GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATIONS

2015

MEMORANDUM

SUBJECT:	**PHYSICAL SCIENCES P2 (10842)**

GAUTENG DEPARTMENT OF EDUCATION

PREPARATORY EXAMINATIONS

PHYSICAL SCIENCES
(Second Paper)

MEMORANDUM

QUESTION 1

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

QUESTION 2

2.1.1 C✓ (1)

2.1.2 A ✓ (1)

2.2.1 Butanal ✓ (1)

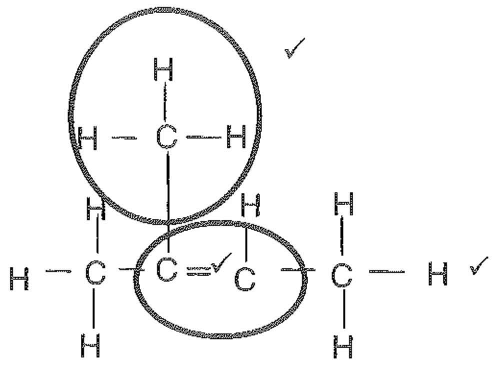
2.2.2 2–methyl✓butan -2-ol ✓ (2)

OR 2-methyl-2-butanol

2.3.1 Water / H_2O ✓ (1)

2.3.2

- Correct functional group ✓
- Methyl group on the second carbon ✓
- Whole structure ✓



Notes:

- Condensed or semi-structural formula: $\frac{1}{3}$
- Molecular formula: $\frac{0}{3}$

(3)

2.3.3 Addition / Hydration✓ (1)

2.4.1 Process by which molecules of two monomers with different functional groups✓react with the elimination/loss of water molecules. ✓ (2)

2.4.2 F✓ (1)

[13]

QUESTION 3

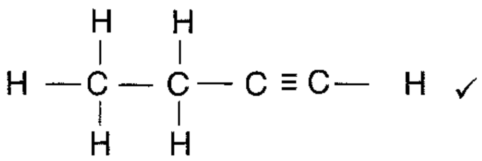
3.1.1 Organic compounds having the same molecular formula✓ with the same functional group situated at different positions. ✓or same side chain at different positions

OR

Organic compounds with the same molecular formula, ✓ but different positions of the side chain / functional groups. ✓

(2)

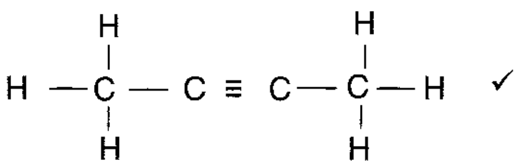
3.1.2



(1)

But -1-yne ✓ /1-butyne ✓

(1)

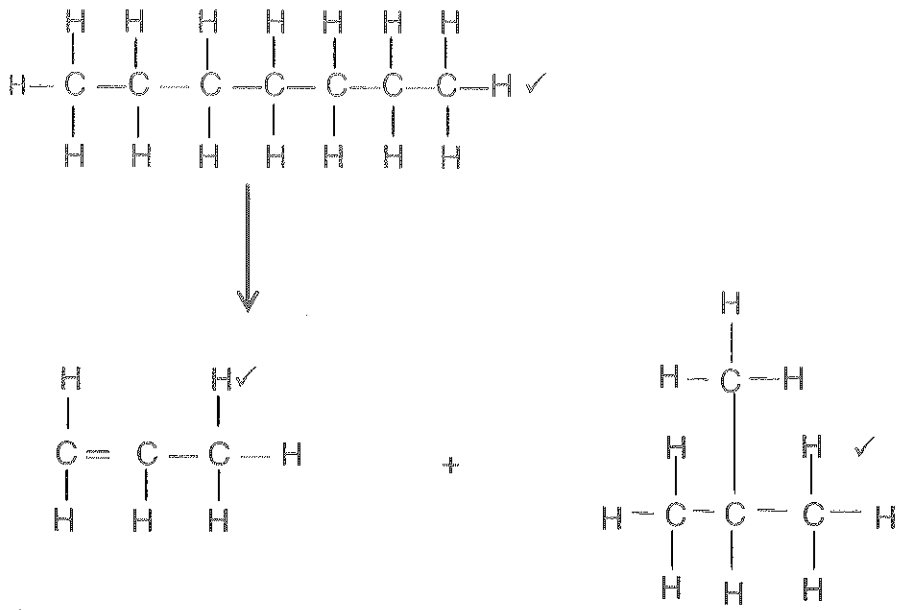


(1)

But-2-yne ✓ /2-butyne

(1)

3.2.1



Reactants✓ Products✓✓ (3)

Condensed/semi-structural formulae:	Max: $^{2}/_{3}$
Molecular formula;	$^{0}/_{3}$
Any additional reactant or products:	Max: $^{2}/_{3}$

3.2.2 Propene✓ and methylpropane ✓ (2)

3.3.1 The temperature ✓at which the vapour pressure of a liquid is equal to the external/ atmospheric pressure ✓ **OR**

The temperature ✓at which a liquid changes phase into the gaseous phase. 1/2 (2)

3.3.2 Propan -1-.ol has only one hydrogen bond ✓between its molecules. Thus, propan – 1 – ol has weaker intermolecular forces between its molecules. ✓ ∴ Less energy is needed to overcome these intermolecular forces, ✓thus propan – 1 – ol has a lower boiling point. **OR**

Propanoic acid has two hydrogen bonds✓between its molecules. The intermolecular forces between the propanoic acid molecules are thus stronger✓ ∴ more energy is needed to overcome these forces, ✓ thus propanoic acid has a higher boiling point. (3)

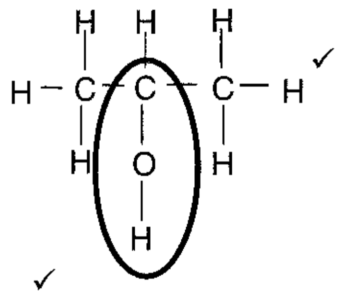
[16]

QUESTION 4

4.1.1 **Q:** Substitution✓/halogenation/chlorination (1)

4.1.2 **R:** Elimination/ dehydrohalogenation/ dehydrobromination✓ (1)

4.2.1



• Functional group • Whole structure correct
Accept –OH condensed in structural formula

(2)

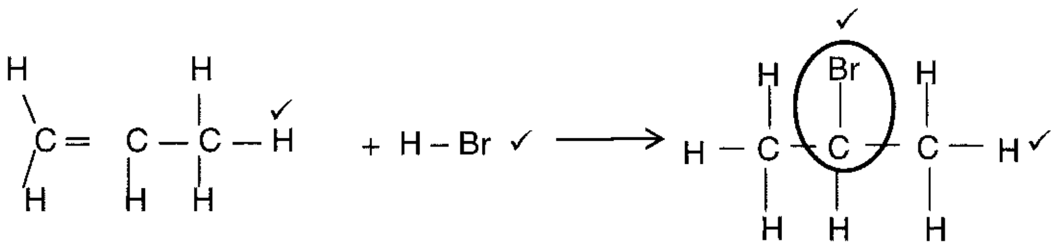
Condensed/semi – structural formulae	Max: $^1/_2$
Molecular formula	$^0/_2$

4.2.2 Propan – 2 – ol ✓ (1)

2-propanol

4.3.1 Hydrogen bromide ✓ (1)

4.3.2



• Functional group✓ • Whole structure correct✓	
Accept HBr Ignore: ⇌	
• **Condensed/semi-structural formulae** Max: $^3/_4$	
• **Molecular formula** $^0/_4$	
Any additional reactant or products: Max: $^3/_4$	Everything correct, ***wrong balancing*** Max: $^3/_4$

(4)

[10]

QUESTION 5

5.1.1 Surface area/state of division/reaction surface✓ (1)

5.1.2 There are more particles available for reaction.✓ /more collisions.
There are a greater number of effective collisions✓per unit of time✓
∴ reaction rate increases (3)

5.1.3 Mass of 15% of original 2 g=0,3 g✓
Number of moles of $CaCO_3$ 0,3 g:

$n = \frac{m}{M}$

$= \frac{0,3}{100}$✓

=0,003 mol.

✓ for both equations

$n_{CaCO_3} : n_{HCl}$

1 : 2

0,003: 0,006✓

$c_{HCl} = \frac{n}{V}$

$0,2 = \frac{0,006}{V}$

V =0,03 dm^3 ✓ (5)

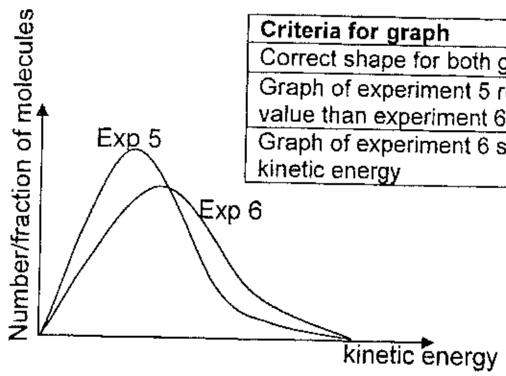
5.2.1 Concentration✓ (1)

5.2.2 Equal to ✓ (1)

5.2.3 The same number of moles/mass/ number of particles of $CaCO_3$ ✓ (produce same number of moles of carbon dioxide). $CaCO_3$ is the limiting agent/Acid is in excess. (1)

5.3.1 (Experiment) 6✓ (1)

5.3.2



Criteria for graph	Mark
Correct shape for both graphs	✓
Graph of experiment 5 reaches a higher maximum/peak value than experiment 6.	✓
Graph of experiment 6 shows more molecules of higher kinetic energy	✓

(3)

If no labels on axes	max:2/3

5.4.1 exothermic✓ (1)

5.4.2 The energy/potential energy of the products is lower than that of the reactants ✓
OR (1)
More energy released than absorbed✓
OR **[18]**
Energy is released

QUESTION 6

6.1 CALCULATIONS USING NUMBER OF MOLES:

Mark allocation:

- USING formula $n = \frac{3,01x10^{23}}{6,02x10^{23}}$ ✓
- Change in n(NO) = Initial mol – equilibrium mol✓
- Using ratio NO(g) : O_2(g) : NO_2(g) = 2 : 1 : 2✓ to determine change in n(O_2) and change in n(NO_2)
- Equilibrium [NO] = equilibrium n(NO) /0,05
Equilibrium [O_2] = equilibrium n(O_2) /0,05
Equilibrium [NO_2] = equilibrium n(NO_2) /0,05 } ✓
- Correct K_c expression (formulae in [ ])✓
- Substitution of concentrations and K_c value into K_c expression✓
- [O_2] at equilibrium✓
- n(O_2) at equilibrium (x 0,05) ✓
- n(O_2) initial = n at equilibrium + n change✓

OPTION 1

$$n(NO) = \frac{3,01 \times 10^{23}}{6,02 \times 10^{23}} = 5 \times 10^{-3} \text{ mol}$$

	NO(g)	O_2(g)	NO_2(g)	
Initial moles	1	0,5006✓	0	
Change in moles	0,995✓	0,4975	0,995	✓ mole ratio
Equilibrium moles	0,005	0,0031✓	0,995	✓ divide by 0,05
Equilibrium concentration	0,1	0,0615	19,9	

$$K_c = \frac{[NO_2]^2}{[NO]^2[O_2]}$$

$$6,44 \times 10^5 = \frac{(19,9)^2}{(0,1)^2[O_2]}$$

$$[O_2] = 0,0615 \text{ mol} \cdot \text{dm}^{-3}$$

[9]

6.2 Large K_c means a high yield of products compared to reactants✓ (1)

6.3 Darker✓ (1)

6.4 Temperature is decreased and the reaction will adjust to resist the change.The exothermic✓ reaction is favoured thus the forward reaction✓ is favoured and the contents become darker.✓ (3)

6.5 No effect ✓ (1)
[15]

QUESTION 7

7.1 Brønsted-Lowry base accepts a proton✓✓ (2)

7.2.1 pH $= -\log[H_3O^+]$✓
$= -\log(0,12)$✓
$= 0,92$✓ (3)

7.2.2 Cl^-✓ (1)

7.3.1 It can act as an acid or a base/ it can accept or donate an H^+ ion✓ (1)

7.3.2 $HSO_4^- + H_2O \rightleftharpoons H_3O^+ + SO_4^{-2}$
✓ reactants ✓products ✓balancing

Ignore → (3)

7.4 Drops of water will change the concentration of the acid/ make it more dilute✓ (1)

7.5.1 Option 1:

$n = \frac{m}{M}$

$= \frac{8,0}{56}$✓
$= 0,14$ mol

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

$= \frac{0,14}{0,25}$✓
$= 0,57$ mol·dm^{-3} ✓ (3)

Option 2:

$c = \frac{m}{MV}$

$= \frac{8,0}{56 \times 0,25}$
✓ ✓
$= 0,57$ mol·dm^{-3}✓

7.5.2 $\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$ ✓ (dilute acid)

$\frac{c_a(40)}{(0,57)(25)}$ ✓ $= \frac{1}{2}$ ✓

OR

$c_a = \frac{1 \times 0,57 \times 25}{2 \times 40}$ ✓ ✓ OR $c_a = \frac{1 \times 0,57 \times 0,025}{2 \times 0,04}$ ✓ ✓

$= 0,178\ mol \cdot dm^{-3}$ ✓ $= 0,178\ mol \cdot dm^{-3}$ (4)

7.5.3 ***Concentrated acid***

n_1 (moles concentrated) = n_2 (moles dilute) ✓

$c_1 \times V_1 = c_2 \times V_2$

$c_1 = \frac{0,178 \times (490 + 10)}{10}$ ✓ ✓ OR $c_1 = \frac{0,178 \times 0,5}{0,01}$ ✓ ✓

$= 8,9\ mol \cdot dm^{-3}$ ✓ $= 8,9\ mol \cdot dm^{-3}$ ✓

(4)
[22]

QUESTION 8

8.1 Electrical energy to chemical energy✓ (1)

8.2 Cathode✓

At cathode, Ag^+ / silver ions gain electrons✓ and are, reduced to Ag/ silver ✓metal (3)

8.3.1 Ag/silver ✓ (1)

8.3.2 $Ag^+ + e^- \rightarrow Ag$✓✓ (2)

$Ag^+ + e^- \rightleftharpoons Ag$	$(\frac{1}{2})$
$Ag \rightarrow Ag^+ + e^-$	$(\frac{0}{2})$
$Ag \leftarrow Ag^+ + e^-$	$(\frac{2}{2})$
$Ag \rightleftharpoons Ag^+ + e^-$	$(\frac{0}{2})$

8.4.1 Electrode X becomes eroded/ smaller/ thinner.✓ (1)

8.4.2 A (silver) layer forms on the medal.✓ (1)

8.5 The rate at which Ag^+ / silver ions are reduced at the cathode is equal to rate at which Ag metal/ silver is oxidised at the anode.✓✓ (2)
[11]

QUESTION 9

9.1 Galvanic✓ cell (1)

9.2 There will no reading/ The reading will be zero/ 0V✓ (1)

9.3 <u>Temperature</u> ✓ and the <u>initial concentrations of the electrolytes</u> ✓

But cannot give 25 °C and 1 mol·dm^{-3} because the investigation is not carried out under standard conditions because the emf values are not for standard conditions. (2)

9.4 The different type of metal/the different half-cells✓ (1)

9.5.1 Voltmeter's terminals✓ have been connected incorrectly✓
OR
Incorrect connection ✓ (+ to anode and – to cathode) ✓ (2)

9.5.2 Aluminium is a stronger reducing agent than zinc✓ and zinc is a stronger reducing agent than copper.✓ (2)

9.6.1 Aluminium/ Aℓ✓ (1)

9.6.2 Zinc/ Zn ✓ (1)

9.7 $2A\ell\,(s) + 3\,Zn^{2+}(aq)$✓$\longrightarrow$ $2A\ell^{3+}(aq) + 3Zn(s)$✓ balancing ✓

Reactants✓ Products✓ Balancing✓
Ignore ⇌

<u>Marking rule 3.9:</u>
If only a reactant(s) followed by an arrow, or only a product(s) preceded by an arrow, is/are written, marks may be awarded for the reactant(s) or product(s). If only a reactant(s) or only a product(s) are written, without an arrow, no marks are awarded for the reactant(s) or product(s).

Examples: $N_2 + 3H_2$ ✓$\rightarrow$ $2NH_3$ ✓ bal. ✓

$N_2 + H_2 \rightarrow$✓	$\frac{1}{3}$
$\rightarrow NH_3$ ✓	$\frac{1}{3}$
$N_2 + H_2$	$\frac{0}{3}$
NH_3	$\frac{0}{3}$

(3)
[14]

QUESTION 10

10.1.1 Iron oxide/iron/aluminium oxide✓ (1)

10.1.2 <u>more collisions per unit time</u>✓
<u>greater surface area</u>/greater number of exposed particles.✓ (2)

10.1.3 Increase the number of moles of N_2 and H_2 (reactants)✓ favours the forward reaction✓

OR

Increase pressure ✓ and thus favours the forward reaction✓ (2)

10.2.1 Calcium hydroxide increases the pH/alkalinity of the soil/ reduce the acidity of the soil.✓

Ammonium sulphate is a fertiliser. ✓ (2)

10.2.2 Ammonia gas is formed which will be released and **reduce** the concentration/number of moles/ of fertiliser.✓ (1)

10.3 $n(NO) = \frac{m}{M} = \frac{720}{24} = 30$ mol✓

$n(HNO_3) = n(NO) = 30$ mol✓ (3)

$m(HNO_3) = nM = (30)(63) = 1890$ g ✓ **[11]**

TOTAL: 150