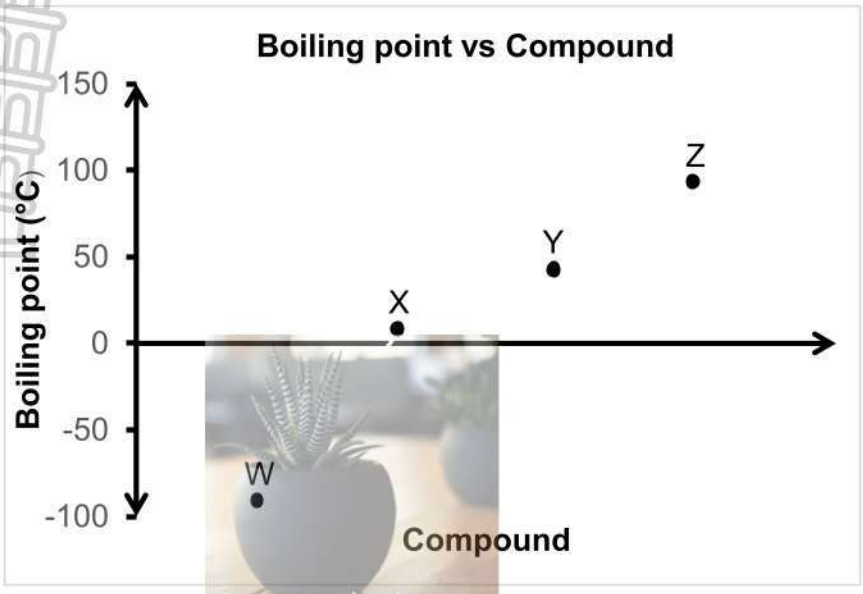
A Linear

B Tetrahedral

C Planar triangular

D Trigonal bipyramidal (2)

1.10 The graph below shows the boiling points of four different compounds. Which compound will have the HIGHEST vapour pressure?



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A Z

B Y

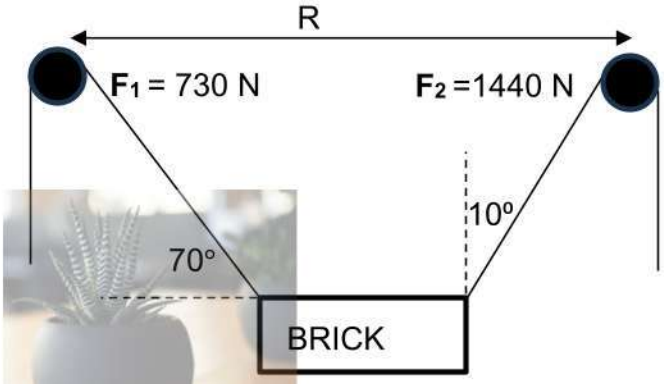
C X

D W

(2)
[20]

QUESTION 2

A brick is lifted by two ropes and two pulleys, as shown in the diagram below. The two pulleys are distance **R** apart. The force, F_1 is 730 N and the force F_2 is 1440 N. F_1 forms an angle of 70º with the horizontal and F_2 10º with the vertical. The brick is moving with a CONSTANT VELOCITY.



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2.1 Define the term *resultant vector*. (2)

2.2 The net force acting on the brick is 0 N. Explain why this statement is true. (2)

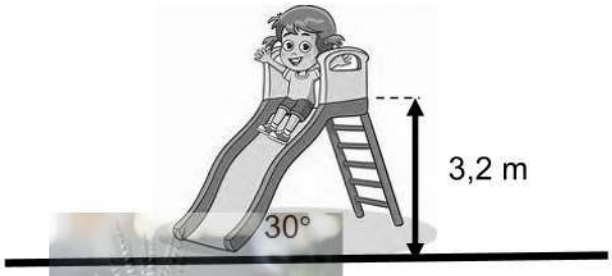
2.3. Calculate the magnitude of the vertical component of F_1. (2)

2.4 Calculate the magnitude of the weight of the brick. (4)

2.5 Explain why the ropes and the pullies will be less effective if the distance **R** between the pulleys is increased while the applied forces remain the same. (2)
[12]

QUESTION 3

A child with a mass of 30 kg slides at the park.The slide has a constant slope and a kinetic frictional coefficient of 0,15. The slide is 3,2 m high which makes an angle of 30° with the ground.



3.1 Draw a labelled free body diagram of the forces acting on the child while sliding down the slope. (3)

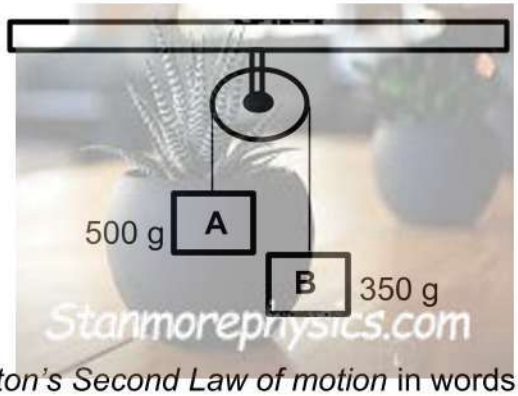
3.2 Calculate the magnitude of the frictional force experienced by the child. (4)

3.3 How will the net force acting on the child change if the child rubs oil on her legs thus lowering her friction. Choose from INCREASE, REMAIN THE SAME and DECREASE. (1)

3.4 The slope of the slide is decreased to 20°. How will this change affect the kinetic coefficient of friction.
Choose from INCREASE, REMAIN THE SAME and DECREASE.
Explain the answer. (2)
[10]

QUESTION 4

4.1 Two blocks, **A** mass 500 g, **B** mass of 350 g, hang on a thin string over a frictionless pulley as shown. Ignore the mass of the pulley and string.



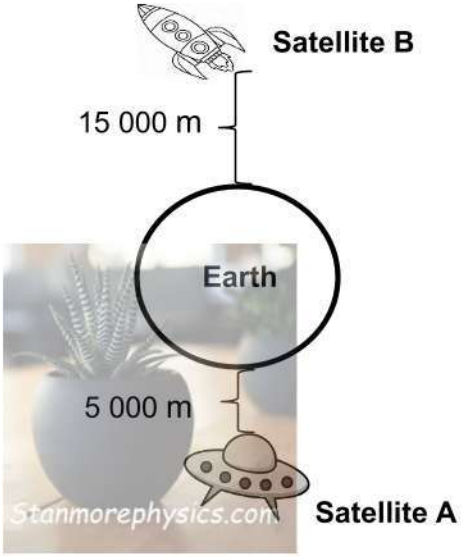
4.1.1 State *Newton's Second Law of motion* in words. (2)

4.1.2 Draw a force diagram showing all the forces acting on block **A**. (2)

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

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4.2 Two satellites orbiting the Earth are situated on opposite sides of the Earth as shown in the diagram. The distance between satellite **A**, with mass 2 800 kg and **B**, with mass 3 500 kg and the surface of the earth is 5 000 m and 15 000 m respectively.



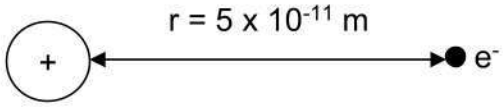
4.2.1 State *Newton's law of Universal gravitation*. (2)

4.2.2 Calculate the magnitude of the force between the Earth and Satellite **B**. (4)

4.2.3 Satellite **A** exert a force 2,74 x 10^3 N on the Earth. Calculate the magnitude of the *net force* experienced by the Earth due to Satellite **A** and **B**. (3)
[19]

QUESTION 5

5.1 A proton and an electron in a hydrogen atom are 5 x 10^{-11} m apart.

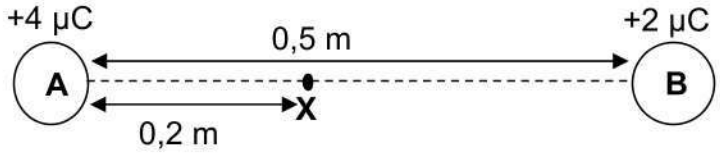


5.1.1 Draw the electric field pattern between the proton and the electron. (3)

5.1.2 State *Coulomb's law* in words. (2)

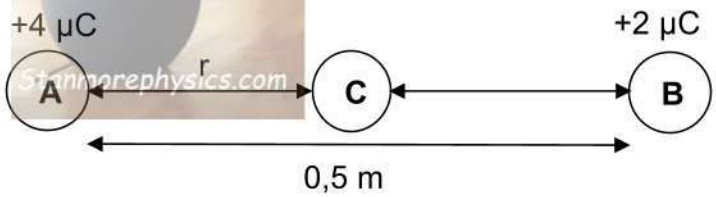
5.1.3 Calculate the magnitude of the electrostatic force that the proton and electron exert on each other. (4)

5.2 In the given diagram identical spheres **A** and **B** are placed 0,5 m apart. Sphere **A** has a charge of +4 µC and sphere **B** has a charge of +2 µC. Spheres **A** and **B** are in FIXED positions. Point **X** is 0,2 m from sphere **A**.



5.2.1 Calculate the magnitude of the electric field at point **X** due to sphere **A** only. (3)

Sphere **C**, with an unknown charge is now placed between sphere **A** and **B** a certain distance *r* from sphere **A.** Sphere **C** which is free to move, remains stationary.



5.2.2 Calculate the distance *r* that sphere **C** is from sphere **A**. (6)
[18]

QUESTION 6

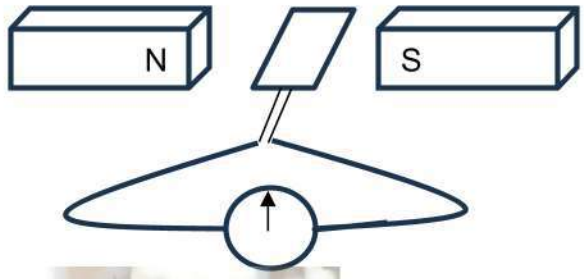
6.1 The following formula applies to Faraday's law of electromagnetic induction:

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

6.1.1 State *Faraday's law of electromagnetic induction* in words. (2)

6.1.2 By what factor will the *emf* change if only the number of turns is doubled? (2)

6.2 A single rectangular coil is connected to a galvanometer and then placed in a magnetic field to investigate Faraday's law as shown in the simplified diagram below.



When the coil is rotated clockwise, the needle of the galvanometer deflects.

6.2.1 Name TWO ways to change the direction of deflection of the galvanometer's needle. (2)

The rectangular coil has dimensions of 0,04 m x 0,06 m. The magnetic field has a strength of 0,5 T.

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6.2.2 Show by means of a calculation that the magnetic flux, Φ, is zero when the coil is in the position as shown in the sketch above. (3)

The coil is now rotated clockwise through an angle of 30° with respect to the horizontal in 2 x 10^{-3} s.



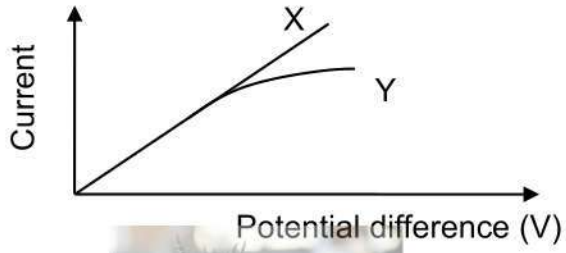
6.2.3 Calculate the:

6.2.3(a) change in the magnetic flux linkage (4)

6.2.3(b) induced emf. (3)
[16]

QUESTION 7

7.1 The two graphs below show the relationship between current and potential difference for two different conductors, **X** and **Y**.

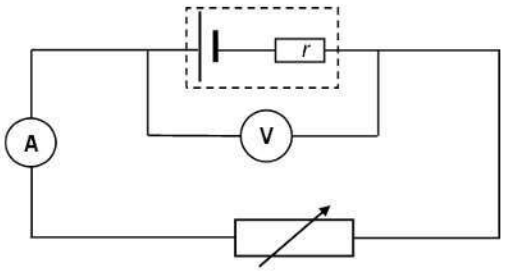


7.1.1 State *Ohm's law* in words. (2)

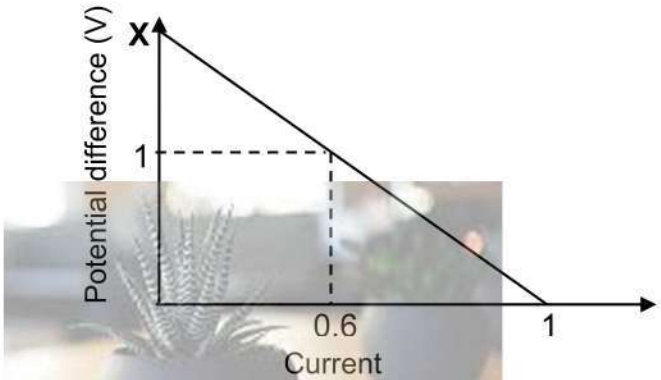
7.1.2 Which ONE of the two conductors, **X** or **Y**, is ohmic?
Refer to the graph and give a reason for your answer. (2)

7.1.3 State ONE condition where non-ohmic and ohmic conductors behave the same. (1)

7.2 Learners want to determine the *emf* and internal resistance (r) of a cell. They set up a circuit as shown in the diagram below and measure the potential difference using the voltmeter for different currents in the circuit.



The results obtained are shown in the graph below. The graph is NOT drawn to scale



7.2.1 Calculate the gradient of the graph. (3)

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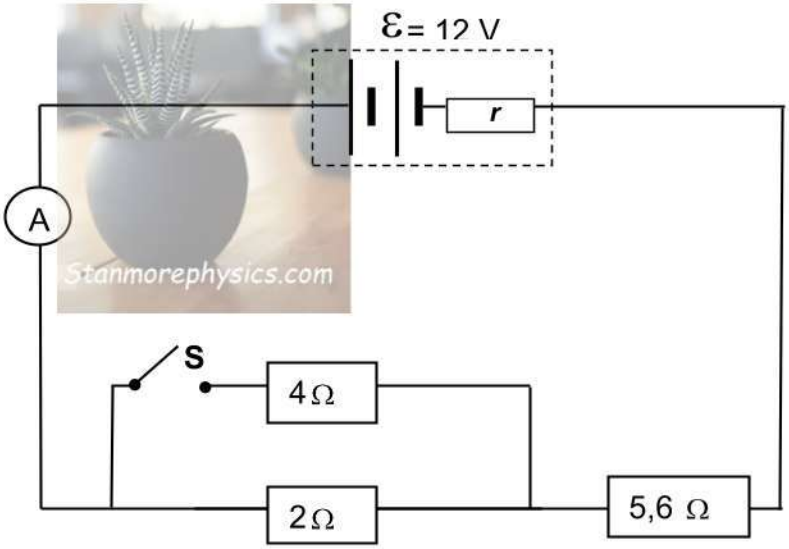
7.2.2 What physical quantity does the gradient of the graph represent? (1)

7.2.3 Calculate the value of **X**. (3)

7.2.4 Determine the external resistance of the circuit when the current was 0,6 A. (3)
[15]

QUESTION 8

The circuit diagram below represents a combination of resistors in series and parallel. The battery has an *emf* of 12 V and an unknown internal resistance r.



With switch **S** OPEN, ammeter **A** gives a reading of 1,2 A.

Calculate the:

8.1 total resistance of the circuit. (3)

8.2 internal resistance of the battery (3)

8.3 energy dissipated in the 2Ω resistor in 180 seconds. (3)

Switch **S** is now CLOSED.

8.4 Explain how the power dissipated by the 5,6 Ω resistor will change after the switch S is closed. (4)
[13]

QUESTION 9

The following compounds are given: NH_3, H_2O and HF.

9.1 Define the term *covalent bond*. (2)

9.2 For the H_2O molecule:

9.2.1 Draw the Lewis structure. (2)

9.2.2 Explain why it is a polar molecule. (2)

9.3 How many lone pair(s) does the HF molecule have? (2)

9.4 The ammonium ion (NH_4^+) can be formed by the reaction between one of the above compounds and a hydrogen ion (H^+):

9.4.1 Name the type of bond formed in this reaction. (2)

9.4.2 Draw a Lewis diagram of the ammonium ion (NH_4^+). (3)
[13]

QUESTION 10

Consider the list of five substances with their formulae and boiling points in the table.

NAME	FORMULA	BOILING POINT (°C)
Carbon dioxide	CO_2	-78
Hydrogen Fluoride	HF	20
Bromine	Br_2	60
Iodine	I_2	145
Water	H_2O	100

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

10.2 Explain the difference in boiling points between the two halogens (Br_2 and I_2) in the table by referring to the intermolecular forces between the compounds and energy. (4)

10.3 Give the name of the type of intermolecular force that exist between water molecules. (1)

10.4 Write down the NAME of one more compound from the list given with the same intermolecular force as water. (1)

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Soda water is made when CO_2 is mixed with water at high pressure.

10.5.1 Identify the intermolecular force between CO_2 and H_2O molecules (2)

10.5.2 Explain why carbon dioxide is not soluble in water at atmospheric pressure by referring to the polarity, type of intermolecular forces and strength of intermolecular forces in each substance. (4)

[14]

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	$9{,}8\ m{\cdot}s^{-2}$
Universal gravitational constant *Universele gravitasiekonstant*	G	$6{,}67 \times 10^{-11}\ N{\cdot}m^2{\cdot}kg^{-2}$
Speed of light in a vacuum *Spoed van lig in 'n vakuum*	c	$3{,}0 \times 10^{8}\ m{\cdot}s^{-1}$
Planck's constant *Planck se konstante*	h	$6{,}63 \times 10^{-34}\ J{\cdot}s$
Coulomb's constant *Coulomb se konstante*	k	$9{,}0 \times 10^{9}\ N{\cdot}m^2{\cdot}C^{-2}$
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	$5{,}98 \times 10^{24}\ kg$
Radius of the Earth *Radius van die Aarde*	R_E	$6{,}38 \times 10^{6}\ m$

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TABLE 2: FORMULAE / *TABEL 2: FORMULES*

MOTION/*BEWEGING*

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

FORCE/*KRAG*

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

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ELECTROSTATIC/*ELEKTROSTATIKA*

$F = \frac{kQ_1Q_2}{r^2}$	$E = \frac{F}{Q}$
$V = \frac{W}{Q}$	$E = \frac{kQ}{r^2}$
$n = \frac{Q}{q_e}$	

ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

$R = \frac{V}{I}$	emf (ε) = I(R + r) emk (ε) = I(R + r)
$R_s = R_1 + R_2 + \ldots$ $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$	$q = I\Delta t$
$W = Vq$ $W = VI\Delta t$ $W = I^2R\Delta t$ $W = \frac{V^2\Delta t}{R}$	$P = \frac{W}{\Delta t}$ $P = VI$ $P = I^2R$ $P = \frac{V^2}{R}$

ELECTROMAGNETISM / *ELEKTROMAGNETISME*

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

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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 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

KEY/*SLEUTEL*

Atomic number *Atoomgetal*

Electronegativity *Elektronegatiwiteit* → 29 / 1,9 / Cu / 63,5 ← **Symbol** *Simbool*

Approximate relative atomic mass *Benaderde relatiewe atoommassa*

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