Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE/*GRAAD* 11

NOVEMBER 2016

PHYSICAL SCIENCES P2/ *FISIESE WETENSKAPPE V2* MEMORANDUM

MARKS/PUNTE: 150

This memorandum consists of 14 pages./
Hierdie memorandum bestaan uit 14 bladsye.

GENERAL GUIDELINES/*ALGEMENE RIGLYNE*

1. CALCULATIONS/*BEREKENINGE*

1.1 **Marks will be awarded for**: correct formula, correct substitution, correct answer with unit.
Punte sal toegeken word vir: *korrekte formule, korrekte substitusie, korrekte antwoord met eenheid.*

1.2 **No marks** will be awarded if an **incorrect or inappropriate formula is used**, even though there are many relevant symbols and applicable substitutions.
Geen punte *sal toegeken word waar 'n* ***verkeerde of ontoepaslike formule gebruik*** *word nie, selfs al is daar relevante simbole en relevante substitusies.*

1.3 When an error is made during **substitution into a correct formula**, a mark will be awarded for the correct formula and for the correct substitutions, but **no further marks** will be given.
Wanneer 'n fout gedurende ***substitusie in 'n korrekte formule*** *began word, sal 'n punt vir die korrekte formule en vir korrekte substitusies toegeken word, maar* ***geen verdere punte*** *sal toegeken word nie.*

1.4 If **no formula** is given, but **all substitutions are correct**, a candidate will **forfeit one mark.**
Indien ***geen formule*** *gegee is nie, maar* ***al die substitusies is korrek****,* ***verloor*** *die kandidaat* ***een punt****.*

1.5 **No penalisation** if **zero substitutions are omitted** in calculations where **correct formula**/**principle** is correctly given.
Geen penalisering *indien* ***nulwaardes nie getoon*** *word nie in berekeninge waar die* ***formule/beginsel korrek gegee is nie****.*

1.6 Mathematical manipulations and change of subject of appropriate formulae carry no marks, but if a candidate starts off with the correct formula and then changes the subject of the formula incorrectly, marks will be awarded for the formula and correct substitutions. The mark for the incorrect numerical answer is forfeited.
Wiskundige manipulasies en verandering van die onderwerp van toepaslike formules tel geen punte nie, maar indien 'n kandidaat met die korrekte formule begin en dan die onderwerp van die formule verkeerde verander, sal die punte vir die formule en korrekte substitusies toegeken word. Die punt vir die verkeerde numeriese antwoord word verbeur.

1.7 Marks are only awarded for a formula if a **calculation has been attempted**, i.e. substitutions have been made or a numerical answer given.
Punte word slegs vir 'n formule toegeken indien ***'n poging tot 'n berekening aangewend*** *is, d.w.s. substitusies is gedoen of 'n numeriese antwoord is gegee.*

1.8 Marks can only be allocated for substitutions when values are substituted into formulae and not when listed before a calculation starts.
Punte kan slegs toegeken word vir substitusies wanneer waardes in formule ingestel word en nie vir waardes wat voor 'n berekening gelys is nie.

1.9 All calculations, when not specified in the question, must be done to a minimum of two decimal places.
Alle berekenings, wanneer nie in die vraag gespesifiseer word nie, moet tot 'n minimum van twee desimale plekke gedoen word.

1.10 If a final answer to a calculation is correct, full marks will not automatically be awarded. Markers will always ensure that the correct/appropriate formula is used and that workings, including substitutions, are correct.
Indien 'n finale antwoord van 'n berekening korrek is, sal volpunte nie outomaties toegeken word nie. Nasieners sal altyd verseker dat die korrekte/toepaslike formule gebruik word en dat bewerkings, insluitende substitusies korrek is.

1.11 Questions where a series of calculations have to be made (e.g. a circuit diagram question) do not necessarily always have to follow the same order. FULL MARKS will be awarded provided it is a valid solution to the problem. However, any calculation that will not bring the candidate closer to the answer than the original data, will no count any marks.
Vrae waar 'n reeks berekeninge gedoen moet word (bv. 'n stroombaan-diagramvraag) hoef nie noodwendig dieselfde volgorde te hê nie. VOLPUNTE sal toegeken word op voorwaarde dat dit 'n geldige oplossing vir die probleem is. Enige berekening wat egter nie die kandidaat nader aan die antwoord as die oorspronklike data bring nie, sal geen punte tel nie.

2. **UNITS/*EENHEDE***

2.1 Candidates will only be penalised once for the repeated use of an incorrect unit **within a question**.
*Kandidate sal slegs een keer gepenaliseer word vir die herhaaldelike gebruik van 'n verkeerde eenheid **in 'n vraag**.*

2.2 Units are only required in the final answer to a calculation.
Eenhede word slegs in die finale antwoord op 'n vraag verlang.

2.3 Marks are only awarded for an answer, and not for a unit *per se*. Candidates will therefore forfeit the mark allocated for the answer in each of the following situations:

- Correct answer + wrong unit
- Wrong answer + correct unit
- Correct answer + no unit

Punte sal slegs vir 'n antwoord en nie vir 'n eenheid per se toegeken word nie. Kandidate sal die punt vir die antwoord in die volgende gevalle verbeur:

- *Korrekte antwoord + verkeerde eenheid*
- *Verkeerde antwoord + korrekte eenheid*
- *Korrekte antwoord + geen eenheid*

2.4 SI units must be used except in certain cases, e.g. $V \cdot m^{-1}$ instead of $N \cdot C^{-1}$, and $cm \cdot s^{-1}$ or $km \cdot h^{-1}$ instead of $m \cdot s^{-1}$ where the question warrants this.
SI eenhede moet gebruik word, behalwe in sekere gevalle, bv. $V \cdot m^{-1}$ in plaas van $N \cdot C^{-1}$, en $cm \cdot s^{-1}$ of $km \cdot h^{-1}$ in plaas van $m \cdot s^{-1}$ waar die vraag dit regverdig.

3. GENERAL/*ALGEMEEN*

3.1 If one answer or calculation is required, but two are given by the candidate, only the first one will be marked, irrespective of which one is correct. If two answers are required, only the first two will be marked, etc.
Indien een antwoord of berekening verlang word, maar twee word deur die kandidaat gegee, sal slegs die eerste een nagesien word, ongeag watter een korrek is. Indien twee antwoorde verlang word, sal slegs die eerste twee nagesien word, ens.

3.2 For marking purposes, alternative symbols (s, u, t etc) will also be accepted.
Vir nasiendoeleindes sal alternatiewe simbole (s, u, t ens) ook aanvaar word.

3.3 Separate compound units with a multiplication dot, no a full stop, for example, $m \cdot s^{-1}$. For marking purposes, $m.s^{-1}$ and m/s will also be accepted.
Skei saamgestelde eenhede met 'n vermenigvuldigingspunt en nie met 'n punt nie, byvoorbeeld $m \cdot s^{-1}$. Vir nasiendoeleindes sal $m.s^{-1}$ en m/s ook aanvaar word.

4. POSITIVE MARKING/*POSITIEWE NASIEN*

Positive marking regarding calculations will be followed in the following cases:
Positiewe nasien met betrekking tot berekeninge sal in die volgende gevalle geld:

4.1 **Subquestion to subquestion**: When a certain variable is calculated in one subquestion (e.g. 3.1) and needs to be substituted in another (3.2 of 3.3), e.g. if the answer for 3.1 is incorrect and is substituted correctly in 3.2 or 3.3, **full marks** are to be awarded for the subsequent subquestions.
***Subvraag na subvraag**: Wanneer 'n sekere veranderlike in een subvraag (bv. 3.1) bereken word en dan in 'n ander vervang moet word (3.2 of 3.3), bv. indien die antwoord vir 3.1 verkeerd is en word korrek in 3.2 of 3.3 vervang, word **volpunte** vir die daaropvolgende subvraag toegeken.*

4.2 **A multistep question in a subquestion**: If the candidate has to calculate, for example, current in die first step and gets it wrong due to a substitution error, the mark for the substitution and the final answer will be forfeited.
*'n **Vraag met veelvuldige stappe in 'n subvraag**: Indien 'n kandidaat bv. die stroom verkeerd bereken in 'n eerste stap as gevolg van 'n substitusiefout, verloor die kandidaat die punt vir die substitusie sowel as die finale antwoord.*

5. NEGATIVE MARKING/*NEGATIEWE NASIEN*

Normally an incorrect answer cannot be correctly motivated if based on a conceptual mistake. If the candidate is therefore required to motivate in QUESTION 3.2 the answer given in QUESTION 3.1, and 3.1 is incorrect, no marks can be awarded for QUESTION 3.2. However, if the answer for e.g. 3.1 is based on a calculation, the motivation for the incorrect answer could be considered.
'n Verkeerde antwoord, indien dit op 'n konsepsuele fout gebaseer is, kan normaalweg nie korrek gemotiveer word nie. Indien 'n kandidaat gevra word om in VRAAG 3.2 die antwoord op VRAAG 3.1 te motiveer en 3.1 is verkeerd, kan geen punte vir VRAAG 3.2 toegeken word nie. Indien die antwoord op bv. 3.1 egter op 'n berekening gebaseer is, kan die motivering vir die verkeerde antwoord in 3.2 oorweeg word.

QUESTION/*VRAAG 1*

1.1 B ✓✓

1.2 D ✓✓

1.3 A ✓✓

1.4 A ✓✓

1.5 D ✓✓

1.6 D ✓✓

1.7 A ✓✓

1.8 B ✓✓

1.9 C ✓✓

1.10 B ✓✓

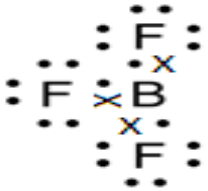
(10 x 2) **[20]**

QUESTION/*VRAAG 2*

2.1.1 Covalent bonding✓/*Kovalente binding* (1)

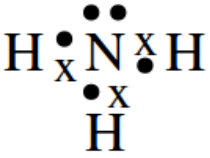
2.1.2 It is the sharing electrons between non-metals.✓
Die deling van elektrone tussen nie-metale. (1)

2.2.1



✓✓ (2)

2.2.2



✓✓ (2)

2.3 The bonds in both molecules are polar due to the difference in electronegativities ✓ between B and F and N and H.
The shape of the NH_3 molecule is pyramidal ✓ and therefore the molecule is polar ✓ because one side of the molecule can be positive and the other side negative.
The shape of the BF_3 molecule is trigonal planar✓ and thus its non-polar ✓ because the charge distibution is symmetrical.
Die bindings in beide molekules is polêr weens die verskil in die elektonegatiwiteite tussen B en F en N en H.
Die vorm van die NH_3-molekuul is piramidaal en dus is die molekuul polêr omdat een kant van die molekuul positief en die anderkant negatief kan wees.
Die vorm van die BF_3-molekuul is trigonaal planêr en dus is die molekuul nie-polêr omdat die ladingverspreiding simmetries is. (5)

2.4.1 Dative covalent bond✓/Co-ordinate bond
Datief kovalente binding/Koördinatiewe binding (1)

2.4.2 The oxygen in water molecule (H_2O) consists of two lone pairs of electrons ✓ that can make bonds with the empty valence s-orbital of H^+ ion. ✓
Die suurstof atoom in watermolekuul(H_2O) besit twee alleenpare elektrone wat bindings kan maak met die leë s-orbitaal van H^+-ioon. (2)
[14]

QUESTION/*VRAAG* 3

3.1.1 Hydrogen bonds ✓/*Waterstofbinding* (1)

3.1.2 Density of ice is less than that of water ✓
Ice floats on top of water providing an insulating layer ✓ between the water and atmosphere.
Digtheid van ys is laer as dié van water.
Ys dryf bo-op water en bied 'n isolerende laag tussen water en die atmosfeer.

OR Water freezes from top down ✓ and capturing heat.✓ (2)
OF Water vries van bo na onder ✓en vang hitte vas. ✓

3.1.3 The mass of 1 dm^3 of water is 1 000 g./
Die massa van 1 dm^3 water is 1 000 g.

n = m/M ✓ = 1000/18 ✓ = 55,56 mol.

Number/*Aantal* = n x N_A = (55,56)(6,02 x 10^{23}) ✓
= 3,34 x 10^{25} ✓molecules/*molekules* water (4)

3.1.4 Water has high heat of vaporisation ✓ due to hydrogen bonds. ✓
OR
Water needs a lot of energy to evaporate due to hydrogen bonds.
OR
The sea acts as a reservoir of heat due to large amounts of energy needed to overcome hydrogen bonds.

Water het hoë verdampingshitte as gevolg van waterstofbindings.
OF
Water benodig baie energie om te verdamp as gevolg van waterstofbindings.
OF
Die see tree op as 'n opgaartenk vir hitte as gevolg van groot hoeveelheid energie benodig om waterstofbindings te oorkom. (2)

3.2.1 INCREASES from **A** to **C**. ✓✓
*NEEM TOE vanaf **A** na* **C** (2)

3.2.2 Molecular mass increases from **A to C**.✓
Strength of the London forces ✓/Dispersion forces/Induced dipole forces increases. ✓
*Molekulêre massa neem toe van **A** na **C**.*
Sterkte van die intermolekulêre kragte Londonkragte/ Dispersiekragte/Geïnduseerde dipoolkragte neem toe.

OF/*OR*

Molecular mass decreases from **C** to **A**. ✓
Strength of the intermolecular forces London forces✓/Dispersion forces/ Induced dipole forces decreases. ✓
*Molekulêre massa neem af vanaf **C** na **A***
Sterkte van die intermolekulêre kragte Londonkragte/ Dispersiekragte/Geïnduseerde dipoolkragte neem af. (3)

3.2.3 C ✓ (1)

3.3 Hydrogen bonds ✓ between NH_3 molecules is stronger ✓ than the London forces ✓/Dispersion forces/Induced-dipole forces or Dipole-dipole forces between PH_3 molecules.
Waterstofbindings tussen NH_3 molekules is sterker as die Londonkragte/Dispersiekragte/Geïnduseerde dipoolkragte of Dipool dipoolkragte tussen PH_3 molekules. (3)
[18]

QUESTION/*VRAAG* 4

4.1.1 Temperature ✓/*Temperatuur* (1)

4.1.2 (a) 60✓✓ (2)

(b) Volume is directly proportional ✓ to Temperature✓/ V α T
Volume is direk eweredig aan Temperatuur/ V α T OR/OF
As temperature increases volume increases proportionally
Soos die temperatuur toeneem sal die volume eweredig toeneem.

Notes/Aantekeninge:
- BOTH independent and dependent variables correctly indicated. ✓
  BEIDE onafhanklike en afhanklike veranderlikes korrek aangedui.
- Relationship between variables correctly identified.✓
  Verwantskap tussen veranderlikes korrek geidentifiseer.

(2)

4.1.3 Pressure ✓/mass✓(number of mole)
Druk/massa (aantal mol) (2)

4.1.4 Thermometer✓/*thermometer* (1)

4.1.5 Kinetic energy of particles decrease, ✓ therefore strength of intermolecular forces increase ✓ hence pressure decrease. ✓
Kinetiese energie van deeltjies neem af, daarom neem die sterkte van intermolekulêre kragte toe en dus neem druk af. (3)

4.2 PV = nRT✓
(0,002)✓(150 000)✓ = n (8,31)(300)✓
n = 0,12 mol

n = m/M
0,12 = 2,04/M✓
M = 17 g.mol^{-1}✓ (Accept/*Aanvaar* 16,96 g.mol^{-1}) (6)

4.3 HIGHER/HOËR✓

For/*Vir* A: $p = \frac{1}{M}(\frac{mRT}{V})$

$p \ \alpha \ \frac{1}{M}$ ✓
But/*Maar* $p = 2p_B$

$2 M_A = M_A$ ✓ (3)
[20]

QUESTION/*VRAAG* 5

5.1.1 Smallest whole number ratio of elements that make up the substance. ✓✓
Kleinste heelgetalverhouding van die elemente waaruit die stof bestaan. (2)

5.1.2

OPTION/*OPSIE* 1

$n(H_2O) = m/M$
$= 19,35/18$✓
$= 1,075$ mol

$n(H) = 2n(H_2O)$✓
$= 2 \times 1,075$
$= 2,15$ mol

$n = m/M$
$2,15 = m/1$✓
$m(H) = 2,15$ g✓

$n(CO_2) = m/M$
$= 47,1/44$✓
$= 1,07$ mol

$n(C) = n(CO_2)$✓
$= 1,07$ mol

mol C:mol H
1,07:2,15
1:2✓

Empirical formula: CH_2 ✓
Empiriese formule

OPTION/*OPSIE* 2

%H in $H_2O = 2$✓$/18 \times 100$✓
$= 11,11\%$

M(H) in H_2O

$= 11,11\%$ of 19,35 g✓
$= 2,15$ g ✓

%C in $CO_2 = 12/44 \times 100$
$= 27,27\%$

M(C) in CO_2 $= 27,27\%$ of 47,1 g ✓
$= 12,84$ g (to 12,85 g)

mol C: mol H
12,84/ 12 : 2,15 /1✓
1,07 : 2,15 (÷ 1.07
1:2✓

Empirical formula: CH_2 ✓
Empiriese formule (8)

POSITIVE MARKING FROM QUESTION 5.1.2
POSITIEWE NASIEN VANAF VRAAG 5.1.2

5.1.3 $M(CH_2) = 1(12) + 2(1) = 14$ g.mol^{-1}
M(true formula)/M(empirical formula)/
M(ware formule)/M(Empiriese formule) = 28/14 = 2 ✓

C_2H_4 **x** = 2 and **y** = 4 ✓(both/*beide***)** (2)

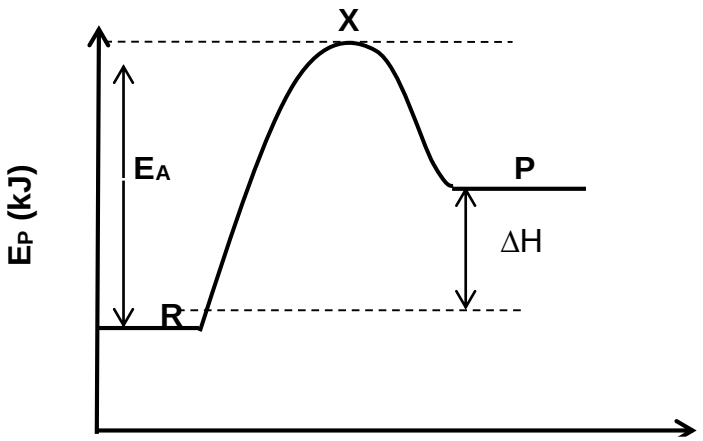
5.2.1 $n(CaO) = m/M$✓ = 11,76/56✓ = 0,21 mol

$n(CaCO_3) = n(CaO)$✓ = 0,21 mol

$m(CaCO_3) = n/M = (0,21)(100)$ ✓ = 21 g
% purity = m(pure compound/m(impure sample) x 100
% suiwerheid = m(suiwer verbinding)/m(onsuiwer monster) x 100

Impure mass/*Onsuiwer massa* = 2100/80 ✓= 26,25 g ✓ (6)

5.2.2



Marking criteria ***Nasienriglyne***	**Marks** ***Punte***
Correct shape as shown. *Korrekte vorm soos getoon.*	✓
Reactants(R) and Products (P) correctly labelled. *Reagense (R) en Produkte (P) korrek benoem.*	✓
Activation energy (E_A) correctly indicated. *Aktiveringsenergie (E_A) korrek aangedui.*	✓
Activated complex (**X**) correctly indicated. *Geaktiveerde kompleks (**X**) korrek aangedui.*	✓
ΔH correctly indicated. *ΔH korrek aangedui.*	✓

Notes/Aantekeninge:
If graph drawn for exothermic reaction: Max. 2/5
Indien grafiek geteken is vir eksotermiese reaksie. Maks. 2/5

(5)
[23]

QUESTION/*VRAAG* 6

6.1.1 Ampholyte ✓/*Amfoliet* (1)

6.1.2 HSO^-_4 .✓and/ en H_3O^+ ✓ (2)

6.2.1 **OPTION/*OPSIE* 1**

c = m/MV✓
= 3,36/(56)✓ (0,25)✓
= 0,24 mol.dm^{-3} ✓

OPTION/*OPSIE* 2

n = m/M = 3,36/56 ✓
✓ = 0,06 mol
c = n/V = 0,06 / 0,25 ✓
= 0,24 mol.dm^{-3}✓ (4)

6.3.1 Potassium sulphate ✓/ *Kaliumsulfaat* (1)

6.3.2 H_2O ✓ (1)

6.3.3 n(KOH) = cV ✓= (0,25)(0,025)✓ = 6,25 x 10^{-3} mol

$n(H_2SO_4)$ = ½ n(KOH) = ½ (6,25 x 10^{-3}) ✓= 3,125 x 10 $^{-3}$ mol

$m(H_2SO_4)$ = nM = (3,125 x 10 $^{-3}$)(98)✓ = 0,31 g✓ *(Accept* 0,306 g*)* (5)

[14]

QUESTION/VRAAG 7

7.1.1 The gain of electron(s) by a substance. ✓✓
Die wins van elektron(e) deur 'n stof. (2)

7.1.2 Al✓
The oxidation number increases ✓ from 0 to +3. ✓✓
Die oksidasiegetal neem toe van 0 na +3. (4)

7.1.3. n (Fe_2O_3) = m/M = 8/160 ✓ = 0,05 mol

n (Al) = m/M = 3,8/27 ✓ = 0,14 mol

n (Fe_2O_3) < n(Al) ✓ (OR/OF Fe_2O_3 is the limiting reagent/*Fe_2O_3 is die beperkte reagens)*

Notes/Aantekeninge:
- Showing calculations of limiting reagent (3 marks/*punte*)
  Toon berekeninge van beperkte reagens
- If NOT showing calculations of limiting reagent (4/7)
  Indien berekeninge van beperkte reagens NIE getoon.

n (Fe) = 2n(Fe_2O_3) = 2 x 0,05✓ = 0,1 mol

m (Fe) = nM = 0,1x 56✓ = 5,6g

% yield = 4,76/5,6 x 100 ✓
= 85% ✓ (7)

7.2 n(O_2) V/V_m ✓= 4,48/22,4 ✓= 0,2 mol

n(C_4H_{10}) = 2/13 n(O_2) = 2(0,2)/13 ✓ = 0,03 mol

n = N/N_A
N = (0,03)(6,02 x 10^{23}) ✓= 1,806 x 10^{23} ✓ or/of 1,85 x 10^{23} (5)

7.3 X2) $4H^+ + NO_3^- + 3e^-$ ✓ → $NO + 2H_2O$ ✓ ✓bal

$H_2S \rightarrow 2H^+ + 2e^-$ to X3) $H_2S \rightarrow S + 2H^+ + 2e^-$✓

$2H^+ + 2NO^-_3 + 3H_2S$ ✓→ $2NO + 4H_2O + 3S$ ✓ ✓bal (7)
[25]

QUESTION/VRAAG 8

8.1.1 Rocks that contains minerals ✓ ✓(like precious stones and metals and which can be mined for economic reasons).
Rotse wat minerale bevat (soos edelstene en metale wat vir ekonomiese redes gemyn kan word). (2)

8.1.2 Deep level mining ✓/*Diepvlakmynbou* (1)

8.2 REDOX✓/*REDOKS.* (1)

8.3 $4\ Au + 8\ ✓NaCN + O_2 + 2H_2O \rightarrow 4✓NaAu(CN)_2 + 4\ NaOH$ (2)

8.4 O_2 ✓✓ (2)

8.5 Alkaline ✓/*Alkalies.*
NaOH is released/Alkaline is released. ✓
NaOH word vrygestel./Alkali word vrygestel. (2)

8.6 Zn ✓ **OR/*OF*** Zinc ✓/*Sink* (1)

8.7 To remove all impurities. ✓/*Om onsuiwerhede te verwyder*. (1)

8.8 To create jobs. ✓
A lot of money can be generated from mineral resources. ✓ **OR**
Economy of the country grows.
Skep werk.
Baie geld kan uit mineraalbronne gegenereer word. ***OF***
Ekonomie van land groei. *(*ANY TWO/*ENIGE TWEE)* (2)

8.9 Cyanide and sulphuric acid leaching into groundwater.✓
Surface and groundwater are polluted due to acid drainage from mines – unfit for consumption. ✓ **OR**
Need massive amount of water that will increase the pressure on water resources.
Water tables lowered – could lead to the formation of sinkholes.
Sianied en swawelsuur loog uit in grondwater in.
Oppervlak- en grondwaterbesoedeling weens suurdreinering van myne – nie geskik vir drink nie.
Benodig massiewe hoeveelhede water wat toenemende druk op beskikbare waterbronne plaas.
Watertafels verlaag – kan lei tot sinkgatvorming.
*(*ANY TWO/*ENIGE TWEE)* (2)

[16]

TOTAL/*TOTAAL*: 150