



# Education

KwaZulu-Natal Department of Education  
REPUBLIC OF SOUTH AFRICA

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 12**

**PHYSICAL SCIENCES P2 (CHEMISTRY)  
PREPARATORY EXAMINATIONS  
SEPTEMBER 2017**

**TIME: 3 hours**

**MARKS: 150**

**This question paper consists of 16 pages including 4 data sheets  
and 1 answer sheet.**

**INSTRUCTIONS AND INFORMATION**

1. Write your centre number and examination number in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of TEN 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 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.
11. Give brief motivations, discussions et cetera where required.
12. Write neatly and legibly.

**QUESTION 1: MULTIPLE CHOICE**

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 the ANSWER BOOK, for example 1.1 D.

1.1 Which one of the following organic compounds contains a carbonyl group?

- A Haloalkanes
- B Alkanes
- C Alcohols
- D Aldehydes

(2)

1.2 Which one of the following reaction types represents the conversion of ETHENE to CHLOROETHANE?

- A Substitution
- B Hydrohalogenation
- C Dehydrogenation
- D Elimination

(2)

1.3 In which one of the following reaction types is methyl methanoate formed?

- A Esterification
- B Hydrolysis
- C Dehydration
- D hydration

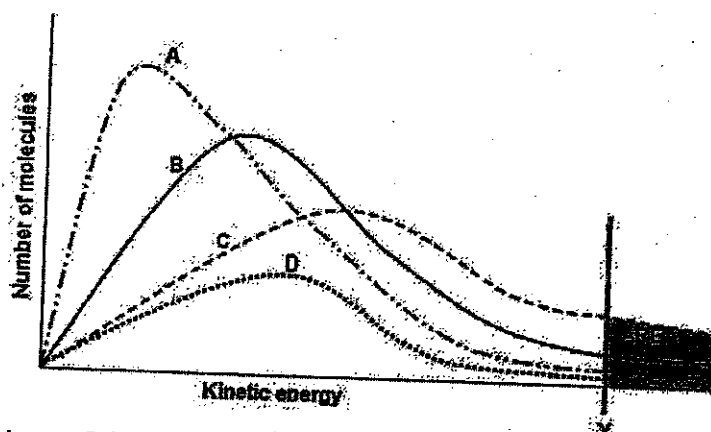
(2)

1.4 50 cm<sup>3</sup> of a 0,1 mol.dm<sup>-3</sup> solution of hydrochloric acid is poured on to 5 g of magnesium powder inside a small test tube at room temperature. Which one of the following factors **will increase** the rate of this reaction?

- A Using 100 cm<sup>3</sup> of a 0,1 mol.dm<sup>-3</sup> solution of hydrochloric acid at room temperature.
- B Using 5g of magnesium ribbon.
- C Decreasing the temperature of the acid solution to 10 °C
- D Increasing the temperature of the acid solution to 80 °C

(2)

- 1.5 Graph B below represents the Maxwell-Boltzmann energy distribution curve for a reaction mixture at a temperature of 300°C. Area X represents the number of molecules in the mixture that have enough kinetic energy for the reaction to take place.



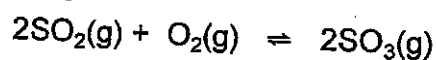
The temperature of the mixture is now increased to 500 °C.

Which ONE of graphs A to D represents the distribution curve of the mixture at this higher temperature?

- A A  
B B  
C C  
D D

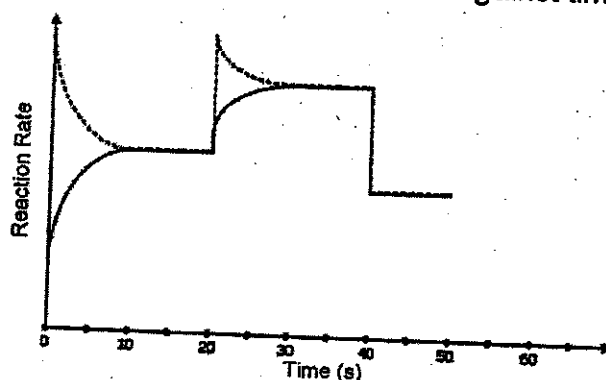
(2)

- 1.6 A mixture of SO<sub>2</sub> gas and O<sub>2</sub> gas was placed into a closed container at 300°C with a small amount of V<sub>2</sub>O<sub>5</sub>.



At certain times, various changes in the physical conditions applicable to the reaction or to the chemicals themselves, were made.

The graph below represents the rate of reaction against time.

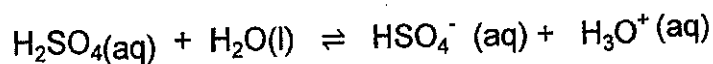


Which one of the changes below explains the change in the graph at 20 s?

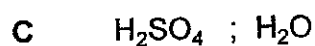
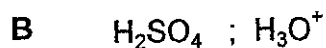
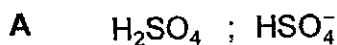
- A Decrease in pressure.  
B Increase in pressure.  
C Decrease in temperature.  
D Addition of a catalyst.

(2)

1.7 Consider the ionisation reaction below:



A conjugate acid-base pair is:



(2)

1.8 During the electrolysis of a concentrated sodium chloride solution, water is reduced and not sodium ions because...

A  $\text{Na}^+$  is a stronger reducing agent than  $\text{H}_2\text{O}$ .

B  $\text{Na}^+$  is a stronger oxidising agent than  $\text{H}_2\text{O}$ .

C  $\text{H}_2\text{O}$  is a stronger reducing agent than  $\text{Na}^+$ .

D  $\text{H}_2\text{O}$  is a stronger oxidising agent than  $\text{Na}^+$ .

(2)

1.9 A solution of copper (II) chloride ( $\text{CuCl}_2$ ) must be stored in a metal container. Which one of the following metals should be used?

A Ag

B Zn

C Mg

D Fe

(2)

1.10 Which one of the following fertilizers provides the least nitrogen per mole of fertilizer?

A Ammonium phosphate

B Ammonium nitrate

C Potassium nitrate

D Calcium nitrate

(2)

[20]

**QUESTION 2 (Start on a new page.)**

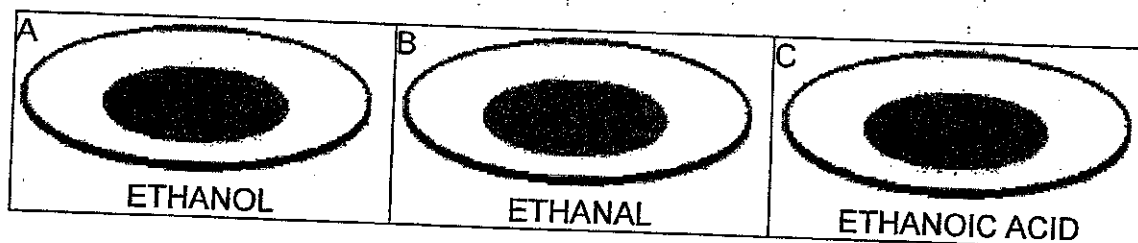
The letters A to F in the table below represent eight organic compounds.

<p><b>A</b></p> <pre>       H   Cl  H   H   H   H                            H - C - C - C - C - C - C - H                                  H   C  H   H   Br  H                         H - C - H                           H           </pre>	<p><b>B</b>      <math>\text{CH}_3\text{COCH}_2\text{CH}_2\text{CH}_3</math></p>
	<p><b>C</b>      but-2-ene</p>
	<p><b>D</b>      <math>\text{CHCCH}_2\text{CH}_3</math></p>
	<p><b>E</b>      3-chloro-3-ethylheptane</p>
	<p><b>F</b>      <math>\text{CH}_3\text{COOH}</math></p>

- 2.1 Write down the IUPAC name of compound A. (2)
- 2.2 Write down the general formula of the homologous series to which compound C belongs. (1)
- 2.3 Write down the structural formula for compound E. (3)
- 2.4 Write down the name of the functional group to which compound D belongs. (1)
- 2.5 Draw the structural isomer for compound F (2)
- 2.6 Write down the name of the homologous series to which compound B belongs. (1)

**[10]****QUESTION 3 (Start on a new page.)**

Learners investigate the evaporation of ethanol, ethanal and ethanoic acid. They place 2 ml of each of the liquids in a watch glass. They then observe the change in the volume of the liquids.

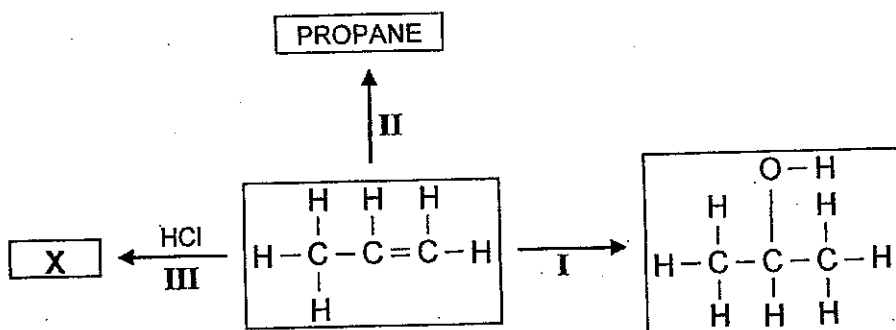


- 3.1 Which one of the above liquids would have the largest volume after 10 mins? (1)
- 3.2 Give an explanation for the answer to QUESTION 3.1. (3)
- 3.3 Which one of the liquids will have the highest vapour pressure after 10 mins.? (1)
- 3.4 Give an explanation for the answer to QUESTION 3.3. (3)

**[8]**

**QUESTION 4 (Start on a new page.)**

The flow diagram below represents various organic reactions. Study the reactions and answer the questions that follow.



- 4.1 State the reaction condition required for reaction I (1)
- 4.2 Write down the formula of the catalyst used in reaction II. (1)
- 4.3 Propane reacts with excess oxygen. Write down a balanced equation for this reaction using molecular formulae. (3)
- 4.4 Use structural formulae to write a balanced equation for reaction III. (3)

**A structural isomer of the product of reaction I is reacted with butanoic acid, to form an ester.**

- 4.5 Write down the name of the catalyst used in this reaction. (1)
- 4.6 Write down the structural formula of the ester that is formed. (2)
- 4.7 Name the ester that is formed Question 4.6 (2)

**[13]****QUESTION 5 (Start on a new page.)**

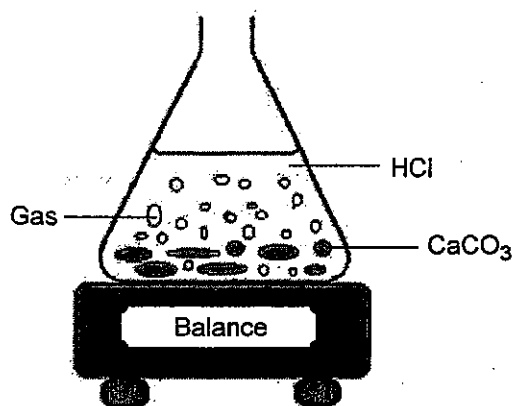
Ethene is used as a monomer in the preparation of a macromolecule, polyethene.

- 5.1 Define a macromolecule. (2)
- 5.2 Name the process by which polyethene is manufactured. (1)
- 5.3 Write down the structural formula for the monomer used to prepare polyethene. (2)

**[5]**

**QUESTION 6 (Start on a new page.)**

In investigating the factors that affect the rate of reaction, some learners react calcium carbonate with excess dilute hydrochloric acid, in a conical flask. The apparatus is setup as shown below.



The change in mass of the conical flask and its contents are recorded every minute. The results for this investigation are shown in the table below.

Time (s)	0	1	2	3	4	5	6	7	8	9
Mass of flask and its contents (g)	178	176,2	174,1	172,7	172,3	172,2	172,1	172,1	172,1	172,1

6.1 Write down an investigative question for this investigation. (2)

6.2 State the independent variable for this investigation. (1)

The above table is re-drawn in the special answer sheet provided.

6.3 Complete the table by filling in the values for the mass of  $\text{CO}_2$  produced. (2)

6.4 Plot a graph of mass of  $\text{CO}_2$  produced vs time elapsed. (5)

6.5 Give a reason why the mass of the flask and its contents remains constant after 6 s. (1)

6.6 Calculate the total volume of  $\text{CO}_2$  (g) produced at room temperature ( $25^\circ\text{C}$ ). Assume the molar gas volume of  $\text{CO}_2$  (g) at this temperature is  $24,46 \text{ dm}^3$ . (3)

The experiment is now repeated at a higher temperature. The volume and concentration of the HCl and the mass of  $\text{CaCO}_3$  used are the same as in the original investigation.

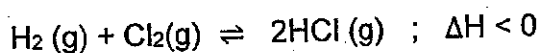
6.7 On the same system of axes used to draw the graph in QUESTION 6.4, draw a sketch graph of mass of  $\text{CO}_2$  produced vs time elapsed, at the higher temperature. Label this graph as **N**. (2)

6.8 Use the collision theory to explain the difference between the two graphs obtained. (3)



**QUESTION 7 (Start on a new page.)**

Ten (10) grams of hydrogen gas and 355 g of chlorine gas are heated together in a sealed 500 cm<sup>3</sup> container. Equilibrium is reached at 450 °C.



The equilibrium constant for this reaction at 450 °C is 60.

7.1 Calculate the mass of chlorine gas present at equilibrium. (10)

The temperature is now increased to 550 °C while the volume is kept constant. The system reaches a NEW equilibrium.

7.2 State Le Chatelier's principle. (2)

7.3 How will the following be affected in this new equilibrium? Write down only INCREASE, DECREASE or REMAINS THE SAME.

7.3.1 The equilibrium constant. (1)

7.3.2 The volume of H<sub>2</sub> present. (1)

7.4 Use Le Chatelier's principle to explain the answer to QUESTION 7.3.2. (2)

**[16]**

**QUESTION 8 (Start on a new page.)**

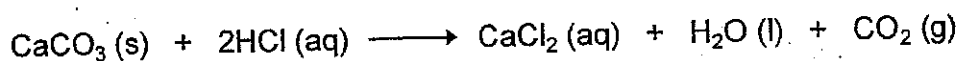
8.1 Concentrated hydrochloric acid with a concentration of 10 mol·dm<sup>-3</sup> is diluted to form 500 cm<sup>3</sup> of a 0,25 mol·dm<sup>-3</sup> solution.

8.1.1 Is the diluted hydrochloric acid a strong acid or a weak acid? (1)

8.1.2 Calculate the volume, in cm<sup>3</sup>, of the concentrated hydrochloric acid that must be used. (5)

8.1.3 Calculate the pH of the 0,25 mol·dm<sup>-3</sup> solution of HCl. (3)

8.2 Calcium carbonate forms a large percentage of sea shells. In order to determine percentage purity of the calcium carbonate in sea shells, learners react 5 g of powdered sea shells with the 500 cm<sup>3</sup> of the diluted hydrochloric acid prepared in QUESTION 8.1. The reaction that takes place is represented by the following balanced equation.



The excess HCl is then titrated with 140 cm<sup>3</sup> of a 0,2 mol·dm<sup>-3</sup> solution of sodium hydroxide.

8.2.1 Calculate the mass of CaCO<sub>3</sub> present in the sample of sea shells. (8)

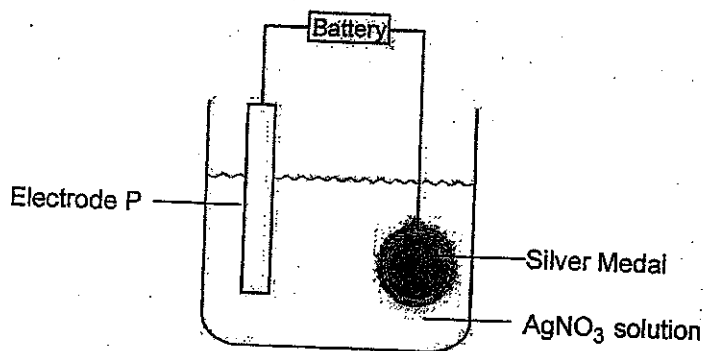
8.2.2 Calculate the percentage purity of the calcium carbonate in the in the sea shells. (3)

**[20]**

**QUESTION 9 (Start on a new page.)**

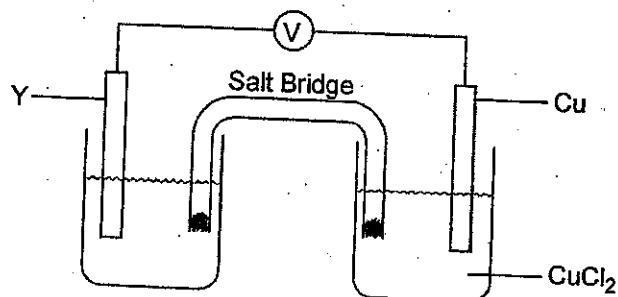
- 9.1 An 800 m athlete, was recently placed first in an international event after the original winner was disqualified. This athlete was required to return the silver medal and receive a new gold medal. When the silver medal was returned it had scratch marks.

The following apparatus was setup to coat the medal with a thin layer of silver.



- 9.1.1 Will the medal be the anode or the cathode? (1)
- 9.1.2 State the direction in which the current must flow in the external circuit. (State from **silver medal to P** or **P to silver medal**) (1)
- 9.1.3 The concentration of the electrolyte solution ( $\text{AgNO}_3$ ) remains constant during the process. Briefly explain why this happens. (2)
- 9.1.4 Give the symbol for the metal that must be used as electrode P. (1)

- 9.2 An electrochemical cell is setup under standard conditions as shown below. Copper (Cu) is used as the cathode and an unknown metal Y as the anode of the cell. The *voltmeter* connected across the two electrodes shows an initial reading of 2,70 V.



- 9.2.1 State the standard conditions that are applicable to this cell. (2)
- 9.2.2 State the energy conversion that takes place in this cell. (1)
- 9.2.3 State two functions of the salt bridge. (2)
- 9.2.4 Use the information given to identify the metal Y. Show all calculations. (5)
- 9.2.5 Write down the oxidation half reaction. (2)
- 9.2.6 Write down the cell notation (symbolic notation) of this cell. (3)

Some silver nitrate ( $\text{AgNO}_3(\text{aq})$ ) is added to the Cu half-cell.

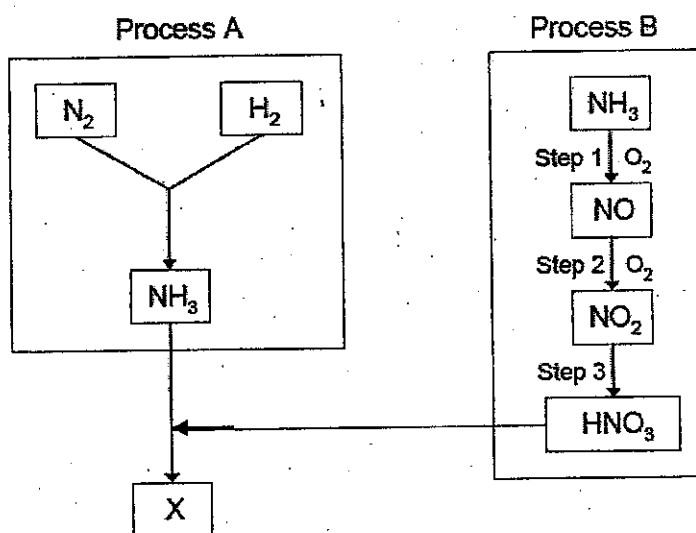
9.2.7 How will the reading on the voltmeter be affected? Write down INCREASE, DECREASE OR REMAIN THE SAME. (1)

9.2.8 Give an explanation for your answer in QUESTION 9.2.7. (3)

[24]

### QUESTION 10 (Start on a new page.)

10.1 The flow diagram below shows two industrial processes that result in the production of a fertilizer, X.



10.1.1 Write down the name of Process A. (1)

10.1.2 Name the method used to obtain the  $\text{N}_2$  (g) used in Process A. (1)

10.1.3 Write down the name of Process B. (1)

10.1.4 Name the catalyst used in Step 1 of Process B. (1)

10.1.5 Write down the formula of the other reactant in Step 3 of Process B. (1)

10.1.6 State two reasons why it is necessary to manufacture fertilizers on an industrial scale. (2)

10.1.7 Give the name of fertilizer X that is produced. (1)

10.2 The following information is found on a 50 kg bag of a fertilizer that you purchase for your lawn.

**22 : 10 : 18 (22)**

10.2.1 What information can you obtain from these numbers? (2)

10.2.2 Calculate the percentage composition of the nutrients in the bag. (3)

10.2.3 The number 18 in the ratio above represents a particular element. Briefly discuss the role this element plays in the development and growth of plants. (2)

[15]

**TOTAL : 150**

**DATA FOR PHYSICAL SCIENCES GRADE 12  
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIIESE WETENSKAPPE GRAAD 12  
VRAESTEL 2 (CHEMIE)**

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

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	$p^\theta$	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	$V_m$	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	$T^\theta$	$273 \text{ K}$
Charge on electron <i>Lading op elektron</i>	$e$	$-1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro-konstante</i>	$N_A$	$6,02 \times 10^{23} \text{ mol}^{-1}$

**TABLE 2: FORMULAE/TABEL 2: FORMULES**

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/of $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$\text{pH} = -\log[\text{H}_3\text{O}^+]$
$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at/by } 298 \text{ K}$	
$E^\theta_{\text{cell}} = E^\theta_{\text{cathode}} - E^\theta_{\text{anode}} / E^\theta_{\text{sel}} = E^\theta_{\text{katoode}} - E^\theta_{\text{anode}}$ or/of $E^\theta_{\text{cell}} = E^\theta_{\text{reduction}} - E^\theta_{\text{oxidation}} / E^\theta_{\text{sel}} = E^\theta_{\text{reduksie}} - E^\theta_{\text{oksidasie}}$ or/of $E^\theta_{\text{cell}} = E^\theta_{\text{oxidising agent}} - E^\theta_{\text{reducing agent}} / E^\theta_{\text{sel}} = E^\theta_{\text{oksideermiddel}} - E^\theta_{\text{reduseermiddel}}$	

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

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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13 Al 27,0	14 Si 28,1	15 P 31,0	16 S 32,1	33 As 74,9	34 Se 78,9	35 Br 79,9	51 Sb 121,8	52 Te 127,6	53 I 126,9	54 Xe 131,3	85 At 210	86 Rn 222	101 Md 258	102 No 259	103 Lr 262	104 Uu 261	105 Uub 262	106 Uuq 263	107 Uuh 264	108 Uus 265	109 Uuo 266	110 Uut 267	111 Uuq 268	112 Uub 269	113 Uut 270	114 Uuq 271	115 Uub 272	116 Uut 273	117 Uuq 274	118 Uub 275	119 Uut 276	120 Uuq 277	121 Uub 278	122 Uut 279	123 Uuq 280	124 Uub 281	125 Uut 282	126 Uuq 283	127 Uub 284	128 Uut 285	129 Uuq 286	130 Uub 287	131 Uut 288	132 Uuq 289	133 Uub 290	134 Uut 291	135 Uuq 292	136 Uub 293	137 Uut 294	138 Uuq 295	139 Uub 296	140 Uut 297	141 Uuq 298	142 Uub 299	143 Uut 300	144 Uuq 301	145 Uub 302	146 Uut 303	147 Uuq 304	148 Uub 305	149 Uut 306	150 Uuq 307	151 Uub 308	152 Uut 309	153 Uuq 310	154 Uub 311	155 Uut 312	156 Uuq 313	157 Uub 314	158 Uut 315	159 Uuq 316	160 Uub 317	161 Uut 318	162 Uuq 319	163 Uub 320	164 Uut 321	165 Uuq 322	166 Uub 323	167 Uut 324	168 Uuq 325	169 Uub 326	170 Uut 327	171 Uuq 328	172 Uub 329	173 Uut 330	174 Uuq 331	175 Uub 332	176 Uut 333	177 Uuq 334	178 Uub 335	179 Uut 336	180 Uuq 337	181 Uub 338	182 Uut 339	183 Uuq 340	184 Uub 341	185 Uut 342	186 Uuq 343	187 Uub 344	188 Uut 345	189 Uuq 346	190 Uub 347	191 Uut 348	192 Uuq 349	193 Uub 350	194 Uut 351	195 Uuq 352	196 Uub 353	197 Uut 354	198 Uuq 355	199 Uub 356	200 Uut 357	201 Uuq 358	202 Uub 359	203 Uut 360	204 Uuq 361	205 Uub 362	206 Uut 363	207 Uuq 364	208 Uub 365	209 Uut 366	210 Uuq 367	211 Uub 368	212 Uut 369	213 Uuq 370	214 Uub 371	215 Uut 372	216 Uuq 373	217 Uub 374	218 Uut 375	219 Uuq 376	220 Uub 377	221 Uut 378	222 Uuq 379	223 Uub 380	224 Uut 381	225 Uuq 382	226 Uub 383	227 Uut 384	228 Uuq 385	229 Uub 386	230 Uut 387	231 Uuq 388	232 Uub 389	233 Uut 390	234 Uuq 391	235 Uub 392	236 Uut 393	237 Uuq 394	238 Uub 395	239 Uut 396	240 Uuq 397	241 Uub 398	242 Uut 399	243 Uuq 400	244 Uub 401	245 Uut 402	246 Uuq 403	247 Uub 404	248 Uut 405	249 Uuq 406	250 Uub 407	251 Uut 408	252 Uuq 409	253 Uub 410	254 Uut 411	255 Uuq 412	256 Uub 413	257 Uut 414	258 Uuq 415	259 Uub 416	260 Uut 417	261 Uuq 418	262 Uub 419	263 Uut 420	264 Uuq 421	265 Uub 422	266 Uut 423	267 Uuq 424	268 Uub 425	269 Uut 426	270 Uuq 427	271 Uub 428	272 Uut 429	273 Uuq 430	274 Uub 431	275 Uut 432	276 Uuq 433	277 Uub 434	278 Uut 435	279 Uuq 436	280 Uub 437	281 Uut 438	282 Uuq 439	283 Uub 440	284 Uut 441	285 Uuq 442	286 Uub 443	287 Uut 444	288 Uuq 445	289 Uub 446	290 Uut 447	291 Uuq 448	292 Uub 449	293 Uut 450	294 Uuq 451	295 Uub 452	296 Uut 453	297 Uuq 454	298 Uub 455	299 Uut 456	300 Uuq 457	301 Uub 458	302 Uut 459	303 Uuq 460	304 Uub 461	305 Uut 462	306 Uuq 463	307 Uub 464	308 Uut 465	309 Uuq 466	310 Uub 467	311 Uut 468	312 Uuq 469	313 Uub 470	314 Uut 471	315 Uuq 472	316 Uub 473	317 Uut 474	318 Uuq 475	319 Uub 476	320 Uut 477	321 Uuq 478	322 Uub 479	323 Uut 480	324 Uuq 481	325 Uub 482	326 Uut 483	327 Uuq 484	328 Uub 485	329 Uut 486	330 Uuq 487	331 Uub 488	332 Uut 489	333 Uuq 490	334 Uub 491	335 Uut 492	336 Uuq 493	337 Uub 494	338 Uut 495	339 Uuq 496	340 Uub 497	341 Uut 498	342 Uuq 499	343 Uub 500	344 Uut 501	345 Uuq 502	346 Uub 503	347 Uut 504	348 Uuq 505	349 Uub 506	350 Uut 507	351 Uuq 508	352 Uub 509	353 Uut 510	354 Uuq 511	355 Uub 512	356 Uut 513	357 Uuq 514	358 Uub 515	359 Uut 516	360 Uuq 517	361 Uub 518	362 Uut 519	363 Uuq 520	364 Uub 521	365 Uut 522	366 Uuq 523	367 Uub 524	368 Uut 525	369 Uuq 526	370 Uub 527	371 Uut 528	372 Uuq 529	373 Uub 530	374 Uut 531	375 Uuq 532	376 Uub 533	377 Uut 534	378 Uuq 535	379 Uub 536	380 Uut 537	381 Uuq 538	382 Uub 539	383 Uut 540	384 Uuq 541	385 Uub 542	386 Uut 543	387 Uuq 544	388 Uub 545	389 Uut 546	390 Uuq 547	391 Uub 548	392 Uut 549	393 Uuq 550	394 Uub 551	395 Uut 552	396 Uuq 553	397 Uub 554	398 Uut 555	399 Uuq 556	400 Uub 557	401 Uut 558	402 Uuq 559	403 Uub 560	404 Uut 561	405 Uuq 562	406 Uub 563	407 Uut 564	408 Uuq 565	409 Uub 566	410 Uut 567	411 Uuq 568	412 Uub 569	413 Uut 570	414 Uuq 571	415 Uub 572	416 Uut 573	417 Uuq 574	418 Uub 575	419 Uut 576	420 Uuq 577	421 Uub 578	422 Uut 579	423 Uuq 580	424 Uub 581	425 Uut 582	426 Uuq 583	427 Uub 584	428 Uut 585	429 Uuq 586	430 Uub 587	431 Uut 588	432 Uuq 589	433 Uub 590	434 Uut 591	435 Uuq 592	436 Uub 593	437 Uut 594	438 Uuq 595	439 Uub 596	440 Uut 597	441 Uuq 598	442 Uub 599	443 Uut 600	444 Uuq 601	445 Uub 602	446 Uut 603	447 Uuq 604	448 Uub 605	449 Uut 606	450 Uuq 607	451 Uub 608	452 Uut 609	453 Uuq 610	454 Uub 611	455 Uut 612	456 Uuq 613	457 Uub 614	458 Uut 615	459 Uuq 616	460 Uub 617	461 Uut 618	462 Uuq 619	463 Uub 620	464 Uut 621	465 Uuq 622	466 Uub 623	467 Uut 624	468 Uuq 625	469 Uub 626	470 Uut 627	471 Uuq 628	472 Uub 629	473 Uut 630	474 Uuq 631	475 Uub 632	476 Uut 633	477 Uuq 634	478 Uub 635	479 Uut 636	480 Uuq 637	481 Uub 638	482 Uut 639	483 Uuq 640	484 Uub 641	485 Uut 642	486 Uuq 643	487 Uub 644	488 Uut 645	489 Uuq 646	490 Uub 647	491 Uut 648	492 Uuq 649	493 Uub 650	494 Uut 651	495 Uuq 652	496 Uub 653	497 Uut 654	498 Uuq 655	499 Uub 656	500 Uut 657	501 Uuq 658	502 Uub 659	503 Uut 660	504 Uuq 661	505 Uub 662	506 Uut 663	507 Uuq 664	508 Uub 665	509 Uut 666	510 Uuq 667	511 Uub 668	512 Uut 669	513 Uuq 670	514 Uub 671	515 Uut 672	516 Uuq 673	517 Uub 674	518 Uut 675	519 Uuq 676	520 Uub 677	521 Uut 678	522 Uuq 679	523 Uub 680	524 Uut 681	525 Uuq 682	526 Uub 683	527 Uut 684	528 Uuq 685	529 Uub 686	530 Uut 687	531 Uuq 688	532 Uub 689	533 Uut 690	534 Uuq 691	535 Uub 692	536 Uut 693	537 Uuq 694	538 Uub 695	539 Uut 696	540 Uuq 697	541 Uub 698	542 Uut 699	543 Uuq 700	544 Uub 701	545 Uut 702	546 Uuq 703	547 Uub 704	548 Uut 705	549 Uuq 706	550 Uub 707	551 Uut 708	552 Uuq 709	553 Uub 710	554 Uut 711	555 Uuq 712	556 Uub 713	557 Uut 714	558 Uuq 715	559 Uub 716	560 Uut 717	561 Uuq 718	562 Uub 719	563 Uut 720	564 Uuq 721	565 Uub 722	566 Uut 723	567 Uuq 724	568 Uub 725	569 Uut 726	570 Uuq 727	571 Uub 728	572 Uut 729	573 Uuq 730	574 Uub 731	575 Uut 732	576 Uuq 733	577 Uub 734	578 Uut 735	579 Uuq 736	580 Uub 737	581 Uut 738	582 Uuq 739	583 Uub 740	584 Uut 741	585 Uuq 742	586 Uub 743	587 Uut 744	588 Uuq 745	589 Uub 746	590 Uut 747	591 Uuq 748	592 Uub 749	593 Uut 750	594 Uuq 751	595 Uub 752	596 Uut 753	597 Uuq 754	598 Uub 755	599 Uut 756	600 Uuq 757	601 Uub 758	602 Uut 759	603 Uuq 760	604 Uub 761	605 Uut 762	606 Uuq 763	607 Uub 764	608 Uut 765	609 Uuq 766	610 Uub 767	611 Uut 768	612 Uuq 769	613 Uub 770	614 Uut 771	615 Uuq 772	616 Uub 773	617 Uut 774	618 Uuq 775	619 Uub 776	620 Uut 777	621 Uuq 778	622 Uub 779	623 Uut 780	624 Uuq 781	625 Uub 782	626 Uut 783	627 Uuq 784	628 Uub 785	629 Uut 786	630 Uuq 787	631 Uub 788	632 Uut 789	633 Uuq 790	634 Uub 791	635 Uut 792	636 Uuq 793	637 Uub 794	638 Uut 795	639 Uuq 796	640 Uub 797	641 Uut 798	642 Uuq 799	643 Uub 800	644 Uut 801	645 Uuq 802	646 Uub 803	647 Uut 804	648 Uuq 805	649 Uub 806	650 Uut 807	651 Uuq 808	652 Uub 809	653 Uut 810	654 Uuq 811	655 Uub 812	656 Uut 813	657 Uuq 814	658 Uub 815	659 Uut 816	660 Uuq 817	661 Uub 818	662 Uut 819	663 Uuq 820	664 Uub 821	665 Uut 822	666 Uuq 823	667 Uub 824	668 Uut 825	669 Uuq 826	670 Uub 827	671 Uut 828	672 Uuq 829	673 Uub 830	674 Uut 831	675 Uuq 832	676 Uub 833	677 Uut 834	678 Uuq 835	679 Uub 836	680 Uut 837	681 Uuq 838	682 Uub 839	683 Uut 840	684 Uuq 841	685 Uub 842	686 Uut 843	687 Uuq 844	688 Uub 845	689 Uut 846	690 Uuq 847	691 Uub 848	692 Uut 849	693 Uuq 850	694 Uub 851	695 Uut 852	696 Uuq 853	697 Uub 854	698 Uut 855	699 Uuq 856	700 Uub 857	701 Uut 858	702 Uuq 859	703 Uub 860	704 Uut 861	705 Uuq 862	706 Uub 863	707 Uut 864	708 Uuq 865	709 Uub 866	710 Uut 867	711 Uuq 868	712 Uub 869	713 Uut 870	714 Uuq 871	715 Uub 872	716 Uut 873	717 Uuq 874	718 Uub 875	719 Uut 876	720 Uuq 877	721 Uub 878	722 Uut 879	723 Uuq 880	724 Uub 881	725 Uut 882	726 Uuq 883	727 Uub 884	728 Uut 885	729 Uuq 886	730 Uub 887	731 Uut 888	73

**TABLE 4A: STANDARD REDUCTION POTENTIALS**  
**TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE**

Half-reactions/Halfreaksies	$E^{\ominus}$ (V)
$F_2(g) + 2e^- \rightleftharpoons 2F^-$	+ 2,87
$Co^{3+} + e^- \rightleftharpoons Co^{2+}$	+ 1,81
$H_2O_2 + 2H^+ + 2e^- \rightleftharpoons 2H_2O$	+ 1,77
$MnO_4^- + 8H^+ + 5e^- \rightleftharpoons Mn^{2+} + 4H_2O$	+ 1,51
$Cl_2(g) + 2e^- \rightleftharpoons 2Cl^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightleftharpoons 2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^- \rightleftharpoons 2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^- \rightleftharpoons Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^- \rightleftharpoons Pt$	+ 1,20
$Br_2(l) + 2e^- \rightleftharpoons 2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^- \rightleftharpoons NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^- \rightleftharpoons Hg(l)$	+ 0,85
$Ag^+ + e^- \rightleftharpoons Ag$	+ 0,80
$NO_3^- + 2H^+ + e^- \rightleftharpoons NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$	+ 0,77
$O_2(g) + 2H^+ + 2e^- \rightleftharpoons H_2O_2$	+ 0,68
$I_2 + 2e^- \rightleftharpoons 2I^-$	+ 0,54
$Cu^+ + e^- \rightleftharpoons Cu$	+ 0,52
$SO_2 + 4H^+ + 4e^- \rightleftharpoons S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$	+ 0,40
$Cu^{2+} + 2e^- \rightleftharpoons Cu$	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^- \rightleftharpoons SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^- \rightleftharpoons Cu^+$	+ 0,16
$Sn^{4+} + 2e^- \rightleftharpoons Sn^{2+}$	+ 0,15
$S + 2H^+ + 2e^- \rightleftharpoons H_2S(g)$	+ 0,14
$2H^+ + 2e^- \rightleftharpoons H_2(g)$	0,00
$Fe^{3+} + 3e^- \rightleftharpoons Fe$	- 0,06
$Pb^{2+} + 2e^- \rightleftharpoons Pb$	- 0,13
$Sn^{2+} + 2e^- \rightleftharpoons Sn$	- 0,14
$Ni^{2+} + 2e^- \rightleftharpoons Ni$	- 0,27
$Co^{2+} + 2e^- \rightleftharpoons Co$	- 0,28
$Cd^{2+} + 2e^- \rightleftharpoons Cd$	- 0,40
$Cr^{3+} + e^- \rightleftharpoons Cr^{2+}$	- 0,41
$Fe^{2+} + 2e^- \rightleftharpoons Fe$	- 0,44
$Cr^{3+} + 3e^- \rightleftharpoons Cr$	- 0,74
$Zn^{2+} + 2e^- \rightleftharpoons Zn$	- 0,76
$2H_2O + 2e^- \rightleftharpoons H_2(g) + 2OH^-$	- 0,83
$Cr^{2+} + 2e^- \rightleftharpoons Cr$	- 0,91
$Mn^{2+} + 2e^- \rightleftharpoons Mn$	- 1,18
$Al^{3+} + 3e^- \rightleftharpoons Al$	- 1,66
$Mg^{2+} + 2e^- \rightleftharpoons Mg$	- 2,36
$Na^+ + e^- \rightleftharpoons Na$	- 2,71
$Ca^{2+} + 2e^- \rightleftharpoons Ca$	- 2,87
$Sr^{2+} + 2e^- \rightleftharpoons Sr$	- 2,89
$Ba^{2+} + 2e^- \rightleftharpoons Ba$	- 2,90
$Cs^+ + e^- \rightleftharpoons Cs$	- 2,92
$K^+ + e^- \rightleftharpoons K$	- 2,93
$Li^+ + e^- \rightleftharpoons Li$	- 3,05

Increasing oxidising ability/Toenemende oksiderende vermoë

Increasing reducing ability/Toenemende reducerende vermoë

**TABLE 4B: STANDARD REDUCTION POTENTIALS**  
**TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE**

Half-reactions/Halfreaksies	$E^{\theta}$ (V)
$\text{Li}^{+} + \text{e}^{-} \rightleftharpoons \text{Li}$	-3,05
$\text{K}^{+} + \text{e}^{-} \rightleftharpoons \text{K}$	-2,93
$\text{Cs}^{+} + \text{e}^{-} \rightleftharpoons \text{Cs}$	-2,92
$\text{Ba}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ba}$	-2,90
$\text{Sr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sr}$	-2,89
$\text{Ca}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ca}$	-2,87
$\text{Na}^{+} + \text{e}^{-} \rightleftharpoons \text{Na}$	-2,71
$\text{Mg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mg}$	-2,36
$\text{Al}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Al}$	-1,66
$\text{Mn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}$	-1,18
$\text{Cr}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,91
$2\text{H}_2\text{O} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g}) + 2\text{OH}^{-}$	-0,83
$\text{Zn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Zn}$	-0,76
$\text{Cr}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Cr}$	-0,74
$\text{Fe}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,44
$\text{Cr}^{3+} + \text{e}^{-} \rightleftharpoons \text{Cr}^{2+}$	-0,41
$\text{Cd}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cd}$	-0,40
$\text{Co}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Co}$	-0,28
$\text{Ni}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Ni}$	-0,27
$\text{Sn}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}$	-0,14
$\text{Pb}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pb}$	-0,13
$\text{Fe}^{3+} + 3\text{e}^{-} \rightleftharpoons \text{Fe}$	-0,06
$2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2(\text{g})$	0,00
$\text{S} + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{S}(\text{g})$	+0,14
$\text{Sn}^{4+} + 2\text{e}^{-} \rightleftharpoons \text{Sn}^{2+}$	+0,15
$\text{Cu}^{2+} + \text{e}^{-} \rightleftharpoons \text{Cu}^{+}$	+0,16
$\text{SO}_4^{2-} + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{SO}_2(\text{g}) + 2\text{H}_2\text{O}$	+0,17
$\text{Cu}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Cu}$	+0,34
$2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^{-} \rightleftharpoons 4\text{OH}^{-}$	+0,40
$\text{SO}_2 + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons \text{S} + 2\text{H}_2\text{O}$	+0,45
$\text{Cu}^{+} + \text{e}^{-} \rightleftharpoons \text{Cu}$	+0,52
$\text{I}_2 + 2\text{e}^{-} \rightleftharpoons 2\text{I}^{-}$	+0,54
$\text{O}_2(\text{g}) + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{H}_2\text{O}_2$	+0,68
$\text{Fe}^{3+} + \text{e}^{-} \rightleftharpoons \text{Fe}^{2+}$	+0,77
$\text{NO}_3^{-} + 2\text{H}^{+} + \text{e}^{-} \rightleftharpoons \text{NO}_2(\text{g}) + \text{H}_2\text{O}$	+0,80
$\text{Ag}^{+} + \text{e}^{-} \rightleftharpoons \text{Ag}$	+0,80
$\text{Hg}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Hg}(\text{l})$	+0,85
$\text{NO}_3^{-} + 4\text{H}^{+} + 3\text{e}^{-} \rightleftharpoons \text{NO}(\text{g}) + 2\text{H}_2\text{O}$	+0,96
$\text{Br}_2(\text{l}) + 2\text{e}^{-} \rightleftharpoons 2\text{Br}^{-}$	+1,07
$\text{Pt}^{2+} + 2\text{e}^{-} \rightleftharpoons \text{Pt}$	+1,20
$\text{MnO}_2 + 4\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 2\text{H}_2\text{O}$	+1,23
$\text{O}_2(\text{g}) + 4\text{H}^{+} + 4\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,23
$\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^{+} + 6\text{e}^{-} \rightleftharpoons 2\text{Cr}^{3+} + 7\text{H}_2\text{O}$	+1,33
$\text{Cl}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{Cl}^{-}$	+1,36
$\text{MnO}_4^{-} + 8\text{H}^{+} + 5\text{e}^{-} \rightleftharpoons \text{Mn}^{2+} + 4\text{H}_2\text{O}$	+1,51
$\text{H}_2\text{O}_2 + 2\text{H}^{+} + 2\text{e}^{-} \rightleftharpoons 2\text{H}_2\text{O}$	+1,77
$\text{Co}^{3+} + \text{e}^{-} \rightleftharpoons \text{Co}^{2+}$	+1,81
$\text{F}_2(\text{g}) + 2\text{e}^{-} \rightleftharpoons 2\text{F}^{-}$	+2,87

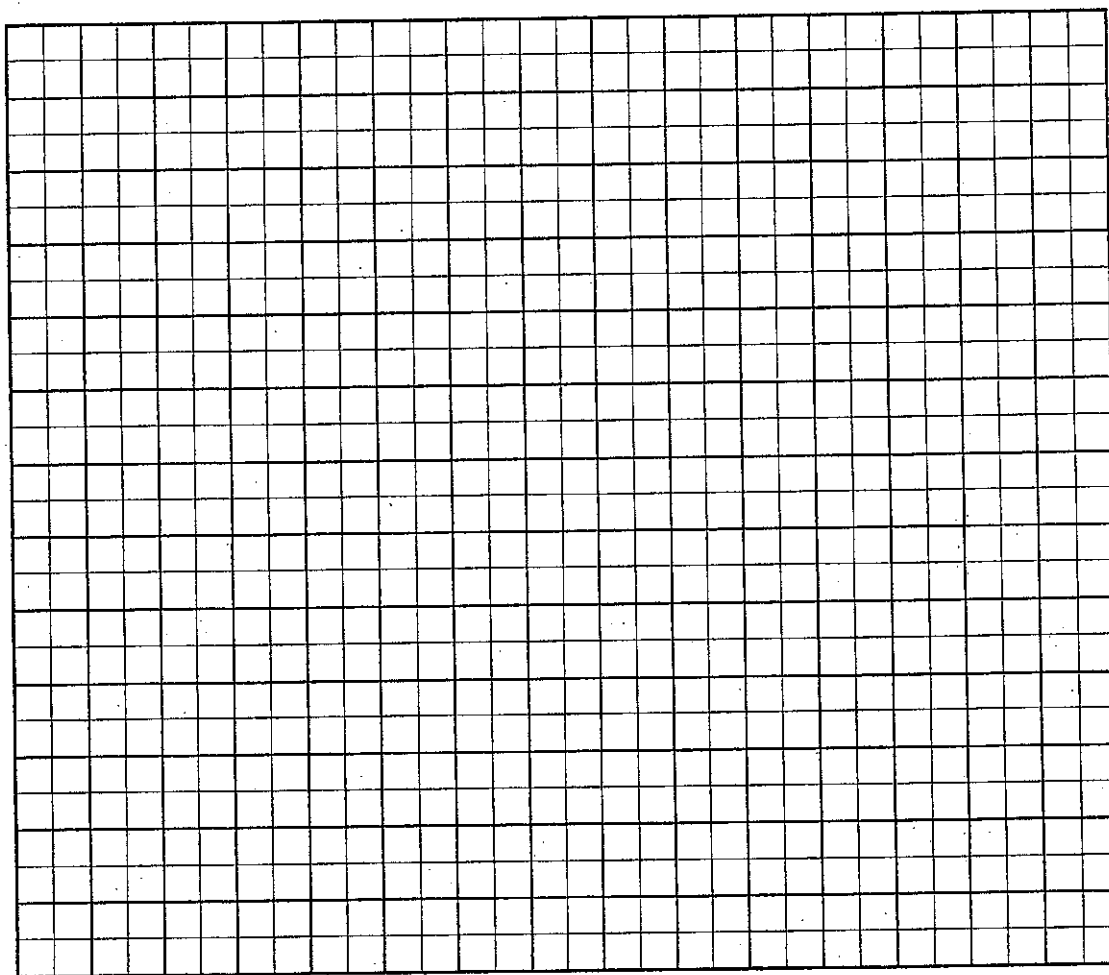




Name: \_\_\_\_\_

**Answer sheet Q6.4 and Q6.7**

Time (s)	0	1	2	3	4	5	6	7	8	9
Mass of flask and its contents (g)	178	176,2	174,1	172,7	172,3	172,2	172,1	172,1	172,1	172,1
Mass of CO <sub>2</sub> (g) produced (g)										



PLEASE TEAR ON DOTTED LINE



# **Education**

**KwaZulu-Natal Department of Education  
REPUBLIC OF SOUTH AFRICA**

**PHYSICAL SCIENCES P2 (CHEMISTRY)**

**PREPARATORY EXAMINATION**

**MEMORANDUM**

**SEPTEMBER 2017**

**NATIONAL SENIOR  
CERTIFICATE**

**GRADE 12**

**TIME: 3 hours**

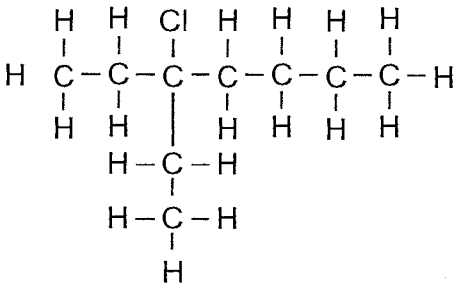
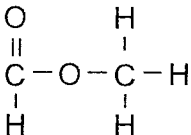
**MARKS: 150**

**This memorandum consists of 9 pages.**

### QUESTION 1: MULTIPLE CHOICE

- 1.1 D ✓✓ (2)  
 1.2 B ✓✓ (2)  
 1.3 A ✓✓ OR C (2)  
 1.4 D ✓✓ (2)  
 1.5 C ✓✓ (2)  
 1.6 B ✓✓ (2)  
 1.7 A ✓✓ (2)  
 1.8 D ✓✓ (2)  
 1.9 A ✓✓ (2)  
 1.10 C ✓✓ (2)  
**[20]**

### QUESTION 2

- 2.1 2-bromo-5-chloro-2,5-dimethylheptane ✓ (2)  
 2.2  $C_nH_{2n}$  ✓ (1)  
 2.3  (3)  
 ✓ correct structural formula  
 ✓ Cl in correct position  
 ✓ ethyl group in correct position  
 2.4 Triple bond ✓ / Accept Alkynes (1)  
 2.5  ✓✓ (2)  
 Accept any correct formula except the molecular  
 2.6 Ketones ✓ (1)  
**[10]**

**QUESTION 3**

3.1 C ✓ OR Ethanoic acid (1)

3.2 Ethanoic acid has the strongest intermolecular forces ✓  
More energy is required to overcome the intermolecular forces ✓  
least amount will evaporate ✓ (3)

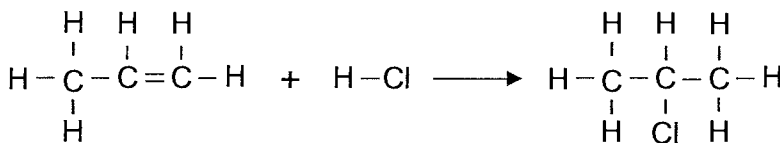
3.3 B ✓ (1)

3.4 Ethanal has the weakest intermolecular forces ✓ (3)  
Least energy is required to overcome the intermolecular forces ✓  
Ethanal has the lowest boiling point and therefore the highest vapour pressure ✓**[8]****QUESTION 4**4.1  $\text{H}_2\text{SO}_4 / \text{H}_3\text{PO}_4 / \text{Heat}$  ✓ (1)

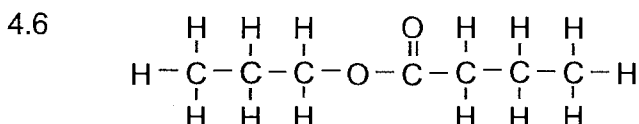
4.2 Pt / Pd / Ni ✓ (1)

4.3  $\text{C}_3\text{H}_8 + 5\text{O}_2 \longrightarrow 3\text{CO}_2 + 4\text{H}_2\text{O}$  (3)If any structural formulae used  $\frac{2}{3}$ ✓ reactants/left hand side  
✓ products/right hand side  
✓ balancing

4.4 (3)

If condensed formulae used  $\frac{2}{3}$ ✓ reactants/left hand side  
✓ products/right hand side  
✓ structural formulae

4.5 Sulphuric acid ✓ (1)

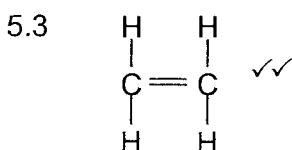
✓ correct functional group  
✓ whole structure correct (2)

4.7. Propyl butanoate ✓✓ Any correct name given for 4.6 (2)

**[13]****QUESTION 5**

5.1 A molecule that consists of a large number of atoms. ✓✓ (2)

5.2 Polymerisation ✓ (1)

**[5]**

**QUESTION 6**

6.1 How does the rate of a reaction change with time? ✓✓ (2)

Any given investigative question

6.2 Time ✓ Mark based on given investigative question. (1)

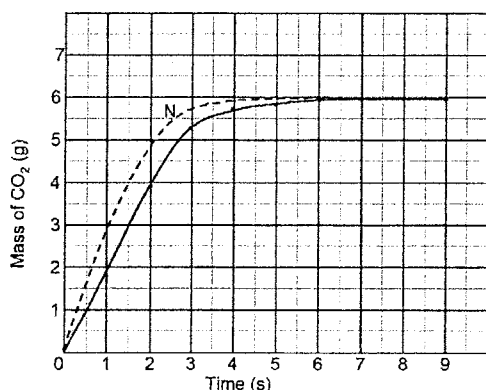
6.3 (2)

Time (s)	0	1	2	3	4	5	6	7	8	9
Mass of flask and its contents (g)	178	176,2	174,1	172,7	172,3	172,2	172,1	172,1	172,1	172,1
Mass of CO <sub>2</sub> (g) produced (g)	0	1,8	3,9	5,3	5,7	5,8	5,9	5,9	5,9	5,9

✓✓

6.4

Graph of mass of CO<sub>2</sub> produced vs time



- ✓ Correct shape
- ✓✓ plotting of all points
- ✓ Appropriate scale and labels on both axes
- ✓ Correct heading

But plotting 5 or less points subtract one mark.

(5)

6.5 The reaction has reached completion. ✓ (1)

OR

One of the reactants is finished. ✓

6.6

$$\begin{aligned} n &= \frac{m}{M} \quad \checkmark \\ &= \frac{5,9}{44} \quad \checkmark \\ &= 0,13 \text{ mol} \end{aligned}$$

1 mol occupies 24,46 dm<sup>3</sup>

0,13 mol will occupy 3,18 dm<sup>3</sup> ✓

**Accept range 3.18 – 3.28**

(3)

6.7 Graph N has a steeper gradient ✓ and finishes at the same point as the original graph ✓ (2)

6.8 Higher temperature, molecules have greater kinetic energy ✓ (3)

More effective collisions per unit time ✓

Reaction rate increases ✓

[19]

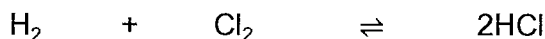
## QUESTION 7

7.1

**CALCULATIONS USING NUMBER OF MOLES****BEREKENINGE WAT GETAL MOL GEBRUIK****Mark allocation/Puntetoekenning:**

- Calculating number of moles of  $H_2$ ,  $Cl_2$  and  $HCl$ . ✓
- Molar ratio. ✓
- Number of moles at Equilibrium. ✓
- Dividing by 0,5 to get the concentration. ✓
- $K_c$  expression. ✓
- Substitution in the  $K_c$  expression ✓
- Calculating concentration of  $Cl_2$  ✓
- Substitution in  $n = cV$ . ✓
- Substitution in  $m = nM$  ✓
- Final answer ✓

7.1



(10)

Initial mass	10g	355g	0g
Initial n	5	5	0
React/Prod	x	x	2x
n at equilibrium	5 - x	5 - x	2x
Conc. at equilibrium	$\frac{5-x}{0,5}$	$\frac{5-x}{0,5}$	$\frac{2x}{0,5}$

✓ Calc no. of

✓ mol

✓ Ratio

✓

✓ dividing by 0,5

$$K_c = \frac{[HI]^2}{[H_2][I_2]} \quad \checkmark$$

$$\checkmark 60 = \frac{\left(\frac{2x}{0,5}\right)^2}{\left(\frac{5-x}{0,5}\right)\left(\frac{5-x}{0,5}\right)} \quad \checkmark$$

$$x = 3,97$$

$$\text{Conc. } Cl_2 \text{ at equilibrium} = \frac{5-3,97}{0,5} \checkmark$$

$$n = C \cdot V$$

$$= \frac{5-3,97}{0,5} \cdot 0,5$$

$$= 1,03 \text{ mol}$$

$$m = n \cdot M$$

$$= 1,03 \cdot 71 \checkmark$$

$$= 73,13 \text{ g} \checkmark$$

No  $K_c$  expression, correct substitution max  $\frac{9}{10}$ Wrong KC expression max  $\frac{4}{10}$

7.2 When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. ✓✓ (2)

7.3

7.3.1 Decrease ✓ (1)

7.3.2 Increase ✓ (1)

7.4 The temperature of the system was increased, according to Le Chatelier's principle, the system reacts by favouring the endothermic reaction. ✓ Hence, the reverse reaction is favoured. ✓ (2)  
**[16]**

### QUESTION 8

8.1 8.1.1 Strong acid ✓ (1)

8.1.2 (5)

Vol. of conc. HCl required

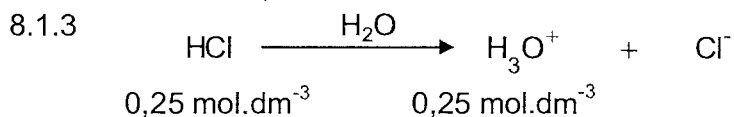
$$\begin{aligned} n &= CV \quad \checkmark \\ &= 0,25 \times 0,5 \quad \checkmark \\ &= 0,0125 \quad \checkmark \end{aligned} \quad \text{OR}$$

$$\begin{aligned} c_1 V_1 &= c_2 V_2 \quad \checkmark \\ (10)(x) &= (0,25)(0,5) \quad \checkmark \\ x &= 0,0125 \text{ dm}^3 \\ &= 12,5 \text{ cm}^3 \quad \checkmark \end{aligned}$$

$$C = \frac{n}{V}$$

$$10 = \frac{0,0125}{V} \quad \checkmark$$

$$\begin{aligned} V &= 0,0125 \text{ dm}^3 \quad \checkmark \\ &= 12,5 \text{ cm}^3 \end{aligned}$$



$$\begin{aligned} \text{pH} &= -\log [\text{H}_3\text{O}^+] \quad \checkmark \\ &= -\log (0,25) \quad \checkmark \\ &= 0,60 \quad \checkmark \end{aligned}$$

(3)

8.2 8.2.1 **Option 1**

$$n(\text{HCl}) = cV = (0,25)(0,5) \\ = 0,125 \text{ mol}$$

$$n(\text{NaOH}) = cV = (0,2)(0,14) \\ = 0,028 \text{ mol}$$

$$n(\text{HCl}) \text{ reacted with } (\text{NaOH}) = 0,028 \text{ mol} \\ n(\text{HCl}) \text{ reacted with } (\text{CaCO}_3) = 0,125 - 0,028 \\ = 0,097 \text{ mol}$$

$$n(\text{CaCO}_3) = \frac{1}{2} \times 0,097 \\ = 0,0485 \text{ mol}$$

$$\text{mass of CaCO}_3 = nM \\ = 0,0485 \times 100 \\ = 4,85 \text{ g}$$

**Option 2**

Volume of HCl reacted with NaOH

$$\frac{C_a V_a}{C_b V_b} = \frac{n_a}{n_b} \\ \frac{(0,25)V_a}{(0,2)(140)} = \frac{1}{1} \\ V_a = 112 \text{ cm}^3$$

Volume of HCl reacted with  $\text{CaCO}_3$ 

$$V_{\text{HCl}} = 500 - 112 \\ = 388 \text{ cm}^3 \\ = 0,388 \text{ dm}^3$$

No. of mol of HCl reacted with  $\text{CaCO}_3$ 

$$C = \frac{n}{V} \\ 0,25 = \frac{n}{0,388} \\ n = 0,097 \text{ mol}$$

No. of mol of  $\text{CaCO}_3$  reacted with HCl

$$n_{\text{HCl}} : n_{\text{CaCO}_3} = 2 : 1 \\ n_{\text{CaCO}_3} = \frac{0,097}{2} \\ = 0,0485 \text{ mol}$$

Mass of mol of  $\text{CaCO}_3$  reacted with HCl

$$m = n \cdot M \\ = 0,0485 \cdot 100 \\ = 4,85 \text{ g}$$

(8)



8.2.2 (3)

$$\begin{aligned}\% \text{ purity} &= \frac{\text{mass of CaCO}_3}{\text{mass of sample}} \cdot 100 \\ &= \frac{4,85}{5} \cdot 100 \quad \checkmark \checkmark \\ &= 97\% \quad \checkmark\end{aligned}$$

**[20]****QUESTION 9**

- 9.1 9.1.1 cathode ✓ (1)
- 9.1.2 P to silver medal ✓ (1)
- 9.1.3 Electrode P is made of silver. Rate of oxidation is equal to the rate of reduction. ✓✓ (2)
- 9.1.4 Ag ✓ (1)
- 9.2 9.2.1 Temp = 25 °C ✓ (1)
- Concentration of the electrolyte solution = 1 mol.dm<sup>-3</sup> ✓ (2)
- 9.2.2 Chemical energy to electrical energy ✓ (1)
- 9.2.3 Maintain electrical neutrality between the two half cells ✓ (2)
- Completes the circuit ✓
- 9.2.4  $E_{\text{cell}}^{\theta} = E_{\text{cathode}}^{\theta} - E_{\text{anode}}^{\theta}$  ✓
- $2,70 = 0,34 - E_{\text{anode}}^{\theta}$
- $E_{\text{anode}}^{\theta} = -2,36 \text{ V}$  ✓
- The anode must be magnesium ✓ (5)
- 9.2.5  $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^{-}$  ✓✓ (2)
- 9.2.6  $\text{Mg}/\text{Mg}^{2+} // \text{Cu}^{2+}/\text{Cu}$  OR  $\text{Y}/\text{Y}^{2+} // \text{Cu}^{2+}/\text{Cu}$  (3)
- 9.2.7 Remain the same ✓ (1)
- 9.2.8 Ag<sup>+</sup> will form a precipitate with the Cl<sup>-</sup>. This decreases the concentration of the Cl<sup>-</sup> in solution, but not the concentration of Cu<sup>2+</sup> ✓✓ (3)
- The reading on the voltmeter can only be affected by a change of concentrations of either Cu<sup>2+</sup> or Mg<sup>2+</sup>/Y<sup>2+</sup>. ✓ (3)
- [24]**

**QUESTION 10**

- 10.1 10.1.1 Haber process ✓ (1)
- 10.1.2 Fractional distillation of air ✓ (1)
- 10.1.3 Ostwald process ✓ (1)
- 10.1.4 Platinum ✓ (1)
- 10.1.5 H<sub>2</sub>O ✓ OR (H<sub>2</sub>O + O<sub>2</sub>) (1)

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10.1.6 Enables plants to grow better and faster ✓ (2)

Increases food production ✓

10.1.7 Ammonium nitrate ✓ (1)

10.2 10.2.1 The ratio of N:P:K or primary nutrients in the bag ✓

Amount of fertilizer in the bag ✓ (2)

10.2.2  $\% \text{N} = \frac{22}{50} \times 22 = 9,68\% \checkmark$

$\% \text{P} = \frac{10}{50} \times 22 = 4,40\% \checkmark$

$\% \text{N} = \frac{18}{50} \times 22 = 7,92\% \checkmark$  (3)

OR

22% ✓✓✓

10.2.3 Potassium✓

Shortage of potassium causes poor quality flowers and fruit (colour and taste) and make leaves have brown or yellow edges. ✓

(2)

[15]

**TOTAL MARKS:** [150]