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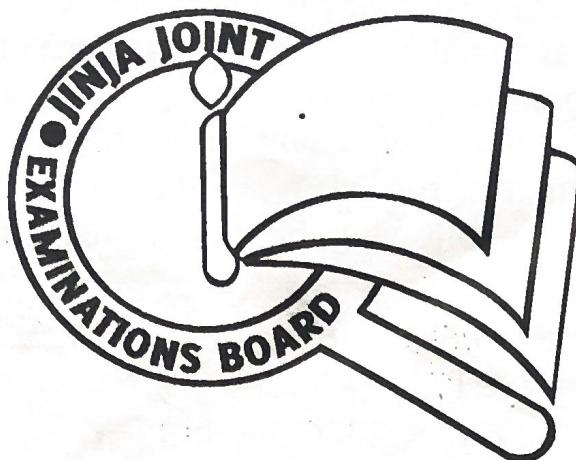
P525/1

CHEMISTRY

Paper 1

August, 2026

2 $\frac{3}{4}$ hours.



JINJA JOINT EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATIONS –AUGUST, 2026

CHEMISTRY

(Principal Subject)

Paper 1

2 hours 45 minutes.

INSTRUCTIONS TO CANDIDATES:

- This paper consists of **TWO** Sections A and B.
- Section A has **TWO Compulsory** Items.
- Section B has two parts, I and II.
- Respond to only **ONE** Item from each part.
- Responses to Section A and B must be written in the answer booklet(s) provided.
- Respond to **FOUR** Items in all.

**BEGIN EACH QUESTION ON A
FRESH PAGE**

No	Basic Code	Weighted Score	Initials
1			
2			
3/4			
5/6			

SECTION A

Attempt all Items in this part

Item 1

Electrochemical cells generate energy from spontaneous redox reactions. Their importance lies in driving modern technology through energy storage, industrial manufacturing etc. A group of S.5 students under their science club have undertaken a project to select the strongest oxidizing and reducing agents between Copper and Zinc, construct an electrochemical cell and apply quantitative chemical principles to make recommendations but they could not proceed. When they consulted their chemistry teacher, he provided them with the following thermochemical and electrochemical data.

First ionization energy of Zn	906kJ mol ⁻¹
Second ionization energy of Zn	1733.3kJmol ⁻¹
Hydration energy of Zn ²⁺ (aq)	2046kJmol ⁻¹ First
ionization energy of Cu	754kJmol ⁻¹
Second ionization energy of Cu	1958kJmol ⁻¹
Hydration energy of Cu ²⁺ (aq)	2100kJmol ⁻¹

Half cell

E°/V

Zn(s) Zn ²⁺ (aq)	+0.76
Cu(s) Cu ²⁺ (aq)	-0.34

Task

The S.5 students are now challenged and have approached you. **Task:** As a chemistry student analyse and interpret the data to address the S.5 issues.

Item 2

A manufacturing company in Uganda uses compound X as a primary intermediate for making a dye which gives blue jeans their iconic colour. The laboratory attendant for the company after her analysis discovered that X is immiscible with water, contains 77.3% C, 7.58% H and the rest nitrogen and that a mixture of X (boiling point 180°C) and water (boiling point 100°C) when steam distilled at 760 mmHg and 98°C gave a distillate which contained 85% by mass water.

Management of the company is now interested in molar mass of X, molecular formula of X and the associated applications of steam distillation. (Hint: Saturated vapour pressure of water at 98°C is 734.9mmHg).

The laboratory attendant is now challenged. Your teacher came across this information.

Task:

As a student of chemistry analyse and interpret the available data to address management concerns.

SECTION B PART I

(Attempt only one Item from this part)

Item 3

The chemistry of period 3 elements is vital to the foundation of modern technology, biology and industry. A telecom engineer advised that how periodic trends affect reactivity and reactions of the elements with water, alkalis and dilute acids is very important in modern technology.

A manufacturing plant dealing in modern technology equipment is interested in how periodic properties of elements affect reactivity, reactions of elements and the health implications of any of the elements. An industrial chemist provided the plant management with the following data:

Element	Na	Mg	Al	Si	P	S	Cl
Electron affinity (kJmol ⁻¹)	-20	+67	-30	-135	-60	-200	-364
Ionization Energy (kJmol ⁻¹)	492	743	579	791	1060	1003	1254

Your laboratory technician came across this information but he is challenged

Task:

As a student of Chemistry prepare a writeup to address the management's concerns

Item 4

The chemistry of Group 17 elements is important for water sanitation, health and industrial manufacturing. An environmental chemist advised that how periodic properties affect reactivity of the elements, reactions of elements with water and alkalis play a great role in their applications in daily life and provided the following data.

Element	F ₂	Cl ₂	Br ₂	I ₂
Atomic radius (nm)	0.072	0.09	0.114	0.133
Boiling point (°C)	-188	-35	59	184

A manufacturing company dealing in antiseptics is interested in how periodic trends affect reactivity, reactions of the elements and health implications if any of any element. Your teacher came across this information.

Task:

As a Chemistry student, analyse and interpret the available data to address the company's issues.

PART II

(Attempt only one Item from this part)

Item 5

Use of nail polish removers and polymers is increasing in Uganda. A chemical plant makes polythene and ethyl acetate, a nail polish remover from propene and methane respectively. As a way of mitigation, excess raw propene is reacted with bromine water while excess methane is reacted with chlorine gas in UV light.

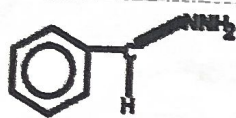
The plant Management is interested in the suitability of its products for their applications, analysis of its mitigation reactions with equations, an evaluation of its synthetic pathways and the possible health implications of its products. Your chemistry teacher came across this information.

Task:

As a student of chemistry make a write up to address the plant management concerns.

Item 6

A school science club wants to produce benzaldehyde hydrazone



() from ethane and propanone (solvent) from propan-1-ol.

One student raised the issue of the managing excess propan-1-ol and the product propanone. The chairperson proposed reacting propanone with 2,4-dinitrophenylhydrazine and propan-1-ol with hot concentrated sulphuric acid as a mitigation measure.

The report was subjected to the patron of the science club who is interested in the suitability of propan-1-ol for its application, analysis of mitigation reaction with equations, an evaluation of synthetic pathways with associated health implications.

Task:

As a student of chemistry analyse and interpret the data to address the club's issues.

PROPOSED SCORING GUIDE

JJEB, 2026

CHEMISTRY THEORY [525/1]

BY

CHRISTOPHER



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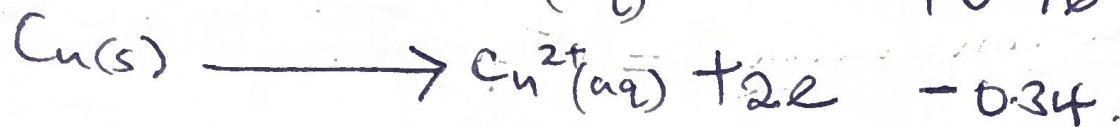
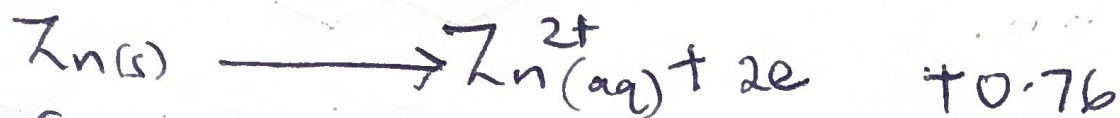
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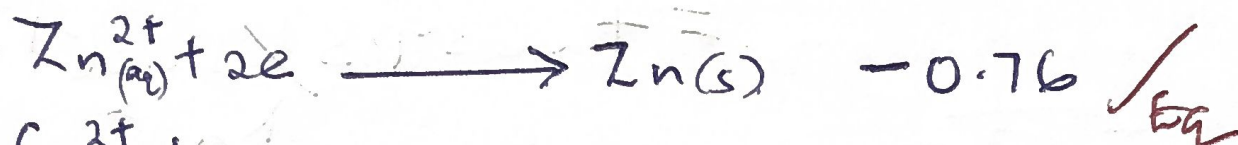
①

MWANGA JOHN CHRISTOPHER

ITEM,



Reduction Potential.



Therefore, Zinc is the more negative reduction Potential and therefore it loses $\checkmark_{\text{Eq}}$ electrons more readily hence it is the stronger reducing agent than copper. $\checkmark_{\text{Eq}}$ $\checkmark_{\text{Eq}}$

Copper has a more positive reduction Potential and therefore, it gains $\checkmark_{\text{Eq}}$ electrons more readily hence it is the stronger oxidizing agent than zinc. $\checkmark_{\text{Eq}}$ $\checkmark_{\text{Eq}}$

$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$$

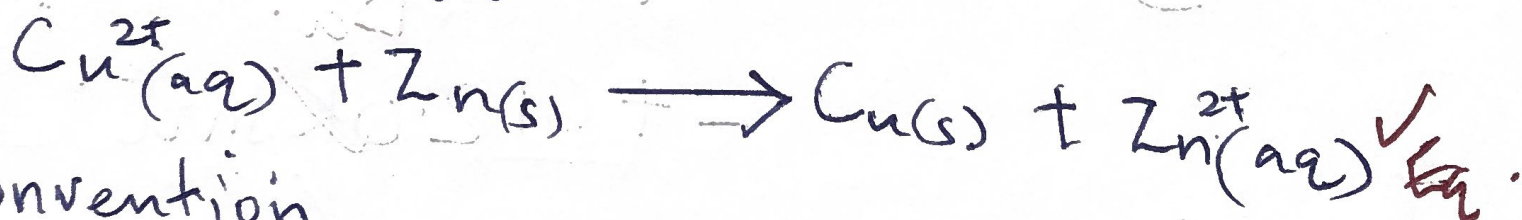
Right - left.

$$= +0.34 - (-0.76) \quad \checkmark_{\text{Eq}}$$

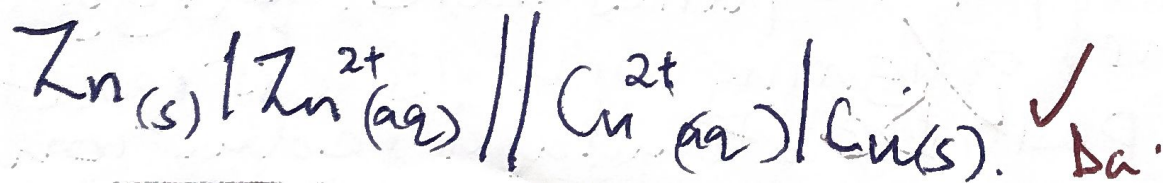
$$E^\circ_{\text{cell}} = 1.10 \text{ V} \quad \checkmark_{\text{Eq}}$$

E°_{cell} is greater than zero. The cell reaction is spontaneous or possible. $\checkmark_{\text{Eq}}$ $\checkmark_{\text{Eq}}$

Equation for overall.



Cell convention



②

For Zinc, Zn.

$$\begin{aligned}\text{Total ionisation energy} &= 1^{\text{st}} + 2^{\text{nd}}. \\ &= (906 + 1733.3) \text{ kJ mol}^{-1} \\ &= +2639.3 \text{ kJ mol}^{-1}.\end{aligned}$$

$$\text{Hydration energy} = -2046 \text{ kJ mol}^{-1} \quad \text{Da}$$

$$\begin{aligned}\text{Net energy} &= (2639.3 + -2046) \\ &= +593.3 \text{ kJ mol}^{-1}\end{aligned}$$

For copper.

$$\begin{aligned}\text{Total Ionisation} &= 1^{\text{st}} + 2^{\text{nd}}. \\ &= 754 + 1958 \\ &= +2712 \text{ kJ mol}^{-1} \quad \text{Da.}\end{aligned}$$

$$\text{Hydration energy} = -2100 \text{ kJ mol}^{-1}$$

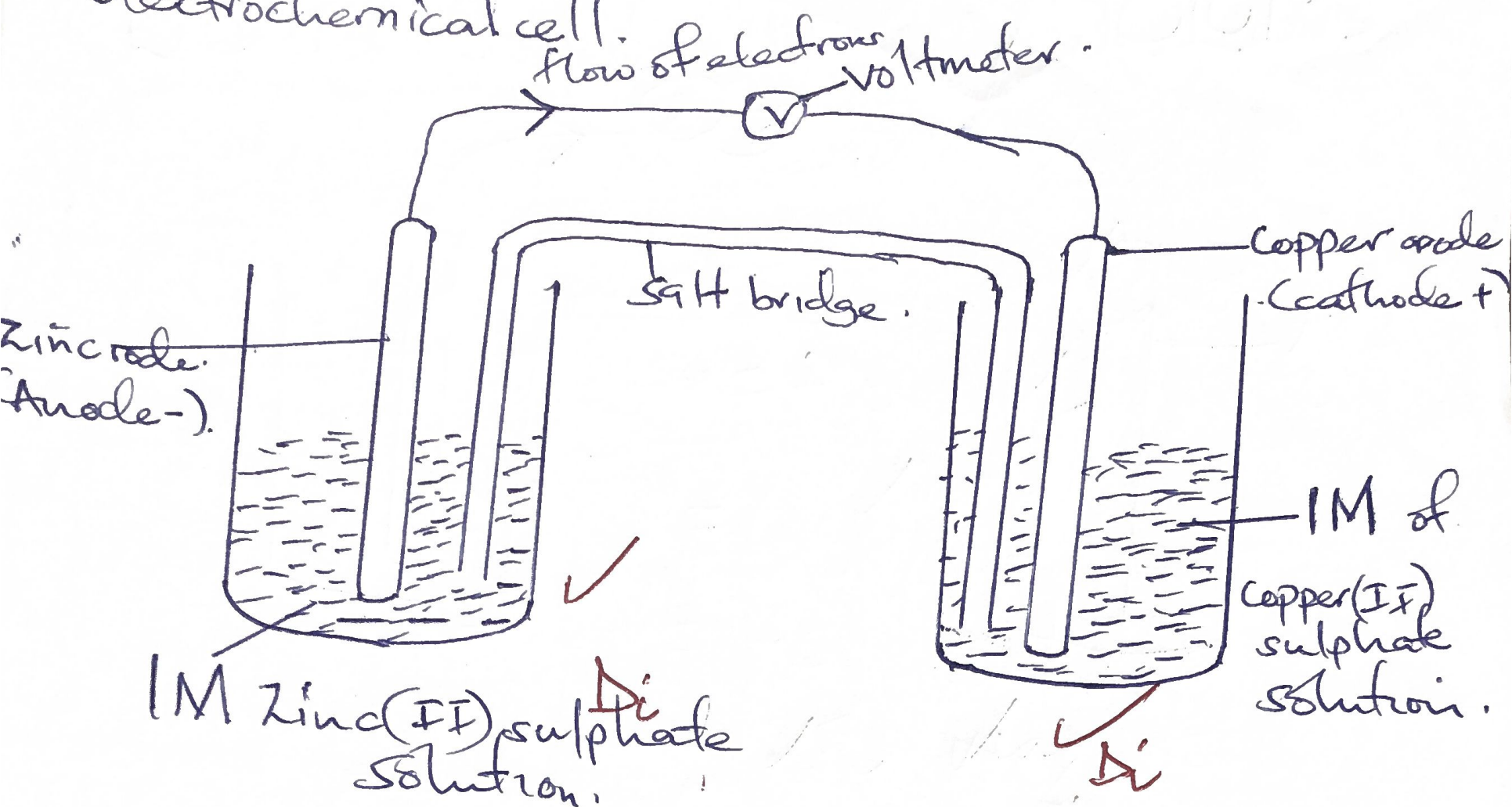
$$\begin{aligned}\text{Net energy} &= (2712 + -2100) \\ &= +612.0 \text{ kJ mol}^{-1} \quad \text{Da.}\end{aligned}$$

Therefore, Copper requires more energy to form hydrated ions, aligning with its less reactive nature and positive standard reduction potential.

③

Compared to Zinc.

Electrochemical cell.



TOTAL SCORES: 15

5 SCORES TRANSFERRED

TO SECTION B.

ACCEPT 20 SCORES

ITEM₂

(4)

Percentage of nitrogen, N

$$= 100 - (77.3 + 7.58)$$

$$= 15.12\%$$

Element	C	H	N
Percentage composition	77.3	7.58	15.12
moles	$\frac{77.3}{12}$ 6.4417	$\frac{7.58}{1}$ 7.58	$\frac{15.12}{14}$ 1.08
Mole ratio	$\frac{6.4417}{1.08}$ 6.	$\frac{7.58}{1.08}$ 7	$\frac{1.08}{1.08}$ 1

Empirical formula. C_6H_7N Da.Molecular mass of water, $H_2O = (2 \times 1) + (1 \times 16)$
 $= 18g.$

$$P_{total} = P_{water} + P_x$$

$$760 = 734.9 + P_x$$

$$P_x = 25.1 \text{ mm Hg. Da.}$$

5

Composition of water = 85.

Composition of x = 15.

$$\frac{\text{mass of x}}{\text{mass of water}} = \frac{P_x \times M_x}{P_{H_2O} \times M_{H_2O}}$$

$$\frac{15}{85} = \frac{25.1 \times M_x}{734.9 \times 18}$$

$$0.1765 = \frac{25.1 M_x}{13228.2}$$

$$M_x = \frac{0.1765 \times 13228.2}{25.1}$$

$$M_x = 93 \text{ Da}$$

Molecular mass of x, = 93g.

$$(C_6H_7N)_n = 93$$

$$93n = 93$$

$$n = \frac{93}{93}$$

$$= 1 \text{ Da}$$

Molecular formula is C_6H_7N Da

(6)

Applications of steam distillation.

Extraction of natural products from plant.
materials such as essential oils used in perfumes,
fragrances and personal hygiene products.
Purifying temperature sensitive organic compounds
below their natural boiling points to avoid decomposition.

TOTAL SCORES 15

5 SCORES TRANSFERRED TO
SECTION B

ACCEPT 20 SCORES

ITEM

3.

⑦

Periodic trends affect reactivity and reaction of elements with water, alkalis and dilute acids.
Health implications of any of the elements.

Trend on the Ionisation energy

Generally, Ionisation energy increases from Sodium to chlorine.

From sodium to chlorine, there is an increase in nuclear charge because a proton is added to the nucleus from element to element. Screening effect almost remains constant because an electron is added to the same energy level.

The increase in nuclear charge, increases effective nuclear charge thus decrease in atomic radius and as a result, the outer most electrons are strongly attracted than the repelled by the nucleus. thus increasing the Ionisation energy of the element. $\uparrow e$

Trend on electron affinity

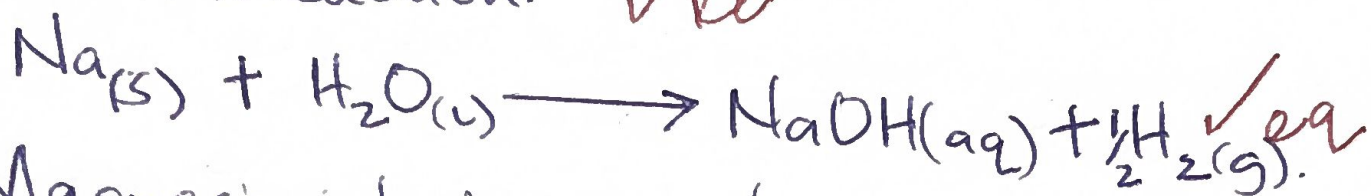
Generally, electron affinity increases from sodium to chlorine.

From sodium to chlorine, nuclear charge increases because a proton is added to the nucleus from element to element. Screening effect almost remains constant because electrons are being added to the same energy level. The increase in nuclear charge increases on effective nuclear charge thus decrease in the atomic radius of the element. $\uparrow e$

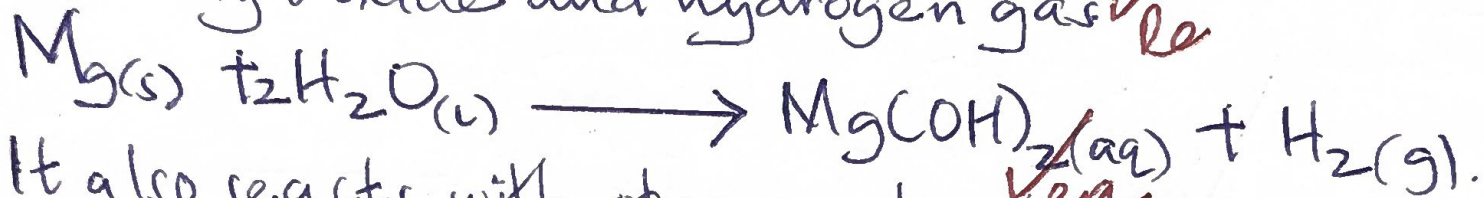
Therefore, this increase on the attraction of the incoming electron hence increase in electron affinity

Reaction with water.

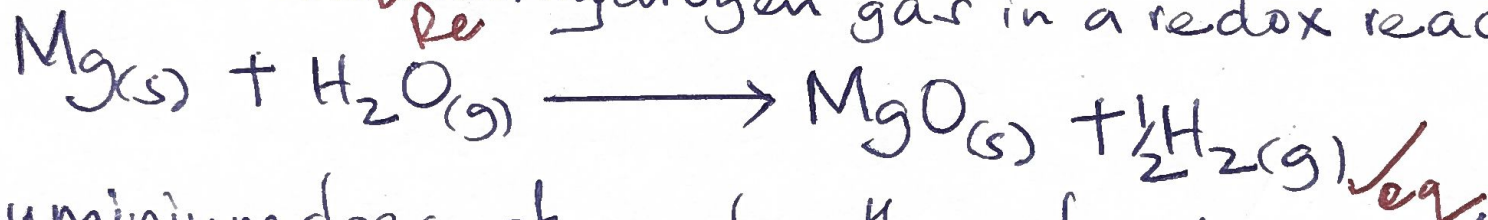
Sodium being a reducing agent, it reacts vigorously with cold water to form sodium hydroxide and hydrogen gas in a redox reaction. ✓ *re*



Magnesium being a reducing agent, it reacts slowly with cold water in a redox reaction forming magnesium hydroxide and hydrogen gas. ✓ *re*



It also reacts with steam on heating to form magnesium oxide and hydrogen gas in a redox reaction. ✓ *re*

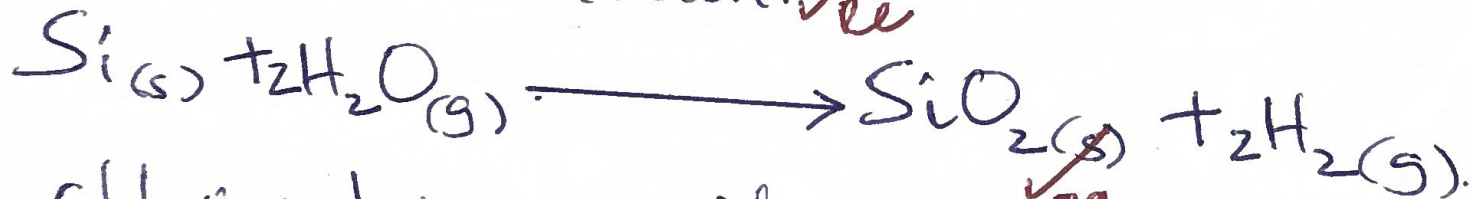


Aluminium does not react with water because it forms a protective layer of Aluminium oxide.

However, Aluminium being highly reducing it reacts with steam on heating in a redox reaction to form Aluminium oxide and hydrogen gas. ✓ *re*

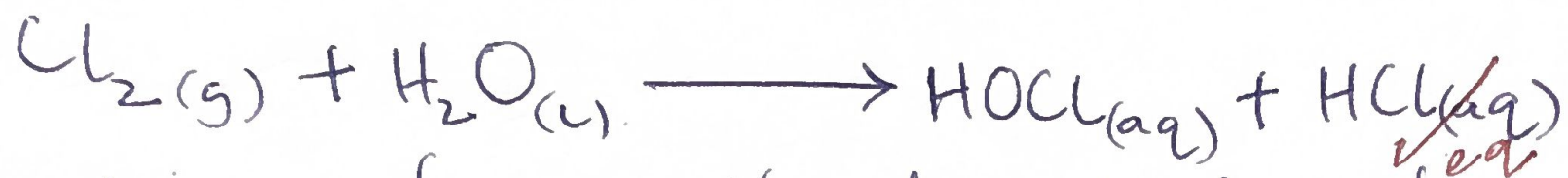


Silicon, being a reducing agent, it reacts with heated steam to form Silicon(IV) oxide and hydrogen gas in a redox reaction. ✓ *re*



Chlorine being an oxidizing agent, it disproportionates in water to form chloric(I) acid and hydrochloric acid in a redox reaction.

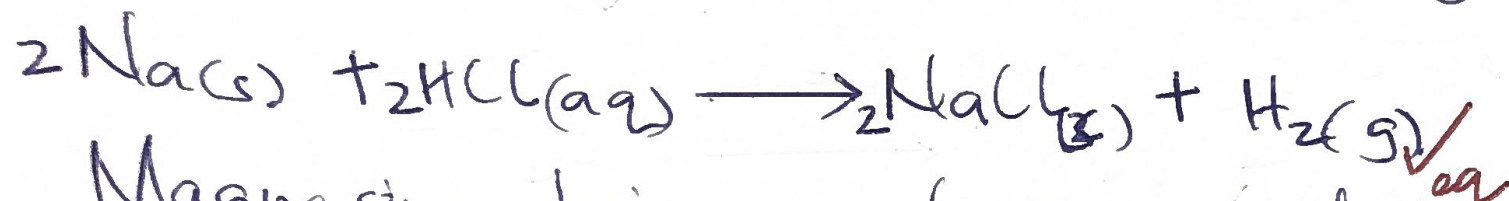
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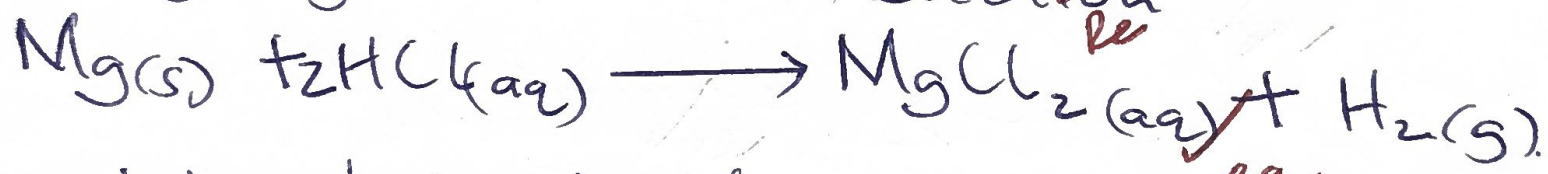
Phosphorus and sulphur do not react with water at room temperature. This is because their chemical bonds are too strong to be broken by water and also lack the high electron affinity or oxidizing power needed to strip electrons from water molecules.

Reaction with dilute acids.

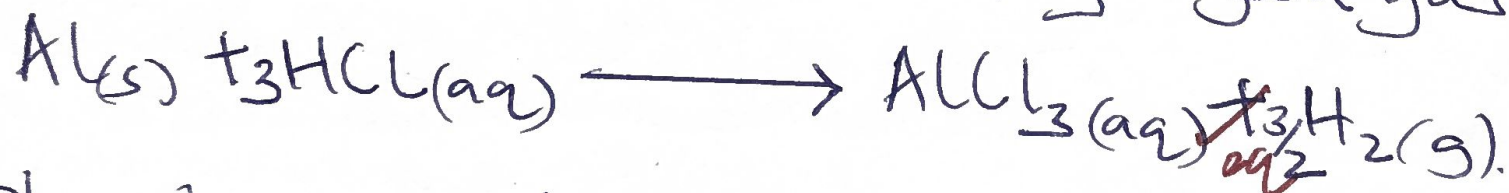
Dilute hydrochloric acid.
Sodium being reducing, it reacts with cold dilute hydrochloric acid to form sodium chloride and hydrogen gas in a redox reaction.



Magnesium, being a reducing agent, it reacts with cold dilute hydrochloric acid to form magnesium chloride and hydrogen gas in a redox reaction.



Aluminium being highly reducing, it reacts with cold dilute hydrochloric acid in a redox reaction to form aluminium chloride and hydrogen gas.

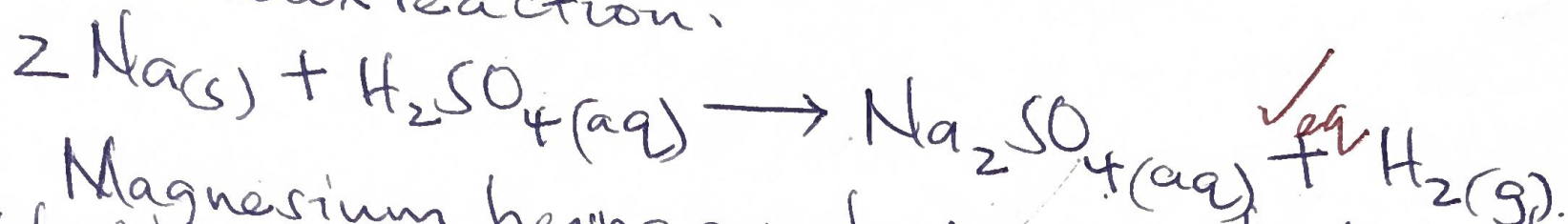


Phosphorus, Silicon, Sulphur, chlorine do not react with dilute hydrochloric acid. This is because of their chemical bonds too strong to be broken by dilute hydrochloric acid.

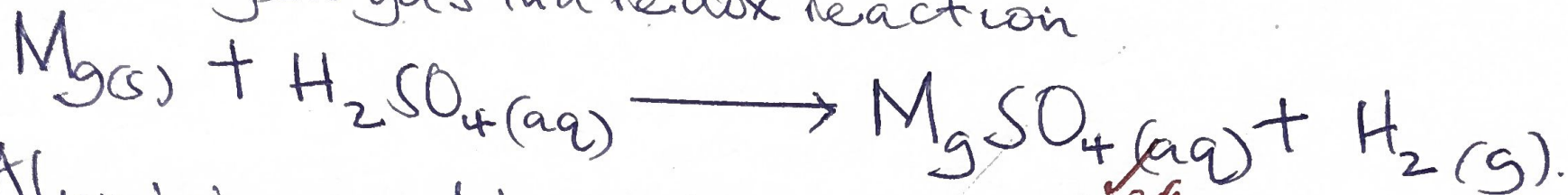
(10)

With dilute sulphuric acid.

Sodium being a reducing agent, it reacts with cold dilute sulphuric acid to form sodium sulphate and hydrogen gas in a redox reaction.



Magnesium being a reducing agent, it reacts with cold dilute sulphuric acid to form magnesium sulphate and hydrogen gas in a redox reaction.

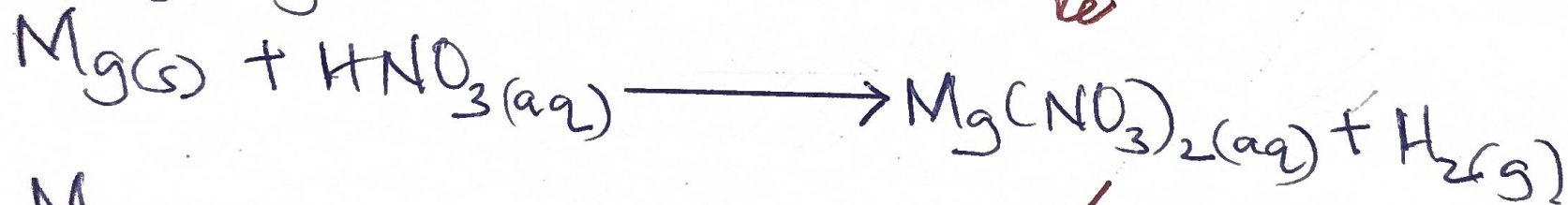


Aluminium, sulphur, silicon, chlorine do not react with dilute sulphuric acid.

Reason.

With dilute nitric acid.

Magnesium being a reducing agent, it reacts slowly with cold dilute nitric acid to form magnesium nitrate and hydrogen gas in a redox reaction.



~~Magnesium~~

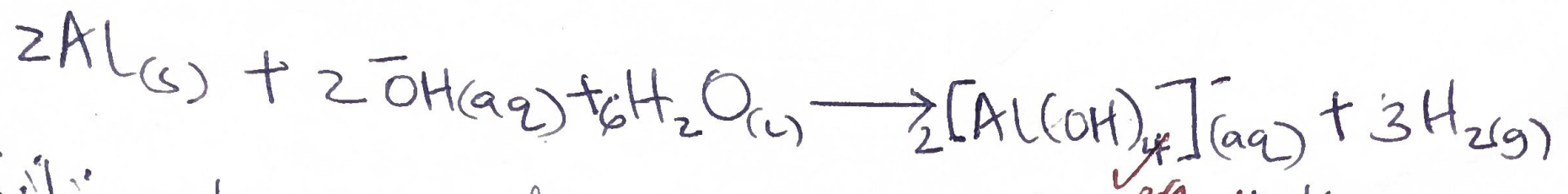
✓
eq

Reaction with alkalis

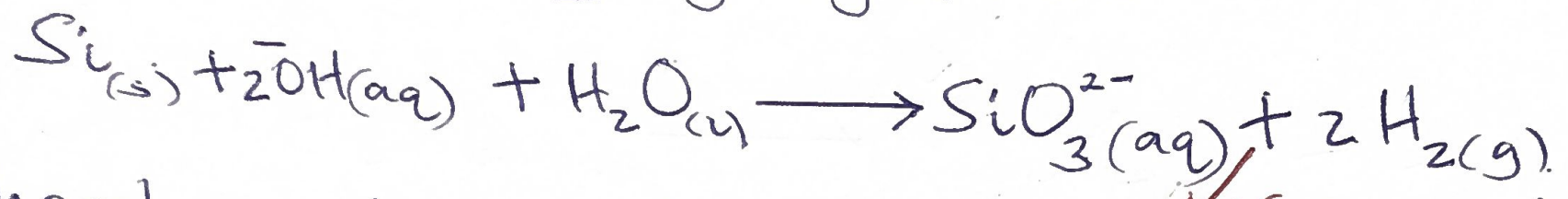
Sodium and magnesium do not react with alkalis at any condition. This is because of their basic properties.

Aluminium, being a reducing agent, reacts with hot concentrated sodium hydroxide solution in a redox reaction to form aluminate ions and hydrogen gas.

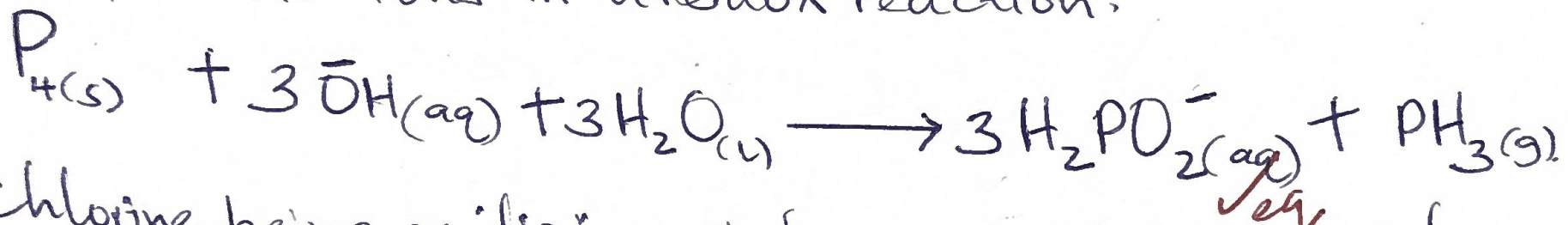
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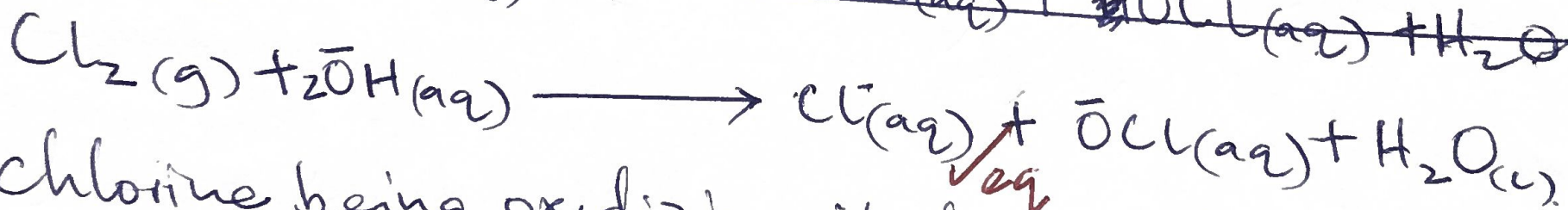
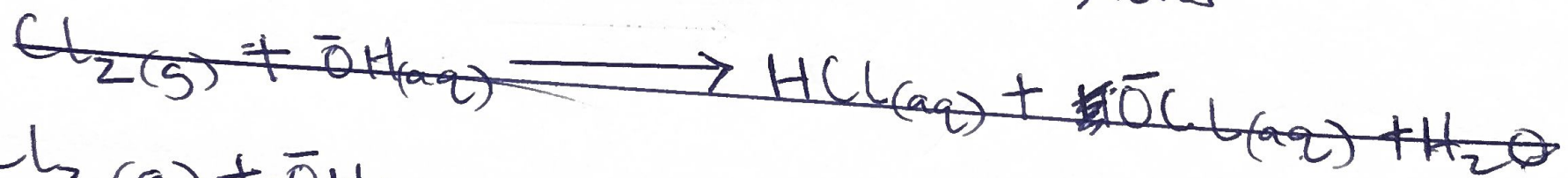
Silicon being a reducing agent, it reacts with both cold dilute sodium hydroxide solution and hot concentrated sodium hydroxide solution to form silicate ions and hydrogen gas in a redox reaction.



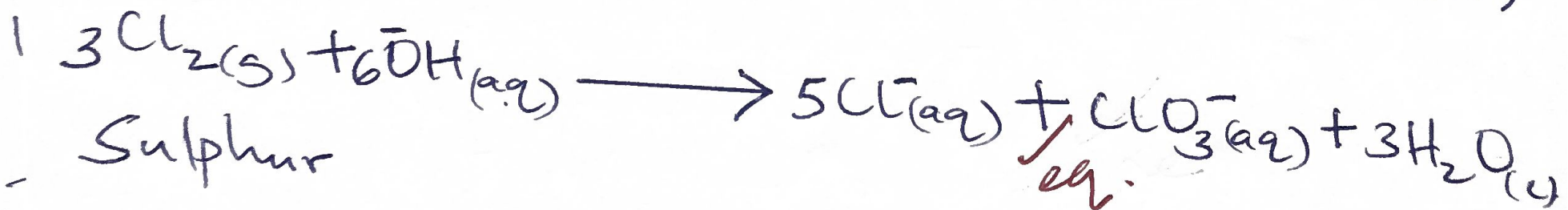
Phosphorous being reducing, reacts with hot concentrated sodium hydroxide solution to form phosphine and phosphinate ions in a redox reaction.



Chlorine being oxidizing, it disproportionates in cold dilute sodium hydroxide solution in a redox reaction to form chloride ions and chlorate(I) ions



Chlorine being oxidizing, it disproportionates in hot concentrated sodium hydroxide solution in a redox reaction to form chloride ions and chlorate(V) ions



Sulphur

HEALTH DANGERS:

(12)

Na, Al, Mg, Si, P, S, and Cl_2

Chlorine is highly toxic ^{Ed.} thus can damage the eye, skin and lungs when too much exposed, Mitigated by wearing protective gears when handling chlorine such as protective clothings, face shield ^{Em.} and among others.

Sulphur dust can irritate the eyes and the respiratory tract, Mitigated by wearing protective clothings

Combustion of Sulphur produce toxic gases, such as sulphur dioxide ^{Ed.} which harms the respiratory system thus leading to death. This can be mitigated by use of converters such that there is no escape of gas ^{Em.}

Accept other alternatives

Phosphorous being highly toxic and can cause severe burns when exposed and damages other organs. Mitigated by avoiding too much exposure when using it or wear protective gear such as protective clothings ^{Em.}

Aluminium fine dust can irritate the lungs, due to prolonged exposure to high levels thus affecting the nervous system. Mitigated by wearing protective gears such as protective face mask ^{Ed.} lead clothing when using the element. ^{Em.}

Sodium on reaction with water cause severe burning ingestion can cause poisoning, Mitigated by wearing protective gears such as gloves, goggles, face shields and many others

Magnesium dust can irritate the respiratory system, burning magnesium ^{Ed} produce intense light that can damage the eye. Mitigated ^{Em} wearing protective gears such that there is reduction in direct exposure to the metal itself.

Accept any one

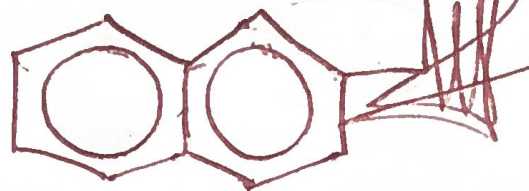
TOTAL SCORES: 25

ACCEPT 20 SCORES

ITEM₄

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(14)



0775967573

Trend on atomic radius

Atomic radius increases from fluorine to Iodine.

From fluorine to Iodine, there is an increase in both nuclear charge and screening effect. This is because from one element to another, there is addition of a fully filled energy level which increases the screening effect more than the nuclear charge.

✓
Te

Trend on boiling point.

Boiling point increases from fluorine to Iodine. This is because atomic radius increases, molecular size and molecular mass hence the magnitude of van der Waals forces also increases. Thus increase in the magnitude of van der Waals forces of attraction thus increase in boiling point. This is because an increase in molecular mass increases the van der Waals forces of attraction thus making the bond strong hence requiring a lot of energy to break thus high boiling point.

Te.

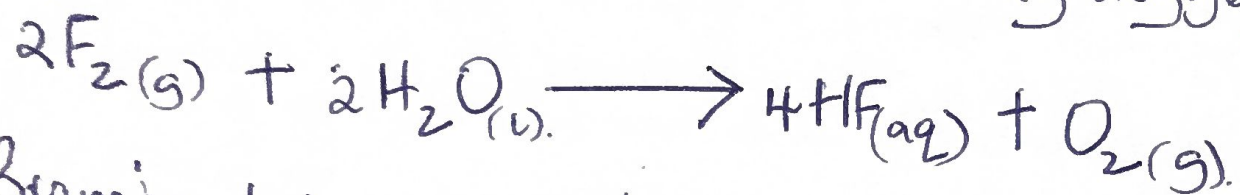
(15)

Reaction with water.

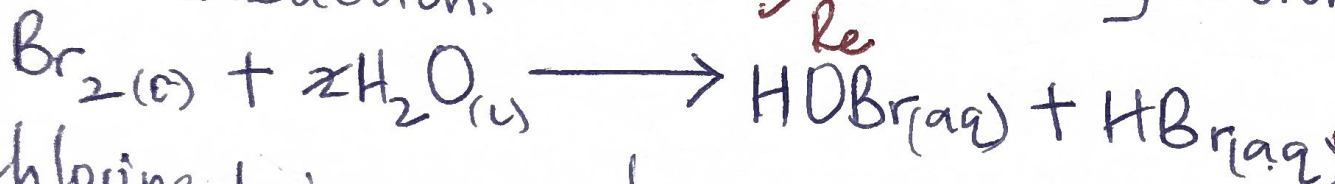
Iodine is soluble in water. This is because Iodine is non-polar yet water is polar. Therefore, the intermolecular force of attraction between the individual molecules of water and individual molecules of Iodine are on average stronger than the intermolecular forces of attraction between molecules of water and molecules of Iodine hence when the two molecules combine, repulsion occurs.

Reject without reason for not reacting

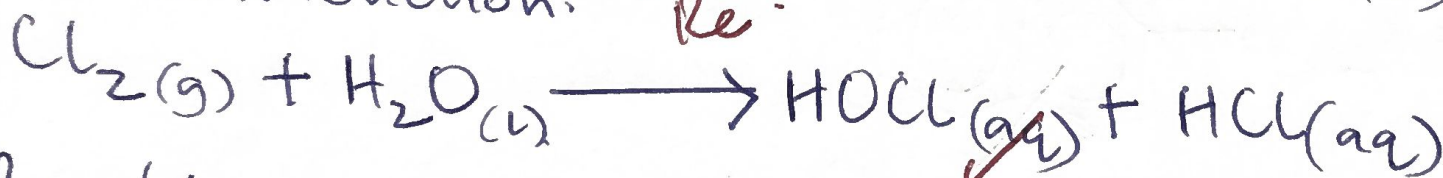
Fluorine being an oxidising agent, it reacts vigorously with water in a redox reaction forming oxygen and hydrofluoric acid.



Bromine being an oxidising agent, it reacts moderately with water to form bromic(I) acid and hydrobromic acid in a redox reaction.

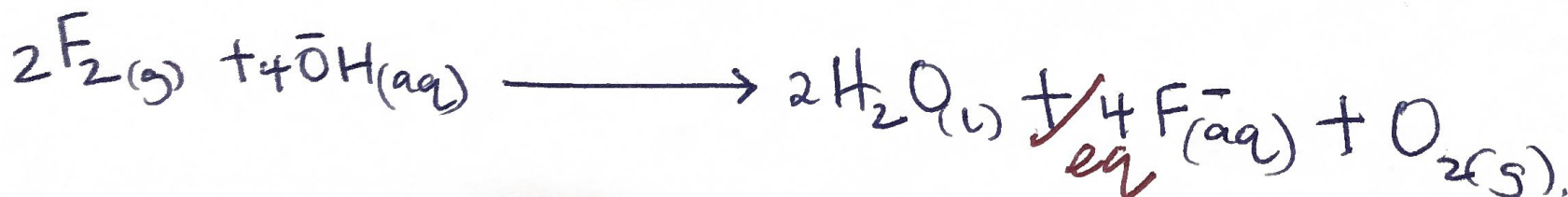


Chlorine being an oxidizing agent, it reacts moderately with water forming hydrochloric acid and chloric(I) acid in a redox reaction.

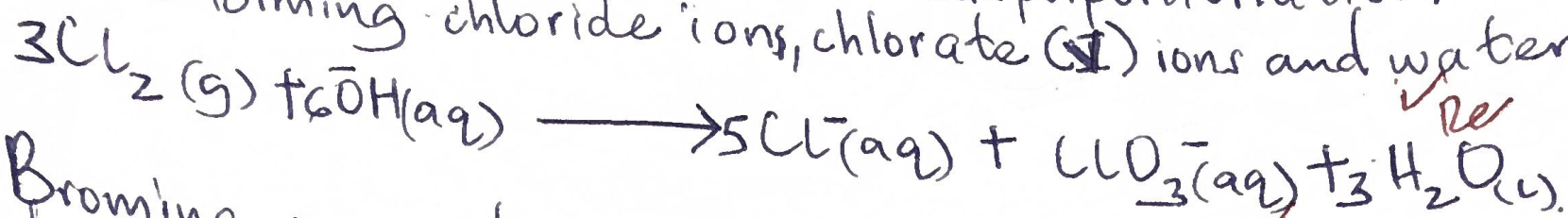


Reaction with alkalis

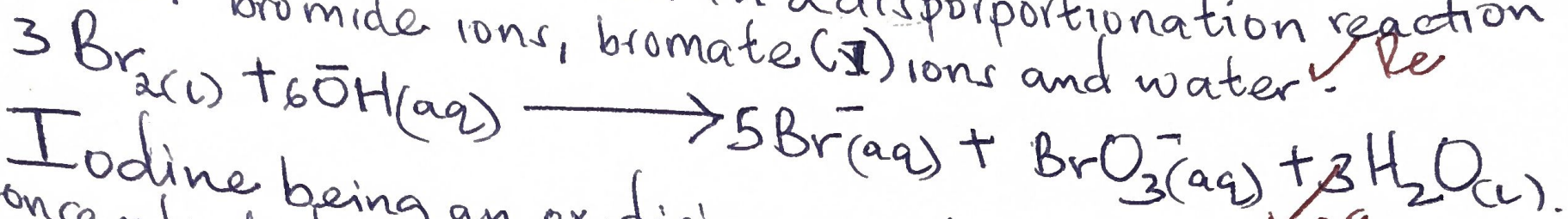
Reaction with hot concentrated sodium hydroxide solution. Fluorine, an oxidizing agent reacts with hot concentrated sodium hydroxide solution to form water, oxygen and fluoride ions in a redox reaction.



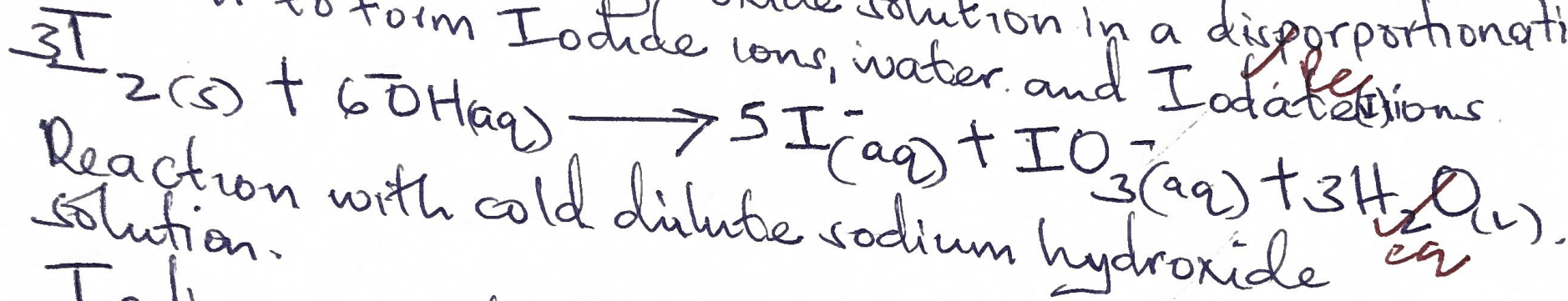
Chlorine is highly oxidizing, it reacts with hot concentrated sodium hydroxide solution in a disproportionation reaction forming chloride ions, chlorate (I) ions and water.



Bromine, an oxidising agent reacts with hot concentrated sodium hydroxide solution in a disproportionation reaction to form bromide ions, bromate (I) ions and water.

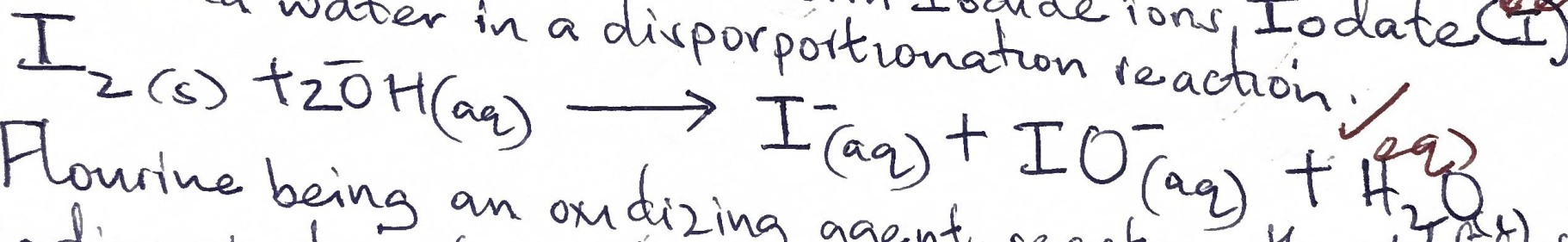


Iodine being an oxidising agent, reacts with hot concentrated sodium hydroxide solution in a disproportionation reaction to form Iodide ions, water and Iodate ions.

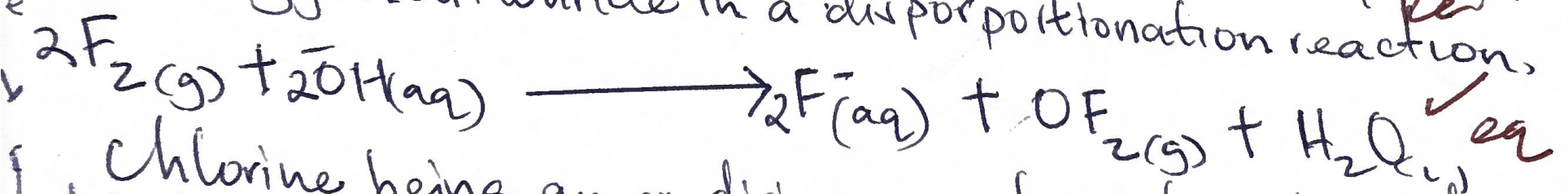


Reaction with cold dilute sodium hydroxide solution.

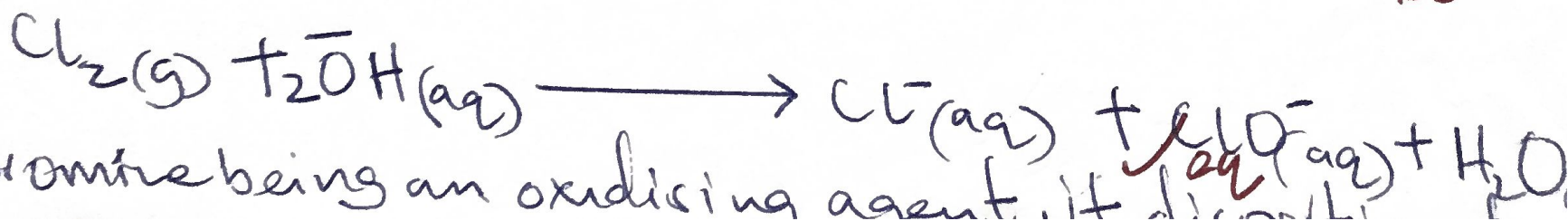
Iodine, an oxidising agent reacts with cold dilute sodium hydroxide solution to form Iodide ions, Iodate (I) ions and water in a disproportionation reaction.



Flourine being an oxidizing agent, reacts with cold dilute sodium hydroxide solution to form Flouride ions, water and oxygen diflouride in a disproportionation reaction.

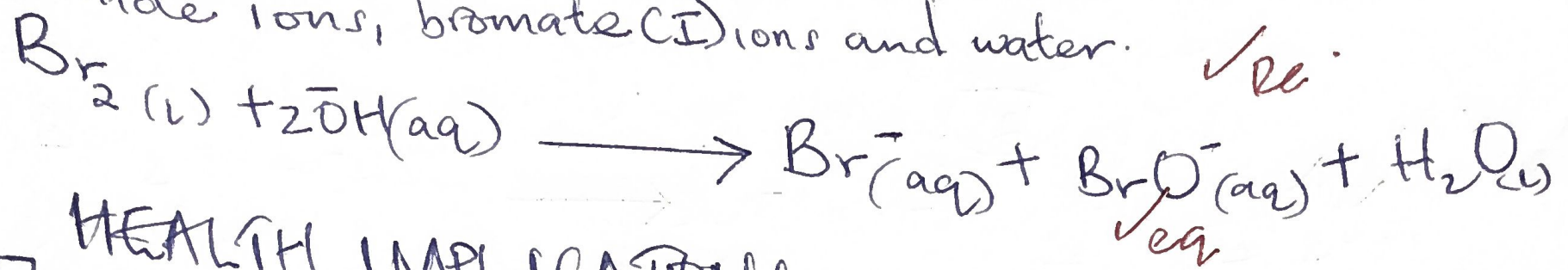


Chlorine being an oxidising agent reacts with cold dilute sodium hydroxide solution to form chloride ions, chlorate (I) ions and water in a disproportionation reaction.



Bromine being an oxidising agent, it reacts with cold dilute sodium hydroxide solution to form bromide ions, bromate (I) ions and water in a disproportionation reaction.

in cold dilute sodium hydroxide solution forming bromide ions, bromate (I) ions and water. ✓ ee.



HEALTH IMPLICATIONS

Fluorine

Being highly reactive with water, causes severe burns thus leading to severe injuries. Mitigated by use of protective gears such as splash suit, face shield mask. ✓ Em.

Chlorine

Being a toxic gas, irritates the eye and respiratory system which if much exposed thus damaging the lungs. Mitigated by wearing protective gears, such as face shield, goggles, gloves and ensuring proper ventilation of the gas. ✓ Em.

Iodine

Prolonged contact may lead to accidental burn on the skin, irritation. Mitigated by use of protective gears such as goggles, face shield. ✓ Em.

Bromine

Being highly toxic and corrosive, irritates the eyes, skin and may damage the respiratory tract. When exposed to it. Mitigated by keeping it in properly labelled tightly closed containers. Wearing protective gears for example face shield, protective clothing. ✓ Em.

Accept other alternatives

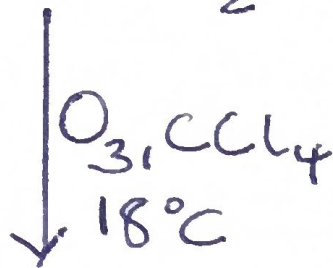
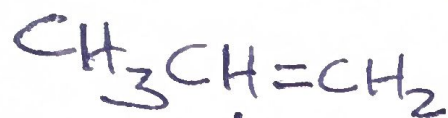
TOTAL SCORES : 25

ACCEPT 20 SCORES

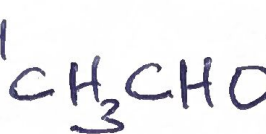
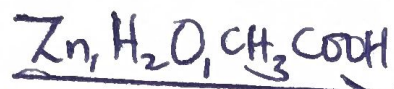
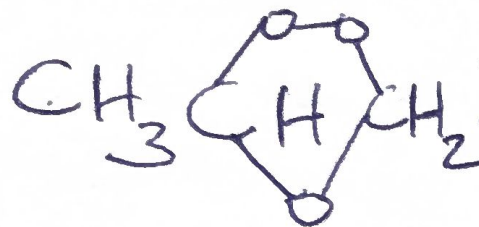
ITEM 5

(18)

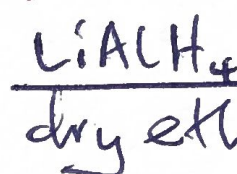
$(\text{CH}_2-\text{CH}_2)_n$ from $\text{CH}_3\text{CH}=\text{CH}_2$



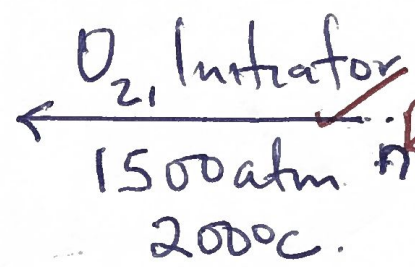
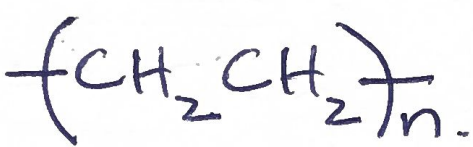
$\checkmark R_1$



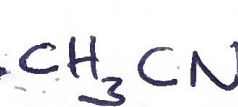
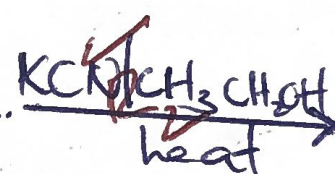
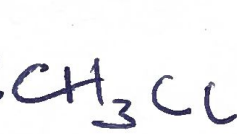
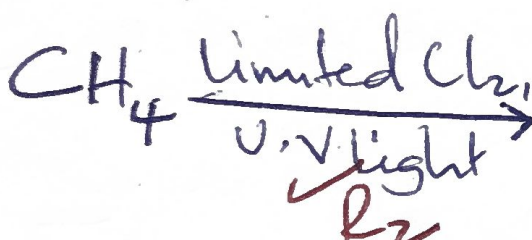
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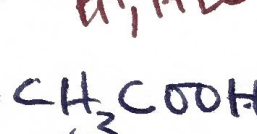
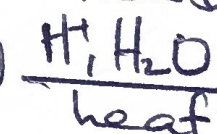
Accept alternative routes



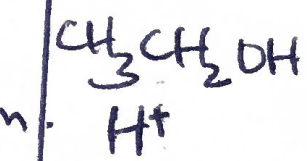
CH_4 to $\text{CH}_3\text{COOCH}_2\text{CH}_3$



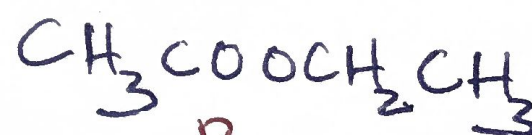
$\checkmark R_2$



Reject H⁺, H₂O

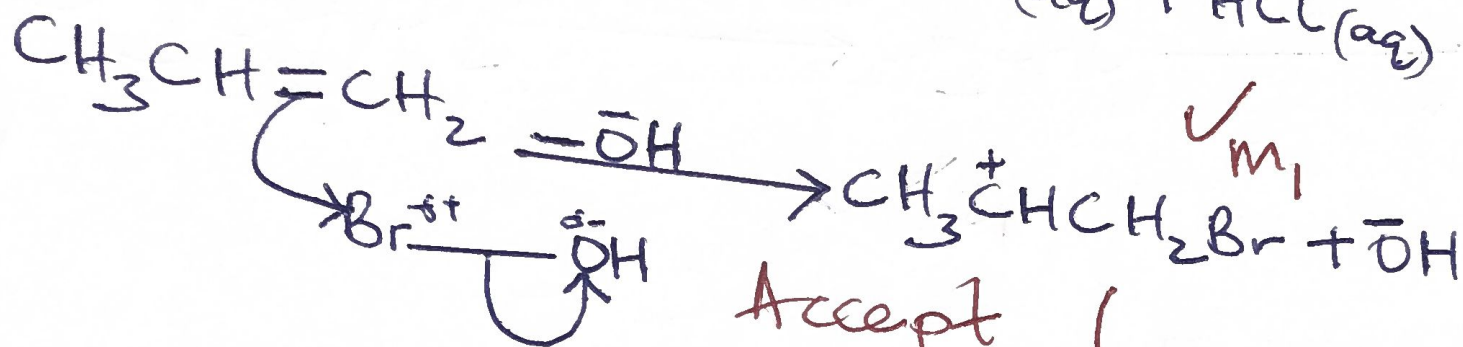
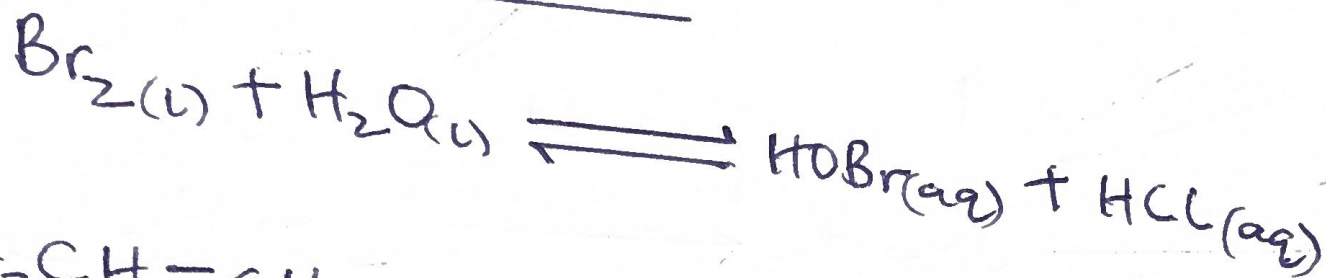
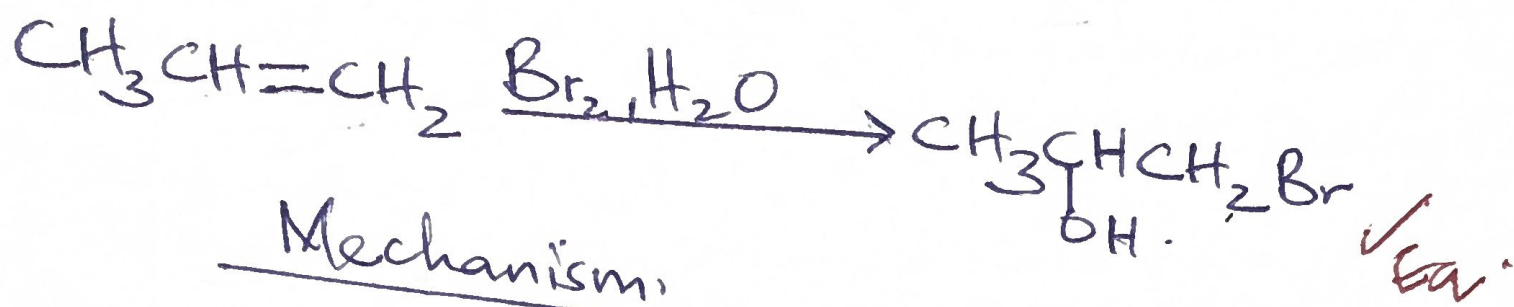


Accept SO_2Cl_2 , di(benzoyl) peroxide
 60°C

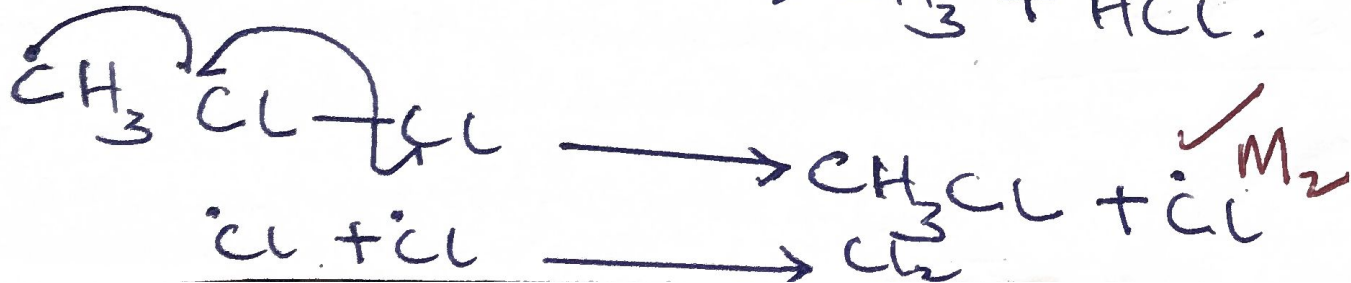
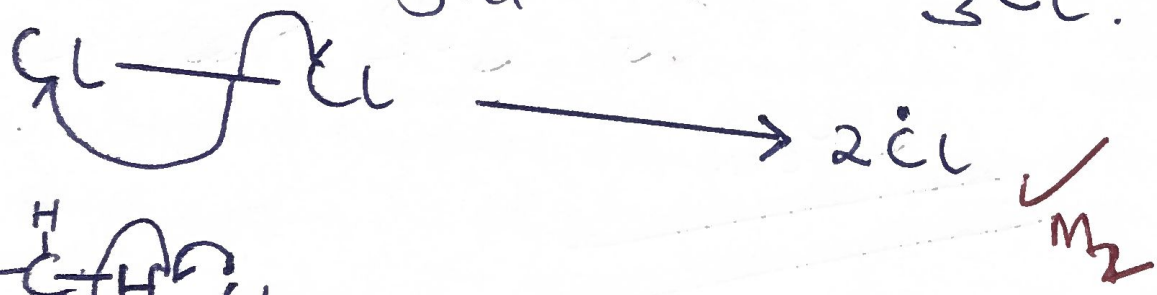
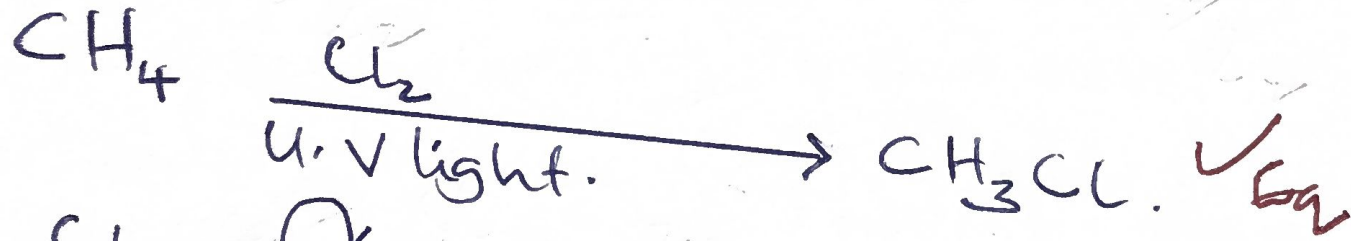


Accept alternative route

19



$\checkmark \text{M}_1$



Suitability

Ethyl acetate being an ester, it acts as an excellent solvent because it ~~dis~~^{pe}solves nail polish quickly thus removing polishes.

Polyethene is highly water proof, making it suitable for containers and packages.

Polyethene being strong and durable, it makes it long lasting.

Accept ~~other~~^{pe} alternatives

Health implication

Prolonged exposure to the product, ethyl acetate may lead to health diseases ~~which~~^{pe} may affect the liver, kidney and the central nervous system leading to death. Mitigated by avoiding prolonged exposure ~~into~~^{pe} the product.

The product, ethyl acetate being highly flammable, can cause fires leading to skin burn of the workers thus leading to severe ~~injuries~~^{pe}. Mitigated by using the in conversion using well-ventilated areas to prevent inhalation of vapours or installing fire extinguishers where the product is kept.

Combustion of polyethene in air releases toxic gases such as carbon dioxide which ~~is~~^{pe} a green house gas causing global warming hence increase in earth's temperature. Mitigated by

(21)

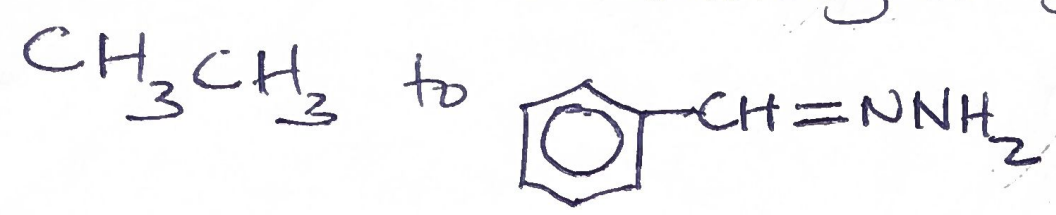
Incomplete combustion of polyethene produces carbon monoxide which ~~is~~ a poisonous gas that reduces the blood ability to carry enough oxygen causing headache leading to death. Mitigated by recycling polyethene into new products ^{such as plastic containers} and many others OR. Avoid Open ^{burn} burning of the product such that there is no release of carbon monoxide OR. ~~and~~ carbon dioxide

TOTAL SCORES : 25

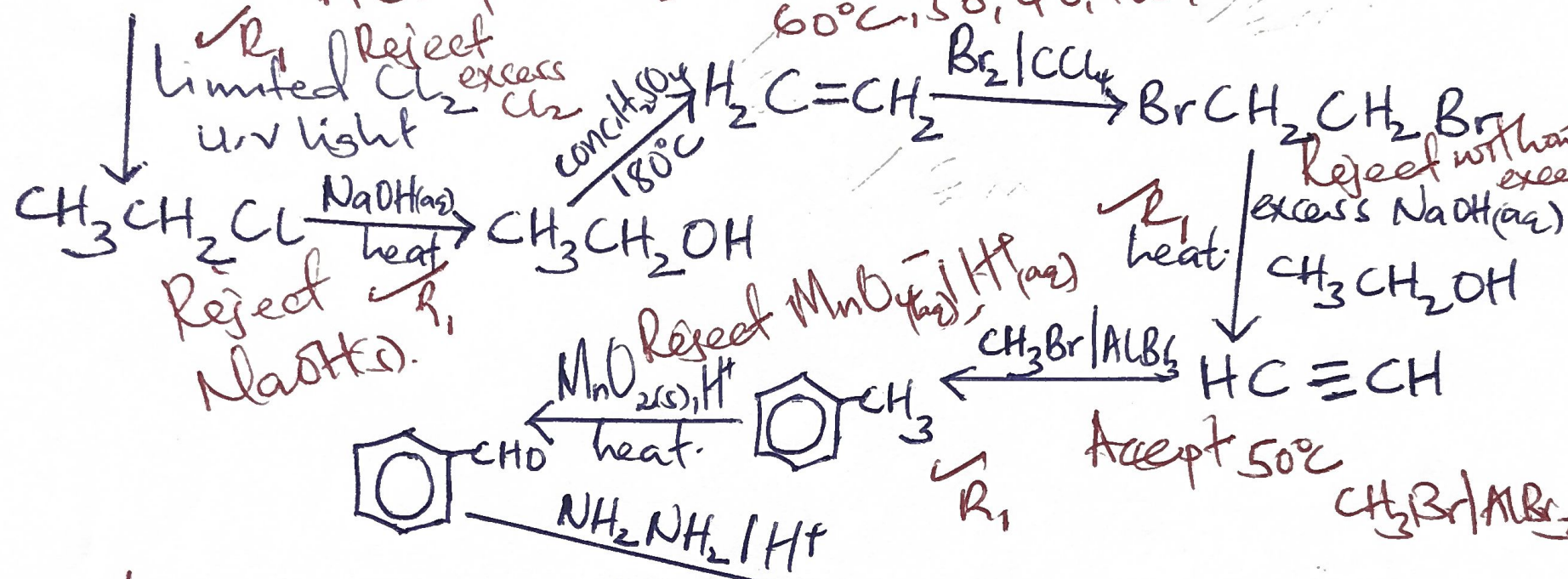
ACCEPT 20 SCORES

ITEM₆

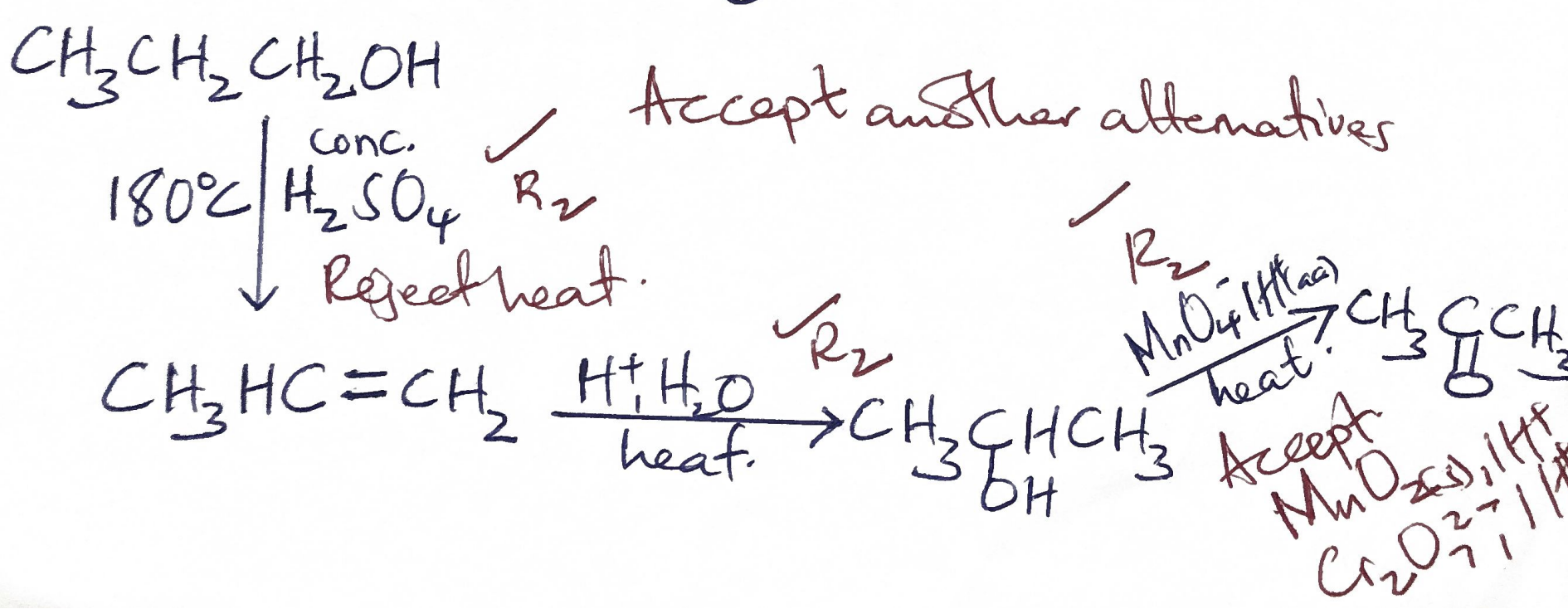
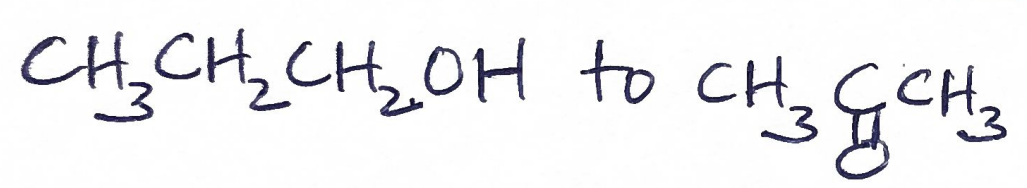
Ethane to benzaldehyde hydrazone.



CH_3CH_3 Accept SO_2Cl_2 , dibenzoyl peroxide.
60°C, 50, 40, 70°C, 80°C

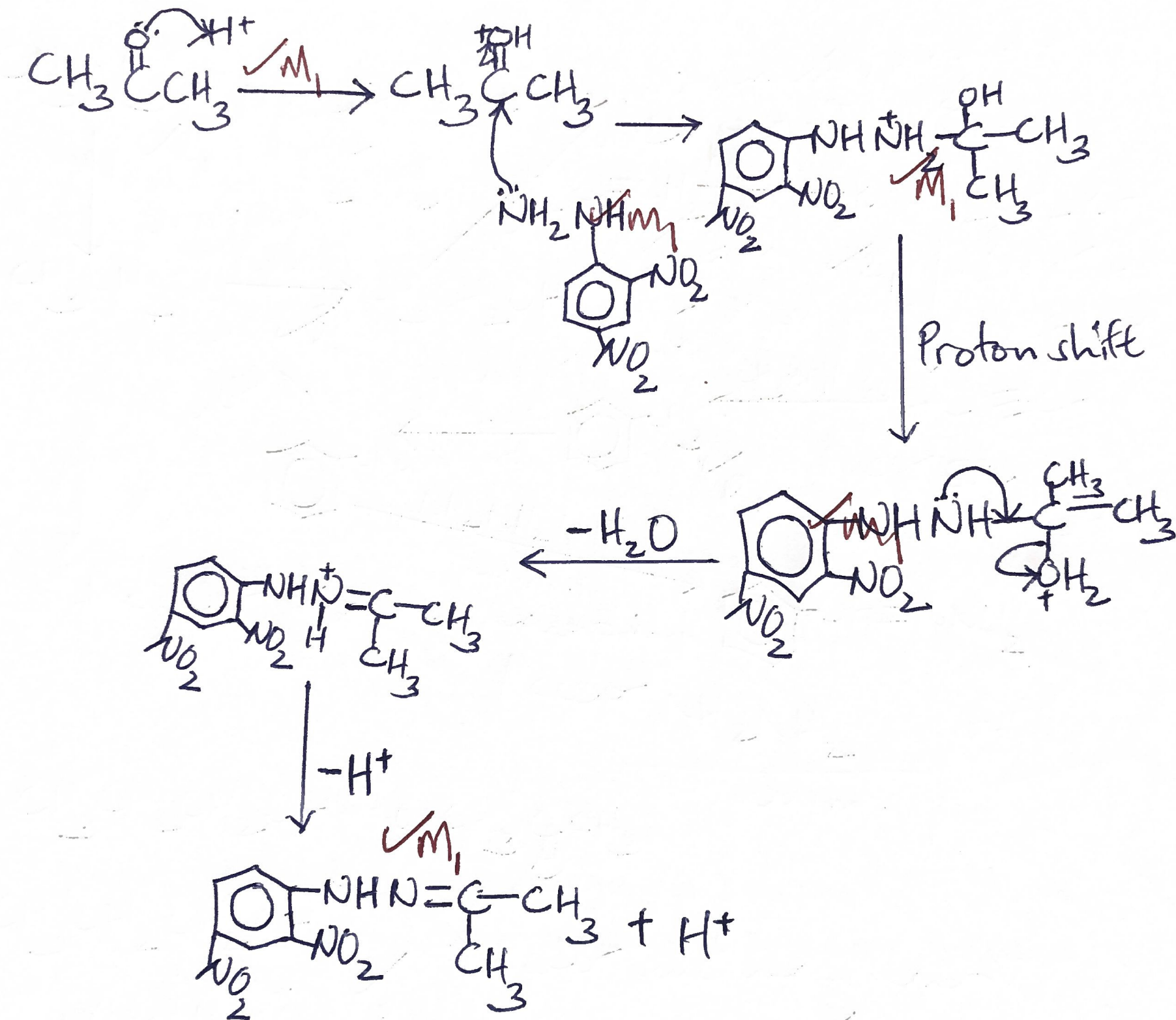
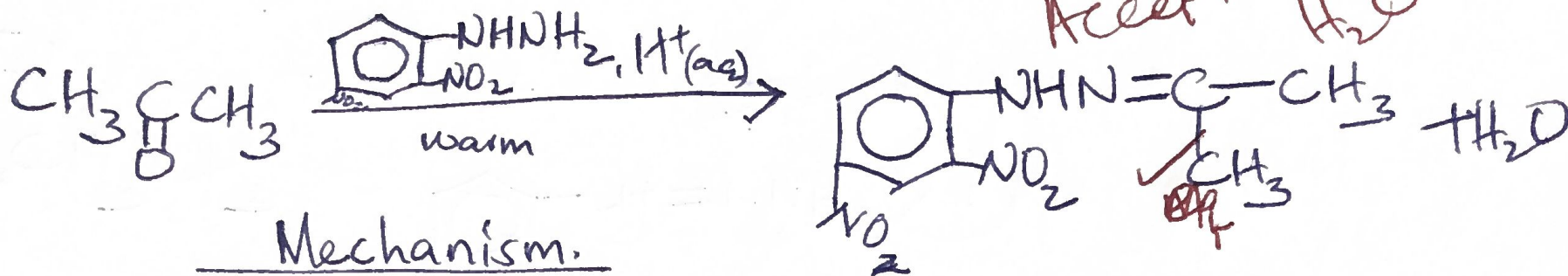


Accept other alternatives
Accept NH_2NH_2
warm.



23

Accept without H_2O



25

Health Implications of Propan-1-ol.

Propan-1-ol being highly flammable, it can cause irritation on eyes, skin and other respiratory problems when exposure or on use. This can be mitigated by wearing protective gears such as face shield ~~or~~ face mask, protective clothing and many others.

Prolonged exposure to propan-1-ol may affect the central nervous system leading to destruction. Mitigated by wearing protective gears when exposed to it.

Propan-1-ol being highly flammable, it can cause fire accidents leading to severe injuries and death. Mitigated by installing fire extinguishers where the product is being used.

TOTAL SCORE: 25

H:O:L:D:E:R:N:E:S:S

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