IJA # 3728
Archival Material from the Shamash Secondary and Frank Iny Schools Including Class Notes, Examinations, and Translations
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The word "adical although often used in this loose sense, actually means an assembly of atoms that behaves as a unit and possesses as its most charact eristic feature an unpaired electron thus a methyl radical cH3 or H. These radicals are very reactive. e.g. nascent hydrogen H which possesses one electron in its outer shell this electron tends to pair up with another electron to form e.g. H:H which is hydrogen gas or other compound.

CRGANIC GROUES: The term methyl groupp, as ordinarily employed, refers to a CH3 assembly which is covalently bonded to some other atom in the molecule

NOMENCLATURE:

We have three types of naming the organic compounds :

(1) Derived name: An organic molecule is named as a substitution product of the first member of the family to which it belongs . e.g. methyl chloride : CHzCl

The most highly sub stituted carbon atom is considered the carbon atom of the patent " methane molecule and the hydrocarbon is named by indicating the groups in order of size which are attached to this carbon atom.

e.g. neopentane may be considered to be derived from methane by replacement of the four Hydrogen atoms by methyl googroups and it is therefore called "Tetramethylmethane"

Note: The derived name is always a single name and no commas or hyphens are used to separate the groups unless the groups themselves require such punctuation.

- (2) To use a common name: we use the name that has no relation to structure e.g. methane, acetylene, ...
- (3) I.U.C. Name: This is the most important method of naming and it is the official system of monenclature.

Because so many isomers are found for every molecular formula, and because of the difficulty of naming them by the old method (which used the common names) The international Commission of chemists which met in Geneva Switzerland in 1892

studied this problem . Then a system was created for nomenclature and this system was ;ater improved and extended many times ., Lastly in 1988 by the international union of pure and applied chemistry. This method of monenclature is called.

the '. I.U.P.A.C. or siply the /. I.U.C. system.

RULES USED IN I.U.C.NAMING: for open chained alkanes.

- 1- the compound is named as a derivative of that hydr@carbon which corresponds to the longest continuous chain of carbon atoms in its formula.
- 2- The carbon atoms in this chain are numbered consecutively from one end to the other, either right to left or left of fight, in order to designate the positions of the substricturent groups by the smallest possible figures.

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3- The position of each branching alkyl group is specified by the number of car

ton atom to which it is bonded in the parent

4- The number designating the position of each of the various usbstituent, groups on the main chain is placed before the name of the substituent group in question and separated from that name by a hyphen . If there are several identical substituent groups present, their numbers are listed together, commas separate

such numbers and a hyphen (-) is used to seperate the last of the listed numbers from the appropriate prefix ,di-, tri-, tetra, indicating how many of the identical substituent groups are present.

5- The name of the alkane is written as one word with numbers and names of the substituent groups including the appropriate punctuation, serving as a prefix

to the name of the basic chain . The substituent groups may be listed in alphabetical order or in the order of increasing size.

Example of nomenclature

- (1) The longest continuous chain is the 7-carbon , in chain. Therefore the basic name is heptane
- (2) The heptane chain is numbered consecutively from left to right rather than vice versa. When the heptane chain is numbered from left to right, two of the methyl groups, rather than one are joined to the second carbon atom.
- (3) There will be a total of four individual numbers in the final; name. The methyl groups are located at positions 2,2, and 6 of the heptane chain and the ethyl group is found at position 4.
- (5) The complete name

"2,2,6- trimethyl-4-ethyl heptane

ALKANES

Occurence of alkanes:

Natural gas and petroleum are mixtures of many hydrocarbons most of which belong to the alkane series. The different types of hydrocarbons can be separated only by fractional distillation into components which have similar

boiling range e.g. the portion that boils between 50and 200 C is; gasoline

which is the fuel used for cars.

The part that boils between 200-300 C is keresene which is used in daily life.

Kerosene or gasoline are mixtures of hydrocarbons which have very close boiling points.

Some general methods of prepation:

(a) By the grignard * ' reaction: About 1900 Grignard , French , observed that a solution of methyl iodide in absolute ether (ether free from water) , reacts with metallic Mg and forms an eth er soluble compound , methylmagnesium iodide CH3 MgI . It was also found that other halogen derivatives behaved similarly

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C2H5Mg Brethvl mylmagnesium bromide

C2H5MgI ethylmagnesium iodide

or in general R MgX where R represents any hydrocarbon group

X 'Halogen

(Cl,Br,I, rarely F)

Grignard reagent: A compound of the type RMg X in absolute or dry ether is known as "Grignard reagent"

When Grignard reagent reacts with water it gives:

or generally :

If grignard reagent reacted with another molecule of alkyl halide or RX we get

e.g.

II Another method for the preparation of alkanes: Reduction of the double bond in unsaturated hydrocarbons

General properties of alkanes:

1- The lowest member of the alkane series , containing 's.'! four or less carbon atoms are gases. from C₁ C₄ gases at room temp.

C18- upwards solids as the cardon atoms increase

the densities of the solids increase.

2- The boiling points of the straight -chained hydrocarbons increase with increase in t

the number of carbon atoms

3 The isomers of the straight -shained hydrocarbons which are branched are lower boiling points than those of the isomeric normal hydrocarbons

isopentane 28

neopentane 9.5 C.

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Chemical properties of alkanes:

The alkanes are less than are most classes of organic compounds and for this reason, have been called paraffins(little affinity) ordinarily, they react with only powerful reagents or under conditions of high temperature and high pressure.

Inactivity with aqueous reagents:- Methane and the other members of the alkane series do not react with water solutions of acids, alkalies, KMnO_A or other oxidizing agents and the usual laboratory reagents. This lack of activity is associated apparently with their non-polar character. High temperatures, strongly electro-

phylic (electron seeking)reagents, or both are usually required in order to bring about any change in the structure of the alkane molecule.

Complete Oxidation (combustion) The alkanes burn in air or oxygen with the formation of CO2 and water .

Here all the C-H bonds are broken also the C-C bonds are broken and ${\rm c0}_2$ is formed in addition to water

$$CH_4 + 2O_2 - CO_2 + H_2O + heat$$
.
 $2C_nH_{2n+2} + (3n+1)O_2 - 2nCO_2 + (2n+42)H_2O + Heat$

The heat generated is very large, that is why methane, butane, and other petroleum products are used for heating puposes and other similar purposes where high energy is required.

An insufficient supply of oxygen leads to the production of soot, formaldehyde (HCHO), and other products.

Halogenation: (or substitution of a hydrogen by a halogen)

The replacement of one or more hydrogen atoms of an alkane by a halogen occurs very slowly in the dark ,but more rapidly in sunlight, or by artificial ultraviolet light. (u.v.,)

Reaction of methane with a halogen leads to all four possible products:

$$_{0}^{\text{H}}_{4}$$
, + $_{0}^{\text{Cl}_{2}}$ + $_{0}^{\text{Cl}_{2}}$ + $_{0}^{\text{CH}_{3}}$ + $_{0}^{\text{Cl}_{2}}$ + $_{0}^{\text{CH}_{3}}$ + $_{0}^{\text{Cl}_{3}}$ + $_{0}^{\text{Cl}_{4}}$

Primary , Secondary and Tertiary H. drojons:

only one other carbon is attached e.g. in the CH₄ here the hydrogen atoms are 1°

also in CH3-CH3 here also the H are 10

Sucondary Hy-atom or 2° H-atom when the H is attached to a 2° carbon atom

e.g. CH₂-CH₂-CH₃ here the carbon atom present in the center is 2° because

it is attaced to two other carbon atoms. And the H attached to this carbon is

called 2° H-atom.

Org. Chemistry P 9 is found in isome man C In the same way a 3° H-atom isobutane

here the the C-H are 3°

CH3-CF + CH3 begause the carbon here is attached to three C atoms

The activity of 1° h-atom differ from the 2° and 3°

2º H-atoms are replaced more rapidly than 1º also 3º is replaced more rapidly than 2° · we was the same of the same

Mechanism of Halogenation of methane:

Consists of the dissociation of meoccular chloring in o 1- Initiation atage:

C1-atoms . Much energy is required to rapture the covalent bond and thes energy is supplied when the Chlorine molecules absorbs a quantum of light energy

Cl:Cl + radient energy ---- 2 Cl* (free radical)

2- Propagation stage. A Cl-stoam which requires an electron to fill its cuber shell collides with methane where it takes up a H-atom and displaces a methyl radical:

The methyl radical, in turn upon coddision with a malecule of Chloring displaces a 'Cl' atem with the formation of methyl chloride. Those stops can be repeated until some reactions rememes one or both of the active free radicals

3-Pasible termination reactions:

A chain of reactions is terminated by combination of the free radicals with themselve , usually on the walls of the reaction vessel so that the energy liberated the formation of the bond may be dissipated, or by the exhaustion of the reaction materials (sometimes the reaction cannot be stopped until we get CCl.

Chlorination of a compound containing a 3° carbon atom,

e.g. isobutane

To come way a 1 - H-atom is found in isometanou

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The society of to k-atom differ from the 2° and 3°

2º Hastoms are replaced more rapidly than to also 2º te mentand nor series

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- Initiation stage: Conslats of the dissociation of meo.coultr chlorens

Ol-atoms . Which shergy is required, to rapture the covalent bond and this energy is supplied when the Chlorine moleculus 252675% a quantum of light changy

Ol: Cl + radiant anergy --- 2 01* (from radioal).

From the mother of takes up a H-atom and displaces a mother training and displaces a mother training with mother to take up a H-atom and displaces a mother training or the mother training and displaces a mother training or the mother training or training or the mother training or the mother training or training or the mother training or training or

H-3-H

The methyl redired, in turn upon condicton with a malcoule of Chlorine displaces a Cl atem with the formation of methyl chloride. Those at pact displaces a Cl atem vith the formation or methyl chor the color removes one or both of the active free remove.

HgC* + C1:C1 - W - CHgC1 + C1* (The C1* and the CHg

definite termination reactions:

SOUP + 9H²O ---- 5USS 5 01. --- 10:10 --- 10:2A

CH), + 01; ---- CH'01 + TUTTA

A chain of reactions to terminated by commination of the frae radicals were to marked a chain of the value of the reaction vessel so that the anhaustion of the reaction cannot be stopped until we get CCL.

The provided and the reaction cannot be stopped until we get CCL.

Owloringtion of a compound containing a 3° carbon atom

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* - partes strag-*

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in this reaction we have 9. 1° hydrogens i.e. nine chances for the reaction we la also have one 3° " i.e. one chance for the reaction we can see from this that the 3° H-atom reacts faster than the 1° with the halogen

. Bromination of alkanes proceeds in somewhat the same manner as chlorianation although less vigourously . Iodine does not react while Fluorine reacts very vigourously leading to the explosion of the reacting vessel.

Florine may be made to react by dilutineg it with nitrogen and by the use of special apparatus which removes the heat of the reaction very quikly

Pyrolysis of alkanes: (craking) When the paraffin hydrocarbons are paaed through tubes tubes heated to 500-800 °C, a thermal decomposition (pyrolysis) or craking occurs whereby the larger hydrocarbon molecules are broken into smaller molecules.

In an alkane there are two types of bonds: (1) the C-C bond and the CH Here the C-C bond is the more easily broken.

The amount of energy required to dissociate a gaseous molecule A:B into the fragments A* & B* per mole is called the bond energy. In ethane molecule the C-C bond energy is 77.7 Kcal/mole whereas the C-H " 98.2 E"

Hence , the pyrolysis reaction, yielding ethylene and $\rm H_2$, may be expexted to proceed by a free radical mechanism as indicated below:

(3)
$$c_2H_5$$
 ——— $cH_2 = cH_2 + H$

step (3) &(4) repeat themslves many times

Overall reaction :

we get mainly ethylene, some CH4 and H2

Pyrolysis of octane

octane which is a larger molecule found in petroleum upon pyrolysis it gives:

othylene + CH,

upon pyrolysis (1)
$${}^{C}_{8}{}^{H}_{16}$$
 + ${}^{H}_{2}$ (2) ${}^{C}_{4}{}^{H}_{10}$ + ${}^{C}_{4}{}^{H}$ (3) ${}^{C}_{4}{}^{H}_{8}$ + ${}^{C}_{3}{}^{H}_{6}$ + ${}^{C}_{4}{}^{H}_{4}$

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In petroleum refining the cracking process is very important to for it makes possible the production of gazoline from hydrocarbons of lesser commercial wall which have higher molecular wt.

Isomerization: Conversion of one isomer into the other, it is of importance in manufacture of high quality gazoline which is used as a fuel fo cars etc.

e.g. Conversion of n-butane into isoputane

Dehydegenation: Alkanes may be converted into alkenes when passed over suitable catalysts at temp. of 500-700°C (the catalyst may be either

Cr, Mo , V, Titanium ...)

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Cycloalkanes: Here the alkanes form rings of the general formula CnH2n which isomeric with the alkenes which have the same general formula e.g.

cyclopropane
cyclobutane
cyclopentane
cyclohexane

80.8

b.p. -34
12
49.2 •C

and the same

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lacentication: Conversion of one lacent into the other, it is of important

s.g. Conversion of n-butane into icoordans

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TER 108 20 - 180 - 180-(SE0+, HO

Debydogramation : Alkanos may be converted into alkenos when present over a talysts at temp . of 500-70090 (the outalyst may be either

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SH + SHO=SHO - FRO-FRO

0H3-0H2-0H3 ----- CH-0H-0H9 + H9

Cyclosistanes : Here the alkanes fore rings of the general formits Under white

isomeric with the alkenes which have the same general formula o.g.

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5. 2.67 9.02 onexedolovo

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S UNSATURATEN'

Alkanes or olefins

The alkenes are characterized by the presense of a double bond between two carbon atoms whih is indicated in the nomenclature of these hydrocarbons by the endinf end

HYDROCARBONS

The general formula implies that the first member of the family might be CH2

methene, but here the carbon atom has two unpaired electrons i.e. wo have a from radica. I which cannot exist as a stable ... ontity because of its valence structure Consequently the family begins with ethylene CH2=CH2

MNomenclature of alkenes :

1- common names : The first four have common names ethyle ne , propylene, butylene amylene

2-There is also the derived name e.g. for propylene we can a say methyle bylene

3- 12U.C. System (most important method of nomenclature)

In applying the I.U.C. system to a hydrocarbon that has a double bond in a side c chain , the name is based upon the longost chain that contants the double bond

-Priority in numbering of the carbon atoms is given to the side nearest to the double bond

CH2-CH2 -C-CH-CH3

2-Ethyl-3-methyl-1-butene Hiere the i 1-butene means that the double bond exist at carbon atom number 1

CH2=CH-CH2-CH3

CH2-CH=CH-CH2

1-Rutene

butone

hexene haptene

octeno

2-Butene

I.V.C. Common name

Ethone ethylene propene propylene

butylene pentene

position of the double bond is indicated by alpha, beta,

instead of 1,2,3,

in common names, the

nonena decone

methylpropene

isoputylene

1-Butene alpha-butylene 2-butane beta - butylene

Electronic structure of the (alkenes:

The two bonds are not identical in the double bond. One of then is ar any bond but the second one which asoconsist of a pair of electrons are most likely to to found above and below. the plane defined by the two carbon and four hydrogen nuclei

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conc. H2SO

C2 H5 OH -H20

ethylene or ethene ethyl alcohol

Some general physical properties :

Ethylene is a colourless gas of a w sweetish, slightly soluble in water . Priopyleneas and the three butylenes are gases also under ordinary conditions

to 017 are liquids

upwards are solids

Charical pro porties :

Since these compounds contain a double bond, they are very reactive compared to the alkanes and try to sturate the carbon atoms which have the double bonds.

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(actually in two sausage-shaped regions lying above and below the two carbon nuclei-

The latter pai of electrons can be attacked more easily than the ordinary by electrophylic (electron-seeking reagnets)

In a molecule containing a double bond, the atoms of the molecule are somwhat held in fixed positions so that rotation of the double bond, though not entirely prohibited, but definitely restricted i.e. it is not so easy to rotate .

Summery ;

(1-) The double bonds restricts rotation and make possible the existence of cis and trans isomers

(2) In chemical reactions, the alkenes are electron donors (lewis Bases)

Cis-Trans or geometrical isomers :- Because of the restricted rotation at the double bondin an alkene molecule Certain alkenes may exist as two distinct types of molecules called cis-trans or geometrical isomers

e.g. 2-butene is known in two isomeric modifications

CH3- C-H CH 2-C-H CH3- C-H

Cis-2-Butano

(I.U.C. nomenclature) Trans-2-Butene

In alkanes the rotation around single bonds is easy and very small amount of energy ? is required. while here when we have a b double bond, the amounts of energy required to convert one form to another are ordinarily much higher than that available to the molecules at room temp. (and in the absence of irradiation) . Therefore these isomers were isolated

Cis-2-pentene

trans-2- pentene

cis -1,2-Dichloro-1-bwomoethane trans un un y un un

Some general methods of preparation :

(1) Cracking of alkanes (2) Dehydration (removal of H20) from alsohols by the action of conc, H2SOA in two sausago-shaped ractons lying above and below the two carcon nucl

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Na-Trans or geometrical isomers :- Negrous of the restricted rotation at the loss of to add an alkane as two distinct types of roadin as a two distinct types of roading as a secure of a

oser 2-butons is known in two isomeric modifications

Trans-2-Butone (I.U.O. nomenolature)

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s-2-p-ntene truns-2- pontane ets-1,2-phionioro-1-bromouthing

Some general mathed of propitation :

Semalis to water of D

Onstal-S-Estono

1) Dehydration (removal of H₂U) from alsohole by the lotton of cone, H₂BO

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athylone is a colourless gas of a secretar, slightly soluble in within opplement and the three setylones are gases also maker endinary conditions.

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10 Oxidation :

(a) Combustion: Alkenes burn in air with a luminous flame. The unsaturation of the molecule results in a greater percentage of carbon in the slkene than in the alkanes of the same number of carbon atoms, and het particles in the flame produce increasedd luminosity. That is why the flame appears luminous whereas in the burning of methane or butane we notice a non-luminous flame (e.g. flame of a bunsen burner)

(b) Baeyer test for unsa turation: Any unsaturated molecule will reduce the colour of a dil. solution of KMnO₄ with loss of the purple colour and the appearence of a brown ppt of MnO₂

This is the first step in oxidation ; if we use hot conc. KMnO_4 solution , complete oxidation to CO_2 and MnO_2 takes place.

2) Addition of H2: In the presence of pt or Ni catalyst, the olefins add hydrogen and form paraffins (alkanes) with the evolution of heat

3) Addition of Halogens:

ethylene bromide

colourless solution

(F2'Cl2 add to the alkenes more rapidly than bromine . I2 gives a reversible reaction

4) Addition of HBr (here the Br ion adds to the carbon atom that has the the lowest number of hydrogens)

5) D Addition of H2SO4

here the OSO. H adds to the C atom with the lowest numbe

This is the basis for the removal of unsaturated hydrocarbons from the first the basis for the removal of unsaturated hydrocarbons from the first the basis for the removal of unsaturated hydrocarbons from the first the basis for the removal of unsaturated hydrocarbons from the first the basis for the removal of unsaturated hydrocarbons from the first the basis for the removal of unsaturated hydrocarbons from the first the basis for the removal of unsaturated hydrocarbons from the first the basis for the removal of unsaturated hydrocarbons from the first the basis for the removal of unsaturated hydrocarbons from the first the basis for the removal of unsaturated hydrocarbons from the first the basis for the removal of unsaturated hydrocarbons from the first the basis for the first the basis for the basis

ethylene and other composite that contain a double bond has the ability to react with itself or with other many changes are composed composed polymers (see book, chapter of org. chemistry)

Note: There are compounds with more than one double bonds e.g called dierement when we have two double bonds, trienes, when we have three double bonds

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PETROLEUM & PETROCHEMICALS

Fetrol was known for a long time. In ancient history it was used in Iraq as a building material (Babylnians or Assyrians used bitumen which is one of the derivatives of petrol for building). Also some of the Indians of North America used to collect and sell the oil or petrol, as it is sometimes called, from the wells of Fennyselvania.

No one however seemed to have realized the importance of this oil until it was found that paraffin oil could be made from it. Then when the internal - combustion machines were invented (e.g. cars, aereplanes...), petroleum became of world wide importance.

Petrol and its products is not only important as a sourseeof fuel and lubric ante but a; so as a raw material i.e. from it we can jet prepare many derivatives such as plastics, synthatic rubber, drugs, etc...

Origin of petroleum: Natural gas and petroheum have bean formed over the cours.

of the ages o by the decomposition of organic material of marine origin (sea plants and animals) and these decomposition prosucts has accumulated in porous 1015

formations on earth pockets capped by rock. When a well is drilled through the cap, natural gas escapes and , for a time , oil may be forced to the surface by pressure . After the pressure has subsided , the oil must be pumped out of the we:

It should be noted that the constituents of one oil well may be different from that of another but all contain saturated hydrocarbons and other products.

Constituents of petroleum:

1- Natural gas: The gas at the weel head contains not only methane, but also

ethane, propane, butane, isobutane and vapours of low boiling-point liquids :pentanes, and hexanes. The hydrocarbons of three or more carbon atoms are easily liquified by cooling and compression and are thus removed from the methane n and ethane. Fractional distillation of the liquid so seperated, yields commercial quantities of propane and the two butanes that are used both as a furl and as raw materials to present other products.

In addition to the hydrocarbons , natural gas may contain $\frac{H_2S}{}$ (compare coal gas which also contains this gas) also natural gas contains $\frac{H_2S}{}$ Helium, $\frac{N_2}{}$.

 $\rm H_2S$ must be removed because gases containing it (sour gases) have a bad odour also they corrode the apparatus used to transport the gases. When a gas is burned and it contains $\rm H_2S$, \rm , SO_2 will be formed from the reaction and the room is filled t with this poisonous gas .

For these reasons HoS has to be remeved from natural gas .

He which is often present to the extent of 1 % or more, is removed by extracting plants from which the He supply may be obtained.

Natural gas as supplied to house s and used contains:

about 82-87 % methane

6-10 % ethane

1-4% % propane

1 % butane

1-8 % Nitrogen (these quantities might sometimes differ a little bit)

II MOTOR FUELS: The production of motor fuels from petroleum consist of several steps:

1.__fractionation: The first operation in the refining of petroleum is a fraction1

distillation by which the crude oil is separated into a series of "fractions"

indistribution: The first operation in the refining of petroleum is a freetail.

distillation by which the crude oil is separated into a series of "fractions"

the Line first operation is refining of petrologic is a recologic

distillation by which the grade oil is separated into a series of "fractions"

Catalyst stright -chained hydrocarbons ----

Organic Chemistry P 16 roc or"cuts" having different ranges of boiling point . In the distillation

process each portion of the distillate is collected between those temperatures that have been found to give best products best suited to various commercial purposes,.

. The fraction that distils between the initial boiling point - 70=°C Petroleum ether " 58-200 \(\delta\) is gasoline medium

"200-300 °C " Kerosene above 300 distillate or furnace

as oil

light lubricating oil medium lubricating oil heavy lubricating oil

at the end oft the distillation, a residue of asphalt or coke remains in the still

Crude petroleum is first passed through petroleum refinaries where it is heated a above 400°C most of it is changed to vapour then this is passed through the fractionating column where the vapours go up from the lower part of the column.

Here the heaviest vapours condense first (e.g. a fraction which boils at 300°C will, as the vapours cool a littles bit, condense at the lower part of the column A black residue which is asphalt and tar and sometimes cloke remains is the still (still: distilling apparatus). The lightet portions of the vapours are passed to other fractionating to columns where they condense at the temp . listed above This method is v called " fractional distillation!

When the heavy lubricating oils are chilled, paraffin wax and vaseline is deposited. After the removal of vaseline, and paraffin wax , the lubricating oils are washed with selective solvents for removal of the sludge forming materials

II Desulphurization: Petroleum distillates often contain HoS and other Sulphur containing materials such as R-SH (mercaptans) which have a bad odour and cause corrosion of metallic containers (remember that HoS is a reducing agent)

The H₂S and some of the sulphur derivatives are remeved by waashing with NaOH solution

The remaining sulphur derivatives are convert ed into the odorless, non-corrosive dialk yl disulphides by treatment with Na, PbO, (sod. plumbite) in the presence of S

R-SH + NaOH ---- RSNa + H₂O

R-SH + Na_PbO_+O_)---- R-S-S-R + PbS + 2 NaOH

The Na, PbO, is called Doctor's solution and this process is called sweetening

III Cracking and reforming: The gazoline obtained by distillation of petroleum,

called "straight -run gazoline" is a poor motor fuel and also is insufficient in amount to meet the demand. Increased quantities of gazo line are obtained by the cracking process (see reactions of alkanes) by which the larger hydrocarbons contained in the "gas oil" are broken into compounds having 5-10 carbon atoms per molecule.

Reforming: After the cracking the product is converted from continous-chain hydrocarbons to branching structures which have higher value as motor fuels

method: Pass gazoline under pressure rap idly over a catalyst contained in a heated steel pipes . The time of contact between the gazoline and the catalyst is 15 seconds

branched chains

15 seconds

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Tests on pure individual hydrocarbons in a motor designed especially for the purpose reveal :

That continuous chain hydrocarbons of branching structure are relatively non-knoking .

an evaluating system was made : since n-heptane knocks badly it is rated as zero while iso-octane has a high "antiknock" characteristic and it is rated as 100

If we have a sample of gazoline and we want to know its qualityi.e. its octane rating, we compare its antiknocking qualities in the test engine with that of a mixture of the two reference hydrocarbons (n-heptane and iso-octane)

If the gazoline has the same anti-knocking value as a mixture of 75% isooctane and 25% n-heptane, that sample of gazoline has an octane rating of 75

Other hydrocarbons has been found recently that are worse that n-heptane, whereas some have been obtained which are better than n-octane. e.g. n-nonane has an octane value of -45 while 2,2,3-trimethylbutane, an octane rating of +116

The addition of tetraethyl lead to gasoline greatly decreases knocking and permits the use of motors with higher compression ratios than would otherwise be possible The combustion of gazoline containing tetraethyl lead produce a deposit of oxide which may roughen the cylinderwalls in the engine. Hence ethylene bromide (C2H4Br2)

and ethylene chloride along with a red dye are incorporated into the o that fluid gazoline in order to remove lead in the exhaust gases as lead halide which is volat volatile at the temp. of the combustion of the fuel.

Note: Synthetic fuels: In the time of war, various countries particularly Germany have been forced to develop methods of preparation of synthetic fuels to supplement supplies of petroleum products . The raw materials of the synthesis of fuels have usually been coal , hydrogen and carbon monoxide.

Petroleum products other than fuels:

1- Cyclopropane : used as anesthetic.

2- naphthas : volatile petroleum fractions that are widely used in the dry-ol cleaning and varnish industries

3-Liquid Farrafin (liquid petrolatum) or Mi neral oil : made from the fractions boiling between 330-390°C

It is used in cosmetic creams, Hairdressings, It is also used as a laxative

4-Lubricating greases . used to lubricate the machines 5-Petrolatum (raseline)

6-Paraffin wax for making candles , coating paper ... t- Other derivatives ...

etrochemical industry is becoming more important every P.TROCHEMICALS: day because many products can be made starting with petroeum as a naw material e.g detergents, plastics, synthetic rubbers , drugs , etc.,

Although petroleum , accumulated in the earth throughout the sages , is of animal origin, it is usually sclassified as a mineral resource and paradoxical as it might se m , we now obtain most of our organic chemicals from the mineral kingdom.

* In the new type of gazoline which contain molecudes which has an high octane rating , there is no more any need to add lead tetraethyl.

stright -chained androcarbons ----- warmened untins testess to street and the seconds

Alcohols

Are derivatives of hydrocarbons with one or more hydrogens replaced by CH groups. Thus we can get monohydroxy alcohols when one H is replaced by CH Also we can get dihydroxy- and polyhydroxy- alcohols We are concerned here with monohydroxy alcohols.

General methods of ... nomenclature :

1- I.U.C. As in the alkanes but here the ane is replaced by ol. e.g propanol C3 H70H

here the position of the CH group should be given a number e.g.

CHz-E-CHOH

we shall have 'methanol, ethanol, propanol ...) In propanod, there are two isomers 1-propanol and 2-propanol

2- There are other type of naming we can say methyl alcohol

ethyl alsohob n-propyl " isopropyl " n-butyl " isobutyl " sec-butyl " tert-Butyl " these are common nz amyl alcohol names isoamyl "

when the chain is longer we use the I.U*.C system

Preparation of alcohols:

1- Hydrolysis of alkyl halide:

2- Hydration of alkenes by the use of H2SO4

The unsaturated gases from the cracking stills at oil refinaries provide large quantities of materials suited to the production of the alcohols by hydration Hydration (i.e. addition of a molecule of water to the double bond) can be accomplished by the use of acids (ordinarily HoSOL)

An alkene by absorption in H2SO4 , forms an alkyl hydrogen sulphate which , in turn yields alcohol by hydrolysis:

3- Alcohols by fermentation: Ethanol C2H5OH may be obtained by fermentation of

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2-methyl-1-propanol

Organic Chemistry P 19

cohols continued

of glucose for other sugars

(aq) glucose or fructose

If we have starch first the starch has to be hydrolysed by the use of another enzyme called diastase:

Zymase (same equation as above) + CO2 g;ucose

The alcohol may be separated from the water by fractional distillation where we get 95.6 % alcohol (ethyl alcohol is called simply alcohol)

Commercial ethyl alcohol has a concentration of about 95%

Absolute alcohol: Can be obtained by distilling the alcohol with lime (CaO)

Physical properties of alcohols:

Alcohols exhibit H-bonding that is why they have higher boiling points than other

derivatives e.g. methanol has the lowest molecular wt of i all the derivatives of methane but has the highe st boiling point. This is due to molecular association or we can say it is due to H-bonding existing between the molecules. That is also the reason why methanol and ethanol are completely miscible with water in all proportions.

The soblubility of alcohols decreases so rapidly with increasing ...lnutber of . of only 1% at 200 . Hexyl alcohol and those higher alcohols in the series

consist mainly of a relatively small portion of the molecule. The alcohols illustratee the re the rule that like dissole like . Those of low mwmbers are solub soluble in water but the higher members are soluble in organic salvents only

Chemical properties of alcohols:

As an example of alcohols we take methyl alcohol or methanol

1-Reactions of alcohols as acids : metallic Na added in small pieces to ethanol reacts with the genile evolution of hydrogen

The fact that one H-atom in the alcohol molecule can be replaced by Na is an imp rtant point in the proof of the molecular structure of an alcohol. The paraffin hydrocarbons have no reaction with Na; hence the H attached to the Oxygen atom is the only one replaced.

The alcohols are extremely weak acids and their salts are readily hydrolysed by water:

Ca also reacts with methyl alcohol but the reaction is slower that Na

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out our agent, despect of two longuous, foreign . Laurers

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Organic Chemistry P 20

2- Reaction of alcohols as bases: The alcohols may act as electron donors (bases) in reactions with acids or with PCl3

a-reaction with acids: Alcohols react with organic acids such as acetic acid (CH_CCOH) also with inorganic acids sich as HCl

In organic chemistry we have the word ester whenever an alcohol reacts with an organic acid the product is called an ester . Here the reaction is reversible We can easily hydrolyse the ester formed by the addition of an acid

3- Reaction with phosphorus halides

FCLYMERIZATION

More than half the chemical industries of the united states is based , at least , in part , upom polymerization processes. A large amount of products ranging from baby bottles to automobile bodies or motor boats are being manufactured from plastic materials which are one type of polymers

Folymerization: Consists of the chemical combination of a large number of molecules of a certain type called monomers, to form a giant molecule called a polymer.

Depolymerization: Is the reverse of polymerization, it is the dissociation of a giant molecule into n units of monomer by a chemical or thermal process.

Polymeri zation reactions iccur in living tissue such as the formation or the building up of cellulose and starch from simple small sugar molecules in plant cells . Also the process of digestion in the body is a process of depolymerization stach is broken up into sugars; Proteins are another type of polymers which are found in plants and animals . They are synthesized from amino acids which are the building units of the proteins. Some proteins are also depolymerized in the stomach into the amino acids and the body makes use of the amino acids liberated to be used as building units in the body (or some amino acids are oxidized further to urea and other products where the body gets use of the energy liberated during these reactions....)

Polymers may be in her

1- Linear: MEM-M-M-M-M...

where one type of molecule reacts with itself to form long chains . These giant molecules that are formed are called Macromolecules (macro: big)

e.g. of such linear molecules: Folyethylene; starch (in polyethylehe the monomer here is ethylene in starch the monomer here is glucose)

2-Linear Co-polymer : M-A-M-A-M-A-

Here we have two small molecules which react together forming long chins e.g nylon

3- Minor cross-linked polymer : M-M-M-M-M-M-M-M-M-M

e.g. of such polymer is vulcanized rubber where X represents -S- atoms

4- Folymer with massive cross-linking e.g. urea-formaldehyde resin which is a type of plastic which does not break easily

It should be pointed out that these are ideal structures . (i) &(2) may well have branches on the chains and the chains are certainly not straight

There appear to be at least three principal arrangements of linear polymers (1) An extended rod-like arrangements ; e.g. polyethylene

In polyethylene, here the polymer is in a rod-like molecules. The rod-like wolecules in polyethylene pack together in an ordered manner(like uncooked spagetti in a box) ; and the resulting crystalline polymer resists distortion when heated to temperatures below the m.p. (about 140 C) and also resists

the solvent action of common solvents.

Tolymerization Organic Chemisrty F 22

(2) A randomly coiled arrangemet (like a tangled string) e.g. bulyl rubber

The polymer assumes a randomly coiled arrangement, one polymer chain becoming intertwined (intermixed) with other chains .

Thus the attractive forces between the chains are small, and the polymer has a a fluid deformable character. The And And And And molecules can uncoil when the polymer is pulled and they return to the randomly coiled arrangement when :... the stress is removed. This gives the polymer a rubber-like characteristic

SOME EXAMPLES OF POLYMERS:

I- Synthetic fibers:

(a) Nylon: the name nylon has been applied to the plastic polyamide which may be made from dibasic acids (acids having two COOH groups) and diamines (molecules having two NH groups

Other dibasic acids and diamines yield polyamides in a similar manner and the nam nylon refers to the general group of such products rather than to an individual substance (i.e. there are many types of nylon molecules but all consist of one general structure)

It is also possible to prepare such polyamides in which different dibasic acid. and various diamines are interspersed in the long "polyamide chains

Thus 'nylons' of widely varying properties can be produced.

The long chained molecules have a random arrangement in an undrawn nylon-fiber but the molecules; become oriented into approximately parallel positions by drawing the fiber to several times its original length

Mechanism of the reaction taking place: In the polymerization reaction a H -atom in the NH2 group of the amine combines with the OH of the COOH group of the . dibasic acid (containing two COOH groups) to form water and the two monomers srelinked together.

then the process is repeated and we get long polymer chains . Nylon is used to : : make great many things from sheerest hosiery to large gears of machinary ,

General reactions :

HOOC-R-COOH + H2N-R-NH2CO-NH-:-R+ NH-CO-R-CO-NH-R'-... polyamide

or simply

-NH-CO-

-CO-NH -

e.g. Nylon-66

-CO-NH-

H2N-(CH2)-NH2 + HO-CO-(CH2)4-COOH + H2N-(CH2)6-NH2 ----- Polyamide +

H20

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**** - En-Our

Organic Chemistry P : 23 polymerization 1970/5th class

IITerylene (Dacron) It is a polyester (monomers are terephthalic acid and ethylene glycol) It is a new synthetic fiber.

In addition to wrinkle-resisting property, and dimentional stability, it id resistent to moths, mildew and abrasion

It is used mainly in clothes.

III -Plastics: this is another group of polymers.

There are two types of plastics

(1) Thermoplastic: which are affected by heat. On heating the y lose their rigid rigidity because there are no permanent bonds between the chains and so, on heating the long molecules will move about and the distance between individual chains will increase. Hence the material becomes less rigid and soften readily with small increases of tempreture, as only small amounts of heat energy are required to ever overcome the weak attractive forces. On cooling the movement becomes less and the material becomes rigid again.

These materials are thermoplastic (softening and hardening are reversible)

(2) Thermosetting: This type of plastic is not affected by heat It is useful in many fields of industry. In this type there are multiple crosss-linkages. That is why they do not soften when heated or a large amount of energy is required to break these cross-linkages where the compound decomposes completely

... M-M-M-M-M-

A A A A A A Multiple cross- linking - resists defomation by heat

Examples of plastics:

I -Folystyrene: Styrene undergoes linear polymerization yielding the thermoplastic polystyrene (affected by heat).

To decrease the themoplatic character another compound is added to it in very low concentration such as divinyl benzene; this is added in small concentration with the styrene prior (before) to polymerization . This results in the formation of crossII- linkages between the polystyrene units.

Uses: Polystyrene is widely used for rigid insulation and for molded articles . I It is not affected by water that is why it is also used in bath materials

II - Perspex (It is methyl methacrylate polymer)

This type of plastic is hard and clear as glass. It is used for making optically clear plates and blocks, lenses and machinable castings and forms

It is a colourless transparent plastic which is sold under the trade name of ' Perspex '

The polymer is of linear character; Cross-linkages between the linear chains are almost non-existent; hence the polymer belongs the to the thermoplastic group and softens when heated: it may thus be reshaped as desired.

Note: Some polymers are decomposed by heat, others by chemical reagents

Cther types of polymers: Carbohydrates. Proteins, Silicones ...

I. D. C.

- 1- Choose longest continuous chain which contain the double bond
- 2- Instead of using the word alkane we use the word alkene i.e. the name should end with ene e.g. Butene
- 3- The numbering of the chain is from the side which gives the double bonds the smaller mumber.
- 4- The double bond is named with the smaller number of the carbon atoms which form the the double bond.
- 5- Side chains are named as in the alkanes

e.g. CH₂=C-CH₂-CH₃ CH2=C-C-CH3 3-methyl-1-butene

2-methyl-1-butene

double bond is opened

CH3-CH=C-CH3 2-methyl-2-butene

Polymerization of ethylene: Folymerization means a condensation reaction where a small molecules condense forming molecules of very large molecular wt.

e,g. ethylene polymerizes in acid medium p forming polyethylene:

CH3--CH2- (cCH2-CH2) -CH=CH2 polyethylene

This polymer is a very important plastic.

Calculations based upon such bombardment exp. as have been described showed that whereas atomic redu are usually of the order of 10 cm, the nuclu of the atoms are of the order of only 10-12 - 10-13 cm in radius. On the basis the volume of the atom is greater than that of the atom 10 times.

From calculations based upon additional data from this same series of exp. Rutherford showed that the number of positive charges on the nucleus of an atom is at least in many cases somewhere near one - half the atomic weight of the element. The number representing the position of an element in the periodic system allowances having made for vacant spaces had previously been given the name atomic number. Since in many cases this number is about one half the atomic weight. Van de Brock made the suggestion in 1913 the atomic number of an element is equal to the number of positive charges on the nucleus of its atom. This hypothesis was soon confirmed by British Physicit Mosely.

Mosely showed that by bombarding elements with cathode rays, X - rays of characteristic wavelength are emitted. If the square roots of the frequescies of these waves are plotted against the "atomic number" straight lines are obtained. The importance of this work was that it gave precision to the idea of atomic number which represents the order of the element in the Periodic table.

Mosely's Law established the conception that each element differs from the preceding one in the table by one nuclear charge & hence by one electron.

THE NUCLEUS

Positive rays -

In 1886 Goldstein found that in a tube having a perforated disc as cathode, if the pressure is not too low, colored rays may be seen to emerge from the side of the cathode opposite to the anode. It thus appears that these luminous rays move toward the cathode rather than in the opposite direction; and that they must therefore consist of positively rather than negatively charged particles. Moreover, studies of these particles by methods beyond our scope indicate that they are not all identical in nature; unlike the electrons which make up cathode rays these positive particles have charges and masses which vary that where as the cathode rays actually start from the cathode these positive rays originate in the space between the two electrodes. These facts support the now well established view that these positive rays consist of the positive residues or ions which are left when one or more of the electrons are k nocked out of an atom or molecule of a gas in the tube by the stream of electron from the cathode. The study of such positive rays has been of profound importance in the development of the theory of the structure of the atom.

By the use of methods similar to those previously employed in the study of cathode ray particles, the ratio of charge to mass(e:m) was determined for the particles constituting the positive rays obtained with various residual gases in the discharge tube. The largest value of e:m for any positive ray particle was that found when hydrogen was used in the tube. This means, of course, that if we assume the charge (e) to have the same value in each case, the mass (m) of the positive ray particle obtained in the hydrogen tube is less than that for any other gas. Careful study has shown that such is indeed the case, and that this positive particle is one of the fundamental particles of matter. Its charge is equal in magnitude but opposite in sign to that of the electron, and its mass in 1836 times that of the electron or 1.0073 atomic weight units; this special type of particle has been given the name proton. The simplest of all atoms, the hydrogen atom, consists of a proton and an electron.

THE NEWTRON & NUCLEAR STRUCTURE

With the single exception of the isotope of hydrogen having a mass of 1, all the atoms have more units of mass than of positive charge in their rubluit is therefore evident that the nuclu of these atoms must contain fundemental particles other than protones and in 1932 the English physicist. J. Chadwick discovered a third type of fundamental subatomic. He was able to show that the highly penetrating radic on emitted by metallic berylium under bombardment by alpha particles consists of streams of particles having a mass of approximately 1 atomic weight unit (1.0087 a.w.n) and carrying no charge. This type of particle was given the name neutron . Although the internal structure of the tomic nucleus still remains a good deal of a mystery, the hypothesis that it is composed of protons and neutrons is now fairly generally accepted. It is accordingly assumed that an atom of approximate atomic weight (mass number) A and atomic number Z has a nucleus composed of Z protons and A-Z neutrons. According to this view, the nucleus of the isotope of lithuim of mass number 7 consists of 3 protons and 4 neutrons, while the isotope of hydrogen of mass number 1 has a nucleus consisting of i proton only, whereas the isotope of hydrogen having a mass number 2 has 1 proton and 1 neutron; in the its nucleus. Thus we see that the nuclu of different isotopes of a given element differ onlyin the number of neutrons they contain; the nuclu of all isotopes of a given element have the same number of protons. (the same positive charge) and the atoms therefore have the same chemical properties.

American physicist.C.D.A.nderson discovered in 1932 that when cosmic rays a form of electromagnetic radiation apparently originating in interstellar space and having very great penetrating power, were allowed to pass through a sheet of lead, two types of particles were obtained. From the photographs of the tracks they produced in a cloud chamber under the influence of a strong magnetic field, it was shown that one of these types was the negative electron with which we are familiar. The other types was soon shown to have the same mass as the electron and the same amount of charge, the tharge in this case is positive, however, and these particles were named positrons.

More recent research on cosmic rays suggests the existence of other nuclear particles and in particular a meson. This has a mass of about 100 times that of the electron and may be positively or negatively charged

Another nuclear particle is the neutrino which has no charge and pratically no mass.

THE PERIODIC CLASSIFICATION

The first classification of elements depends upon the difference in the physical and chemical properties, classified as metals and non netals. It was found that this classification is not sharp. Tries were aade to classify elements in small groups depending on the similarity of chemical properties and its relation with the atomic weight.

THE TRIPLE CLASSIFICATION

Dobereiner (a German Scientist in 1829) found that elements that are chemically similar can be classified ingroups of three elements. hen the atomic weight of one of the three elements. When the atomic weight of one of the three elements in any given group is equal to the arithematical mean of the weights of the two other elements. Such a group is Li (7) Na (23) K (39).

Continued p. 6.

so that
$$= \text{Na} = \frac{\text{Li} + \text{K}}{2} = \frac{7 + 39}{2} = 23$$

also C1 (35.5) Br (80) I (1265)
Br = C1 + I = 35.5 + 126.5 = 80

eritie calco alut mort state for itilla note, i sand apoisticales and the chief the adultate and the chief the calco and the first the calco and the chief the calco and t The state of the s Homely measand that by bombarding elements with carbon press M. . Tops of the following the first service of the f men't interiorate of this work was that it may provided to constraint off the under which represents the order of the element in the Port die toble. mort stall in tour to done test notingents and linelinesee was a visualt as onth softwartes a univer sout a mi deat based alaterion dies as theday if the presence is not too low, enlored rays may to a or to emerg reduced the control of the cotton rather than in the openation derection; in they must thoractor or maident positively rather than neglicially abstract the neglicial of these particles by methods beyond our scope redicate they are not all identical in matural unlike the electrons which ry that where as the cathode rays actually start from the astrode those cathodes are rays originate in the space between the two electrodes. These installed the constitution of the constitution of the classical of the classical or tone or sore of the clastrons are comen from the cathode. The study of such positive rays has been at profound postence in the development of the theory of the structure of the office, dethinds the cartier the rathe of charge to mestern) was deter thed for out in the discharge to! . The largest value of erm for any positive ray right was that found when hydrogon was used in the tabe. This hears, of condition was that if we assume the charge (a) to have the same value in and one, the manual in the hydrogon tube is less the that one other ass. Careful study has shown that and the case, and the case, and the tother as the case of the fundamental particles of action. Its tothe position but opposite in sign to that of the clocken, and the equal in magnitude but opposite in sign to that of the clocken, this man in 1856 times that of the clocken or 1.0073 atomic weight unite; this greated type of particle bes been given the news proton . The simplest of all With the sime have more units of mass then of positive charge in their right is cherefore sydent that the nucle of these sites aust their right is cherefore sydent that the nucle of these sites aust their right is particles other than protones and in 1952 the smallest physical. Chadwick discovered a third type of fundamental magliab physical. On the site the highly penetrating root on station of the site of success of supplemental considering a site of success of supplemental considering and the success of supplemental considering and set of success of supplemental considering and carrying no charge. This type of remains and the nume new root deal of a mystery, the incoming the station of the chart of the success of the chart is composed of protone and neutrons is now fairly generally seconds. It is accordingly answed that an atom of approximate about a station of the must see of the sations of protons and a sations of the number of neutrons they contain the two aleases of a given element of neutrons they contain the came chemical properties of a given element atoms the came chemical properties.

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the physical and chemical properties, classified as metals and non a the difference of the physical and chemical properties, classified as metals and the single were of the to classify of the this classified as mall properties on the sintlarity of commical properties and its relation with the atomic weight.

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Continued p. 6.

25 = 25 + 5 = 1 + td = 24 faft os

(20sr) I (88) in (2.88) I (4865)

Un = 01 + I = 75.9 + 125.5 = 80

2. The atom consists of (i) the nucleus at the centre (ii) and system of electrons in motion outside the nucleus. The mass of the atom is entirely concentrated in the nucleas, the volume of the atom is the volume which contains all the moving electrons.

THE ELECTRON

One of the most important steps in the development of the theory of atomic structure was the discovery of the electron and the determination of its characteristics. The first experimental evidence that electrical charge is not a continuous fludd but made up of discrete particles was obtained in 1833 by Micheal garaday in his studies of the conduction of an electric current by solutions of various substances. It was Stony 1874 and Helmholtz 1881 who first clearly understood their theoratical significance and stated the principle of the atomic nature of electricity in 1891 Stoney proposed the name electron for the elementry unit of electric charge.

Of all the studies involving the electron none has been more fruitful than those concerning the rays which emanate from the cathode (the negative electrod when an electric discharge is passed through a tube containing a gas at low pressure and hence are known as cathode rays. At ordinary pressures gases are extremely poor conductors of electricaty and a very high voltage is therefore required to produce a discharge through a gas between two electrodes under these conditions. If

If the pressure of the gas in the tube is decreased however the conductivity rises rapidly. When the pressure has been reduced to the range of 0.01 to 0.001 mm Hg, the tube is filled with an invishle radiation, the presence of which is indicated by the fluorescence produced where it strikes the walls of the tube or a fluorescent screen placed in the tube.

The invisible rays have the following properties:

- 1. These rays proceed in straight lines from the cathode indicated by the fact that an opaque object in the tube causes sharply defined shadow in the fluorescent at the end of the tube apposite the cathode.
- 2. These rays have a mass. If a small paddle wheel is placed properly suspended in the path of a thin beam of the rays, then impact on the wheel causes it to rotate.
 - 3. They are deflected by an electric field.
 - 4. There are deflected by a magnetic field.

All of these properties as well as may others indicate that cathode rays are composed of negatively changed particles of appreciable mass. When it became apparent that these particles are identical with the elementary particles of electricity postulated by Stoney, they were called electrons. It is important to note that the nature of these cathode ray particles is independent both of the nature of the metal used for cathode and of the nature of the residual gas in the tube.

Metals have a tendency to emit electrons under the influence of dectromagnetic radiation, this phenomenon is known as the photoelectric effect. Only a few of the metals show this effect under the action of visible light but many more exhibit it when irradiated with electromagnetic rediation of shorter wave length and hence higher energy such ultraviolet light.

THE CHARGE MASS OF THE ELECTRON

The ratio of the charge on an electron to its mass was determined in 1897 by English J\$J. Thomson by investigation of the behavior of the beams of electrons in electric and magnetic field. Such a calculation is possible because the extent to which a beam of electrons is deflected under these conditions depends upon the charge on the electron, its mass and the velocity with which the electron is moving. The most recent work indicates that the ratio of the charge to mass of the electron is 1.759 x 10 coulom/gm - irrespective of the source of electrons.:

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Current Subjects for which no marks are available at present are marked (x).
Marks for subjects marked (na) are not available to this School.

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	Islamic Histor		1	-	1	1	1	1		2 "
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	Geography	III 5 001 y	-	-			-			2 "
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	History & Geo			1						5 "
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	ng mark(Drawing is	option	al)						1 2 "
	1 200	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				4				^

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J. The atom consists of (1) the nucleus at the centre (11) and system of slockwine in motion outside the sucleus. The mess of the atom is the atom of the standard in the masters, the volume of the atom is the volume which contains all the contains all the contains all the contains

to great the most important steps in the development of the the treatment of the the contraction of the contraction of the determination of the telephone that short the telephone telephone the telephone tel

continuous fluid bet made up of discrete particles was obtained in 1833 by
lebest paraday in his studies of the conduction of an electric current by
olutions of various substances. It was Stony 1874 and Helmholtz 1881 who first
learly understood their theoretical significance and stated the principle.
I the stonic nature of electricity in 1891 Stoney proposed the new electron

Of all the studies involving the electron none has been more fruitful than those concerning the rays which emenate from the cathode (the nagative electrical and the third that the cathode has a tube containing a gas at low present a conditional present a paste are entered to the cathode rays, at ordinary present a caste are entered to produce of electricaty and a very high voltage is therefore required to produce a discharge through a gas between two electrodus under

If the presents of the gas in the tube is dooressed however the conductivity riess rapidly. When the presents has been reduced to the range of 0.00 to 0.001 mm Hg, the tube is filled with an invisble radiction, the presents of which is indicated by the fluorescence produced where it strikes the walls of the tube or a fluorescent screen placed in the tube.

The invisible rays have the following properties:

1. These rays proceed in straight lines from the enthode indicated by the fact that an openue object in the tube causes sharply defined shadow is the fiddenessent of the end of the tube apposite the enthode.

2. These rays have a mass. If a small paddle whool is placed properly amapended in the path of a thin beam of the rays, then impact on the whoel causes it to rotate.

3. They are deflected by an electric field.

A. There are deflected by a magnetic field.

All of these properties as well as may others indicate that datheds rays are composed of negatively changed particles of appreciable case. When it became apparent that these particles are identical with the electrons, It is important to note that the nature of these cathede ray particles is independent both of the nature of the metal used for dathede and of the nature of the recident gas in

Meinle have a tendency to emit electrons under the influence of locaronagnetic radiation, this phenomenon is known as the photoclocked effect under the action of who hatele show this effect under the action of which it when irrediated with electromagnetic rediction of there wave length and homee higher energy much ultraviolat light.

WOSTOBLE BUT TO SEAM EDGARD BET

The matte of the charge on an electron to its mass was determined in approximation of the backward of the behavior of the behavior of the beautiful and magnetic field. Such a calculation is useful consecution the extent to which a beam of cleatrons is deflected under these conditions depends upon the charge on the electron, its mean and the velocity at hard the cleatron is recent work indicated that the charge in the electron is 1.750 x 10 content for

Date: /

- P.3 -

Other Examinations passed by the above candidate:

- 1. Iraq State Baccalaureate Examination for Primary Education, in June/ and September 19, passing with distinction and/ranking 1st, 4th.etc. among 20, 28, etc. candidates from Frank Iny Primary School/or Menahem Daniel Primary School/or School in Baghdad. This examination is, in standard, equivalent roughly to the Common Entrance Examination of the English Schools or to grade 7 of the American Schools.
- 2. Certificat d'Etudes Primaires Examination, conducted in Baghdad by a special commission from the Lebanon, in May 19, ranking 1st, 3rd, etc. among 20,28, candidates from Frank Iny School and 4th, 6th, etc. among candidates from all Schools in Baghdad.
- 3. Cambridge University Lower Certificate Examination in English for overseas students, in June/December 19, ranking among candidates from Frank Iny School.
- 4. Brevet Elementaire Examination in French, Literary Section, or Scientific Section, conducted in Baghdad by a special Commission from the Lebanon, in May 19, ranking among candidates from Frank Iny School and among candidates from all Schools in Baghdad.
- 5. Iraq State Baccalaureate Examination for Intermediate Education, in June/and September 19 ranking among candidates from Frank Iny School and among candidates from all Schools in Baghdad/or Iraq.
- 6. Iraq State Entrance Examination to the Fourth Secondary Form, Scientific Section, in Mathematics, Physics and Chemistry, in June/and September 19, ranking among candidates from Frank Iny School and among candidates from all Schools in Baghdad/or Iraq. His or her marks in this examination were as follows:

.....% in Mathematics.
.....% in Physics & Chemistry.

7. London University General Certificate of Education Examination in the following subjects:

%Mark	or Grad	e obtained	Subject _	Level	Date
	-	(Arabi	ally sat at	Advanced Ordinary	June/Nov./Jan 19
	- (Oral) French (Frenc	h was ally sat at	Advanced Ordinary	June/Nov. Jan. 19
	-		h Language	Advanced Ordinary	June/Nov.Jan.19
	-	Englis	h Literature	Advanced Ordinary	June/Nov.Jan.19
	-	Pure M	athematics	Advanced Ordinary	June/Nov.Jan.19
	-	Applie	d Mathematics	Advanced Ordinary	June/Nov. Jan. 19
	-	Physic	S	Advanced Ordinary	June/Nov.Jan.19
	-	Chemis	try	Advanced Ordinary	June/Nov.Jan.19
	-	Additio	onal Mathematic		June/Nov.Jan.19
	-	Furthe	r Mathematics	Advanced	June/Nov.Jan.19

-P.4-

Date:

Note: 1. Highest mark in both ordinary and advanced level subjects is 100. Lowest passing mark in ordinary level subjects is 45. Lowest passing mark in advanced level subjects is 40. Marks from 30 to 39 inclusive in the advanced level subjects are considered a pass at the ordinary level.

Note 2: Highest grade in both ordinary and advanced level subjects is1.

Lowest passing grade in ordinary level, as well as advanced level subjects is 6. Grades 7 & 8 in advanced level subjects are considered a pass at the ordinary level.

Note 3: Grades A, B, C, D, E and O are grades of pass in descending order of merit for ordinary level subjects. For advanced level subjects, Grades A to E are passing grades in order of merit. Grade O in advanced level subjects, is considered a pass at the ordinary level.

. The above student took the Scholastic Aptitute Test and the Achievement Tests given by the College Entrance Examination Board of Box 592, Princeton, New Jersey, U.S.A., administered by their examination centre in Baghdad in March/December/February/May 19 . His or/her marks in these Test were as follows:

Scholastic .	Aptitute Test (SAT)	Achievement Tests				
Verbal	Mathematical	English	Advanced Math.	Physics	Chemist-	
• • •	5 0 A	* * *		• • •	• • •	
800	800	800	800	800	800	

Note: Highest mark is 800, Lowest mark is 200.

The above cardidate has also passed the Iraq State Baccalaureate Examination for Secondary Education, Scientific/Commercial/Section, in June/September 19 ranking among candidates from Shamash Secondary School and among candidates from all Schools in Baghdad/Iraq.

He/She is now oligible for entry into any higher institute of University standard in Iraq or He/She is now eligible for entry into the College of Commerce or the School of Economics or the College of Literature of the University of Baghdad.

In addition to the above, Mr/Miss sat or will be sitting in January 19 or in June 19 for the London University G.C.E. Examinations in Physics, etc.

at the ordinary level and in English Literature

at the Advanced level. The results of these examinations are expected to be announced by the British Council in Baghdad, sometime in the first half of next October/April. The above candidate has high hopes of passing in all of them.

Prior to his/her joining Frank Iny Intermediate/Primary School in October 19, the above candidate/Mr/Miss did six/seven or years of Primary Schooling at/the oldestablished Alliance School in Baghdad which was united with Frank Iny Primary School in October 1951,/or/Frank Iny Primary School,/or/Menahem Daniel Primary School.

(cont'd.p.5)

Date: /

While in Frank Iny School and Shamash Secondary School, both of which are under the same administration, the above candidate distinguished himself/herself as a brilliant student of very good character,/or/was always diligent and of good character. For more than one academic year/or/ During the academic years October 19 - June 19 , the above candidate was appointed by the School as the monitor of his/her class. On more than one occasion during the different stages of his/her studies in these two schools, he/she was chosen by his/her classmates as the exemplary student of his/her class, and was accordingly awarded a prize by the school. He/She also won many/or/other school prizes in different years/ or He/She also won school prizes on different occasions for excellence in his/her academic work.

His/Her/hobbies at School were sports: mainly swimming or tennis/or/basket ball, social service and dramatics. At one time he/ she was an active member of the School's Bulletin Committee.

At present Mr/Miss is attending the Fifth/Fourth Form of Shamash Secondary School/Third Form of Frank Iny Intermediate School, and is doing extremely well/ or and is making good progress. In June 19 he/she will be sitting the Iraq State Baccalaureate Examination for Secondary Education, Scientific Section/Commercial Section. To judge by his/her Secondary School record, he/she should be able to pass this examination with distinction/satisfactorily/ or in due course, or he/she stands a good chance of passing this examination. He/She will then be eligible for entry into any higher institute of University Standard in Iraq, or and in case of passing, he/she will then be eligible for entry into/any higher institute of University standard in Iraq/ The College of Commerce or the School of Economics or the College of Literature of the University of Baghdad.

Mr./Miss is physically and mentally quite fit. I recommend him/her for/admission/higher studies to any University abroad as an excellent candidate/or without reserve/ or as a fairly good candidate.

Mr/Miss this certificate at his/her own request.

is supplied with

Should Mr/Miss be admitted to an institute of University Standard, he/she might be able to pull along successfully.

A.S. OBADIAH, for Principal.

Arrest second, so/one should be able to pass this second military and an addition and a second military of the source, or he/one should be seen to second of second of the source of the second of the

SHAMASH SECONDARY SCHOOL

Date:

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TO WHOM IT MAY CONCERN

This is to certify that Mr/Miss/sat successfully the Iraq State Baccalaureate Examination,/Scientific Section,/ Commercial Section,/ in June this year, 196, having obtained the following marks in the different subjects:

	Subject	Mark
	Arabic Language	
	English Language	
	Solid Geometry	
	Botany & Zoology	
	Algebra & Trig	
	Chemistry	•
	Physics	
	Arabic Language	
	English Language & Correspondence	
	Business Methods & Commercial Law	
	Commercial Arithmetic	
	Commercial Geography	
	Book-keeping & Accountancy	
	Economics	
	Total out of ()	
	Average mark in all subjects	
-	No.of students in class	
	Rank of student in class	

Marking System followed in the Baccalaureate Examinations for Secondary Education:

- 1. Maximum mark is: 100
- 2. Minimum passing mark in each subject is: 50.
- 3. Honour mark in each subject is 85-upward.
- 4. Average mark in all subjects, qualifying for admission to the University of Baghdad is: 67- upward.

While in Shamash Secondary School, Mr/Miss/
was always diligent and of good character/ distinguished himself/herself/
as a brilliant student of good character. His/Her punctuality in attending this school is noteworthy.

I recommend him/her for admission to any university abroad/for higher studies abroad as a fairly good/ as an excellent/ as a fair candidate.

He/She is supplied with this certificate at his/her/own request.

A.S. Obadiah, Principal.

PHYSICS

Introduction: We live in a world full of natural phenomena which always repeat themselves before us affecting either our senses of hearing or our sense of sight, or our sense of touch, etc.... Man since the very primitive ages, could not but try to find explanation to those phenomena. Living beings, animals & plants, for example afford a good source of observation and a subject for study to the biologists. Similarly phusists and chemists are engaged to present explanations to the different phenomena that take place on matter, such explanations that can be accepted by the human mind; and thereupon to make use of these inferences in our practical life, to construct machines, to make medicine, etc..... for man's good.

But Physics is that science which is to give scientific answers to such questions as the following:-

Why does a falling body move wiht an increasing speed ?

Why does an aeroplane fly ?

Why does a stick seem broken when part of it is immersed in water ?

Why does a boat float while a stone sinks ?

How does an electric bell ring ?

How does a wireless-set (Radio) operate ? etc.....

The answers to these questions and the like come under the science of Physics; or in other words, Physics deals with the behaviour of matter when it is under the effect of external force.

Importance of Physics: The study of Physics is the story of man's slow release from the ignorance, fear and superstition that surrounded and engulfed him in former times; and his gradual development of the conviction that he himself can understand and in which he can, to some extent, control the world and his destiny.

The study of Physics is indeed of enormous practical importance for the daily life of every man. It, at the same time, goes far beyond this. It has taught man not to fear his surroundings but by understanding them to control them. It has taught him that by scientifically examining his superstition he can banish his fears. And what does this scientific method involve? It involves refusing to conduct our lives according to prejudice, emotion, whim, or superstition. It involves that we do not give judgement until we know all the facts. There is no study that gives a better training in the use of the scientific method that the study of the elements of Physics.

Properties of Matter: - Matter is anything that occupies space and has weight; and generally has the following properties:-

- (a) It occupies space.
- (b) It cannot be destroyed.
- (c) It can be divided to a limited extent. For instance, if you take a piece of brick, and start crushing it, you will be able to make it into small particles like powder. If you go on crushing these small particles, you will reach a stage when you will no longer be able to crush the particles any further.
- (d) It can be found in different forms, or states, such as solids, liquids & gases, Examples: iron, water, & oxygen respectively.
- (e) Matter usually affects one or more of our senses. Examples :-The table affects our sight. Chlorine affects our sense of smell. The wind affects our sense of touch.

Three states of matter :- We stated above that matter can be found in different states, and these are as follows :-

Solids: These have definite size and shapes, e.g.: The black board.

Liquids: These have definite volumes but have variable shapes, they will have the same shape as the shape of the vessel in which they are contained. e.g.: water.

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Gases: These have variable volumes and shapes. e.g. Air. They will always have the same volume and shape of the space they fill.

A matter can be changed from one state to another. For instance, if we heat a piece of ice (solid), it will change into water (liquid). And if we heat the water thus formed it will start to boil and change in to vapour (gas).

We give the following names to the fifferent changes that take place on the state of the matter.

- 1. Melting: When a body changes from the solid state to the liquid state.
- 2. Freezing: When a body changes from the solid state to the liquid state to the solid state. It is just the opposite of Melting.
- 3. Vaporization: When a body changes from the liquid state to the gaseous state.

4. Condensation: When a body changes from the gaseous state to the liquid state.
It is just the oprosite of vaporization.

If you consider a piece of ice heated on a fire, you will have the following changes in order: Melting and Vaporization, but if you consider some vapour cooled down, you will have the following changes in order: Condensation and Freezing.

MEASUREMENT

In our daily-life we always come across such problems; what is the length of a room? What is the weight of a certain body? How long did some one live? In order to overcome these difficulties we must find certain means to give clear answers to the above questions. This means is the adoptation of Measurement.

Measurement is therefore the finding of units for length, mass and time.

There are two systems for Measurement.

- 1. The British System: Which is adopted mainly in England and in the Dominions.
- Units of Length: The British Unit of length is the foot (ft).

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 The British Unit of length is the foot (ft).
- b. Unit of Mass :-

The British unit of mass is called the pound (1b).
2240 lbs = 1 ton.

c. Units of Time:-

The Unit of Time in the British System is the second.

60 seconds = 1 minute

60 minutes = 1 hour.

2. The Metric System:-

This system is used in France and other parts of Europe. It is more widely used than the British system.

equal to 1 of the circumference of the Globe at the Equator.

Continued. p. 3.

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The Unit of Time in the British System is the second.

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Continued, n. 3.

of a metre = 1 decimetre (dom)

1 of a metre = 1 centimetre (on)

1 of a metre = 1 millimetr (mm)

10 metres = 1 decametre
100 " = 1 hectometre

1000 " = 1 kilometre

b. Units of Walght :-

The unit of weight is called the Gram (gm) which is the weight of 1 cubic cm of distilled wated at 4°C. (Centigrade)

1000 gm = 1 kilogram (kg)

1 gm = 1 milligram (mgm)

. Units of time : (The same as in the British System)

Some useful relations between the British & Metric System:

1 inch = 2.54 cm .

1 1b = 0.45 kg.

1gallon= 4½ litres.

5miles = 8 kilometres

DENSITY & SPECIFIC GRAVITY

wood is bigger than that of iron. In like manner if we take equal volume of wood & iron, we can find that the iron weighs much more than the wood. The reason for this difference in volume is because the cubic cm. of iron weighs more than the cubic cm. of wood, and in Physics, iron is called DENSER than wood.

We therefore have the word DENSITY which is the property of a matter which tells us how much a unit of volume actually weighs or is mass per unit vol.

In Metri. System the DENSITY is the weight of a cubic om. in grams; while in British System it is the weight of a cubic feet in lbs.

If we take a body of aluminium having a volume of 100 c.c. which will be found to weigh 270.0 gm., we find that every cubic cm. weighs $\frac{270}{100} = 2.7$ gm./c.c. which is the density of aluminium in Metric System.

We can thus say that :-

Density - Mass Volume

And if we give the symbols :-

D for Density. V for Volume. M for Mass.

We can write the following formula :- $D = \frac{M}{V}$ (for both Systems) Finding Densities :-

a. of Solids :-

In order of ind the forst, of any colid, we have to weigh it first, then we must firnd its volume, which can be measured easily if it is a regular solid such as a cube, a prism, a sphere, etc.....

The volumes of such a regular soild is easily calculated if we measure its dimensions. But how can we obtain the volume of an irregular solid? We all realize that as a solid is lowered into water the level of the latter rises.

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If the water is in a measuring cylinder, i.e., a glass vessel graduated to indicate volume in c.c. or in cub.in., and a body is lowered into it until totally immersed, the change in reading of the water level will indicate the volume of the solid. If the solid dissolved in, or reacts with water another suitable liquid must be used.

b. of Liquids: - To find the density of a liquid take a vessel of given volume (called specific gravity bottle). Weigh it empty; then fill it with the liquid and weigh it again.

The difference in weight gives the weight of the liquid. Divide this weight by the volume of the vesse, you get the dendity.

c. Of Gases:-

resise (S. I. bidges)

Take a glass sphere provided with a tap. Fill it with the gas and weigh Then evacuate it by an air pump and weigh again. The difference in the weight gives the weight of the gas. Divide this weight by the volume of the vessel which you can determine by weighing the amount of distilled water which fills the sphere.

To compare the Densities of some well-known matters, we have :-

Water Aluminium 11.3 gm/c.c. 706.25 lb/cu.ft. 1 gm/ c.c. 1 gm/ c.c. 2.7 gm/c.c. 62.1 lb/cu. ft. 168.75 lb/cu.ft.

We notice from above that aluminium is 2.7 times denser than water and this is true in both systems, In physics we call the number 2.7. which is the ratio of the densities of aluminium and water as the SINCIFIC GRAVITY of aluminium.

.: SPECIFIC GRAVITY of a matter (x) = _ Density_of Matter (x)s Density of Water

or: Density of Matter (x) = Its Specific Gravity x Density of water or more generally we have:

Specific Gravity = Mass of a certain volume of a substance Mass of the same volume of water

Or in words: It is the ratio of the mass of any volume of a substance to the mass of an equal volume of water.

The Specific Gravity is abreviated as S.G.

In order to find the Specific Gravity of a substance we must have a volume of the substance and an equal volume of water we divide the weight of the substance by the weight of water to get the S.G. of the substance.

Of all solids platinum has the highest G.G. while cork the least. Of all liquids mercury has the highest S.G. while ether the least. Of all gases chlorine has the highest S.G. while hydrogen the least.

"orked Examples.

1) A rectangular block of wood measures 100 cm. x 40 cm. x 15 cm. If it weighs 48 kg. Find its density and its specific gravity. The volume of the block = 100x40x15 = 60000c.c. The weight of the block = $48 \times 1000 = 48000 \text{ gms}$. Since D= N $\frac{1}{2}$ D = 48000 = 0.8 gm./.c.c.

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(x) gentle on the matter (x) = Density of Matter (x);

or Beneity of Hatter (x) = Its Specific Orayity x Depaits of water or

The Specific Gravity is abreviated as S.G.

In order to find the Specific Grantin of a substance we must have a volume of water we divide the weight of the substance be the weight of the substance between the substance between the substance of the substance

Of all solide platfmum has the bighest 0.0. while cork the lenst. Of all liquids percury has the bighest 8.6. while other the lenst. Of all gases chloring has the highest 8.6. while hydrogen the least

Solution :-

Wt. of water = 70.22 - 20.12 = 50.10 gm.

Wt. of liquid = 95.27 - 20.12

= 75.15 gp. But since y lume of liquid - volume of water.

:. S.G. of liquid = 75.15

Examples I

- 1. A lottle filled with water weighed 100g. The bottle empty weighed 20g. Find the capacity of the bottle in cubic centimetres ?
- 2. A flask holds 2520 g. of glycerin when filled. What is the capacity of the flask?
- 3. A 10-c.o. graduated cylinder weighs 19.43 gm. empty and 155.89 gm. when full of mercury. What is the density of mercury ?
- 4. A rectangular block of wood measures 150cm x40cm.x14cm. If it weighs 67.2 kilograms, what is its density ?
- 5. Find the weight of a column of mercury of height 30 inches & cross section 1 sq. inch (SoG. of mercury = 13.6)
- 6. A bottle weighs Kgm, Full of water it weighs Ygm. Full of milk it weighs Zgm. What is the desaity of milk?
- 7. Find the S.G. of salt solution from the following data :-Wt. of bottle - 20.12 gm. Bottle + water, 70.82 gm. Bottle + solution, 71,72gm.
- 8. A vessel filled with an overflow pipe is full of water. A piece of rock of weight 1001b & specific gravity 2.5 falls int it. What weight of water overflows and what volume does it occupy? (Density of water 62.5 lbs, per cu. ft.).
- 9. Find the density of a mixture containing 40c.c. of water and 60c.c. of oil of
- 10. A piece of steel wire of lengths 24in, and cross-section 0.2 sq.in. weighs 1.12lb. What is its specific gravity ?
- 11. A bottle weighs 40gm, when empty and 120gm, when filled with water & 130 gm. when filled with equal volumes of water and will Find the density of the oil ?
- 12. A bottle weighs 15gm, when empty and 151gm, when filled with mercury and 33gm. when filled with salt solution. Find the density of the solution ?
- 13. Explain how the specific gravity of a liquid can be found by using a specific gravity bottle. A specific gravity bottle weighs 40gm. when empty and 240gm. when filled with water. When 260 gm. of sand is placed in the bottle, which is then filled up with water, the total weighs of the buttle and contents is 400gm. What is the specific gravity of sand ?
- 14. A specific gravity bottle weight 20gm. when empty and 70gm. when filled with water Sand, weighing 20gm. is put into the empty bottle, which is then filled up with water, the total weight being 82gm. Calculate the specific gravity of the sand?
- 15. A closed glass flask weighs 72.59gm, and it weighs 72.01gm. when partially evacuated. It is then opened under water and 450c.c. of water enter the flask. Calculate the density of air under these conditions ?

PRESSURE IN LIQUIDS LIQUID PRESSURE BENEATH A FREE SURFACE.

Definition of Force :- In order to lift a kil gram of mass we must use an upward push or pull. The greater the mass, the greater is the force which we must use. Also if a body is moving we can bring it to stop if we use a push in a direction opposite to the direction of movement of the body. This push or pull is called FORCE.

Force is therefore defined as: Anything is capable to move a body from rest or to bring it to stop if it is moving.

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     4. A rectangular block of word we sured 150.0 s40:m. x14cm. If it weight 67.2 kilo-
    . Find ten weight of a column of months of inches & cross saction of me.
       6. A boile weight Not of actor it weight Igm. Pall of wilk is weight Zgm.
                            7. Find the S G of well released on 1 or the foll wing data :-
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        to the column does it coordy? (Density of water 60 5 lbs. per ou. ft.).
 10. A piece of even wire of leng 24 n. and or sa-section 0.2 sg.in. wetche 1.121h.
   11. A F the weighe dogs when ampty and trops when filled with water & 130 gm. when
           file and to equal with burd I find to a complete of the old to
     12. A with worder them when empty and thism when filled with moroury and light.
   grawing b blic. A special gravity bittle weighs 40gm. when empty and 240gm; when
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    water, the total water being 82gm, Calculate the appointe gravity of the sond?
   quated. It is temm openud under water and 4500.0. of water enter the flash, Cal
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Unit of Force: Intthe british System the unit of force is the pound which is the force required to lift, or maintain a mass of 1 lb. In the Metric System it is the gram which is the force required to lift or, maintain a mass of 1gm.

Force beneath the Surface of Liquid:-

When a liquid is contained in a vessel, it exerts a force on the base of the vessel. This force is due to the mass of the liquid. The force per unit of area is called Pressure.

If we imagine that a vessel contains water to a height of 1cm. then oncan area of 1sq.cm. of the base, there is a weight of 1gm., or a pressure of 1gm. per sq. cm. If the vessel contains water to a height of 2 cms., then every square centimetre carries 2 cubic centimetres of water or two grams. The pressure will thus be 2 gms/sq. cm. Now if water is substituted by another liquid of higher density such as Mercury, then the force exerted on the base will be more.

From above, we can conclude the following rules :-

- 1. The pressure is directly proportional with the height of the liquid.
- 2. The pressure is directly proportional with the density of the liquid.

 Therefore if :-

P stands for pressure,

D stands for density of liquid,

H stands for height of column of liquid.

Then, we have P=HxD.

If the area of the base of a vessel is equal to (A) then the total force (F) exerted on it is equal to the product of the area times the pressure per unit area.

: F = PA.

WOORKED EXAMPLES:-

- Q./ A liquid of S.G. 1.7 is contained in a vessel having a base 20 x 30 cms.

 If the vessel is filled to a height of 15 cms. Find the pressure & total force on the base of the vessel?
- A./ Since the units are in the Metric System,

 $D = S_{\circ}G_{\circ} \times 1 = 1.7 \text{ gm/c}_{\circ}C_{\circ}$

P = Hxx D = 15 x 1.7 = 25.5 gm/sq.cm.

Area of base = $20 \times 30 = 600 \text{ sq. cm.}$

 $F = P \times A = 25.5 \times 600 = 15.300 \text{ gm}_{\odot}$

(cont'd.P.7)

Unit of Force: latthe british System the unit of force is the pound which is the force required to lift, or uninted a mass of 1 lb. In the Metric System it is the gran which is the force required to lift or, unintein a mass of ign.

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WORKED SEAMELES:

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force on the bane of the vesuel ?

A. Since the units are in the Metric System,

D 0 403 7-1 = 1 x .0.8 a 0

P = Fex D = 15 x 1,7 = 25 5 gn/aq-en

res of base = 20 x 30 = '00 sq. on

F = P x A = 25.5 x 600 = 15 500 gm.

(cont'der. T.)

Level of Liquids in Connecting Vessels: It is a familiar fact that when water is poured into a tea-pot it stands at exactly the same level in the spout as in the body of the tea-pot; or if it is poured into a number of connected vessels like these shown in the diagram, the surfaces of the liquid in the various vessels lie in the same horizontal plane.

EXAMPLE II

- 1. Find the force on a horizontal surface 2ft, by 4ft. submerged in water, (a) to depth of 2ft.; (b) to a depth of 4ft.?
- 2. Find the pressures on the surfaces of the preseeding problem ?
- 3. Find the force on a horizontal surface 10 cm. sq. submerged in water to depth of (a) 10 cm.; (b) 100 cm.; (c) 100 m.?
- 4. Find the pressure on the surfaces of the preceeding problem .
- 5. A standpipe 100ft. high is filled with water. Determine the pressure at the bottom in pounds per square feet and in pounds per square inch?
- 6. A hole 5 cm. sq. is made in a ship's bottom 7m. below the water line. What force in kilograms is required to hold a board above the hole?
- 7. How high is a column of water that is supported by a pressure of 5 kg/cm2?
- 8. The area of the bottom of a tank is 100 sq. ft. The tank is filled with 126,000 lbs. of oil (S.G. = 0.8). Find the pressure in pounds per square inch on the bottom of the tank?
- 9. What is the difference in pressure in the water pipes on two floors of a building, if one is 12 m. higher than the other?
- 10. If the point of a lead pencil has an area of $\frac{1}{500}$ in², and you push it against a piece of paper with a force of 2 lbs. How great is the pressure?
- 11. The total weight of oil in an oil container is 28 Kg., and the area of the bettem of the container is 70 cm². If the S.G. of oil = 0.4 gm/c.c., what must be the depth of the oil?
- 12. If the water pressure in the city mains is 70 lb/in²., how high above the town is the top of the water in the standpipe?

Pascal's Principle

Transmission of Pressure by Liquid :-

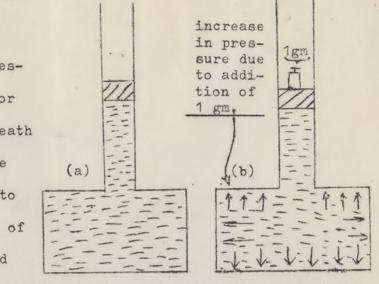
Let us imagine a vessel of the shape shown in figure (a) filled with water up to the level (ab). If we assume the upper portion to be 1sq.cm. in cross section.

nevel of Liquids in Connecting Vessels: It is a faciliar fact that when water at as twogs edt at level essa edt vitosse to abanda il toq-set a cial berrog at the body of the ten-pot; or if it is poured into a number of connected vessels the these shown is the disgree, the surfaces of the liquid in the various vassantiq inducation same out at ohi after

- (a) retew at begreedue . 12h to sit op fit. submerged in water. (a)
- Z. Find the presentes on the surfaces of the presending problem ? 3. Find the force on a horizontel surface 10 or squerged in water to
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- a piece of paper with a force of 2 lbs. Now great is the pressure ? it. The tetal weight of oil in an oil container is 28 Mg., and the area of the
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- 12. .If the water presence in the city mains is 70 lb/in . how high above the town is the top of the water in the standpipe ?

Tatuw Atiw Ballit (a) army to at moons squar and to Isasay a animat am tel up to the level (ab). If we asen e the upper portion to be 'legion, in cross cont'd.P.8).......

Then because the density of water is 1gm/c.c., the force with which it presses against any sq.cm. of the interior surface which is (h) centimetres beneath the level (ab) is (h)grams. Now if we add 1gm. of water (that is, 1 c.c.) to the tube, the pressure on any sq.cm. of the interior vessel will be increased



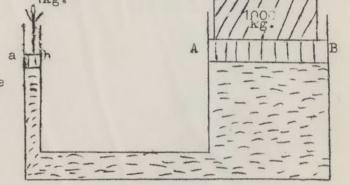
by(0). If we now put a weight of 1gm. on the surface of water through a piston as in figure (b) the same result happens. It is to be noted that this increase of pressure of 1gm. per sq.cm. is not applicable only on the base, but on all the sides of the vessel as well, and the pressure on every square centimetre will be increased by 1gm.

We therefore arrive at Pascal's Principle which states :-

- The pressure applied anywhere to a body of confined liquid is transmitted in the same magnitude to every portion of the surface of the containing vessel,

Application of Pascal's Principle :-

Consider a vessel of the shape shown in the figure. If the area of the cross section of the cylinder (ab) is 1sq.cm. and that of the cylinder (AB) is 1000 sq.cm. a force of 1Kg. applied



to (ab) would be transmitted by the liquid so as to act with a force of 1Kg. on each square centimetre of the surface (AB). Hence the total upward force exerted against the piston (AB) by the 1Kg. applied at (ab) would be 1000Kgs.

HYDRAULIC PRESS

An important application of Pascal's Principle is the Hydraulic Press as in(fig) which is a useful mechanical contrivance in which the pressure of water acting on a small arm A is transmitted equally to a large plunger B (Pascal's Principle) and since the area of the plunger is much larger than the arm, an enormous force can be exerted by the plunger for the purpose of pressing bales of cotton or binding broks, etc.....

Then because the density of water is

'grafe.o., the force with which it presses equinst any sq.os. of the interior

surface which is (n) dentinetres beneath
the level (ab) is (h)grams. Now if we
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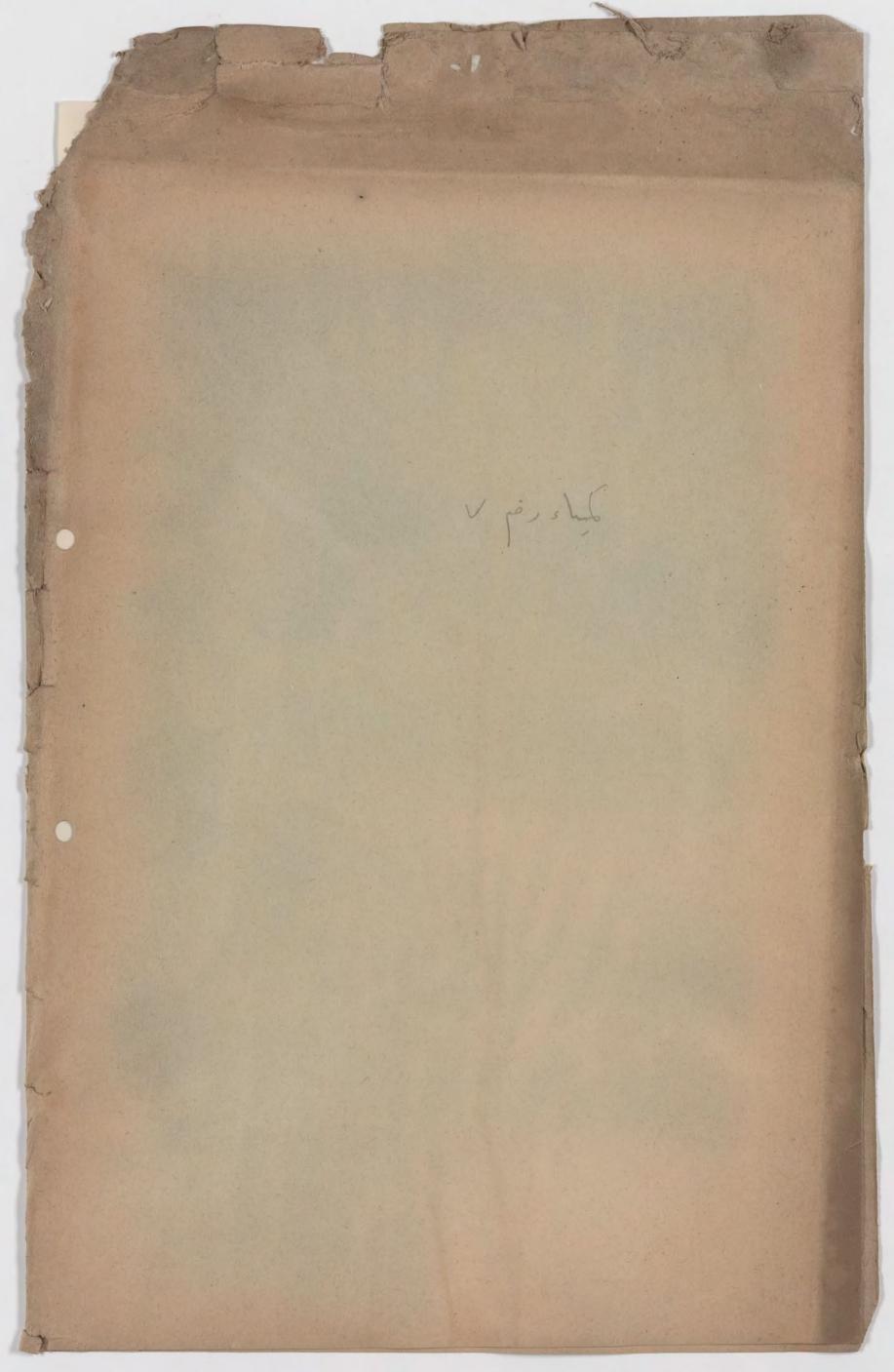
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Consider a vessel of the shape shown in the figure. If the gree of the cross section of the cylinder (ab) is 'sq.cm. and that of the cylinder (AB) is its food of the cylinder (AB)

to (ob) would be transmitted by the liquid so as to dot with a force of 15g. on each square centimetre of the guriage (AB). Hence the total upward force exerted against the picton (AB) by the TER, applied at (aB) would be 10000000.

SULEVILLE DETERMENT

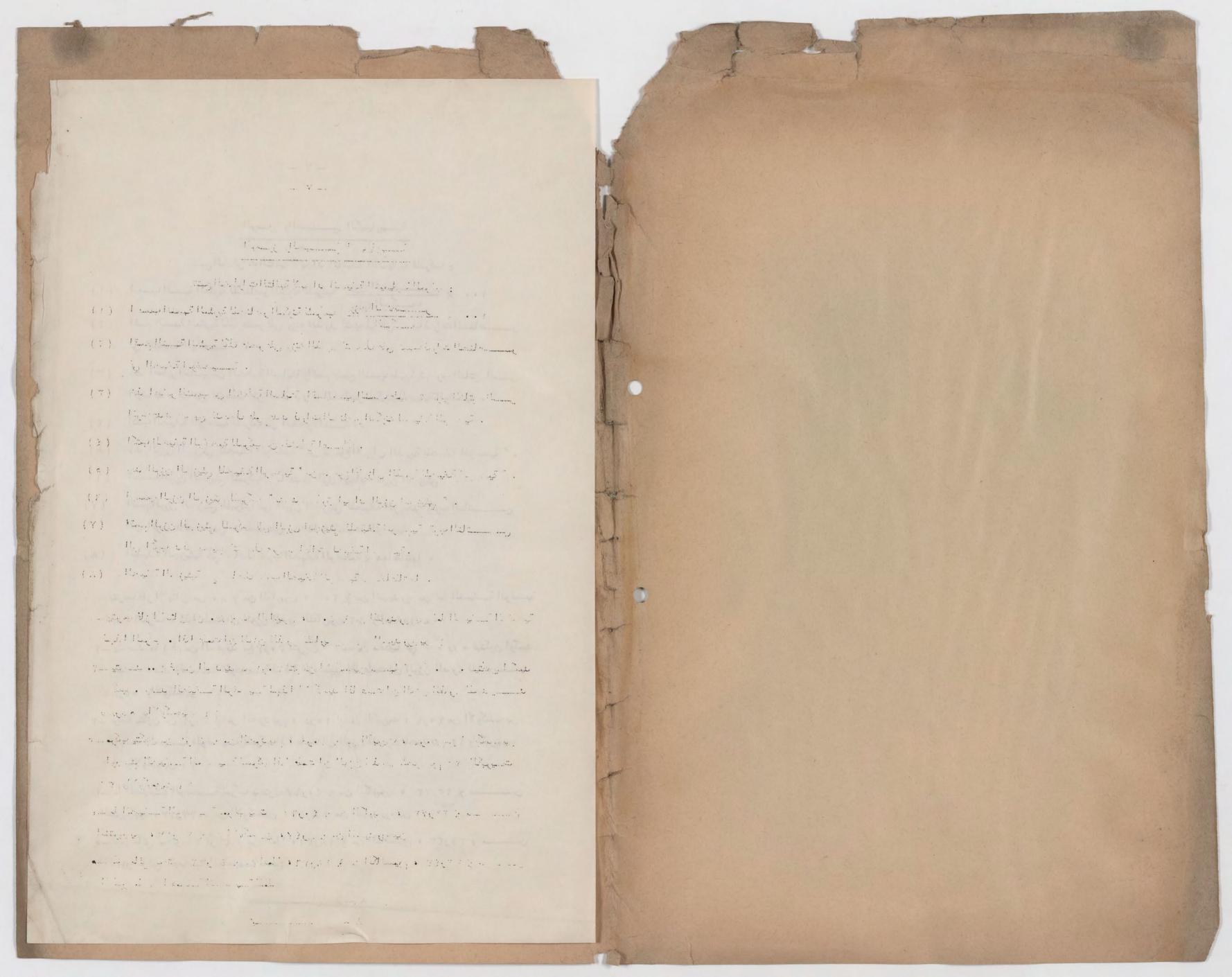
An important application of Fascella intending to the Hydraulic Press on in Which is a useful such and contrivence in which the pressure if enter enting on a smell arm A is transmitted equally
to a large plunger B (Fascel's Frinciple)
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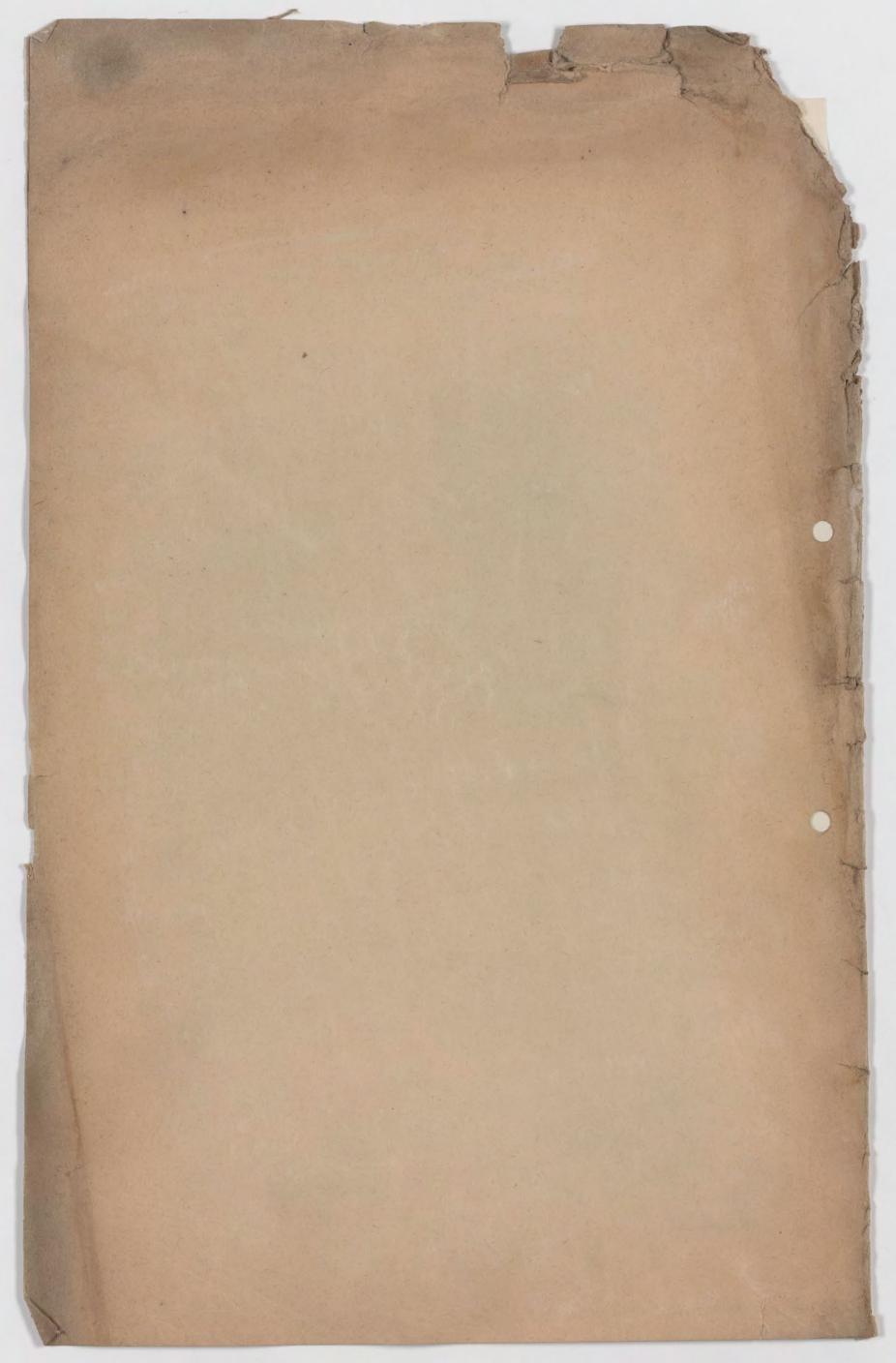


الرمسوز والصيمين الكيميا ويسة

تتبع الخطوات التالية لا يجاد الصيفة الكيمياوية للمركب:

- (۱) احسب النسبة المئوية للمناصر المكونة للمركب وزن المنصب × ۱۰۰ × وزن المركب
- (٢) اقسم النسبة المئوية لكل عنصر على وزنه الذرى فتعصل على نسب ذرات المناصير في الصيفة الوضمية.
- (٣) خذ اصفر النسب من الخطوة السابقة واقسم جميع النسب عليها ثم قرب النات السب المدن اقرب عدد صميح فنعصل على عدد ذرات المناصر المكونه للصيفة الوضعية .
 - (٤) اكتب الصيفة الوضعية للمركب من الخطوة اع_لاه.
- (٥) جد الوزن الجزيئي للصيفة الوضعية "من مجموع الاوزان الذرية للصيفة الوضعية " .
 - (٦) احسب الوزن الجزيئي للمركب "باحدى طرق ايجاد الوزن الجزيئي " .
- - (/) الصيضة الجزيئية مي عاصل ضرب الصيغة الوضمية x مضاعفاتها .
- ز_ يتركب غاز الايثان من ٨٠ ٪ من الكاربون ، ٢٠ ٪ من المهيد روجين فعا الصيفة الوضعية للهذا المركب ، اذا علمت ان الوزن الذرك للكاربون ١٢ والمهيد روجين ١
- ٢- يتعدد ١٠٠ غم من الحديد مع ١٠٠ تر من الاوكسيين معسوبا في ظ ٠ ق ٠ فيتكون اوكسيد صلب ٠ جدد الصيخة الوضعية لهذا الاوكسيد انا علمت ان الوزن الذري للحديد ٥ ٨ ٥ ٥ والاوكسيين ١٦
- ٣- مركب يتكون من ١٦٦٦ ٪ من الصوديوم ، ٥٠٠٤ ٪ من الكبريت ، ١٠٠٣ من الأوكسجين اوجهد الصيفة الوضعية للمركب اذا علمت ان الوزن الذرب للصوديوم ٣٣ والكبريت ٣٣ والأوكسجين ١٦ والأوكسجين ٢٦ والأوكسجين ٣٠
- ٤ ما الصيفة الوضمية لمركب يحتوى ٢٢ر٠٤ ٪ من الكاربون ، ٢٣ر٢٣ ٪ مصنف النتروجين ، ١٣ر٢٧ ٪ من الاوكسجين ، ٢٤ر٨ ٪ من المهيد روجين
- هـ ملح مائي يحتوى ٣٢ر٥٤ ٪ من الما ، ١٨٦٦ ٪ من الكالسيوم ، ٣٤٦٣ ٪ مسن الدلور ما عني الصفية الوضعية للملح





الحسابات الكيمياوي

- (١) ما وزن كا ربونات الكالمسيوم التي عند تسخينها التام تمعلي ٢١ غم من الكلسر المي له
- (٢) اذيب عشرة غرامات من اوكسيد الكالسيوم في الما ، ماوزن كاربونات الكالسيوم الناتجة مسن امرار كفاية من ثاني اوكسيد الكاربون عليه .
 - (٣) ما عجم النتروجين الجاف في ١٢ م وضفط ٢٧٠ ملم / زئبق النات من تسخين ٣٠٢ من نترات الامونيوم ،
- (٤) اوكسيد الرصاص الاحمر Pt304 عند اتعاده من عامل النتريك لاعطا عنرات الرصار وثاني اوكسيد الرصاص Pb02 ماوزن فون اوكسيد الرصاص الناتي من تفاعل Pb0 عمر ماوزن فون اوكسيد الرصاص الاعمر م
 - (ه) اذيب وزن معين من الفضة في عامر النتريث ثم رسبت الفدة على هيئة كلوريد الفضة باضافة ملئ الطعام ، فاذا كان ٢٣٤ م من كلوريد الفضة قد ترسب في مقدار وزن الفضة فسي النموذج ،
- (٦) ما وزن كلوريد المترسب من الحافة لتر واعد من معلوب ١٠٪ من ملح الطعام الى معلوب نترات الفقية .
 - (Y) عومل ، ه سم من عاصر الكبريتيك مع معلول كلوريد الباريوم الساخن عتى تمام الترسيبوبعد غسل الراسب وتجفيفه وجد انه يزن ه ١٦٥ غم ، احسب تركيز العاصر في هذا المعلول .
- (A) اذيب ٢ غم ملح كلوبر 10H2O ، Na2SO4 ، 10H2O في الما ثم رسب با ضافة كمية وافية من كلوريد الباريوم المترسبة .
 - (١) احسب وزن اوكسيد الزئب الاحمر الذي يعطي من الاوكسيدن ما تعطيه ه غرامات من كلورات البوتاسيوم .
- (١٠) ما مقد ار وزن غاز الكلور بالضرامات التي يمكن المصول عليها من تسخين . ه غم من ثاني اوكسيد المنفنيز مح كفاية من عامر الهيد روكلوريك .
- (11) ما عجم ثاني اوكسيد الكاربون في ٢٧ م و ٥٠٠ ملم / زئبن الذر يمكن المصول عليه من تفاعل الغم من كاربونات الكالسيوم من عامر المهيد روكلوريا المخفف .
 - (١٢) اغم من مخلوط كاربونات الكالسيوم واكسيد الكالسيوم عند معاملته مع عامر اعطى ١٩٠ سم من ثاني اوكسيد الكاربون في ١٥، ٥ و ٧٤٠ ملم / زئبق ١٤ عسب النسبة المئوية للكاربونات في المغلوط .
 - (١٣) نموذ من كاربونات الصوديوم اللامائية الجارية يزن ٥٥، غم اعطى ١٠٢ سمٌّ من ثاني اوكسيد الكاربون فيظ ٥ ق عند معاملته مع الحاصر ، احسب وزن الشوائب في هذا النموذ ي .
 - (١٤) نموذ عير نقيمن ثاني اوكسيد المنفنيزيزن ه غم يحرر ١٠٠ سم فيظ . ق عند اكسدة كمية كافية من كلوريد المهيد روجين ، احسب النسبة المئوية للاوكسيد النقي في النموذ .
 - (١٥) ما مقدار وزن ثاني اوكسيد الكاربون الذى عند امراره في علوب هيد روكسيد الكالسيوم الناتج من اخلفة ه ١٤ ٤ غم من اوكسيد الكالسيوم الى الما ً لت ويله الى كاربونات الكالسيوم وعند اضافة عن كريد المهيد روسين الى المعلول ، مامقد ارغاز ثاني اوكسيد الكاربون الناتي عن التفاعل ومن اى المادتين يتخلف باق وما مقد اره .

- (١١) ما وزن كا رويات الكالسيوم التي عند تسمينها التام تحال ١٦ فم من الكاس الي .
- ا الذيب عشرة غرامات من اوكسيد الكالسيوم في الما" . ماوزن كاربونات الكالسيوم الناتية مسن امرار كناية من ثاني اوكسيد الكاربون عليه .
- (ابر) ما من المتدورين الماف في ١١ أو قدا ١٧٠ مام / زهد الناص من صدين ١٨٧ من نشرات الامونيور .
- (ع) الأسيد الرما بالا سر والأطع عند الاعادة من مامر النشوب لاعداء تشراح الرما وثاني الوسيد الرما بالناش من خفا عد ١٩١٧ غم من الاوكسيد الرما بالناش من خفا عد ١٩١٧ غم من الاوكسيد الاحمر .
- (ه) الناس وزن مدين من الله و في عامر النترية عم رسيت الله و على عيدة كلوريد الله و با الله على الله على الله على الله و با الله و في على الله و في الله و في على الله و في على الله و في الله و في
- (1) ماون الوريد المتوسب من الفقائد والد من معلوب ، الا من على الناحل الد معلوب نقوات الفاحة .
- (لا) عيما ، و مرحن الد الكيرية عي مالود المورية الباريوم الما ت على عام القرسيبي مد في من المالول .
- (١) النصب و غرب على على م 100 م 100 م 100 من الما " من سب با دافة كسة وافية عن كلوبيد الما يوم المسب وزي تمريطات الما يوم المترسبة .
- () ا حسب رزن اوکسید الزعبالا سرالذ ، بمان من الاوکسیدن ما حدایه د فراما عدی کورات البوتاسیون .
- (١٠) ما عقد ار وزن غاز الكلور بالنواعات التي يمكن المحول عليها من عسفين ، و غم من كاعي الأسيد المنتقبين من كانها قا من مامي المهمد يوكلورين .
- (١١) ما يم كان الأسيد الكارون في ٢٦ أو ٠٥٠ علم / زئين الذر يمكن المصواطية من تفاعل
- (١١) اغرب مناوا كارونا عالكالسيور واكسيد الكالسيور عند معاطف من مامر اعال و المرا من غاني الكسيد الكارون في 10 أو ١٤٠٠ مار / زئين دا سب النسبة المؤونة للكارونات في المنابط .
- (١١) نول من المونات العوديور اللاطفية الم الية يون ٢٥٠ فراصل ٢٠١ سرامن كاني الوسيد الدارون فيا . د عند معاطئه من الماس ما مسرون الشواهيف عدا النبول .
- (١١) نسوف غير نقيب كاني اوكسيد المنفشر بين و غير بدر ١٠٠٠ سيم في ا ، ن عند اكسدة .
 الاست النبية من الوريد السيد رو من ، اسب النسبة المشوية للاوكسيد الدقي في النسوف .
- (د) ما علمار وزن ثانها وكسيد الكارون الذي عند امراره في الوب مهد روكسيد الكالسيوم النافي من الله عن ع إ فرمن اوكسيد الكالسيوم الن الما " لد ويله الن كان تا تالكالسيوم وعند الماقة عن ع م ع من كانوريد السيد، وجين الن المحلول ما مشدار غاو ثانها وكسيد الكانون الناقي من التناهل ومن الماللاتين يشدا بال وما مشدار .

- (۱۹) تفاعلت ۱۰۰ غم من محلول عامض المهيد روكلوريك مع كمية كافية من كاربونات الصود يوم فاعطت ۲۳٫۷ لتر من ثاني اوكسيد الكاربون تعت ظ.ق. فاذا علمت ان كثافية المعلول الحامضي تساوى ۱۱٫۲غم/سم۳ من فاعسب عيارية الحامض والنسبة المعويية لغاز كلوريد المهيد روجين في المحلول .
- (٢٠) وجد بالتجربة ان ٢٥ سم٣ من مخلوط عامضي الكبريتيك والهيد روكلوريك المخففين تعادل ٨ر٢٢ سم٣ من معلول هيد روكسيد الصود يوم المشر عيارى والنسببة بين وزني الحامضين في مخلوطهما هي ٢:٣ على الترتيب. احسب وزن كل من الحامضين في لتر من محلولهما.
- اذيب في الما واكمل المعلول الى ٥٠ مس ما من عامض ثنائي القاعدة يعتوى على جزيئتين من ما التبليو اذيب في الما واكمل المعلول الى ٥٠ مس ١٦٠ من هذا المعلول اعتاجيت لمعادلتها ٢٦ سم٣ من عيارت كاربونات الصوديوم ، احسب : __

١- الوزن المكافي وليلورة العامض .
 ٢- الوزن الجزيئي للعامس اللامائي .

1_ النسبة المئوية لوزن كاربونات الصود يوم في النموذج . ٢_ عدد جزيئات ما التبلور في كاربونات الصود يـــوم .

التجاريـــة "Na2Co3.10 H2O" احتاجت لمعادلتها الى ١٣٥٥ ســة التجاريـــة النسبة المئوية للنقاوة في المــادة .

(٢٤) عند تخفيف عامل النتريك ٢٠ مرة وجد ان ٢٥ سم٣ من المعلول المغفف للحامل تحتاج لمعادلتها ٣٠ سم٣ من عشر عيارى هيد روكسيد الصوديوم، احسب تركيز عامل النتريك الاصلي بالفرامات في اللهرية.

اذيبت بلورات من صودا الفسيل "كاربونات الصوديوم المائية " في الماء وكـــان المحلول يحتوى على ٢٠٠٣ غم في كل ٢٠٠٠ سم ٣ شم وجد ان ٢٠ سم ٣ من هذا المعلول تتعادل مع ٨١١٨ سم ٣ من معلول عشر عيارى لعامض الكبريتيك ، اعسب النسبة المئويــة لماء التبلور في بلورات صودا الفســـيل ؟

علل ما يلــــي :

1- يوضع صوف الزجاح او الرمل الجاف او الزئبق في قصر الاسطوانة الداخلية في تجربة فكتور مايـــر .

٢_ لا يمكن تسييل غاز ثاني اوكسيد الكاربون في درجة اعلى من + ٣١ م ٥٠

٣_ ملح الطعام ملح لا مائي ورغم ذلك فان الملح المستعمل في البيوت يصبيح رطبا في الشتاء.

٤_ ترتفع درجة غليان السائل وتنخفض درجة انجماده عند اذابة مادة غييير متطايرة فيه.

هـ لا تستعمل الأوزان المطلقة لحساب الأوزان الذريـة.

٦ ـ لا تستعمل طريقة مراوات لا يجاد الوزن الجزيئي لملح الطعام.

٧_ الا وزان الذرية هي مجموع اوزان البروتونات والنيوترونات ورغم ذلك فنجد ان الاوزان الذرية كسيرية.

٨ لا يمكن تعيين مكافي والمغنيسيوم بطريقة حرقه في الهوا و بقصد تحويله السي

٩_ تحضر الحوامض ذات درجة الغليان الواطئه من الملاحما مع عامس ذو درجهة غليان عالية ورغم ذلك لا يعضر عامس الكاربونيك بهذه الطريقة.

. ١- لا تعتبر الكحولات من القواعد بالرغم من احتوائها على مجموعة أو اكتـر من مجاميع المهيد روكسيل .

1 1_ تستعمل كاربونات الصوديوم الحامضية لازالة الحموضة الزائدة في المعدة.

١٢ ـ يفير محلول كبريتات النحاس الزرقا ورقة عباد الشمس الزرقا الي حمرا .

١٢_ بلورات كبريتات النحاس المتزهرة عديمة اللون والمتميعة زرقــــا .

١٤_ يعتبر هيد روكسيد النحاس قاعدة ولكنه لا يعتبر قلويا .

· 人民間, 中华、《李安·安尼·安尔·哈·安尔·哈·安尔·哈·安尔·哈·安尔·哈· العبد في الأجام و الإدام التي الكني الكانون فيد الذي الادام الدواج الاداء التعلق المالاي المالاي المالية The transfer will be the state of the state of the same THE WILLIAM WILLIAM STREET, ST المناسات من المناسات Little of the party of the part of the state of th المادية المادي المادية السالاسة الإخرية لون كوريا كالصوريم في الشودى the first of the second of the second of the second The state of the s والمنافية وعلى المالياتيا ، يرسي يوجو جاري ميريكيد النواني الملية والد Janilein Kale Jimi Jose Illeria Residence of the second the transfer was topol this

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ه ۱- يظهر راسب رمادى اللون عند اضافة كلوريد القصد يروز الى كلوريد الزئبقيك ويسود هذا الراسب عند زيادة كلوريد القصد يروز.

٦ ١ - يحضر الهيد روجين من تفاعل الخارصين غير النقي مع عامض الكبريتيك المخفف ولا يستعمل مع الحامض المركدز.

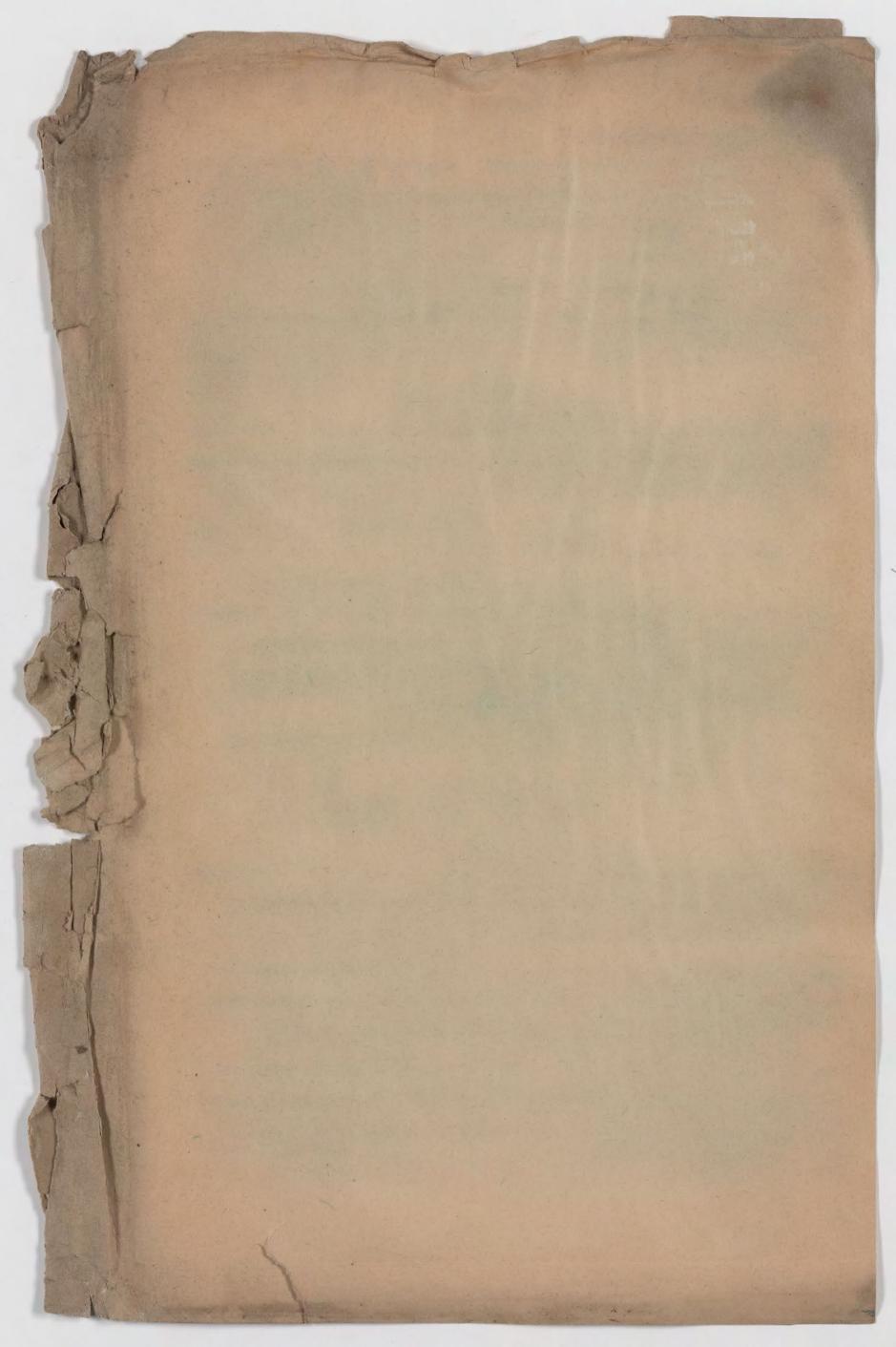
١٧ ـ تكتسي برادة النحاس البنية اللون بلون ابيض براق عند وضعها في معلول احد املاح الزئبق .

۱۸ - تحضر النورة من تسخين كاربونات الكالسيوم الى درجة لا تزيد على ١٢٠٠م ولا تقل عن ٩٠٠م م٠٠

٩ ١- لا يمكن تعيين عيارية هيد روكسيد الصوديوم بأذابة وزن معين منه في حجم ثابت من الماء .

واكماله الى لترتحصال المحلول عيارى للحامض بينما عند اذابة وزن جزيئي من H_2 C_2 O_h في الماء وأكماله الى لترتحصا على محلول عيارى للحامض بينما عند اذابة وزن جزيئي من H_2 C_2 O_h في الماء واكماله الى لتر نحصل على محلول C_3 من الحامض .

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Answer 8 questions Mathematics 1

Time allowed: Three hours

Specimen Paper on 1968 Syllabus.

(1)i. Find the values of A for which the equation in x $x^2 - x + 1 = \lambda (x^2 + x + 1)$

where to 1, has equal roots and find, also, the range of values of for which the roots are real and unequal.

If one of the roots is four times the other, find them.

ii. Find the positive values of x and y which satisfy the simultaneous equations.

 $\log_y x + \log_X y = 2\frac{1}{2}$, x + y = 12

(2)i. If x^4 and higher powers of x are neglected, find by how much $\sqrt[3]{1+x}$ differs from 1+1 x-1, x^2 and hence evaluate $\sqrt[3]{1010}$ to five decimals. al places.

ii. Prove by induction that 6 is a factor of m(n + 4)(n + 5) for all positive integral values onho

(3)i. Express in the form x + iy

(a)
$$(3 + 2i)$$
 $(2 - i)$,

(b)
$$(3 \div 21)/(2 - 1)$$

Show the complex numbers (3 + 2i) and (2 - i) on an Argand diagram and on it show how the results to (a) and (b) can be obtained geometrically,

ii. If P is the point in an Argand diagram representing the complex number z and if |z-1|=2|z-2|, find the locus of P.

(4) Prove that the equation of the circle on the line joining the poits (x_1, y_1) and (x_2, y_2) as diameter is

$$(x - x_1)(x - x_2) + (y - y_1)(y - y_2) = 0$$

O is the origin. A the fixed point (a, 0), where a is positive, and P a point on the positive part of the y-axis such that the angle OAP= 0. Q is a point in the first quadrant such that PQ is perpendicular to AP and equal in lenght to %AP. Find the coordinates of Q in terms of a and and determine the locus of Q as varies.

Show also that as To varies the circle on AQ as diameter passes through a fixed point on the y-axis, and find the coordinates of that point.

(5) Find the equation of thechord joining the points (ap2, 2ap) and (aq2, 2aq) on the parabola y = 4ax

PQ is a chord of this parabela passing through the focus S(a,0). PM and ONare drawn perpendicular to the line x + a = 0 meeting it at M and N respectively. Prove that

- (a) PN and QM pass through the origin,
- (b) MN subtends a right angle at the focus,
- (c) the tangents to the parabola at P and Q form with SM and SN a restangle one vertex of which lies on MN.

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2)1. If x and higher powers I x are neglected, that by how much \$ lext and filters from I + 1 x - 1 x - 1 x and heree evaluate \$ 1010 to five decima

ii. Prove by inquestion that 6 in a fact r of n(n+1)(n+5) for all

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(5- 50/25 = F) (A)

(4) (25 0.5) (4)

(c) (1 + En/3) "

Show the complex numbers (3 + 21) and (2 - 1) on an Argand diagram and on at show how the results to (a) and (B) can be obtained ground strings for

(4) Prove that the equation of the circle on the line joining the pexter (xy yq) and (xy yq) as diemoter is

0 = (x - x) (x - x) + (x - x) (x - x)

of in the origin. A the fixed point (a.0), where a is positive, and P a point on the positive part of the y-axis such that the angle CAPs O. Q is a point in the first qualment such that PQ is perpendicular to AP as appeal in length to MAPs Fied the crordinates of Q in torus of a and a termine the locus of Q as yerles.

Show also that as D veries the circle on AQ as dismeter passes through a timed point on the 3-onis, and find the coordinates of that points.

(5) Find the equation of the checkerd d-integrate (ap. 2mp) and (aq. 2mq) on the removals y a her.

PQ is a chord of the spared to pared to the interest the rocas S(a,0). PM and office drawn perpenditures to the line x + a = 0 meeting it at M and M respectively. Prove they

- .miniro ont dancord pace MD bas MI (a)
- , and of the algar Tright a monatura MM (d.
- c) the tangents to the prescots of P and Q form with SM and SM a restangle one vertex of which lies on MM.

Page 2

(6)i. Find the limit as 0 tends to 000f

ii. A and B are positife acute angles such that $2A - B = \frac{7}{4}$. If tan B = 1/239, find tan A without using tables.

iii. Show that cot $(\theta + 75)$ - tan $(\theta - 75) = \frac{4\cos 2\theta}{1+2\sin 2\theta}$

(7) Find the general solutions of the equations

- (a) $\sin^2 7\theta \sin^2 6\theta = \sin^2 \theta$;
- (b) $5\cos 2\theta + 12\sin 2\theta = 9$,
- (c) $3\cos 2\theta + \sin \theta 1 = 0$
- (8)i. State De Moivre's theorem and use it to prove that $\sin 6 \theta = \sin 2 \theta (4\cos^2 \theta 1)(4\cos^2 \theta 3)$.
- ii. Express the roots \propto and β of the equation $x^2 2x + 4 = 0$ in the form $r(\cos \theta + i \sin \theta)$. Hence obtain α and β and form the equation whose roots are α and β .
- (9) If $f'(x) = \frac{2-\sqrt{x}}{x^2}$ and f(1) = 0, find f''(x) and f(x), the dashes denoting differentiations with respect to x.

Show that the graph of f(x) has only one turning point and find, correct to two decimal places; the value of the function at that point, stating whether it is a maximum or a minimum value.

Show that f(4) and f(5) have opposite signs, and draw a rough sketch of the graph of f(x).

(10) The curves $y^2 = x$ and $x^2 = 8y$ interpath at the origin O and at a point P. The tangent at P to the first curve meets the y-axis in H and the tangent at P to the second curve meets the x-axis in K. Prove that OP bisects HK.

Find

- (a) the area between the two curves,
- (b) the volume obtained by rotating this area completely round the Transles.

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it. Papress the roots on and & of the equation x" - 2x'+ 4 = C in the form r(cos o + thin 8). Hence obtained and A and form the countries whose

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Show that the graph of (x) has only one turning point and find, cor rect to two decimal places. the value of the function at that point, .

Show that f(4) and f(5)have opposite signs, and draw a rough akatch

To tait every. In al airs a state weets the x-axis in I. Prove that OF

. Page 1 'Time allowed: Advanced Level Answer 8 questions Mathematics II Pure Mathematics

1. (i) The rth term is ar +br2, where a and b are constants. Find the sum to n terms.

A series is of the above form, the sums to three and five terms respectively being 180 and 690. Determine the fourth term.

(ii) Find the real factors of $x^4 + x^2 + 1$. Sum to <u>n</u> terms the series whose <u>q</u>th term is $-\frac{q}{4} + \frac{q^2 + 1}{q^2 + q}$.

2. (i) Show that, for all values of x and y,

$$x^2 + xy + y^2 > 0$$
.

Deduce that $(x + y)(x^3 + y^3) < (x^4 + y^4)$.

(ii) If p,q,r and s are positive numbers, prove that

$$(p + q) \left\{ \frac{1}{p} + \frac{1}{q} \right\}$$
and that
$$(p + q + r + s) \left\{ \frac{1}{p} + \frac{1}{q} + \frac{1}{r} \right\}$$

$$(p + q + r + s) \left\{ \frac{1}{p} + \frac{1}{q} + \frac{1}{r} \right\}$$

3. (i) The equations $6x^3 - 2x^2 + 11x + 10 = 0$ $12x^3 + 11x^2 + 20x + 12 = 0$

have a common root. Find it.

(ii) The roots of the equation $x^3 + px + q = 0$ are $\propto \beta$, and γ . Find the equation whose roots are

(a)
$$(\beta + \gamma)^3$$
, $(\gamma + \alpha)^3$, $(\alpha + \beta)^3$,
(b) $\frac{\beta}{\gamma} + \frac{\gamma}{\beta} + \frac{\alpha}{\alpha} + \frac{\alpha}{\gamma} + \frac{\beta}{\beta} + \frac{\alpha}{\alpha}$.
= $\cos^2 \frac{\gamma}{3} + i \sin^2 \frac{\gamma}{3}$, expand in ascending powers of x,

$$(1 + x)^{3n} + (1 + \omega x)^{3n} + (1 + \omega^2 x)^{3n}$$
, where n is a positive integer.

(ii) Solve the equation $(1 - z)^3 = 8(1 + z)^3$, expressing your results in the

5. Prove that $\cos 75 = \frac{\sqrt{3} - 1}{2 - \sqrt{2}}$ and that $\tan 75 = 2 + \sqrt{3}$. A right pyramid has for its base a regular dodecagon (12-sided polygon) of side 2a . The lenght of each slant edge of the pyramid is 5a .

(a) the inclination of a slant face to the base is $\cos^{-1}(\frac{2}{2} + \sqrt{3})$.

(b) the inclination of a short edge to the base is

$$\cos^{-1}\left(\frac{\sqrt{6}+\sqrt{2}}{5}\right)$$
.

If \emptyset is the angle between two slant adjacent faces, find $\cos\emptyset$.

6. P(a cose, b sing), Qua cosi, b sing) and R(a cosy, b sing) are points on the ellipse $-\frac{x}{3} + -\frac{y}{3} = 1$ such that PQ and PR are chords through the foci (ae, 0)and(-ae,0) b respectively. Prove that

 $\cos \frac{\theta - \eta}{2} = e \cos \frac{\theta + \eta}{2}$ and that $\tan \frac{\eta}{2} = \cot^2 \frac{\theta}{2}$. N is the foot of the perpendicular from P to the x-axis. QR meets the x-axis at T, and C is the centre of the ellipse. Prove that the rectangle TC.CN is constant.

Answer 8 questions Mathematics II Three hours.

1. (1) The rin term is ar where a and r ere constants, Find the sum

tively being 780 and 690. Determine the fourth term.

. 2. (1) Show that, for all velues of x and y,

Define that $(x + y)(x^2 + y^2) \leq 2(x^4 + y^4)$

(at) Is p.q.r and a are postdive numbers, prove that

0 = 01 + x 11 + 3x = 2x = 0 and 11 + 10 = 0

12x2 + 11x2 + 20x + 12 = 0

have a common root. Find it.

(iii) The roots of the equation x + px + q = 0 are of to above and (iii)

where n is a positive integer. $(1+x)^{3n}+(1+\omega x)^{3n}+(1+\omega^2 x)^{3n},$

ons at affect the galacetas . (x + r)8 = (x - r) doltenes ent ovica (11)

5. Prove that coa75 = 12 -1 - and that tan 75 = 2 + 13. (nogglog Sobie-Sf) negacebob values a seed at vot and bimaryg fight A . at all blustyq edd to each slant dose to dancel edf . as able to

(a) the inclination of a slant face to the base is cos (= 1 (2)).

(b) the inclination of a short edge to the base is con-1 [16 + 12].

. Nece built , asset theselfs that a cut neswird algue wit at N II 6. P(a cosé, b sing), C. (a cos . ' sing) and R(a cosg, b sing) are points. on the ellipse - - - - cuch that PQ and PR are chords through the faci (se, O)and (-ae, O) respectively. Prove that

cos -- - cos -- e cos -- end that tan -- cos -- - cos H is the foot of the perpendicular from P to the x-exis. OR meets the x-exis at T. and C is the centre of the ellipse. Prove that the restangle IC.Cl is constant. 7. Find the equation of the norman rectangular hyperbola xy = c2.

P is a point on the hyperbola and P' is the opposite end of the diameter PP'. The normal at P'meets the hyperbola again at Q. Find the loci of

- (a) the centroid of the triangle PP'Q,
- (b) the midpoint of PQ.
- 8, Find the coordinates of the point of intersection of the lines

$$-\frac{x}{2} - \frac{1}{2} - \frac{1}{2} = \frac{y}{3} - \frac{4}{3} = \frac{z}{1} - \frac{1}{1},$$

$$-\frac{x}{2} - \frac{3}{2} = \frac{y}{1} + \frac{2}{1} = \frac{z}{1} - \frac{1}{1},$$

and find also the equation of the plane containing these two

- 9.(i) Differentiate $\sin^{-1}\left\{\sqrt{\left\{\frac{x}{x}-\frac{1}{t}\right\}}\right\}$ with respect to x.
- (iii) Find $\int \cos 3\theta \sin^n \theta d\theta$, where n is a positive integer. (iii) Evaluate $\int_{0}^{\frac{\pi}{4}} \phi \sec^2 \phi d\phi$.
- 10. (i) Find the maximum and minimum values of $-\frac{x}{2}$ and distinguish between them.
- (ii) Show that the values of x for which the tangents to the curve y = x cos x are parallel to the x-axis are roots of the equation $x = \cot x$.

Use tables to find the smallest positive root of this equat+ ion and sketch the graph of y for - 1 T.

regard the equation of the names

rectangular hyperbolm .xy = c2.

Fis a point on the hyperbola and P' is the opposite off of the diameter PP'. The normal at P'meete the hyperbola again at Q. Find the lock of

(a) the controld of the triangle PF'Q,

(b) the midpoint of PQ.

s. Find the coordinates of the point of intersection of the lines

and find also the equation of the plane containing these two

9.(1) Differentiate sin $\sqrt{\left\{\frac{x-1}{x+1}\right\}}$ with respect to x.

(ii) Find / cos 30 sin c do, where n is a positive integer.

(111) Evaluate / A Oscc 2040.

to. (i) Find the maximum and minimum values of $\frac{x}{2}$ and disting-

uish between them.

(ii) Show that the values of x for which the tangents to the curve $y = x \cos x \cos parallel$ to the x-axis are roots of the sequetion $x = \cot x$.

Upo rables to find the smallest positive root of this equate ion and sketch the graph of y for $-4\pi \left(x \right) \sqrt{3}$.

Formula of Pascal's Principle :-

- If f stands for the force of the small pistan.
 - F stands for the force on the large piston.
 - a the area of the small piston,
 - A the area of the large piston.

:. $\frac{f}{a}$ = the pressure on the small piston; and $\frac{F}{A}$ = the pressure on the large piston; and because these pressures are equal: :. $\frac{f}{a} = \frac{F}{A}$.

WORKED EXAMPLE.

- of 30 lbs acts on the small one, what 1 ad will be supported by the other?
- A. Area of small piston = π r²

 $= \pi (2^2) = 4 \pi in^2$

Area of large piston = π \mathbb{R}^2

$$= 77(25^2) = 625 \% in^2$$

Pressure per inch square on small piston = $\frac{f}{a} = \frac{30}{4\pi}$, and this is equal to the pressure on the large piston, :. Total force on large piston :-

$$\frac{30}{-4 \pi} \times 625 \pi = \frac{30 \times 625}{4} = \frac{4687.5 \text{ lbs.}}{4}$$
Or applying the formula: $\frac{f}{a} = \frac{F}{A}$: $\frac{f}{r^2 \pi} = \frac{F}{R^2 \pi}$

$$\frac{30}{4} = \frac{F}{625}$$
:. $F = \frac{625 \pi \times 30}{4 \pi} = \frac{18750}{4} = \frac{4687.5 \text{ lbs.}}{4}$

EXAMPLE III

- 1. Two pistons of a hydraulic press have areas of 2 and 70 in respectively.

 What force applied to the small piston will overcome a resistance of

 35000 lbs on the large piston?
- 2. A man exerts a force of 50 lbs on one pist n of a hydraulic press whose area is 0.5 in². What pressure does he cause in the liquid? What force does the liquid exert on the other piston whose area is 6 in²?
- 3. A bottle full of water is closed by a stopper whose area is 3 cm². The area of the base of the bottle is 40 cm². When a force of 27 lbs pushes on the stopper, what is the force caused on the base of the bottle?

 (cont'd.P.10).....

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F stands for the force on the large plates.

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-modalic paral of the large piston-

:. E = the pressure on the scall miston;

and the thousand on the large platfort and because these pressures are

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Q. The piston in a hydraulic press have modif 2 in. if a weight of 30 lbs note on the scale one; whom I am will be supported by the other 2

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Sal T += (Sa) T =

Area of large plates a 77 R

77 (25") = 525 77 ta"

Fresure per inch square on small platon = $\frac{1}{6} = \frac{30}{4\pi}$, and this is equal to the pressure on the large platon; : Total force on large platon := $\frac{30}{4}$ x $\frac{30}{$

 $\frac{1}{253} = \frac{05}{4}$

PIL HILLMAKE

What force applied to the model pieron will evercode a resistante of store applied to the model pieron will evercode a resistante of store which each or the large wiston ?

2. A man exerts a force of 50 ths on one pist a of a hydrablic press those area is 0.5 in. What presents does a couse in the liquid ? What force does the liquid a what force does the liquid server of the other piston whose erea is 6 in. ?

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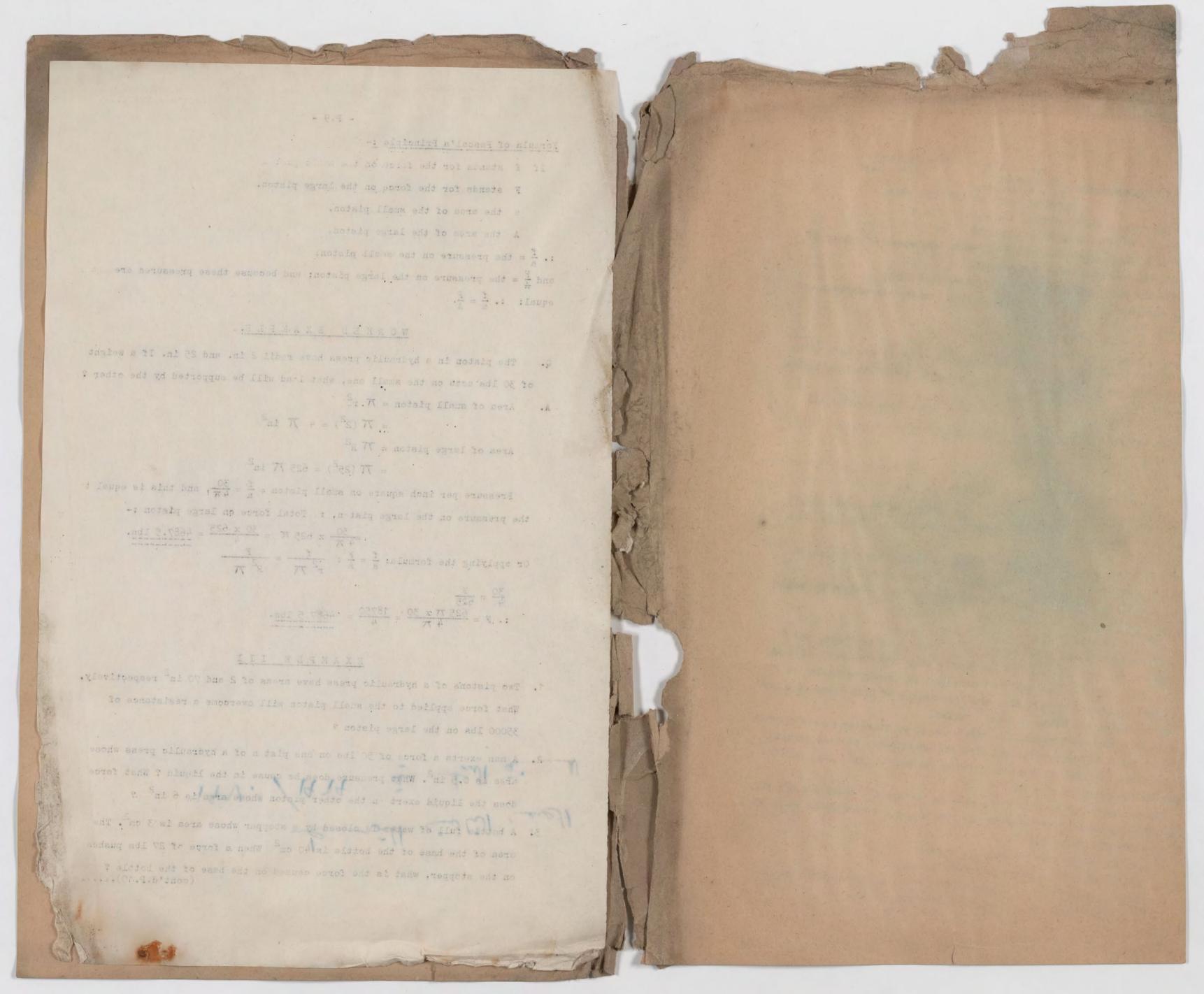
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 (cont'd.P.10)......





January 1965 Ordinary Level ADDITIONAL MATHEMATICS (3) THEORETICAL MECHANICS

GENERAL CERTIFICATE OF EDUCATION
EXAMINATION
January 1965
Ordinary Level
ADDITIONAL MATHEMATICS (3)
THEORETICAL MECHANICS
Two hours
Answer any SIX questions.
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Credit will be given for the orderly presentation of material: candidates who neglect this essential will be penalized.
All necessary working must be shown.

Take g as 32 ft per sec per sec.

- 1. Forces of magnitude 1, 4, 3 and 5 lb wt act along the sides AB, BC, CD and DA respectively of the square ABCD in the senses indicated by the order of the letters. AB is 12 inches long and the line of action of the resultant of the forces cuts AD produced at X. Calculate the magnitude of the resultant, the angle its line of action makes with AD and the length of AX.
- 2. ABCD is a square uniform plate and E and F are the mid-points of AB and BC respectively. The corner EBF is cut off and the plate freely suspended from A. Calculate the angle which AD makes with the vertical.
- 3. A non-uniform rod AB weighs 30 lb and hangs in a vertical plane supported by two strings AC and BC attached to a peg C. AB = 10 in., AC = 12 in. and BC = 8 in. If, in the position of equilibrium, AB makes an angle of 30° with the horizontal find, by drawing or by calculation,
 - (a) the distance of the centre of gravity of the rod from A,
 - (b) the tensions in the strings.
- 4. A body of mass 15 lb is on the point of slipping down a plane when the inclination of the plane is 25°. If the inclination of the plane is reduced to 15° find the least force, acting parallel to the plane, necessary to move the body
 - (a) up the plane,
 - (b) down the plane.
- 5. A stone is thrown from the top of a cliff 112 ft above sea level with a speed of 120 ft per sec at an elevation 9. If $\tan \theta = 4/3$ find how far from the foot of the cliff the stone enters the sea and the direction of flight at that instant.
- 6. A car of mass 15 cwt freewheels down a slope of 1 in 20 (i.e.sin⁻¹ 1/20) at a uniform speed of 20 m.p.h. Find, in 1b wt, the resistance to motion.
 - On reaching level ground the engine is switched on and works at 15 horse power. Assuming the resistance to motion to be unchanged, find the initial acceleration of the car.
- 7. A bullet of mass 3 oz is fired with a horizontal velocity of 1,200 ft per sec from a gun of mass 70 lb. If the gun is free to move from rest find its momentum and kinetic energy as the bullet leaves the muzzle. If the gun fires 250 such bullets per minute find the average force required to keep it at rest.
- 8. A railway truck of mass 10 tons is travelling at 30 m.p.h. on a curve of radius 300 yards. If the rails are on a horizontal plane find the horizontal thrust exerted by the rails on the truck and state its direction.

 If the distance between the rails is 4 ft 8½ in. find how much the outer rail must be raised so that the lateral thrust of the rails on the truck is eliminated.

and you can top 12 St. to 3 coleT. Terese of regritude 1, 4, 5 and ; these act along the state it, 80, 10 and the course indiagned by the order of the course indiagned by the order of the late of the late of the course of the forequest of the regulated the forequest of the regulated the state of the regulated the design of the regulated. The saginful the sagin is a time of action makes with a sagin indicate of the regulated. Ch remaining loved ground the oughn is switched on the earlies at 15 longs power, power, the touchestance to morton to be unchanged, families in initial accessoration of the core A realized the second to test to troudline at 30 mps; and to 20 mps; and the last of the last of the second of the second of the collection of the second of the collection.



Terms used in Arithmetic

المصطلحات المستعملة في الحساب

	·	المصطلحات المستعملة في ال
1	. To count	المد (عديمد لاعدا)
2	. Number	7_00
3	. Figures= Numberals	٣_ارقام
4	• Symbols	٤ – رموز
5	. A concrete number	ه ـ عدد محين (له وحدة معينة)
6	. An abstract number	٦ عدد مجرد عن الوحدة (مثل النسب المثلثية)
7	. Numeration	γ_التعداد _الترقيم
8	. Notation, (to denot)	٨ ـ تمثيل الاعداد بالأرقام (يمثل بـ)
9	. Naught= cipher= Zero= 0.	٩_ الصفر .
10	• One= unity= a unit	٠٠ الوحدة
11	. digit, (plural, digits)	١١ _ مرتبة (جمعها مراتب)
12	. The decimal system	۲ ر_ النظام المشرى ٢ رسبة الأحاد ١٣
13	. Unit's place	
14	. Ten's place	٤ ١٠ رتبة المشرات
15	. Hundred's place	ه ۱ – رتبة المئات
16.	. Addition	١٦ - الجمع
17	. Sum= total= sum-total= amount	٧١- عاصل الجمع
18.	. The sign of addition, is the plus	۱۸ - علامة الجمع هي علامة الزائد (+) (+) sign(+)
	The sign of equality, is (=) rea	
	Subtraction	٠٠-الطي
	The difference of two numbers	٢١ ـ الفرق بين عددين عاصل طح عددين
	Complementary addition	٢٢-الطن بالمتم الحسابي
	Subtrahend	٣٧- المطروح
	Minuend	١٩٠١ المطروح منه
270	The sign of subtraction,	ه ٢ - علامة الطرح هي علامة الناقص (-)
26	is the minus sign(-)	
	The difference or the remainder	٢٦ نات الطن عباقي الطن
	Multiplication	٢٧ ـ الضرب
	Multiplicand	٢٨ ـ المضروب
	Multiplier	٢٦ _ المضروب فنه
	Product	٠ ٣- حاصل الضرب
	Partical Products	١ ٣ - حواصل الضرب الجزشية
	Factors	٢٣ ـ الموامل
22.	The sign of multiplication,	٣٣ علامة الضرب هي الملامة (x)
24	is the cross sign (x)	
74.	The commutative law in addition	٤ ٣- قانون الابدال في الجمع والضرب
	& multiplication.	مال: ٥+٢=٢+٥،٤×٥=٥×٤٠
35.	Example: 5+6= 6+5; 5x4=4x5; a.k	
))·	The Distributive er associative]	
	addition & multiplication Example: a+b-c=(a+b)-c=(a-c)+b e	مثال: ا بب = جب ا ا با ب
	c(a+b)=ca+cb etc	
36.	The factor Law	٠٠ ا ا ا ا ا ا ا
,	Example: a(b.c)=(a.b)c=b.c.a., e	٢٣ - قاتون الموامل عمثال:
37.	Multiplication table	
16	orbitographe	٧ ٣- جدول الضرب

Perms used in Arithmetic

المالات الستعلة في الصاب

They Can't have I have	many of same	
fullate (or your x or)	To count	, I A
7_366	Number	.5
Tout I dy	Pigurese Numberale	N. P
3-046	Symbole	A.
amate may (to pate a mis)	A concrete number	5.
المعدد مجرد من المومدة (مثل النس	An abstract number (ightall ,	. 6.
y_llantle_llaging	Numeration	7.
المستشيا الاعداد بالارقام (بمثل بـ)	Notation, (to denot%)	.8
Jan Marie x	Naughte cipher= Zeros O.	9+
· r-there's	One= unity= a unit	10.
السمرتبة (جسيا مراتب)	digit, (planal, digita)	-11-
7 (- 16/1) these	The decimal system	"ST
	Unit's place	13.
3 to got Hande	Ten's place	445
01-0-5160	Hundred's place	15.
r 1-11mg	Addition	16.
· Y (- stall Hong	tuuona =[stot=mua =[stot =mua	17.
A (distilling of skattleter (+)	The sign of addition, is the plus sign(+)	18.
o (makin Hamilgia (m.)	The sign of equality, is (=) read equals	
· 7-140	Subtraction	
الإسالفرق بين مد د ين سمامل من عدد		
177- Hely Haley Heading	Complementary addition	
77-1600	.Subtrahend	
30/- Har ag site	puenatu	
م ١- علامة الماس عن علامة الماعدر-)	The sign of subtraction.	
	is the minus sign(-)	
الاسطى اللان عالي اللان	The difference or the remainder	
٧٧- الخرب	Multiplication	
ATmillabagger	basoklakiluk	
27- Mary See	Hultsplier	
· you what though	Product	
الإسمواصل الفرب الموثية	Partical Freducts	
7 7 millionelate	Factors	
۱۳ ماد خالفرب مي المادة (x)	neitheightfum to mais off	
	is the cross sign (x)	
ع المسال عن المسال عن المساولان	The commutative law in addition	446
20: 0+/=/+0:3x0=0x3:		200
hap a spel	Example: 5+6= 6+5; 5x4=4x5; a.b=b.a	
ه ٣- النون النون أن النبي والغرب	The Distributive or associative law in	*66
all stops of (1+4) may	constron & multiplication	
a (top) and by a a t	eddition & multiplication Example: a+b-c=(a+b)-c=(a-c)+b ets; c(a+b)=ca+cb etc	
-(1++)=+1+-+15.		
ry_ dies line distribute	The factor Law	100
1x(+x+)=1x+x+=+x+x1	Example: a(b,c)=(a,b)c=b,c,c,, etc	
Y you ghow I likely	eldst moltspilglightun	=36

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(p.2)
                                        ٨٧- البرهان على صعة العمل باسقاط التسمات
 38. Proving by nines
                                                              ٣٩ - اسقاط التسمات
39. Casting out the nines
                                    . ٤ _ البرهان على صحة العمل باستعمال المدد ١١
 40. Proving by elevens
                                                  ١ ٤ ـ حاصل ضرب ثلاثة عوامل او اكثر
 41. The continued product of three
      or more factors.
                                                                        ٢٤_ القوة
 42. Power
                                                ٣٤ _ القوة الثانية لمدد او مربع المدد
 43. The second power of a number or the
      square of a number.
                                               ٤٤ _ القوة الثالثة لمدد او مكمب المدد
 44. The third power of a number or the
      cube of a number.
                                                             ه ٤ _ القوة الرابعة لعدد
 45. The fourth power of a number
      The base of the power اساس القوة
                                                                ٦٤ _ الاس_اس القوة
 46. Index or exponent
                                                             ٧٤ ـ الرفع الى القوى .
 47. Involution
                                                              ٨٤ ـ استخراج الجذور
 48. Evolution
                                                                       13_ القسمة
 49. Division
                                                                      • ٥- المقسوم
 50. Divident
                                                                   ١ ٥- المقسوم عليه
 51. Divisor
                                                            ٢٥ - خارج او ناتج القسمة
 52. Quotient
                                                                   ٣٥- باقي القسمة
 53. Remainder
                                                          ٤ هـ المقسوم المقسوم عليه x
  54. Dividend= Divisor x: quotient + Remainder
                                                   خارج القسمة+ باقي القسمة.
                                                        ه ٥ م علامة القسمة ( ÷ ) او ( / )
  55. The sign of division (+) or (/)
                                             ۲ ٥ - ٥ + ۲ ( تقرأ ه تقسيم ۲ او ه على ۲)
  56. 5:2 (read 5 divided by 2
            or 5 over 2).
                                                                       ٧ هـ الاقواس
  57. Brackets
                                                     ۸٥-> اكبر من إمثلا: ٥٥ ٣] ٥- د اصفر من [مثلا: ٣ د ٥]
  58. > is greater than (Example: 5>3)
  59. \( is less than (Example: 3 \( 5 )
                                                 • ٦- الطول ، المسآحة ، العجم ، السعة ،
  60. Length, area, volume, capacity,
                                                                 الزمن ، الزاوية .
          time, angle.
                                                ١٦- السلسلة الواحدة= ١٠٠ علقة= ٢٢
  61. One chain=100 links= 22yards
                                                ٢٦- مقياس طولي = ١٠ ميل=٢٢٠ يارد .
  62. One furlong 10 chains 220 yrds.
                                                         ٣٢ ـ القامة الواحدة = ٢ اقدام
  63. One fathom = 6ft.
                                                          ع ٦- الميل البحرى الواحد =
  64. One knot= 6080 ft.= one nautical mile
                                                                 ٠٨٠٦ قدما
       = one geographical mile: (admiralty mile)
        = the length of one minute of arc or the equation
  65. One mile= 5280 ft.=(1 English or statute mile) م7 م قدراً الميل الواحد = ٠٦٥ قدراً
                                                       ٦٦ الفرسخ الواحد = ٣ اميال.
  66. One league = 3 nautical miles.
                                                                     ۲۲ ع انجات
  67. One hand = 4 inches
                                                          ٨٦_ القصبة_ = 1/0 ياردات
  68. One pole = 5½ yards
                                                                   ٦٦ - السنة الكبيسة
  69. A leap year
                                                     . ٧_ الدزينة الدرزن = ١٢ وحدة
  70. One dozen = 12 units
                                                              ٧١ - الكروس = ١٢ د زينة
   71. One gross
                                                                      74- . 7 eats
  72. One score
                                                                       ٣٧- ٢٤ ورقة
  73. One quire
```

74. One ream= 20 quires = 480 sheets of papers

٤ ٧ - بند ورق= ٠ ٨٤ ورقة

75. Denomination.

lowest terms.

٥٧- نوع.

(S.a) Ay- Had i do and Had dud - Hand is . 18. Proving by mines Jun I wild I lawate \$39. Casting out the mines . 3 - Thyalo de and Head plantall Have 11 40. Proving by elevens 13- dal age of 65 sold to 184 41. The continued product of three or more factors. 73-11200 42. Power ع عد القوة النائية لمدد او سيم المدد hy. The second power of a number or the . reduum a to exampa. 33-11268 Halles lave to Day House and the third power of a number or the cube of a number. 03_ High Haland Lake 45. The fourth power of a number The base of the power all ulul de Index or exponent V3_ May My Miles hy. Involution 13- Intigl , Hickory 48. Evelutton 13 3 - Phillips noisivhi . pa · o_ Millianon SO. Divident 10 m Hatilian alus 51. Divisor ٢٥ - على أو نائح النسخ 52. Quotient ٣٥- ياقي القسة SS. Remainder 3 on Holings Holings also x 54. Dividenda Divisor x quotient + Remainder Al of Hancis of the Hims. 00- all al 1 limas (+) 12 (1) 55, The sign of division (+) or (/) 10-0+7 (till a timen 7 /2 0 de 7) 56, 5:2 (rend 5 divided by 2 or 5 over 2). You It let w 57. Brackets 10->12,00 jak: 0)7] 58. > is greater than (Example: 5>3) roughour will : 4607 59. (is less than (Example: 3 (5) . putte de ellent es ellergalleras 60. Length, area, volume, capacity, الرس ، الزامة . time, angle, 1 Tarthalala Hel at San . 1 alasa 77 61. One chain=100 links= 22yards 7.5- differ the = for mile . 77 de. 62. Queglyrlgngrajo chains= 220 yrds. Tr- Mas Helmas - riving 63. One fathem = 6ft. 31-11mb 1400 16/26= 64. One knote 6080 ft.= one nautical mile · A+TEd = one geographical mile: (admiralty mile) = the length of one minute of arc or the equation 65. One miles 5280 ft.=(1 English or statute milby 6 7.4. = 42-611 dell-70 77- Hemy Helal = 7 ladle. 66. One league = 5 nautical miles. VI 3 tedie 67. One hand = 4 inches AT_Plana = do youla 66. One pole = 5% yards July Harris 1 Daniel 69. A Leap year · Y- The proside is a 71 goes of 70. One dozen = 12 units. 1 V - Magazine 7 1 till 71. One gress 7 Home . 7 girls " 72. One score TY- 37 PLES 73. One quare 3.7- pl (1 = + 13 e/2) 74. One ream= 20 quires = 480 sheets of papers

حول خمس د نانير و ۳ د راهم Example: Reduce £5 3s 4d. to the same وه ١ فلسا الى نوع واحد من denomination, the pence: £5 3s 4d.= العملة والفلس مثلا: 5x20x12+3x12+4= 1240 d ٥×٠×٠ + ٣٠ × ٥ + ١٥ + ١٥ + ١٥ + ١٥ + ١٥ = ١٥ ا ه فلسا ٢٧ _ مفاعف. 76. Multiple ٧٧_عامل مشترك 77. Common factor ٨٧ _ اعداد متثالية 78. Consecutive numbers ٧٦ اعداد زوجية 79. Even numbers . ٨_ اعداد فردية 80. Odd numbers ١٨_ اعداد اولية 81. Prime numbers= primes ٢ ٨ ـ اعداد غير اولية 82. Composite numbers ٨٣ اعداد لا يوجد بينها عامل مشترك سوى 83. Numbers prime to one another الواحد مثال: ١٣٠٤ ١٣٥٤) (Ex: 4, 13, 25, 49) ٤ ٨ عددان مجموعها مكون من تسمات (مثلا: 84. Two Complementary numbers · (99=YE+70) (Ex: 25+74=99) ه ٨ ـ قابلية القسمة على عدد (مثلا: ٢٩ قابل 85. Divisibility by a number القسمة على ٣). (Ex: 39 is divisible by 3) ٦ ٨ ـ ترتيب تصاعد ي = ترتيب متصاعد 86. Ascending order ٧ ٨ ـ ترتيب تنازلي = ترتيب متنازل 87. Descending order ٨٨ التحليل الى الموامل 88. Factoring = resolving into factors ٨ ٨ العامل المشترك الاعلى 89. Highest common factor (H.C.F.) Greatest common factor (G.C.F.) = Greatest common measure (G.C.M.) العامل المشترك الاعظم القاسم المشترك الاعلى = Highest common divisor (H.C.D.) • ٦- متنوع 90. Miscellaneous 1 9- المضاعف المشترك الاصغير 91. Least common multiple= lowest المضاعف المشترك الادني common multiple (L.C.M.) ٢٠ _ اشارة او تلميح الى كيفية الحل 92. Hint ٣١٠ عدد صحبح 93. An Integer = a whole number 94. The Integral part of the number ع ٩ _ الجزء الصحيح من العدد (١٥ر٣) (3.51) is (3). (") on ه ٩- الكسر 95. Fraction ٢٦_ الكسر الاعتبادي 96. Vulgar fraction= common fraction ٧٧_ الكسر المشرى 97. Decimal fraction ٨٩ _ بسط الكسر = صورة الكسر 98. The Numerator of a fraction ٩ ٩ مقام الكسر عضرج الكسر 99. The Denominator of a fraction 100. Proper fraction (ex: 17) · · ا _ كسر حقيقي (مثار ١٧ _) · · ١٠١ ـ كسر لفظي (مثلا: ٢٥ ـ) 101. Improper fraction (Ex: 25) ۲ ، ۱ - عدد کسری (مثلا: ۲ ، ۲) = عدد مختلط 102. A mixed number (ex: 52 2 ٣ . ١ _ اخترال الكسور 103. Reduction of fractions ٤ . ١ - اختصار الموامل المشتركة من بسط كسر 104. Cancelling the common factoran from the numerator & denominator of a fraction. ٥٠١ - اختصار الكسر الى ابسط حديه 105. The reduction of a fraction to its

Denomination, o Vim Lego حول غمس د تا دير و ٧ درامم Example: Reduce £5 3s 4d, to the same وه ا غلسا الي دوم واحد من denomination, the pence; \$5 3s 4d.= المعلق الغلب مثلا . 5x20x12+3x12+4= 1240 d 0x + 7x + 0+ 7x + 0+ 0 (= + + + 0 + + 0 (+ 0) = 0) (0 ilm) ry_sidely. ofditing .go YY alah ani 77. Common factor AY laste willis 78. Consecutive numbers y-laule jest · اعداد فرد ية 80. Odd numbers (Am laste letis 81. Prime numbers= primes 7 Am locale in toles 82. Composite numbers Mulable K year mind old min i me 83. Numbers prime to one another Helat Mb: 327(2072/3) (Ex: 4, 13, 25, 49) 3 1- and it a ground afect at and a fall: 84. Two Complementary numbers (07+3Y=PP). (Ex: 25+74=99) ه رس قابلية القسمة على عدد (مثلا: ٢٧ قابل 85. Divisibility by a number Himas day 710 (Ex: 39 is divisible by 3) الله ترتيب تمامد و = ترتيب متمامد 86. Ascending order ٧٨ موتيب تنازلي = ترتيب متنازل 87. Descending order AM Plant It, Hadd 88. Factoring = resolving into factors Phallold Hand & 18 day 89. Highest common factor (H.C.T.) Greatest common factor (G.C.F.) = Greatest common measure (G.C.M.) الحامل المشترك الاعظم Ildas : Lang 116 de, (.C.O.H) rosivib nommoo JaenaiH Fights must a 90. Miscellaneous 1 - Madde Harris & 16 ming 91. Least common multiple= lowest المناوف المترا الادني common multiple (L.C.M.) المارة او تلويج الى كيفية الما 93. An Integer = a whole number Y / - the owners 94. The Integral part of the number 3 pullet llacy of laber (1017) (3, 51) is (5). de (7) 0 /- 112mg 5/- 112mg 18 ocula o 96. Vulger fractions common fraction y markey Harry 97. Decimal fraction Almand Hang = ong 8 Hang 98. The Numerator of a fraction PP- Jallen - My 112mg 99. The Denominator of a fraction 100, Proper fraction (ex: 17_) · · (- The alie, (oil Y) 1. (- to lity (all: 27 -) 101. Improper fraction (Ext 25) 102. A mixed number (ext 52 2 7-1- and lage (ill : - 70) = and wall 7. (_12316 112mg 103. Reduction of fractions 3 o pulitale thought that to your long 104. Cancelling the common fact to. from the numerator & denominator of a fraction. os (- lated | land | land on a standard of the lated of the land of the lated of th lowest terms.

- P.4 -106. Comparison of fractions ١٠٧ ـ مقلوب المدد (٣) هو (٣) 107. The reciprocal of the number 3 is $(\frac{1}{2})$ 8. A complex fraction (Ex.: 7 ١١٠ المسور المشرية المنتهية 110. Terminating decimals ١١١- الكسور المشرية الدورية 111. Recurring decimals (Ex.: 0.3; 0.431) (مثلا: الله ١٠٠٠ و ١٠٠٠ و ٠ ١١٢ المالارقام المشرية (الارقام يمين الفارزة المشرية) 112. Decimal figures ١١٢ - المراتب المشرية (عدد الارقام يمين الفارزة المشرية) 113. Decimal places 114. Significant figures (Ex.: in • ١٠٠٣٦٧ مثلا في المدد ١١٤٠) ١١٤ الرقم ٣ هو اول رقم مصنوى بعد الفارزة العشرية) the number 0.00967 the number 3 is the first significant figure ١١٥ - كسر دوروبسيط (مثلا: ١٠٠) after the decimal point). 115. A pure circulator (Ex.: 0.6) ۱۱۱ – کسر دوری مرکب (هٔ ۴ ۲۳ ر مثلا) ۱۱۷ – الکسر الاعتیادی الکافی الی الکسر 116. A mixed circulator (Ex.: 0.7325) 117. The generating fraction of a recurring الدورن ١٠ : - الله هو الكسر fraction (Ex.: 1 is the generating fraction المكافئ ير الدوري سر ٠) of 0.3)١١٨ ١- التقريب (مثلا : ٢٣٤ر ٠ = ٢٧ر ٠ صعيماء ١ 118. Approximation (Ex.:0.734=0.73 الى اقرب مرتبتين عشريتين) • correct to two decimal places). · 1/25 -119 119. Error . ٢ ١- الخطا المطلق = الخطا الحقيقي . 120. Absolute error ١٢١_ الخطا النسبي (مثلا الخطا النسبي = 121. Relative error (Ex.: the relative error is $\frac{1}{50}$). ٢٢ (_ الخطأ المئوى (مثلا: ٢ ٪) 122. Percentage error (Ex.: 2 %). ١٢٣ النظام المترق . 123, The Metric System ٤ ٢ ١- المحدل (مثلا: ٧ = ٥ + ٢ + ٨ + ٢) 5+3+8+12 124. Average=mean (Ex.:7=____) ١٢٥ نسبة (مثلا: ١٣٠٠ ٢٠) 125. Ratio (Ex.: 2 or 2:3) ١٢٦ - تناسب (مثلا : ٣ = ١٢٦ 126. Proportion (Ex.: 24 or 2:3:4:6) (7: 8 = 7: 7 ١٢٧ - عدا النسبة . 127. The two terms of a ratio ١٢٨ - مقدم النسبة . 128. Antecedent ١٢١- تالي النسبة. 129. Consequent • ١٣٠ الطرفان (في التناسب) 130. The extremes (in a proportion) ١٣١ - الوسطان (في التناسب) 131. The means (in a proportion) ١٣٢ الوسط المتناسب بين عدد ين 132. The mean proportional between two numbers ٣٣١ _ الثالث المثالب لمددين 133. The third proportional to two numbers

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115. A pure circulator (Ex.: 0.6)
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133. The third proportional to two numbers

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٤ ١٦ - الرابع المتناسب لثلاثة اعداد
   . The fourth proportional to three numbers
                                                               ه ۱۳ د تناسب طردی.
135. Direct proportion
                                                               ١٣٦ ـ تناسب عكسي
136. Inverse proportion
                                      ١٣٧ مترا ساعة يوم ١٣٧ مترا ساعة يوم
137. Compound proportion
                                      W A YO " A.
                                                             ١٣٨ التقسيم التناسبي
138. Proportional division
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139. Partnership
                                                               • ٤ ١ _ النسبة المئوية
140. Percentage
                                                                      13 9- الرب
141. Profit
                                                                    7 ٤ ١ _ الخسارة
142. Loss
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144. Taxes
                                                               ه ١ ١ - الربع البسيط
145. Simple interest
                                                                ١٤٦ - الربع المركب
146. Compound interest
                                             ١٤٧ ـ رأس المال = المهلية ( في الموليح إلياك
147. The principal
                                                   ١٤٨ - الجملة = رأس المال + الربع
148. The amount=the principal+the interest
                                                             ١٤١ - سنويا = بالسنة
149. Per annum
                                                             ١٥٠ - الخصم = الحسم
150. Discount
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151. Nominal value of a draft
                                                        ٢٥١_ القيمة الرالية للكبيالة
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                                                                      Juan - 109
153. Shares
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154. Stocks
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155. Bonds
                                                    ١٥١- المساهمون = حاملو الاسهم
156. Shareholders
                                                                no lund oy -10 Y
157. Dividend (each shareholder's profit
     from the total profit)
158. The term "stock" is applied to the
     capital of a company, any portion
     of which, large or small, may be bought
     or sold.
159. The meaning of the expression "3% stock
     at 102" is that a company is paying a divi-
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dend of 3% on its capital or stock, £100 of

which is at the time selling for £102.

المرز فراط يلري مع المهاري الشرأ الماد

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	The meaning of the expression "3% stock	159
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	Clockwise rotation	۲۱ هـ دوران باتجاه عقارب الساعة
522.	Counterclockwise rotation or anticlockwise rotation	٢ ٢٥- = مضاد لدوران عقارب الساعة
523.	The first, second, third & fourth quadrants	٣٣ هـ الربع الاول والثاني والثالث والرابع
524.	To rotate or to revolve	٢٢٥ يه ور
.725.	Sine (sine)	٥٢٥ - الجيب = جا ه
526.	Cosine (cos.)	٢٦ ٥- جيب التمام = جتا ه
527.	Tangent (tang)	٢٧ ٥ ـ الظل = ظا هـ
525.	Cotangent (coto)	٢٨ ٥- ظل التمام = ظتا هـ
529.	Secant (secQ)	٢٥ - القاطع = قا هـ
530.	Cosecant (cose)	٠ ٣ ٥ - قاطع التمام = قتا هـ
531.	Tables of natural functions	٣١ - جداول النسب المثلثية
532.	Solution of the right triangle	٢٢٥ - حل المثلث القائم الزاوية
533.	" " " shlique "	٣٣٥- = المائل الزوايا
534.	The law of sines	٤ ٣ ٥ - قانون الجيوب
535.	The law of cosines	ه ٢٥ هـ قانون جيوب التمام (او قانون السربيع)
536.	The law of tangents	٢٦٥ قانون الظلال
537.	Horizontal & wertical Components	γ ۲ ٥ المركبات الافقية والرأسية
538.	The resultant force	٣٨ ٥- المحصلة (للقوة)
539.	Inaccessible distances	٣٩٥ مسافات لا يمكن الوصول اليها
54.	Trigonometric equations	ه ٤٥ ممادلات مثلثية
541.	" identities	۱ ع م متطابقات
542.	Relations between the functions of an angle	٢ ٤ ٥ - العلاقة بين النسبة المثلثية للزاوية
543.	Circular measure of an angle	٣٤ ٥- التقدير الداعرى للزاوية
544.	A radian	٤٤٥ - زاوية نصف قطرية
545.	A. vector	٥٤٥ خط د و طول معين وجبهة معينة
5-6.	The directed line	٦٥ ٥٠٠٠ الخط الانجاهي
10	Simple harmonic motion	٧٤ ٥- الحركة التوافقية البسيطة.

917. Trigonomoury به اللها اب اسم مع ال onelions we melies of the content of the

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538. The resultent force

Sell Polations between the functions

TOTOLY A . PAGE

SIGNIFICANT DIGITS

Sicnificant digits of any number any the reliable or necessary digits - digits which tell the digree of accuracy of our measurement or estimate, and which must be retained when we change our decimal system of units.

Any number is formed out of one or more of the following digits:

0 1 2 3 4 5 6 7 8 9 The digits 1 through to 9 in any number are always significant but

the digit zero is not always so. The following cases must be carefully

(1) The zeros to the left of approximate numbers are always insignificant They are there, simply because of the particular unit of measurement we have chosen; consequently they are not important in that they do not add to the degree of accuracy of our measurement and can be easily dispensed with by a suitable change of units. For example: 75, 0.75, 0.00075

The zeros in the last two numbers are insignificant. Let us suppose :that75 represents the distance between two points in cms.; then 0.75 represents the same distance in metres and 0.00075 in kms, In each of the 3 cases the degree of accuracy of our measurement (i.e. 2 significant figures) has not changed, the zeros have been added to the left of the number because we changed our decimal system of units from cms, to meters and then to kms.

- (2) Zeros in between two significant digits of a number are always signi-These zeros are an integral part of the number and cannot be omitted by any decimal change of units; e.g. the distance between two points to three significant digits is 309 metres; change the units to km, the distance becomes 0.309 kms. The zero is still there, change to cms, and the middle O is still there.
- (3) Zeros at the right of a whole number may or may not be significant. With experience and common sense, the student will be in a position to tell which is which. The following hints, however, are helpful: (i) If the number is the result of counting, the zeros are significant.i.e. the annual salary of the U.S. President is \$150.000 or the annual allowances of the British Queen is £500.000. The zeros in these two numbers are significant.
 - (ii) If the number indicates a measurement or an estimate, the zeros at the end are insignificant e.g. the distance of the moon to the earth is 233,000 miles; it is obvious that this is not an exact number, we have simply rounded off our measurement to the nearest 1000miles. Whis number is correct to 3 eignificant figure Again when we say the estimated profit of a business man during the year to come is £7500, this figure cannot be exact as we have simply estimated the profit to the nearest £100; the zeros are, therefore, insignificant and the number is said to be correct to 2 significant digits.
- (4) Zeros to the right of the decimal point are always significant; they are important, otherwise there would not be a point in putting them there, e.g. 27,00m, means that we have carried out our measurement accurately to the nearest cm; this figure is, therefore, correct to 4significant digits. On the other hand 27 is correct to two significant digits.

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(۱۰) أعرق ٢٦ر، غم من غبار الكاربون بتيار من الاوكسجين وأمرر ثاني أوكسيد الكاربون الناتئ على منتفع يعتوى على هيد روكسيد البوتاسيوم فاذا كان وزن المنتفي والمهيد روكسيد تبل وبعد امرار الخاز ٨٠ر٢٥ غم و ٤٨ر٤ ه غم اعسب مكافيين الكاربون .

(١١) نموذج من النارصين يعتوى كمية من أوكسيده. هر . فم من هذا النموذج اذبيت في عامض مررت ٢١٥ سم٣ من الهيد روجين الباف في درجة ٢١م و وضف طور ٢٠٠ مام/زئبق احسب النسبة المئوية لا وكسيد النارصين في النموذج علما بان مكافي والخارصين مر٣٤ غم .

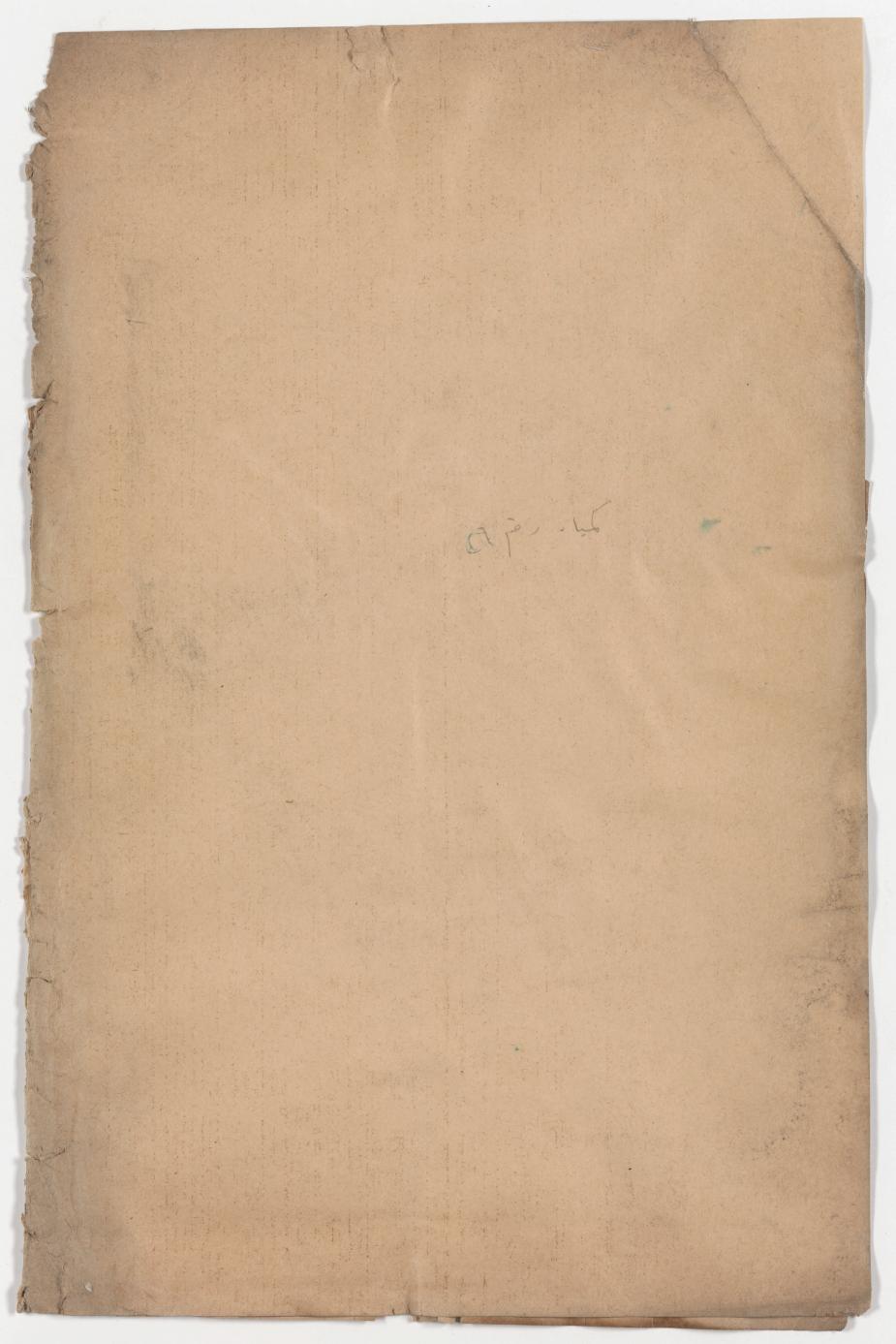
" الأوزان الذريه"

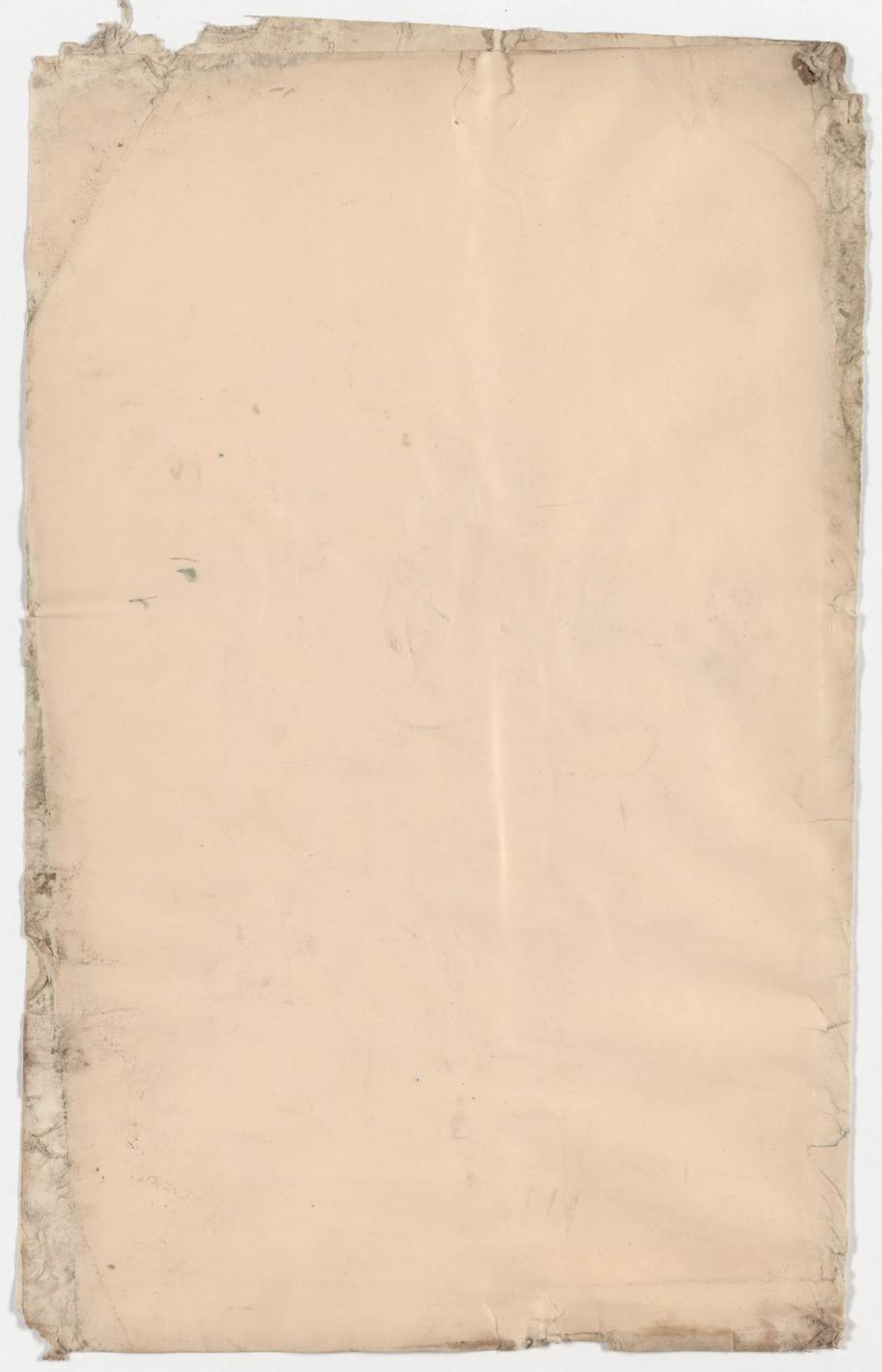
الوزن الذرى التقريبي × المعرارة النوعية = ١٥٤

الوزن الذرى التقريبي = التكافو "وهو عدد صحيي"

الوزن الذرى المشبوط = الوزن المكافي ع × التكافو .

- (۱) اذا كانت الحوارة النوعية للبلاتين والماس، المنيسيوم وسائل الاوكسجين مي على التوالي ٣٠٥٠ ، ١٦١٥٠ ، ٢٤٣٥، فهل توعيد مذه الارقسام قانون دولون وبتي اذا كانت اوزانها الذريه ٢ره١٠ ، ١٦، ٢٣٢٤، ٢١٠٠
 - (٢) ما المرارة النوعية التقريبية لفلز وزنه الذرى المضبوط ١١٢ ؟
- (٣) اذا كانت الحرارة النوعية لفلز ٣٠٠٠و٠ ، ٥٣ر٣ غم من هذا الفلز اعداى عند در٣) اكسدته ٥٠ر٤ غم من الاوكسيد فما هو الوزن الذرى المضبوط لهذا الفلز.
- (٤) عند تسخين ١٦٦٨ فم من برادة فلز الى وزن ثابت وفي تيار مستمر من الاوكسيجين حصلنا على ١٥٢٠ فم من اوكسيد الفلز، فما الوزن المكافي ولفلز واذا علميت الفلز واذا علميت الفلز، فما الوزن المكافي الفلز واذا علميت الفلز واذا علميت الفلزة النوعية له ١١و٠ فما الوزن الذرى المضبوط له ،
- ه) ، ٢و، غم من فلزعند اذابته في حاص المهيد روكلوري اعلى ١٦٦ سم ٣ مـــن المهيد روجين الذي قيس وهو جاف في ظ.ق، فاذا كانت الحرارة النوعية للفلـــز ٢٥٠ فما المكافي ، الوزن الذرى التقريبي ، التكافو ، ثم اضبط الـــرون الذرى للفلز .





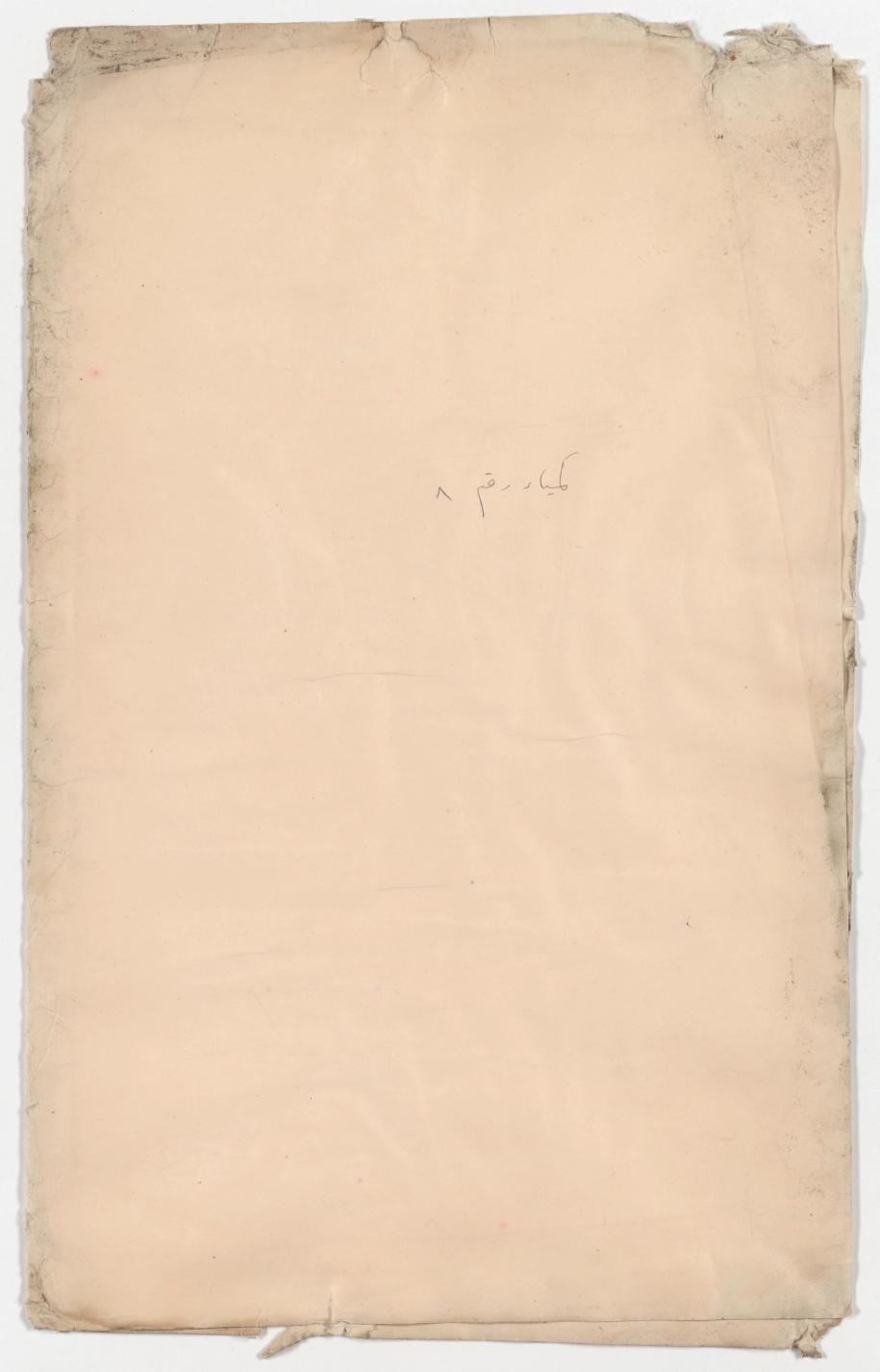
1. 其中中中央101×6年初的100×6年度1 The solution was the training " You to see you have not the see the read in the read the see a for it so there is no Survey of the superior with the state of the survey of the المراسا الم الملهور و 19 1 the contract of the contract of A- in the state of ٠ و المالي المالية الم mathet was a will the good to y again and thank they are المال مع المعرف المالية المعرف A Company Maring Maring Marine 1 12 with the second the se The relation the same the one of the state of the state of the same س على الوقعيد الكارون و جمود في من السنا "اوسنة النبيسة الرقمية لي سرف عدام بعون من المسيس والكانون وقت وسند أن الكانون بذك أبراء بأو however we show I gove y day described in a line of the - as Harlah Ilko & I hope her gree taged and aye aye yam in Ilkings الده عم من المهمل در المن و ١٥ مره عمر من عار الكله Star HOTAX - World Con 170 C 7724 The property of the second the first of a like the White of the little 110 years

- ٦- ملح مائي يحتول ١٦ر١ / من الصوديوم ، ١٢ر١ / من الكبريت و ١١١ / من الاوكسبين ١٢٥٥ / من العا الحسب الصيفة الوضعية للملح .
- ٧- ملح يحتوى ٢٣ر١١ ٪ من الصوديوم ، ٢٩ر٦ ٪ من الكبريت ، ٢٥٦٥ ٪ من الهيد روجين وحين وحين و ٢٦٦٢ ٪ من الاوكسجين احسب صيفته اذا علمت ان جميح الهيد روجين متحدا بالاوكسجين مكونها ما التبلور .
 - ٨ بلورات من كبريتات الخارصين يحتوى على ١ ر٣٤ ٪ من ما التبلور احسب عدد جزيئات ما التبلور المرتبط بجزيئة واحدة من الملح .
 - ا مند سعب عد ما التبلور من ١٥٥٦ غم من صوب النسيل تبقى ١٥٥٠ غم مسن موب النسيل تبقى ١٥٥٠ عم مسن ما التبلور المرتبطة بجزيئة من المل .

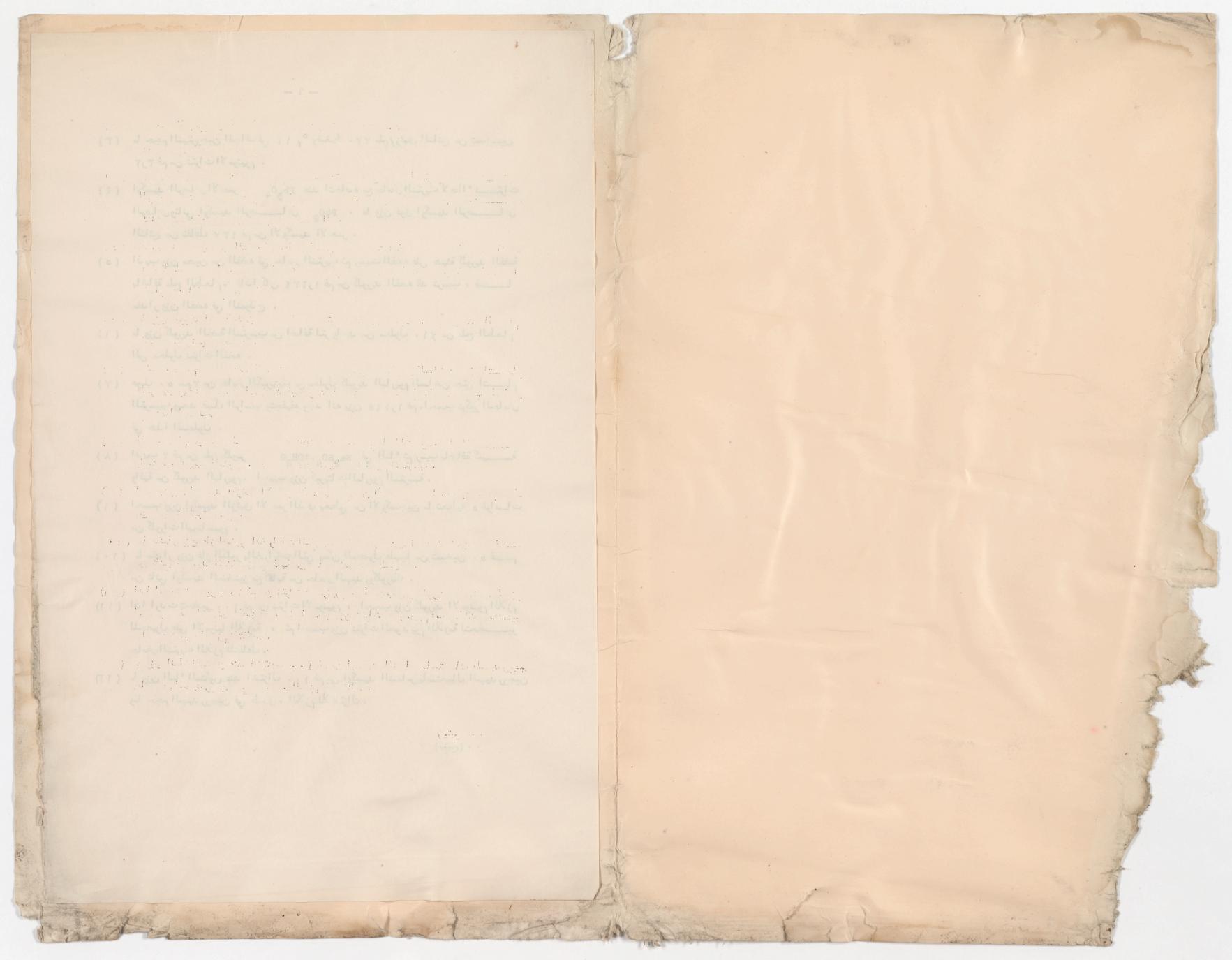
 - السركب في جو من الاوكسجين وقد امتر الساء بواسطة كلوريد الكالسيوم وامتر ثاني اوكسيد الكاربون بواسطة البوتاسية الكاربون بواسطة البوتاسية الكاربون بواسطة البوتاسية الكاربون و ١٠٠٠ غيم من المادة اعطت ٦٨٠٠ غيمية من ثاني اوكسيد الكاربون و ٥٠٠٠ غيم من المادة الوضعية لهذا المركب.
 - ١٦ ـ مركب متطاير يتكون من المهيد روجين والكاربون وقد وجد ان الكاربون يشكل ٢٦/٦ ٪ وان المهيد روجين يكون ٢٦/١ ٪ فاذا كانت الكثافة النسية للمركب ٢٣ احسب الصيفة الجزيئية .
- ۱۳ مند التعليل الكبي لـ ١٠ غم من مادة وجد انها تعتوى على ٢٨ ر٣ غم من الكاربون و ١٣ مره غم من الكاربون و ١٣ مره غم من غاز الكلور وقد وجد ان ٢٥ مر٢ غم من هسدنا المركب يشغل حجما قد ره ٢٢٤ سم عند تحويله الى الحالة الفازيدة وذلك فسدي درجية ٥٠٠ م وضفط ٨٢٥ ملم / زئبق ، ما الصيفة الجزيئية لهذا المركب.
- ١٤ كلوريد فلز مثل M اعطى النواتي التالية عند تعليله ٢٤ر٤٣ ٪ من الفلز و ١٤ ٥ر٥٥ ٪ من الكلور وكانت الكثافة النسبية له ١٢ ٨ والحرارة النوعية للفلز و ١٤ر٠ احسب من ذلك الوزن الذرى المضبوط للفلز وما الصيفة الجزيئية لهذا الكلوريد.
- ه ١- مادة هيد روكاربونيدة تتكون صدن ٢٧٦٦ ٪ من الكاربدون و ١٤٦٧٢ ٪ من الهيد روجين ويزن اللتدر الواحد منها في درجدة ٣٠ م وضفط ٥٥٠ ملم / زئبق ٨٠٣٦ر، غدم العسب الصفدة الجزيئيدة لهذه المادة .

العسابات الكياب

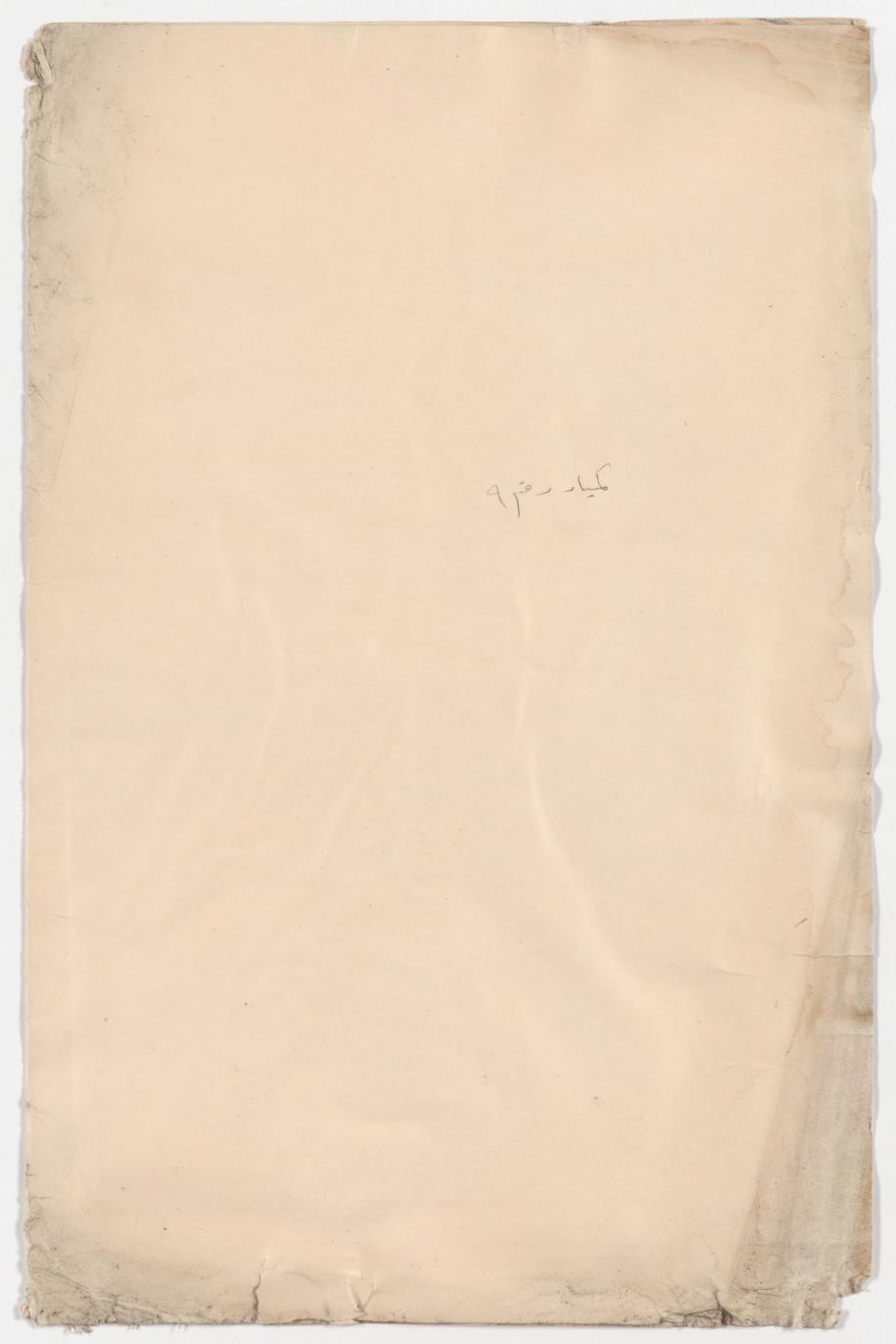
- ١- ما وزن كاربونات الكالسيوم التي عند تسخينها التام تعطي ٢١ غدم من الكلس الحي .
- ٢_ اذيب عشرة غرامات من اوكسيد الكالسيوم في الما * . ما وزن كاربونات الكالسيوم النات من امرار كفايدة من ثاني اوكسيد الكابون عليب







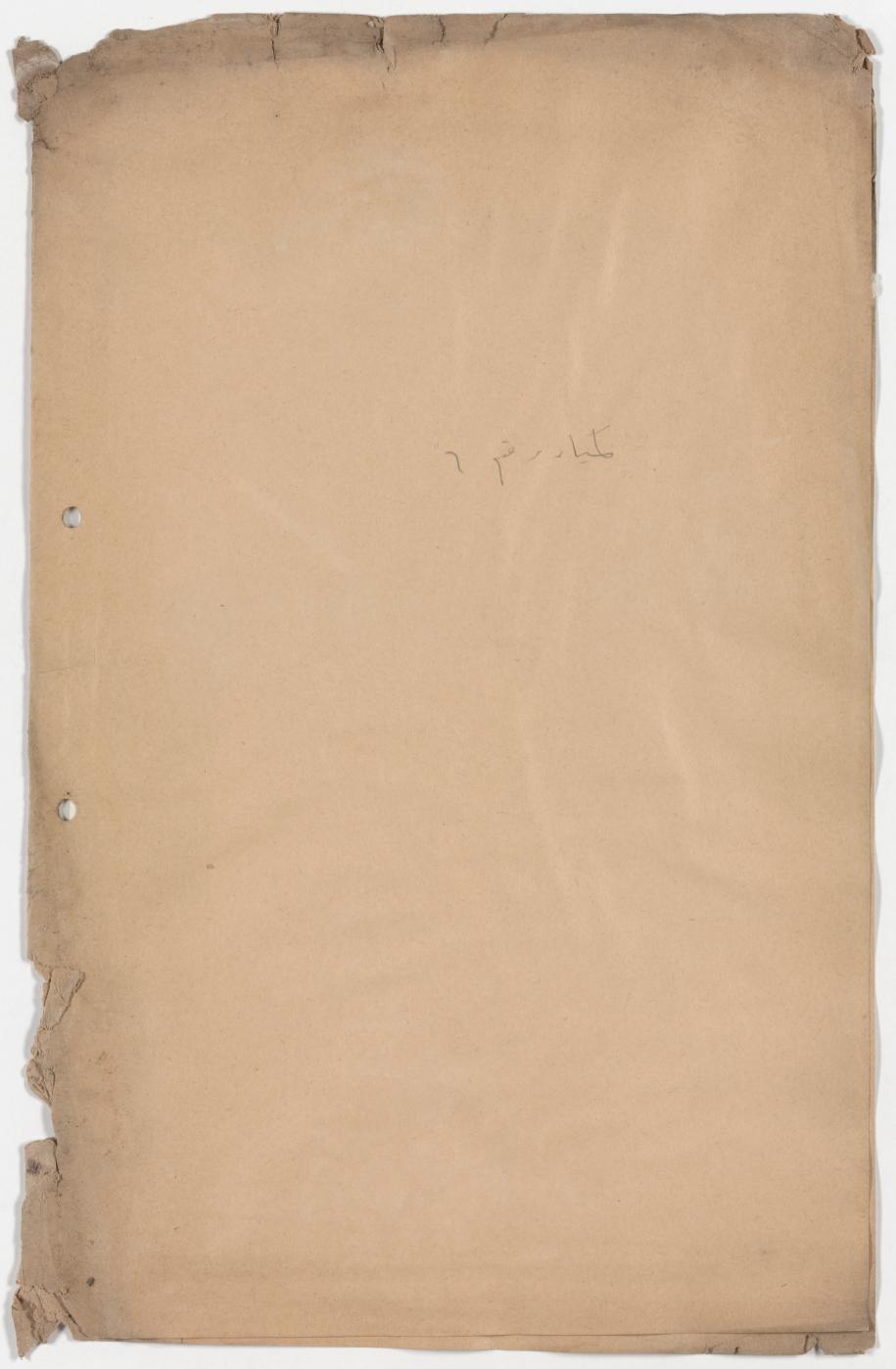
- (٣) ما حجم النيتروجين الجاف في ١٢م وضفط ٧٧٠ ملم/زئبق الناتج من تسخيين ٢٨ مم من نترات الامونيوم .
- (٤) اوكسيد الرصاص الاحمر Pb304 عند اتحاده مع حامض النتريك لاعطاء نـــترات الرصاص وثاني اوكسيد الرصــاص Pb02 ما وزن فوق اوكسيد الرصــاص الناتج من تفاعل ١٣٧ غم من الاوكسيد الاحمر .
- (ه) اذيب وزن معين من الفضه في حاص النتريك ثم رسبت الفضه على هيئة كلوريد الفضة باضافة ملح الطعام، فاذا كان ٢٣٢ر١ غم من كلوريد الفضه قد ترسب، فملل مقدار وزن الفضه في النموذج .
- (٦) ما وزن كلوريد الفضة المترسب من اضافة لتر واحد من محلول ١٠٪ من ملح الطعام الى محلول نترات الفضه .
- (٧) عومل ٥٠ سم ٣ من هامض الكبريتيك من معلول كلوريد الباريوم الساخين هي اتسام الترسيب وبعد غسل الراسب وتجفيفة وجد انه يزن ١٦١٥ غم العسب تركير العامض في هذا المعلول .
- (A) اذیب ۲ غم من ملح کلوبر Na₂SO₄.10H₂O في الما ثم رسب با ضافة کميـــة وافية من کلوريد الباريوم المسب وزن کبريتا تالباريوم المترسبة.
- (٩) احسب وزن اوكسيد الزئبق الاحمر الذي يعطي من الاوكسجين ما تعطيه و غرامات من كلورات البوتاسيوم .
- (۱۰) ما مقدار وزن غاز الكلور بالفرامات التي يمكن المصول عليها من تسخين ٥٠ غـــم من ثاني اوكسيد المنفنيز مع كفاية من حامص الهيد روكلوريك .
- (۱۱) اذا اردت تعضير ۱۰۰ غم من نترات الامونيوم ، احسب وزن كلوريد الامونيوم اللازم للحصول على الامونيا اللازمة ، ثم احسب وزن نترات الصوديوم اللازمة لتحضيير حامض النتريك اللازم للتفاعل .
- (١٢) ما وزن الماء المتكون عند اختزال ١٠٠ غم من اوكسيد النحاس باستعمال الهيد روجين وما حجم الهيد روجين في ظ.ق. اللازم للاختزال.





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- (٦) عند اخترال ٢٠,٣ غم من اوكسيد فلز بخاز المهيد روجين نتى ٢٧و. غم من الما فاذا علمت ان المرارة النوعية للفلز ٤٥٠٥، فما الوزن الذرى المضبوط للفلز ؟ وما حجم المهيد روجين في الظروف القياسية الذي قام بحملية الاغترال.
- (Y) اوكسيد فلزيحتوى على ٥٣ / من الفلز وان وزن اللتر من هذا الاوكسيد في ظ.ق. هو ١٤ ره غم احسب الوزن الذرى والتكافو.
- (A) فلزيكون كلوريدين يحتوى احد ها على ١ر٤٤٪ والثاني على ٥ر٤٣٪ من الفلسيز فاذا كانت الحرارة النوعية له ٢ رو. احسب الوزن المكافي والتكافو لكل مسين الكلوريدين والوزن الذرى المضبوط للفلز .
- (٩) ٤ ه . و . غم من فلز كون ٢٦٧ و . غم من الكلوريد العسب وزنه المكافي واذا كليان الفلز ثلاثي التكافو العسب الوزن الذرى المضبوط للفلز .
- (۱۰) فلز عرارته النوعية ١١٤و٠ وعند اختزال ١٨٦ ١٦٦ غم من اوكسيدين مختلفين اعطى كل منهما ١٠١٠ غم من الظز احسب التكافو والوزن الذرى المضب وطلم المنا الظز .
- (۱۱) وجد ان ٢٦٦٦ غم من كلوريد احد الفلزات يعتوى على ١٣٥٥ غم من الفلز . فمسا الوزن المكافي والفلز ؟ واذا علمت ان المرارة النوعية للفلز ٢٦٥، فما الوزن الذرى المضبوط .
- ١٢) اغم من فلز ثنائي التكافو مثل x عند اذابته في عامض الكبريتيك المخفف اعطيب ١٢٣ سم٣ من الهيد روجين في درجة ١٥م وضفط ٢٦ سم/زئبق احسب مكافيي الفلز ووزنه الذرى المضبوط .
- اعطى ٢٨٤ره غم من البوراكس المتبلور الذى صيفته الجزيئية الجزيئية السوزن السوزن الملح اللامائي عند تسفينه وتجفيفه، فاذا علمت ان السوزن الدرى للصوديوم ٢٣ وللاوكسجين ١٦ والمهيد روجين ١ اعسب الوزن السندرى للبورون .





الأوزان الجزيئية

١- الوزن الجزيئي للماز او البخار = ٢ × كثافته النسبية " " الكثافة المالقة له × عر ٢٢

" للمادة غير المتأينة = وزن المذاب × ثابت الدرجة × ١٠٠ وزن المذيب × مقد ار الانخفاض او الارتفاع

- ٦ر . غم من سائل عند تبخره شفل عجما قدره ١٧٦ سم ٣ عند درجة ١٥٠ م وضفط ٠ ٥٠ ملم/زئبق . احسب الكثافة البخارية والوزن الجزيئي لهذا السائل .
- (٢) احسب الوزن الجزيئي لماز اذا علمت ان ١٥ عسم منه في درجة ١١م وضفط ٢٥٢ ملم/ زئبق يزن ٥ر٢ غم .
 - (٣) ما هو حجم ه غم من رابع كلوريد الكاربون في درجة ٢٦م ه وضغط ٥٠٠ ملم/زئبق اذا علمت ان الوزن الجزيئي ١٨٣٥٨٤
 - اذا علمت أن اللتر الواعد من مادة متطايرة في درجة ٤٠ م وضفط ١٨٥ ملم/زئبت يزن ٨٦ آيها في المسب الوزن الجزيئي .
- (٥) احسب وزن اللتر الواحد من غاز الأمونيا تحت الظروف القياسية اذا علمت ان الوزن الجزيئي ١٧
 - يحتوى معلول مائي على ٥ر٤ غم من مادة غير متأينة مذابة في ١٢٥ غم من الماء. وجد ان درجة انجماده _ ٢٢ ٣٠٠١٥ احسب الوزن الجزيئي لهذه المادة .
 - (٧) اذيب ١٨ر٤ غم من سائل غير متطاير وغير متأين في ٥٥٠ غم من الما و فغلى المعلول في درجة ١١٠٠١م احسب الوزن الجزيئي لهذا الساعل .
 - (٨) ما درجة انجماد وما درجة غليان معلول سكر القصب النات من اذابة . م عم من السكر في ١٥٠ غم من الماء اذا علمت ان الوزن البزيئي لسكر القصب ٢٤٣٠
 - (١) درجة انجماد نموذج من النفتالين ٢ر٠٨م٥٠ وعند اذابة ١٢٥ر٠ غم من مادة فييي ٧٠٠٧ من هذا النموذي من النفتالين وجد أن المعلول انجمد في درجة ٢٥٥٢م اعسب الوزن الجزيئي للمادة المذابة اذا علمت ان ثابت انجماد النفتالين ١٦٨م٠
 - (١٠) اى المحلولين يغلي في د رجة اكثر محلول يحتوى ٤٠ / وزنا من الكليسيرين ام محلول يحتوى على ٦٠٪ وزنا من الاسيتون اذا علمت ان الوزن الجزيئي للكليسرين ٩٢ وللاسيتون ٨٥٠

and the second second

٠٥٧ علم / زيد ١٠ مس المنافة المسائرية والوزن المرزي لم ذا السائل ١ (سرم) المستالون المربع لا إلا طمعان و ١٥ ملم منه في درية ١٨ أو ما ٢٥٧ملم الاص

الرزن الرزي لليادة غير المتايدة ما المتايدة ما المتايدة ما المتايدة ما المتايدة ما المتايدة المتايدة

(- ع) اذا طبحان اللعرالوا من طبق حاليرة في صربة - ع أو خط ه ١٧ كم / زائد بنن المراجعة المر

90 112° 161 desito the of the cas, he ? 112 - 7371

التموان عن الكنالين و د ان الم لواداد عد في در ة ٢٥٥٧ مُا سيالون المرتبي للمادة

للمفالخامس الاعدادي (العلمي)

الا وزان الرزئي

1- الوزن الرزيئي للماز او البهار = ٢× كثافته النسبية

٢- الوزن الرزيئي للذاز او البنار = الكثافة المطلقة له x ٢٠٠٤

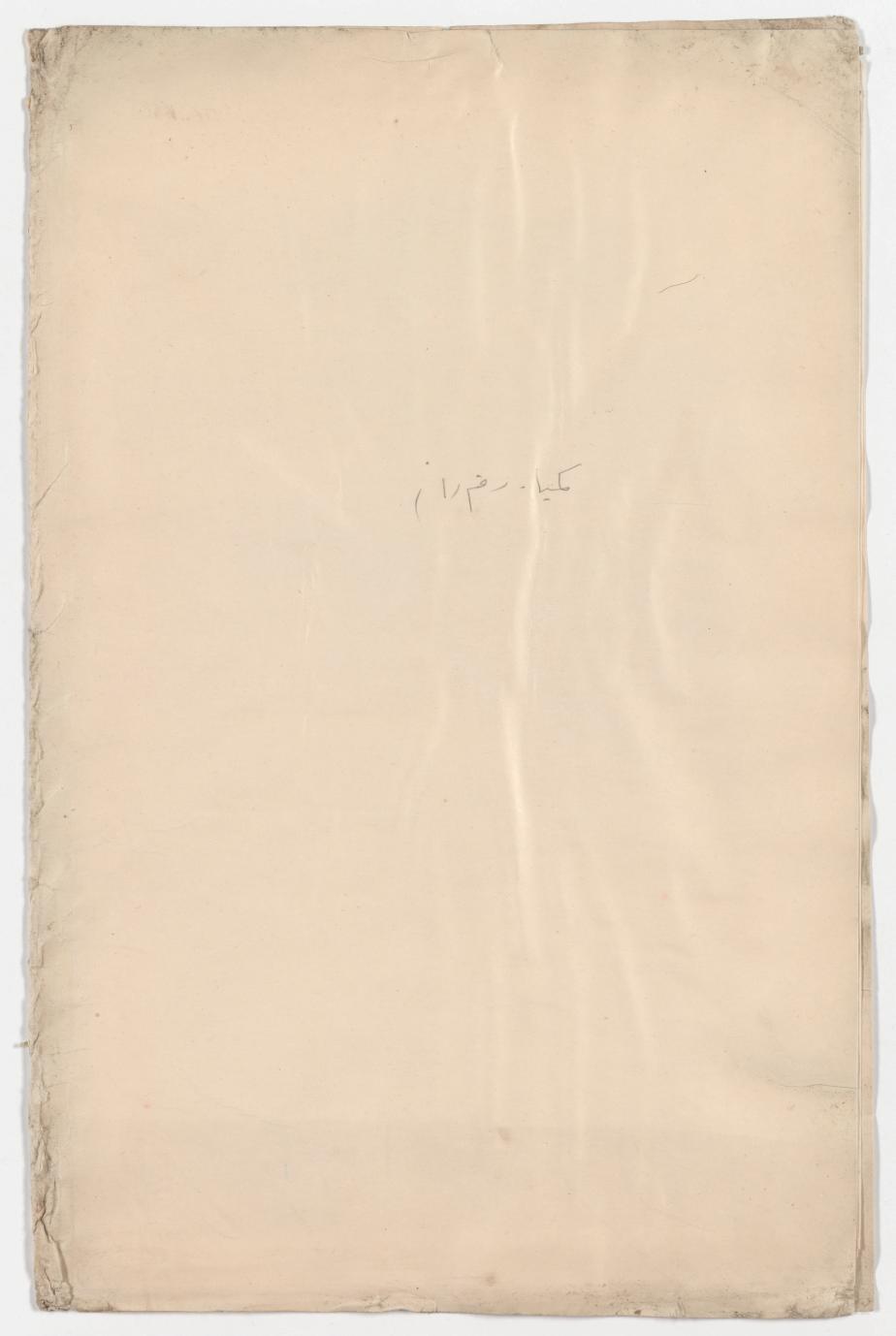
وزن المذاب x ثابت الدرجة x

٣_ الوزن البرزيئي للمادة غير المتاينة = _____

وزن المذيب x مقدار الانخفار او الارتفاع

اسئلة على الأوزان الرزئية

- (س) ، ، ، غم من سائل عند تبخره شغل عجما قدره ١٧٦ سلم عند در من ، ه م وضفط من ١٧٦ ملم / زئبق ا عسباللافة البخارية والوزن الجزيئي لهذا السائل ١
- (س٢) احسب الوزن الجزيئي لذازاذ! علمتان ١٥ علم منه في درجة ١٨م و فعلم ٥ ملم /زئبت يزن ١٥ عم؟
 - (س٣) ما هو جدم هغم من رابع كلوريد الكاربون في درية ٢٧م و ضفط ١٥٠٠ ملم / زئبق اذا علمت ان الوزن الجزيئي ١٥٣٠٨٤
 - (سرية) إذا علمت أن اللتر الواعد من مادة متطايرة في درجة . ٤م وضفط ٢٨٥ ملم / زئبت يزن ٢٨٦ (فم اعسب الوزن الجزيئي ؟
 - (سه) احسب وزن اللتر الواعد من غاز الأمونيا تعت التاروف القياسية اذا علمت ان الوزن الجزيئي ١٧
 - (س٦٠) يو توى مولول مائي على ه ، ٤ غم من مادة غير متاينة مذابة في ه ١ ٦ غم من الما . وجد ان درجة المادة ١ مرحة المادة ١
- (سن٧) اذيب ١٨١) غم من سائل غير متطلير وغير متاين في ٥٥٠ غم من الما و فضلى المعلول في درجة المعالل المعالم الم
- (سر٨) مادرية انهماد وما درجة فليان محلول سكر القصب النات من اذابة ٣٠ غم من السكر في ١٥٠غم من السكر في ١٥٠غم من الماء اذا علمت ان الوزن البازيئي لسكر القصب ٢٣٤٢
- (سرد) درية انجماد نموذي من النفتالين ٢٠٠٨م وعند اذابة ٢١٥٠٠ غم من مادة في ٢٠٠٧ من هذا النموذي من النفتالين وجد ان المدلول انجمد في درجة ٢٠٥٢م المسبالوزن الجزيئي للمادة المذابة اذا طمتان ثابتانهاد النفتالين ٦٨م؟
 - (س. ۱) المعلولين يخلي فعدرجة اكثر معلول يعتوى ٤٠٪ وزنا من الكليسرين ام معلول يعتوى على ١٠٠٪ وزنا من الاسيتون اذا علمت ان الوزن الجزيئي للكليسرين ٢٦٪ وزنا من الاسيتون اذا علمت ان الوزن الجزيئي للكليسرين ٢٦٪ وزنا من الاسيتون اذا علمت ان الوزن الجزيئي للكليسرين ٢٦٪ وزنا من الاسيتون اذا علمت ان الوزن الجزيئي للكليسرين ٢٦٪ وزنا من الاسيتون اذا علمت ان الوزن الجزيئي للكليسرين ٢٦٪



بالماء

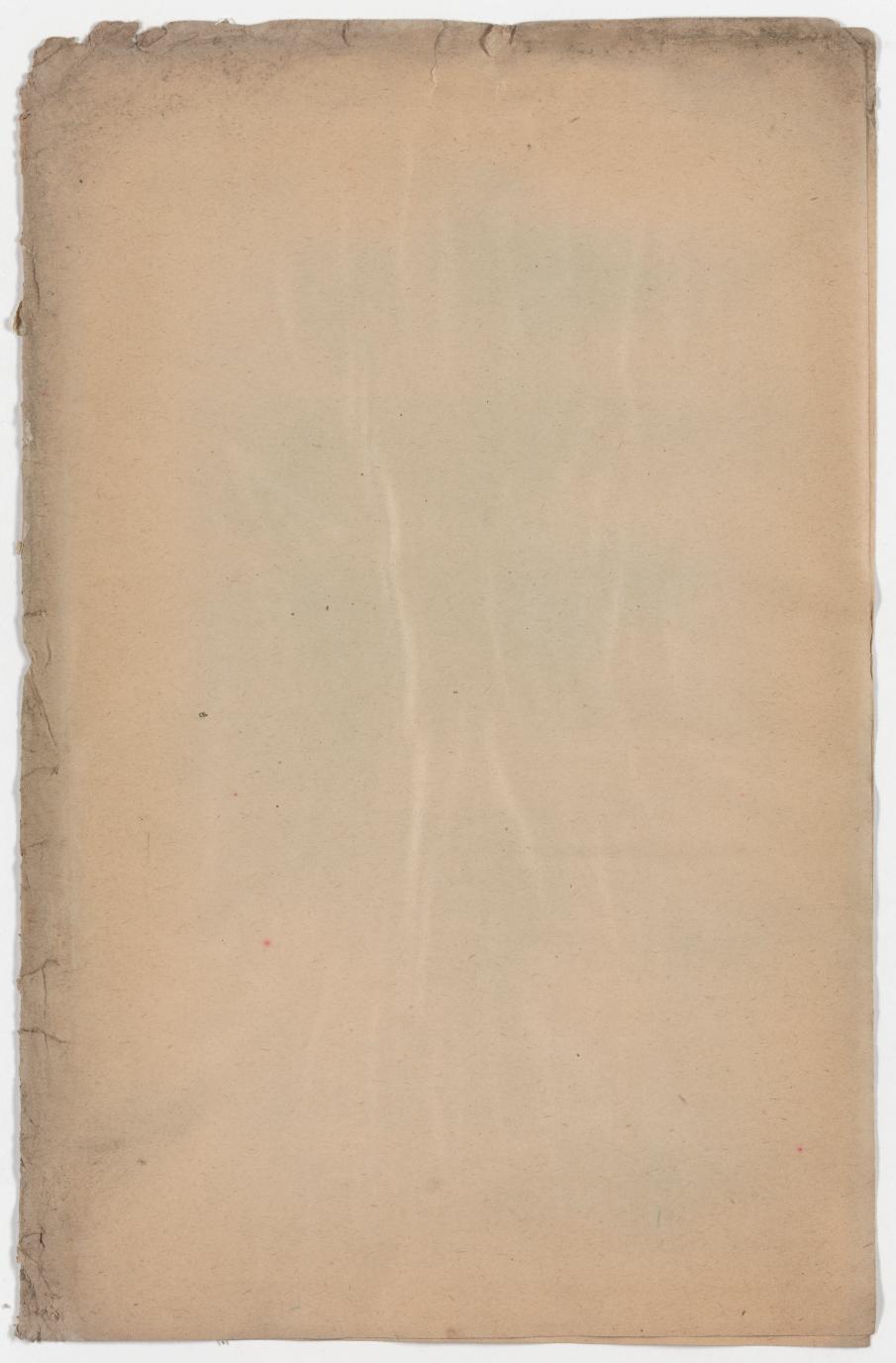
January Committee the Land or to 12 the first transfer There are all the things or as the Late of all and there is not all all as Plant state Mil to the Trong to logically being a growthing that the million to the state of the sta T) The way there It was a there It was now (of a by) the will be it it in State of the state ME Course to the the characterist of the health of the training of the training I (Type in the series on a life of the car of the carbon of the المريد والمراج المراجع والمراجع المراجع المراج tradicate to a my destinate that I adopt if we contact at a may a to Charles to the control there are all (1) Miles & formal mention of with a second state of (a many) and the thereone. 1 - 4 (L) 1 (1) The Committee of the state of t The second of th CONTRACTOR CONTRACTOR CONTRACTOR CONTRACTOR hiller to the grant of week of my (2/63) on the house he have to

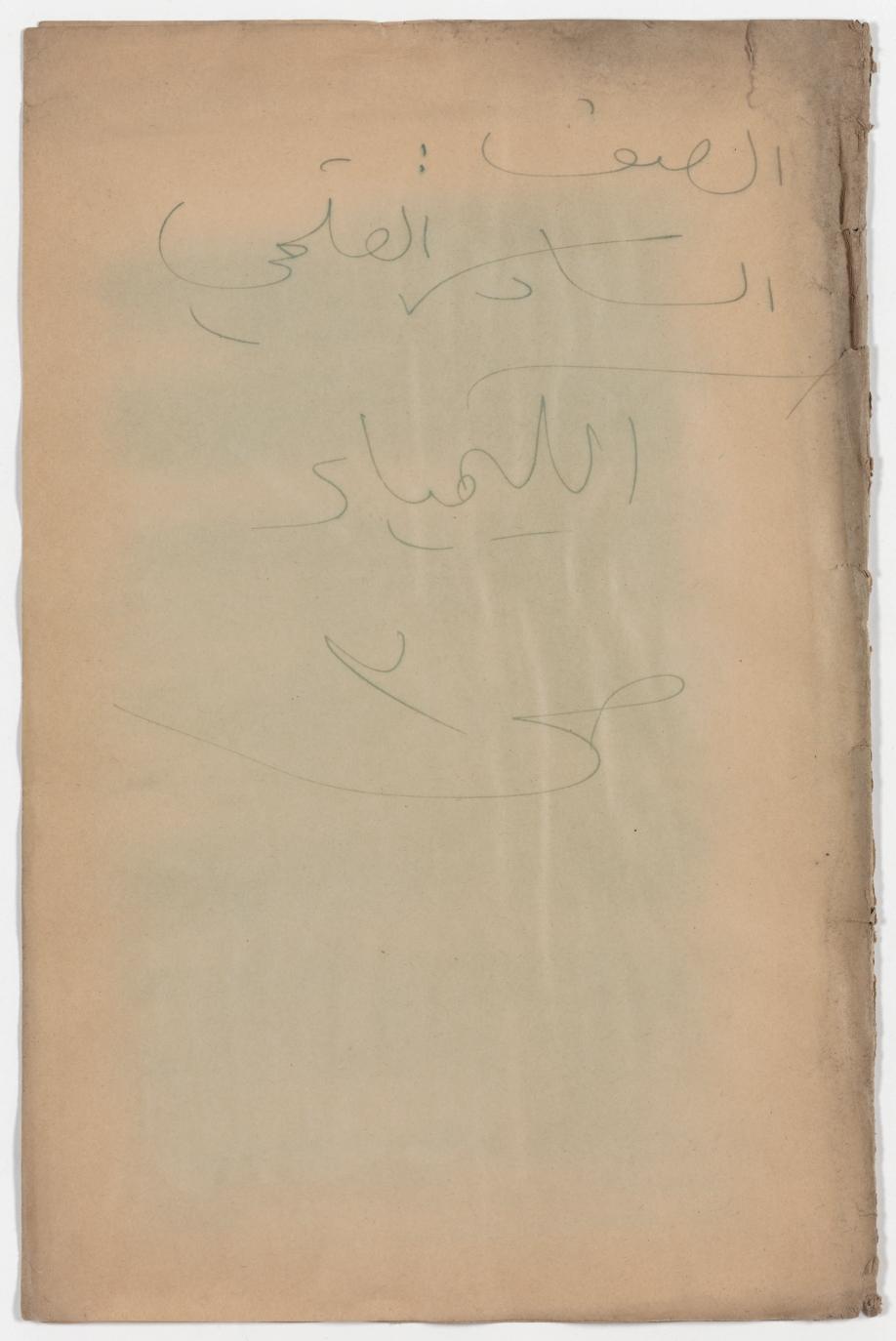
(1)

- ٢٧) نعوت جين من الكاربونات عود لت بحامض قياس فاحتاج النموذج الأول ٧ر مرة بقد ر مااحتاجه النموذج الثاني فاذا كان النموذج الأول هو كاربونات البرتاسيوم ، وكان النموذج الثاني خليدا ، من (اغم كاربونات الصود يوم) والباقي كاربونات الليثيوم ، احسب مقد اركاربونات الليثيوم في النموذج الثاني اذا كان النموذج ان بنفس الوزن ،
 - ريادة من هيد روكسيد الصوديوم ثم قطر المعلوب الناتج وامتر غاز الامونيا في الما واضيف اليه زيادة من هيد روكسيد الصوديوم ثم قطر المعلوب الناتج وامتر غاز الامونيا في (١٠٠ سمّ) من (١٠٠ عامل المهيد روكلوريك ثم احتاج المعلوب الرقبقي (٣٣ر٣٣ سمّ) من (٥١ر٠٤) من قاعدة . احسب النسب المعلوبية تك من مكونات الخليد .
 - الما يو الما عن مادة غذائية عند تعليلها تحررت الأمونيا ثر امتصت في الما وعود لت مع حامد الهيد روكلوريك احسب عيارية الحامر اللازم بدعيث تكون قرا أة السحاجة مساوية للنسبية الما يو المركب .
 - وم الله الموات الموديوم ومادة غير فعالة او كاربونات الموديوم ومادة غير فعالة او بيكاربونات الموديوم ومادة غير فعالة او كاربونات الموديوم وبيكاربونات الموديوم ومادة غير فعالة او كاربونات الموديوم وبيكاربونات الموديوم ومادة غير فعالة او كاربونات الموديوم وبيكاربونات الموديوم ومادة غير فعالة او كاربونات الموديوم ومادة غير فعالة او كاربونات الموديوم ومادة غير فعالة الموديوم ومادة غير فعالة الموديوم ومادة غير فعالة او كاربونات الموديوم ومادة غير فعالة الموديوم ومادة فيربونات الموديوم ومادة غير فعالة الموديوم ومادة فيربونات الموديوم ومادة فيربوم ومادة

النموذج مقدار الحامر باستعمال الفينول فثالبين مقدار العامر اللاضافي باستعمال النينول فثالبين البرتقالي المثين البرتقالي المرا السم المرا المرا السم المرا المرا

- رس الأكسدة (اغم) من كبريتات العديد وز الامونيوم اعتا ، (٥ سعم) من عامل النتريك . ما عجم الما اللازم المنافته التي (٠٠ هم) من هذ العالم الما اللازم المنافته التي (٠٠ هم) من هذ العالم الما اللازم المنافته التي (٠٠ هم)
- اليها عامل الكبريتيك ثم اضيف الله (١٤٠ سمّ) من معلول كبريتات العديد وزالا مونيدوم الدايكرومات اضيف اليها عامل الكبريتيك ثم اضيف الله (١٤٠ سمّ) من معلول كبريتات العديد وزالا مونيدوم العاوية على ستة جزيئات من ما التهلور والتي تركيزه (١٠٠ غم) في اللتره ما المعلول الناتي موكسدا ام مختزلا وما عجم (١٠٠ ع) من المعلول الموكسد او المختزلا وما عجم (١٠٠ ع) من المعلول الموكسد او المختزلا والمختزلا وما عجم (١٠٠ ع) من المعلول الموكسد او المختزلا والمختزلا والمختربات والمختزلا والمختزلا والمختزلا والمختزلا والمختزلا والمختزلا والمختزلا والمحلول الناتي موادن المحلول النات

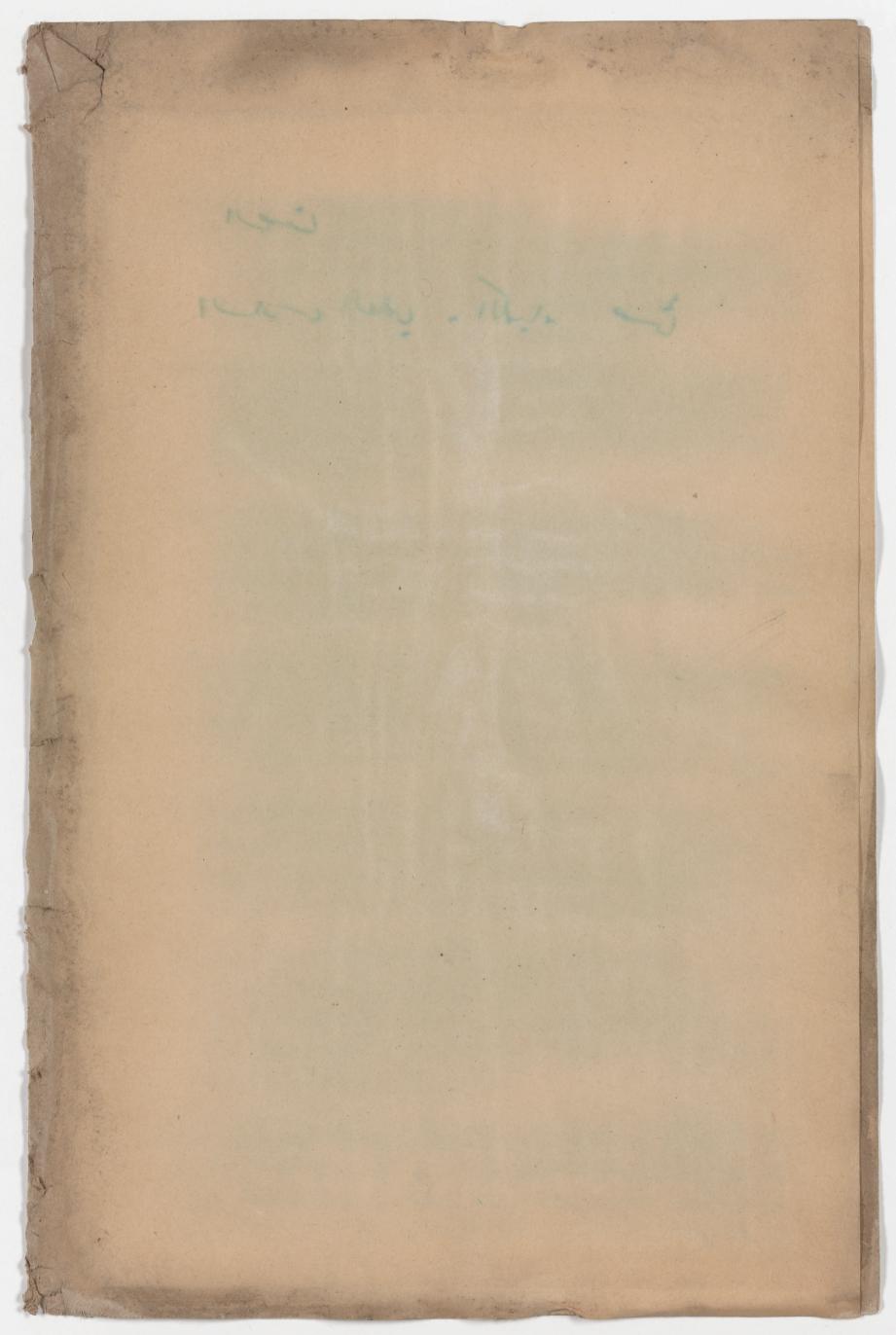




y ... or ... I familia Hay . Healing the games. ور) أديب رغر من كارونا عالماللسيوم التقيدة في ١٠ يميم " من معلوك عاصر البيد وكورسية how to what the car the oran ? as and a surger must there say had the will (. 1) my " or whole are recommended you had not build to get I are a which Ilda Il de a la come a la come a la come de م 7) و جروفي من مناوط علمي الطمساع و كارونات المود يوم اللاماعيد م أذ يبت في الماء المقار وأكلت الى ١٠٠١مم، (١٠٠)مم من مذا المعلول اعتاب لما دانينا : مره ٢٠٠٧ من الرومياري عامد الكيريتياء المسبب النسبة المؤية لكل من الملتيسين & Milyd I Vali 17) Land & & Marine of the state of the land of the state ٣٠٦١ في من بلورات كريد التاليد يهدور أن يسب في ١٠ وسيم من المعلسول , arome (07) my " or and that yet to and the sity my " mine مشدر عياري برديد العرضامين برم. 77) on A thousand it o young " - washed about the grand of all the grand of the the The identity to the ACT Thing? or which are given though you them time او فيهاوي الذا كالمت النسبة بيس وي المالميس في مناوليمسيا مسيس الفرح على الترميسية احسب وزن كل من الما يتيسن في لتسبر من ماولهسكا. 47) The many deglar of aget the many the dame to the to a do the decide down your in the read to a young of an all the النسية الشيري قلماء التبليون بليرات صردا النسيل. ع م ا ا عسب وزن او کوالات الصول يسوم الناف عيسة و حامد الاو کواليث المقبلود ٥ الاه م المقبلود ٥ المقبلود (Ille of whole I at the lease to the terms :o you Too Hardely will her rong on the graph comme there are think to I would Thistyl Which o you, " as time thestal parts 7,2 you," as I . 10,3 as protiement a My my War. to oyon I related record to an english protection may the former to ويسب اخترال دفيرالمرسم من المملسول واستمام لله الرفاد و جد أنه يحسب الخ ACT TON TO SCIENTIFICATION (16 8 de 10 m) to Hollens It de Kanners.

ص٧- تتمية أسطة الكيميا ، التعليلية المجميدة .

- ور) أذيب اغم من كاربونات الكالسيوم النقيسة في ٠٤ سم من محلول حامض المهيد روكلوريك فوجد أن زيادة الحامض تحتاج الى ٥٢ سم من محلول هيد روكسيد الصوديوم لمعادلتها ٠ (١٠) سم من محلول هيد روكسيد الصوديوم احتاجت لمعادلتها ٤ر٨سم من محلول الحامض الحامض الخامض الأصلي ، أحسب تركيز الحامض و القاعب دة .
 - ٢٠) ه٣ر٤غم من مخلوط ملح الطعام وكاربونات الصوديوم اللامائيسة ، أذييت في الماء المقطر وأكملت الى ١٠٠ سم ٥٠ (٢٠) سم ٥ من هذا المحلول احتاجت لمعادلتها هره ٧سم ٥ من ١٠٠عيارى حامض الكبريتيك ، احسب النسبة المئوية لكل من الملحيسن في الخليط الاصليسي .
- (٢١) احسب × في الصيفة (FeSO4 · ×H2O) من المملوسات التالية: -٢١ عم من بلورات كبريتات الحديد وز أذيبت في ٥٠٠ هسم من المحلول محمد في (٢٥) سم من هد ذا المحلول احتاج الى ١٩٥٩ سمن عشر عيارى برمنكنات البوتاسيوم٠
- ار عيارى، فاذا كانت النسبة بين وزن كل من الحامضيين في لترمن معلولهما الحامضيين في التربيب العسب وزن كل من الحامضيين في التربيب من معلولهما العامضيين في معلولهما المساولة على التربيب، احسب وزن كل من الحامضيين في لتربيب من معلولهما الحامضيين في التربيب، احسب وزن كل من الحامضيين في لتربيب من معلولهما
- و كان المحلول يحتوى على و الفسيل المائية في الماء وكان المحلول يحتوى على على و كان المحلول يحتوى على و كان المحلول على وجد أن و الماء من هذا المحلول على وجد أن و الماء من هذا المحلول تتعادل مع المرا المسم من محلول عشر عيارى لحامر الكبريتيك و احسب النسية المئوية المئوية الماء التبلور في بلورات صودا الفسيل.
- و بسب وزن كبريتات الحديد وز و كبريتات الحديديك في اللتسر من معلولهما اذا علمت أن و ٢ سم اعتاجت ٢ ر١ ٢ سم من و ١ ر ٠ عن برمنكنات البوتاسيوم للتأكسيد و بحد اختزال نفس الحجم من المحلول واسطة ملفسم الزنك و جد أنه يحتال مر٢ ٢ سم من برمنكنات البوتاسيوم زيادة على احتياجه في الحالمة الاولى للاكسيدة .



was Robert & Dans , Marchen & March

من الرام من صود النسباء اذبت في الماء وأكساء السملول الله - 10 سم اء الولا اسمه من من من اللسماء الكرون ا من من الماد لتبساء واسم المن من منا المسلول أحسب المناد المسلمة المناد كا من المداد يسبوم في المناولي .

The see of the said and a Higher by Doger to Have your organics

۱۱) و مسم " من معلول تشرات الرصال وأصفليسا و مسم" من معلول علين الكيريثيات وراع للترسيسية كيريشسات الرصاع ترسيا تاسنا و وجد أن زيادة الماسرا عنا ستالس و بسم " من عياري هيد روكسيد المود يسوم ما وزن نشرات الرصاع بالفرايات فيسسي اللتر من البحسلول ؟

١١) غليط من صود الفسيط وبيكارونات الصود يوم فعادلت من ٥٧ وميار المام من المام من المام ، من المام ، المام وبيكارونات المام ال

١١) أله بين اغم من كاربوسات أسد الفلزات في و ٢ سم " من عيارف حامد المبيد روكوريه فوده أنه على بود اسم " من عيارف عيد روكسسيد المود يسوم لمصادل المالا المالا المترقسيين فاسسب كافي كاربونات الفلز.

١١) يا تود سامر الكريتيا التعارد على ها من وزنه ما و فاذا كان وزنه النوس عمد ا ضا درنيوه الصيارد ؟

ه ١١) ما عبدم تاني أوكسيد الكانون تعد ط و . اللازم للتفاعل مع التر من مطول عبدروكسيد البان سيرم الذي تركيزه المبازي ١١ه ع ؟

المودين العادل ، وفي عن الله الكرية المسال قوة العاسية ما معادل ميد وراسيد المودين العادل ، وفي عن في الله و المسال قوة العاسية من الله من الله و ال

السما من المراض عبد وكسميا "مود يسوم بج تحور وغم من كاربيد ما المود يوم البادية المادية المرادية المادية المرادية المرادية ما مرم عبارى عامل المهدد يوكوريان اللازم المسماد السماد السماد المرادية . و سم المرادية المسماد السماد الم

مدا ، اسم " من معتوى على عاملي النترب والبهد الالورب ، به مثال لمعادلت القامسة مرد اسم " من عبارت عبد ركسيد المرد موم و عند القربسيب باستعمال زبادة سين التواجع و عند القربسيب باستعمال زبادة سين التواجع التواجع التواجع المعامل الماد في من الوربسيد . التحسيد المحسيد المح

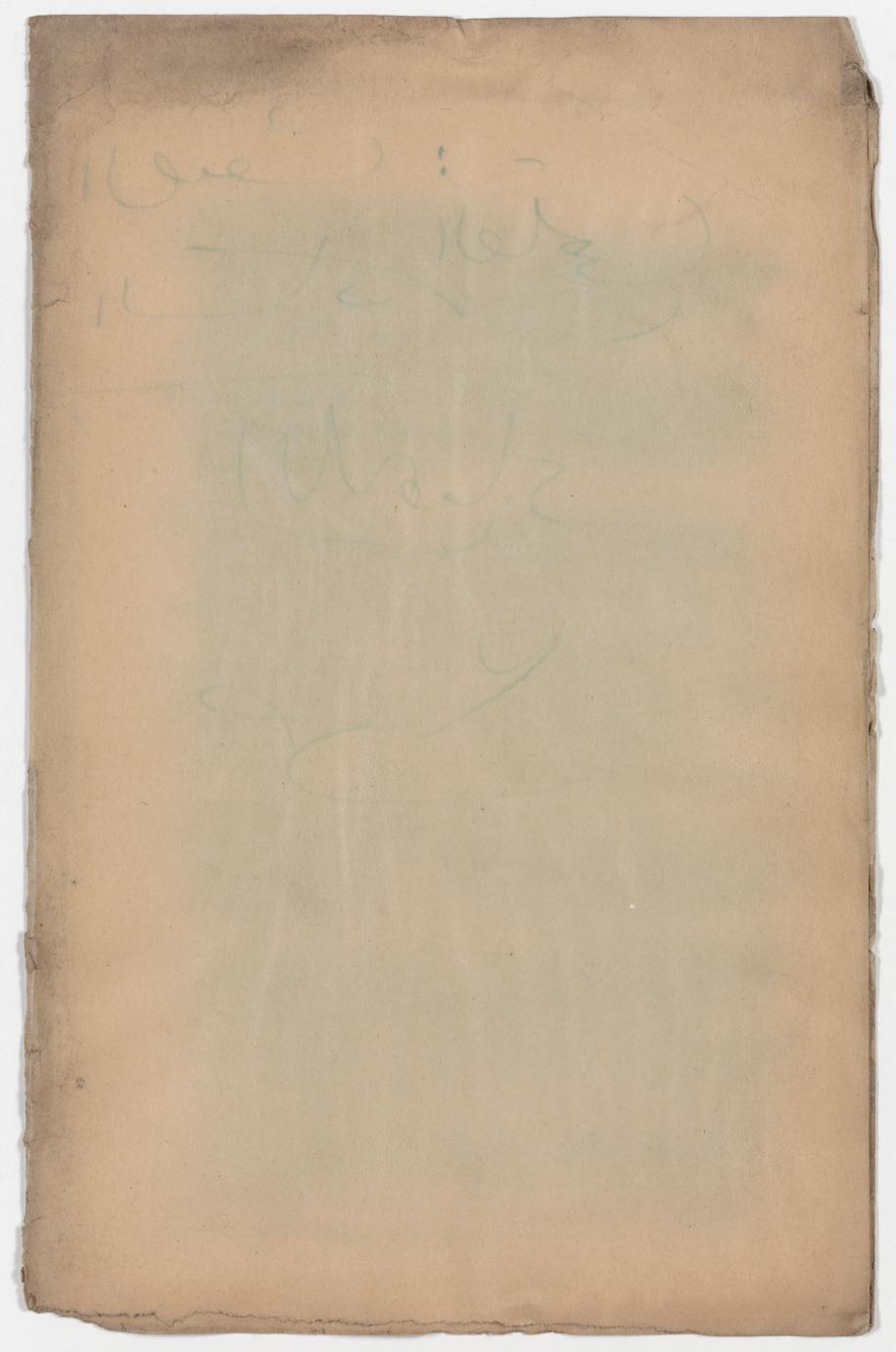
Maccon .

صلاحتكاء الكيماء التعلملسة المجمسية

- و النسبة المثويات ما النبيات في الماء و أكسل المحلول الى ١٥٠ سم ، ٣ ١٥٠ سم ، ٥٠ من هذا المحلول أحسب:

 ١- النسبة المثويات لوزن كا ربونات الصوديات وم في النبوذج .
 ٢- عدد جزيئات ماء التبلور في كا ربونات الصوديات وم .
- (۱۱) هسم من معلول نترات الرصاص ، أضيفلها هسم من معلول عامض الكبريتيك ١راع فترسببت كبريتات الرصاص ترسيبا تاسا و وجد أن زيادة العامض اعتاجت الى و مسم من عيارى هيد روكسيد الصوديوم ما وزن نترات الرصاص بالفرامات فيسيب اللتر من المعسلول ؟
 - و بيكاربونات الصود يوم تعادلت مع ه ٧ ر عيارى عامض المهيد روكلوريك بحيث أن ٨ ر اغم من الخليط احتاجت الى ٣ ٢ سم من الحامض ، فاحسب النسبة المئويسة للخليط.
 - 17) أذيب اغم من كاربونات أحد الفلزات في ٢٥ سم من عيارى حامض الهيد روكلوريك فوجد أنه يلزم ور٠١ سم من عيارى هيد روكسيد الصوديوم لمعادلية الحامض المتبقي فاحسب مكافئ كاربونات الفلز.
 - ١٤) يحتوى حاصل الكبريتيك التجارى على من وزنه ما فاذا كان وزنه النوعي ١٨٤ فما تركيزه الميارى ؟
 - ه ۱) ما حجم ثاني أوكسيد الكاربون تحت ظ .ق . اللازم للتفاعل مع لتر من معلول هيد روكسيد الباريسوم الذى تركيزه الميارى ۱/ه ع ؟
- 17) نحتاج ١٦٤ ٢سم من محلول عامض الكبريتيك لمعاد له ٢٥سم من محلول هيد روكسيد الصود يوم الحاوى ٢٠غم من في اللتر ، احسب قوة الحاسض مقدرة بالفراسات في اللتر من محلوليسيه .
 - ١١) خليسط من ٢غم من هيد وكسيد الصوديدوم مع ١٧٥ راغم من كاربونات الصوديوم المائية أذيبت في الماء واكمل المحلول الى لتر ، ما حجم عيارى حامض الهيد روكلوريك اللازم لمعسادليدة ، ه سم من هسدا المحلول.
 - ۱۸) ۲۰سم من يحتوى على حامضي النتريك و الهيد روكلوريك . يحتاج لحماد لته التاسة هر ۱۸ من عيارى هيد روكسيد الصود يوم و عند الترسيب باستعمال زيادة مسن نترات الفضية وجد أن ۲۰سم من المحلول الأصلي يمطيبي ۱۸ و ، غم من كلوريسد الفضية واحسيب وزن كل من الحامضين في لتر من المحلول الأصليب.

يتب ع ٢٠٠٠٠٠٠



.. . .. () أوسند دالة المعرضة (١٤٥١) و دالمية القاعدية (١٥٦) لمعلول عامد الهيد وكوريدان y) أحسب وركيسز أبون البيد رونيوم في حطول ، اذا طمت أن د المدة الموضدة فيده (EF) ٣) . أغسب دالة المعرف في درجة و ٢ م لمحلول ار ، مولازي من سيانيد المرد يسوم . ع) أحسب تركيز أيونات المهدوركسيد في معلول ١٠٠ عيارى من عامن الكيريتين . 112 J. Hadden - Herryannan D ١١) ما مسم عيدروكسيد الموديم الساود على ، ٢٥م الترالذ و يمكل لسادلت ، ١٠مم ين مماول عامر الكبريتين الماوي على ١٥ مم المي . م) عملول ن البوط سنة الكاوية يعتود على وفي/ لترس عمد ما مجم عام اللبريتية المدفقة المعاود على برقم المترين المعاسد اللازم المعاد لدة و برسم من الموقاسسة الكاويسة عملاده . . . يبخير المعلول المتصادل ، ما وزن الراسسية المتكون . ع) أحسب مجم مطول عامل الكيريتين المارى على عقر الترس العاصص اللان لما د السنة ٠٠٠ مم ٢ من فار الأمونيا في ط وق . ه) أذيب افران عيدوكسيد الموديور الملب في . ومم " من فيارى عامد البيد ووكورت ، الما جدم عيارى عبد روكسيد الموديوم الذوم لسادلة الماعز المتقسسين ١) ١٠ (سم عمر ما مساد النقويت عناهاست مع كاربونا ع الكالسيوم النقية "الكلسيات" سأذاب و يرزفم من البلورات، المسب توكسر المساسسية. Y) en lo . Tog to adel sugo de out they lie or aget the lade O HOT. 00 and advantable pulled or of this of which also de literature قط النسسية الطويسة للنقبارة في العادة . ١١ ١٠ و . في من أحد الفلوات أف يه في ١٠ . ومن " من عبارى ساسر الكيريدية فوجد يصد ذلك أنه يان الله و مسم من عبارة العدة اساماله مع ما يكافئ الناسير . ١١٧٠ من على على الناعة ومتوى على جويتين من ناء العلود أن يب في الماء وأكما Thought the . 07mg 7. 07mg 7 as all thought todas had a ball togal Fymy 7 as عاري كاربونات الموديع. احسب :-٧- الوزن الجزيش للما من اللاماش. whoman of a so a

194./1/10

الكيمياء التحليلية

الصفالساد سالعلمي

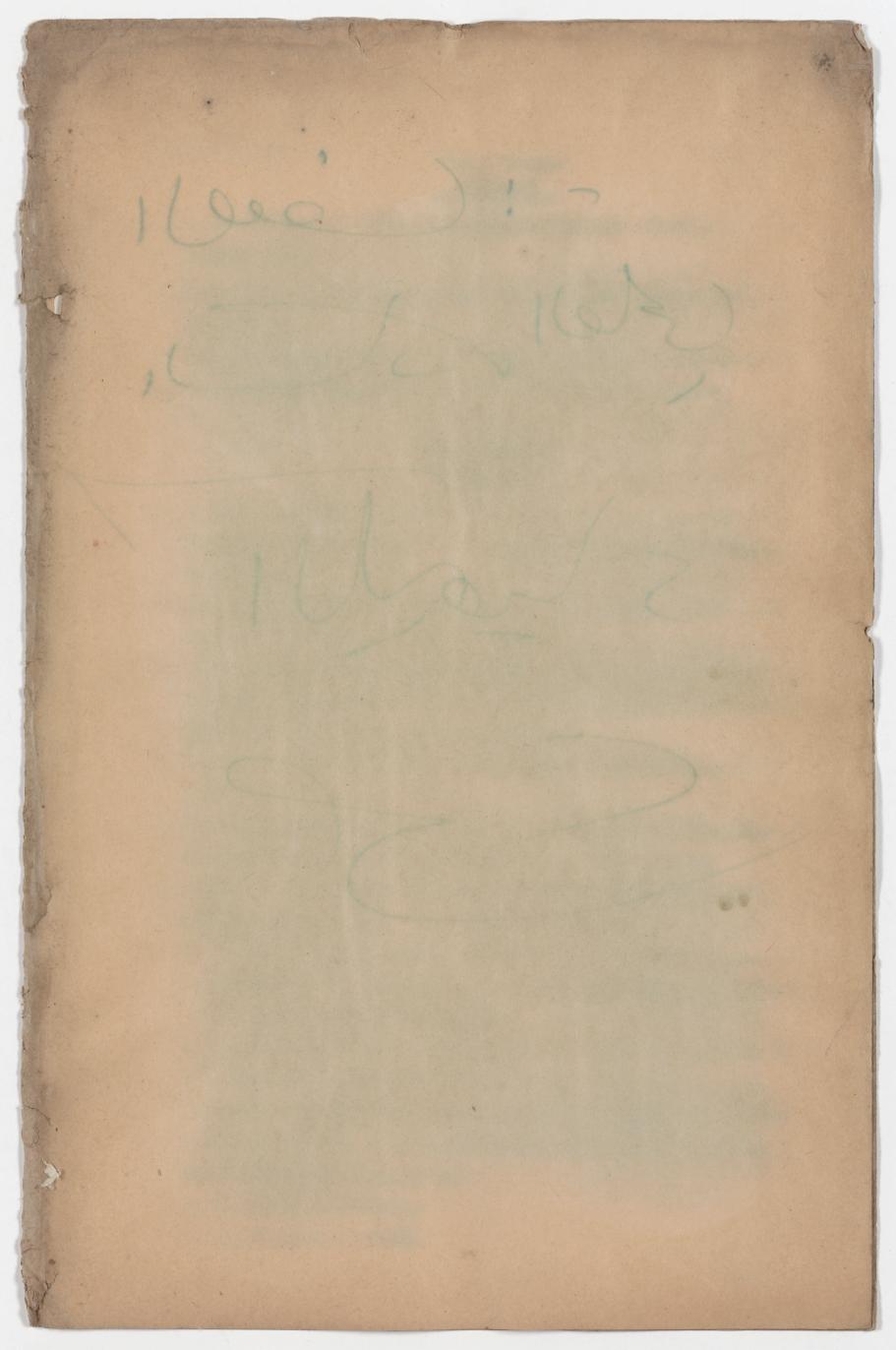
- ٢) أحسب تركيز أيون الهيد رونيوم في محلول ، اذا علمت أن دالمة الحموضة فيه (PH) تسلوى ٨ر٤٠
- ٣) أحسب دالة الحموضة في درجة ٥٢٥م لمحلول ١ر. مولارى من سيانيد الصوديدوم.
 - ٤) أحسب تركيز أيونات الهيد روكسيد في محلول ١ر٠ عيارى من حامض الكبريتيك.

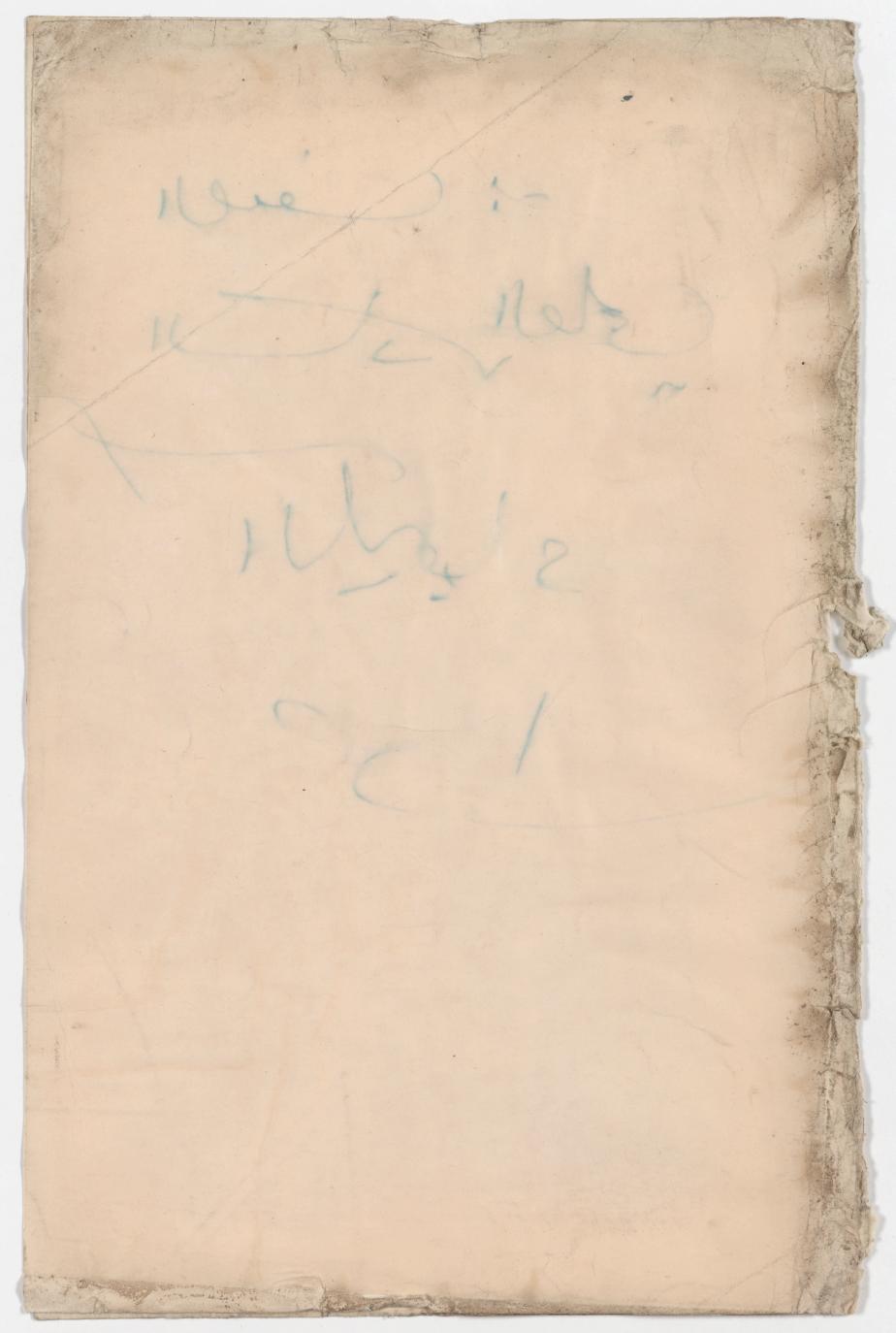
الكيميا، التحليلية

- ﴿) ١٠٠٠سم من محلول الصود الكاوية احتاجت لمعادلتها ١٠٠٠سم من محلول عاميض المهدد روكلوريك الحاوى على ٣ر٧غم من الحامض في اللتر، أحسب تركيز الصود الكاويية في محلولها محلولها الكاويسة
- ٢) ما حجم هيد روكسيد الصوديوم الحماوى على ٢غم/لتر الذي يحتاج لمعادلته ١٠٠ سم ٣ من محلول حامض الكبريتيك الحاوى على • ٢ غم/لتر •
- ٣) محلول من البوتاسية الكاوية يحتوى على على على المرمن الله ما حجم حامض الكبريتيك المخفف الحاوى على المغفر المرمن الحامض اللازم لمعادلة ه ٢سم من البوتاسية الكاوية و وغيد تبخير المحلول المتعادل، ما وزن الراسيب المتكون.
- إ أحسب مجم محلول حامض الكبريتيك الحاوى على عغم/لتر من الحاصض اللازم لمعادلية
 إ أحسب مجم محلول حامض الكبريتيك الحاوى على عغم/لتر من الحاصض اللازم لمعادلية
 إ أحسب مجم محلول حامض الكبريتيك الحاوى على عغم/لتر من الحاصض اللازم لمعادلية
- ه) أذيب اغم من هيد روكسيد الصوديوم الصلب في مهم من عيارى حامض الميد روكلوريك ، ما حجم عيارى هيد روكسيد الصوديوم اللازم لمعادلة الحامض المتبقيين.
 - 7) ١٠٠ سم من حامد ف النتريث تفاعلت مع كاربونات الكالسيوم النقية "الكلسايت" فأذابت ه ٨ر اغم من البلورات، احسب تركيز الحامدة
- ٨) ٦ر وغم من أحد الفلزات أذيب في ١٠٠ سم من عيارى حامض الكبريتيك فوجد بمد ذلك أنه يحتاج الى ٥٠ هسم من عيارى قاعدة امعادلته ، ما مكافئ الفليين الفليين .
- ٩) ٨٣٨ (غم من حامض ثنائي القاعدة يحتوى على جزيئتين من ما التبلور أذيب في الما وأكمل المحلول الى ٥٠ ٢ سم ٥٠٠ من هذا المحلول احتاجت لمعادلتها ٢٦ سم ٥٠ من عيارى كاربونات الصوديوم . احسب :-

١- الوزن المكافئ لبلورات الحامض،

٢_الوزن الجزيئي للحامض اللامائي .





equation expressing C in terms of we home find the speed at which the cost per contitos mile is least. The ship makes a veyege of 800 neutical miles at a speed of 13 knots (A) the length of the edge after 16 hours;

Pure Mathematics- G.C.E 'A' Level

Supplementary Exercises

From

Sixth Form Pure Mathematics- By C. Plumpton & W.A. Tomkys Vol. I

Page 30

Miscellaneous Exercises I

- 5. A curve whose equation is of the form $y=ax^2 + bx + c$ crosses the y-axis at right angles at the point where y = 12 and also passes through the point (3, -15). Find
 - (i) the values of a, b and c;
 - (ii) the coordinates of the points at which the curve crosses the x-axis;
 - (iii) the gradients of the curve where it crosses the x-axis.(N.)
- 6. Find the equation of the tangent and the equation of the normal to the curve $y=(3-2x^2)^2$ at the point where x=1. (N.)
- 8. If the abscissae of three points P,Q,R on the curve $y=x^2+x+1$ are x, x h, x + h respectively, show that the chord QR has the same gradient as the tangent to the curve at P.
- 9. The total running cost of a ship per hour is £ $(13+\frac{v2}{52})$ where v knots is the speed. If £C is the cost per nautical mile, write down an equation expressing C in terms of v; hence find the speed at which the cost per nautical mile is least.

The ship makes a voyage of 800 nautical miles at a speed of 13 knots. How much money would have been saved if the journey had been made at minimum cost? (N.)

- 11. A block of ice in the form of a cube, whose edge is 2 m, begins melting, and its volume decreases at a constant rate, the block remaining cubical. If the rate of melting is such that the edge measures 1 m after 28 hours, find
 - (i) the length of the edge after 16 hours;
 - (ii) the rate at which the length of the edge is decreasing at that time. (N.)
- 12. Find the maximum and minimum values of the function $\frac{1}{3}(4x^3-3x-1)$. Sketch the curve $y=\frac{1}{3}(4x^3-3x-1)$ and find the greatest and least values of y for values of x in the range 1.5 to + 1.5 inclusive. (N.)

(cont'd.p.2)..

Tochen frams Japen III + IK G. C. En Advanced Cevel Opplied Moth Jan. 1965

A particle is cusponded from a fixed point by a light inextensible string of length 1 and is given an initial horizontal velocity of [5]. Prove that it will just be able to describe a complete vertical circle provided that the string can sustain a tension of not loss than six times the weight of the particle.

If it feet the string explace that the grashest initial horizontal velocity weight of the particle find the grashest initial horizontal velocity into don be given the particle without breaking the string, and determine in this case where the particle will come to instantaneous rest.

(1) Prove that if a particle is suspended from a fexed general type of the string position of the string of the displaced vertically from its schill bring position if will execute simple harmonic motion.

9. A particle is suspended from a fixed point by a light inextensible string of length 1 and is given an initial horizontal velocity of $\checkmark(5\text{gl})$. Prove that it will just be able to describe a complete vertical circle provided that the string can sustain a tension of not less than six times the weight of the particle.

If in fact the string can sustain a tension of only three times the weight of the particle find the greatest initial horizontal velocity which can be given the particle without breaking the string, and determine in this case where the particle will come to instantaneous rest.

- 10. (i) Prove that if a particle is suspended from a fixed point by an elastic thread and is displaced vertically from its equilibrium position it will execute simple harmonic motion.
 - (ii) A light elastic thread OP of natural length a and modulus of elasticity 2mg lies on a smooth horizontal table. The end O is tied to a fixed point on the table and a particle of mass m is tied to the end F. The thread is just taut and P coincides with a point A on the table. The particle is pulled along the table directly away from O until OP = 3a/2 and is then released from rest. Find
 - (a) the time it takes to return to A for the first time,
 - (b) the further time that elapses before it returns to A for the second time,
 - (c) the speed of the particle when OP = 6a/5.

A is the upper and B the lower of two points distant & apart on a line of greatest slope on a plane inclined to the horizontal at an angle cam M. A pertuale rests on the plane et A. its coefficient of frietio with the plane being 4/5. Show that the apand with which it wast te projected down the plane in order just to reach B is 14/2gd), and that it is then projected up the plane from B with the same initial speed it will only travel a distance 8/31 before coming to rest.

The particle is removed and a second particle, whose coefficient of the frietion white the plane is 3/4, is projected down the plane from A with the same initial apaced. Show that it reaches B in half the time when the same initial apaced. Show that it reaches B in half the time defend by the itre; particle.

proved from A the ball appears at one mement to be passing a point I on the mast and ball a second later to be passing a point C 24 ft below F. The the the the passing a point C 24 ft below F. The the the the ball and its time of flight.

(Take g as 32 ft per sec²).

the road remissions being 11 lb wt per ten.

Find the value of p to the nearest integer.

Find the maximum speed wal, n the train will be able to reach when the track becomes level, the road resistance remaining as before.

If the train, then travelling on the level at this maximum speed, can be stopped in one mile by chutting off steam and applying the brakes, find the braking rorse in 1b we per ton.

Two parallel walls of a room are 12 to apart, A point P on the floor on a sell and a point G is A it from the other wall, the line PG being perpendicular to the walls. A particle is projected with speed I it per sec from P directly towards the speed from Q with apaced 2 it set as a directly towards the speed for the speed 2 it per sec directly towards the wall measure to it. The floor is smooth and the conflictents of rectlering between the particles and the wall and servery the rational fine that the floor is smooth and servery the rational first particles and the particles to rest by the

e masses of the perilder.

E. Maths. III

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ground and the other end on a smooth plane. The bear and the plane ground and the other end on a smooth plane. The bear and the plane of the anne of the line of intersection of the plane and the ground. Prove that the horizontal force P while the plane and the ground. Prove that the beam to maintain will have to be applied to the lower end of the beam to maintain

2. (i) OADO is a rectangle. O is the point (0,0), A the point (2,0) and E the point (2,1), the unit of measurement along each exis being 1 ft. Forces of F, Q and R lb wt act respectively along OA, AE and in the directions indicated by the order of the letters. Their resultant lies along the line, x + 2y = 7. Find the magnitude of the

5. A is the upper and B the lower of two points distant d apart on a line of greatest slope on a plane inclined to the horizontal at an angle tan 3. A particle rests on the plane at A, its coefficient of friction with the plane being 4/5. Show that the speed with which it must be projected down the plane in order just to reach B is 1 1 (2gd), and that

if it is then projected up the plane from B with the same initial speed it will only travel a distance d/31 before coming to rest.

The particle is removed and a second particle, whose coefficient of friction with the plane is 3/4, is projected down the plane from A with the same initial speed. Show that it reaches B in half the time taken by the first particle.

6. A ball is projected under gravity from a point A on level ground directly towards a tall vertical mast 108 ft away and strikes the ground at the foot of the mast. Show that during its flight the ball when viewed from A will appear to be descending the mast with uniform

Viewed from A the ball appears at one moment to be passing a point F on the mast and half a second later to be passing a point Q 24 ft below P. Find the initial velocity of the ball and its time of flight.

(Take g as 32 ft per sec2).

7. An engine of 300 horse-power can just pull a train of mass 200 tons up an incline of 1 in p (i.e., sin 1/p) at a speed of 15 miles an hour, the road resistance being 11 lb wt per ton. Find the value of p to the nearest integer.

Find the maximum speed which the train will be able to reach when the track becomes level, the road resistance remaining as before.

If the train, when travelling on the level at this maximum speed, can be stopped in one mile by shutting off steam and applying the brakes, find the braking force in 1b wt per ton.

(Take g as 32 ft per sec²).

8. Two parallel walls of a room are 12 ft apart. A point P on the floor is 3 ft from one wall and a point Q is 4 ft from the other wall, the line PQ being perpendicular to the walls. A particle is projected with speed 1 ft per sec from P directly towards the nearer wall and simultaneously a second particle is projected from Q with speed 2 ft per sec directly towards the wall nearer to it. The floor is smooth and the coefficients of restitution between the particles and the walls, and between the particles themselves. are in each case 3/4. The particles meet at a point X and the first particle is brought to rest by the impact. Find the distance of X from the nearer wall and the ratio of the masses of the particles.

Find also the time that will elapse before a second collision between the particles occurs.

GENERAL CERTIFICATE OF EDUCATION EXAMINATION

JANUARY 1965 Advanced Level

MATHEMATICS III
Applied Mathematics

Three hours
Answer EIGHT questions.

1. A uniform beam of weight W rests with one end on smooth horizontal ground and the other end on a smooth plane. The beam and the plane make angles 9 and x respectively with the same direction of the horizontal and the beam is perpendicular to the line of intersection of the plane and the ground. Prove that the horizontal force P which will have to be applied to the lower end of the beam to maintain equilibrium is

W tan x 2 (1 + tan x tan 0)

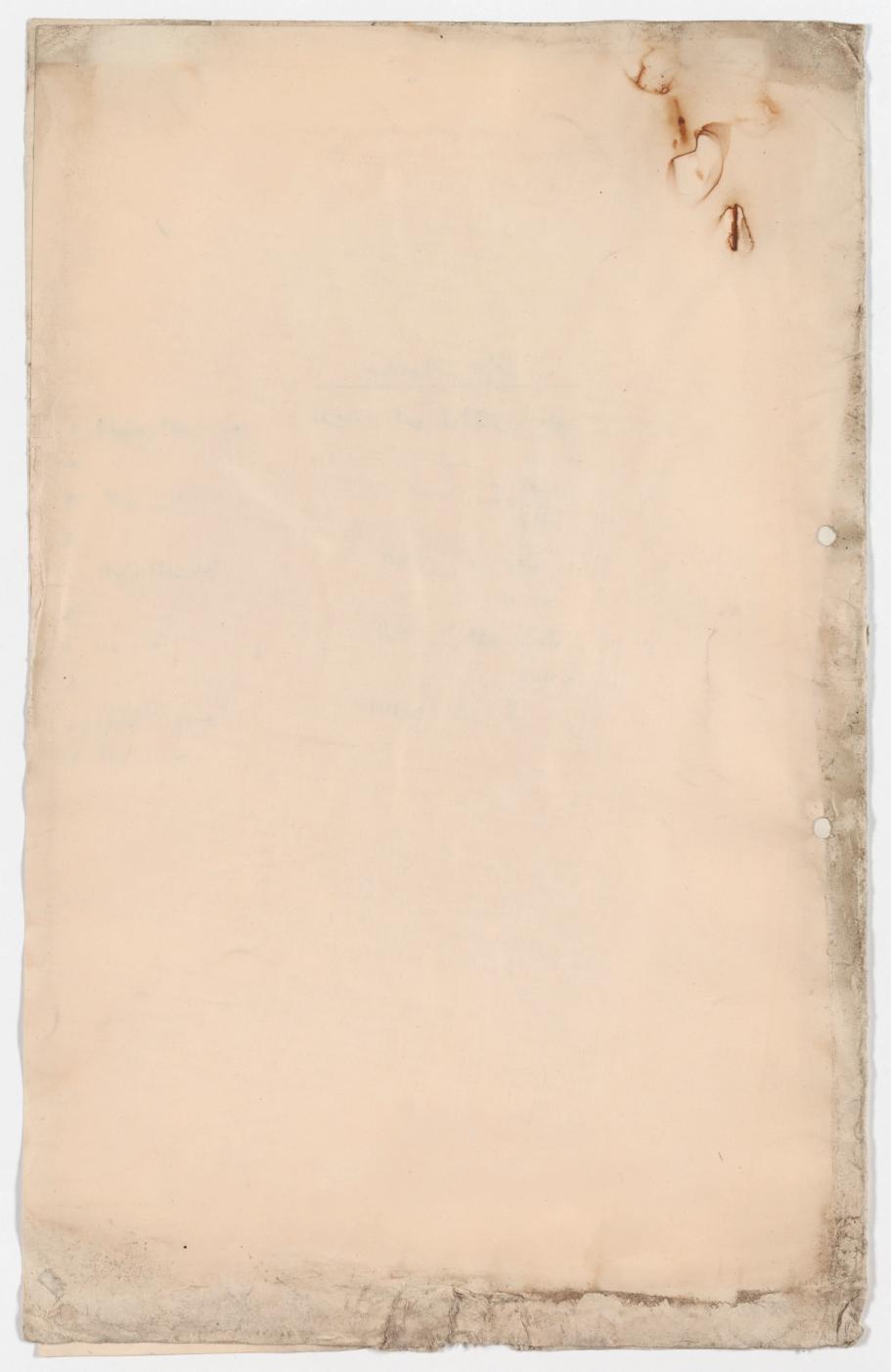
and deduce the force which would have been required had the plane been vertical.

Find what increase in P will be necessary to maintain equilibrium when a weight W is attached to the beam one-quarter of the way up the beam.

2. (i) OABC is a rectangle. O is the point (0,0), A the point (2,0) and B the point (2,1), the unit of measurement along each axis being 1 ft. Forces of P, Q and R lb wt act respectively along OA, AB and BC in the directions indicated by the order of the letters. Their resultant lies along the line x + 2y = 7. Find the magnitude of the resultant in terms of P.

Find also the moment of a couple which when added to the system would transfer the resultant to the line x + 2y = 9.

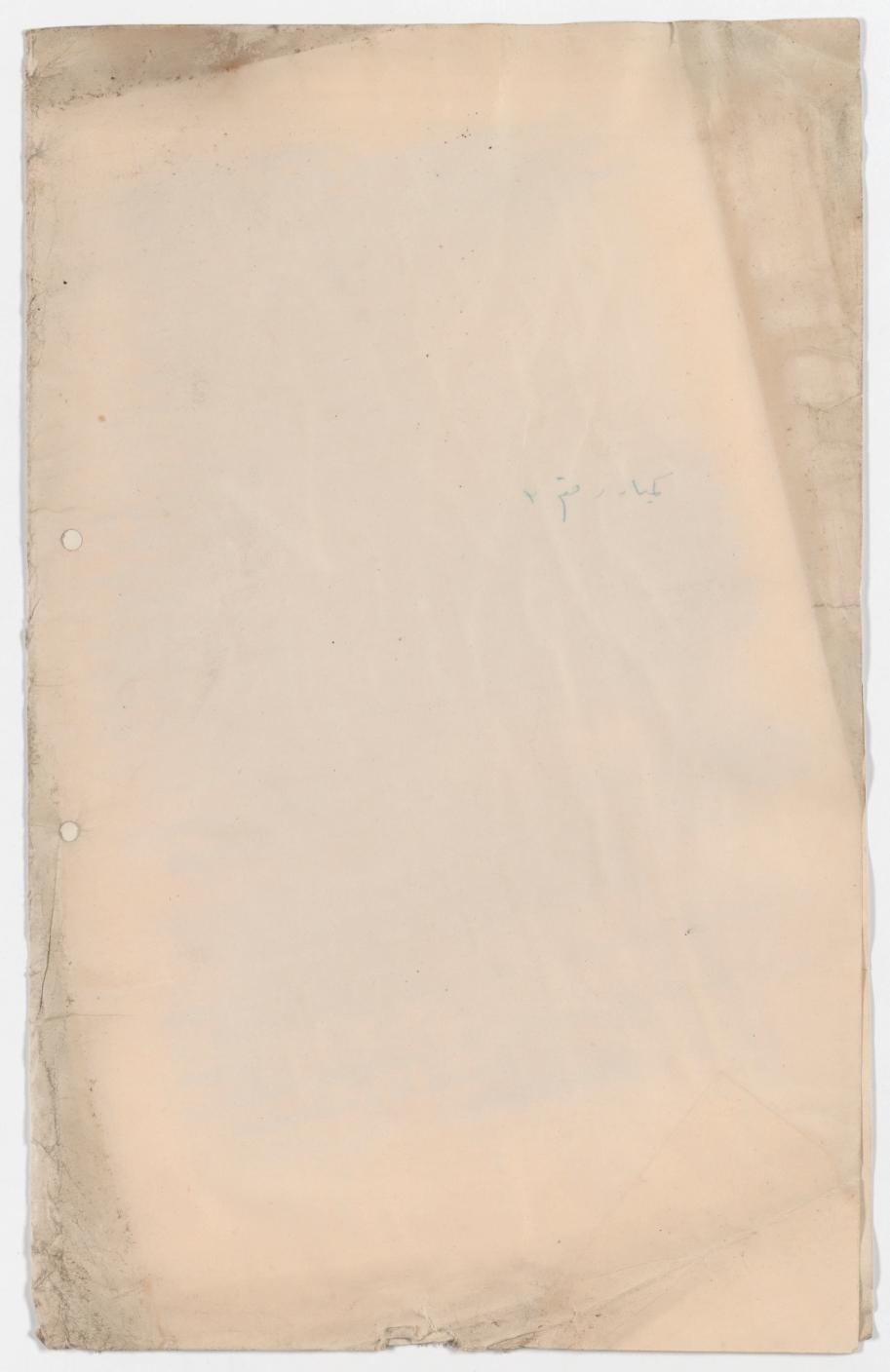
- (ii) O is any point in the plane of a square ABCD whose diagonals intersect at E. Four forces are represented completely by 30A, 20B, 30C and 20D. Show that their resultant passes through E, and find its magnitude in terms of OE.
- 3. A uniform lamina ABCED of weight W has the shape of a square ABCD on the side CD of which a triangle CED has been described externally to the square. CE = ED and the angle CED = 2x. The lamina is placed in a wertical plane with the side AD in contact with a horizontal table and it topples in that plane about D. Prove that tan x / 3/6. It is required to prevent this toppling by applying the least possible force to the lamina at one of the points A, B, C or E. Find which point should be chosen, and calculate the minimum force required in terms of W and x.
- 4. A uniform rod of weight 4W and length 2a is maintained in a horizontal position by two light inextensible strings each of length a attached to the ends of the rod. The other ends of the strings are attached to small rings each of weight W which can slide on a fixed rough horizontal bar with which the coefficients of friction are each ½. Show that in equilibrium the distance between the bar and the rod cannot be less than 4a/5, and find the greatest and least possible distances apart of the rings.



مامانامات لليمن العدل المزيل لل ا اللغة العرب (4) ٢ الدين (1) = 2 (1) : EII ه اللغة المربه. (4) = = = 7 الثان المؤلفارا VILLE (4) = - ^ النالئ المؤط ٩ الله المرب ١٠ النابية

- (١١) عند اذابة ٣ غم من مركب عضوى في ١٠٠ غم من الفينول وجد ان الانخفاض في درجة الانجماد للفينول ٢٠٠١م في المسلب الانجماد للفينول ٢٠٠١م في المسلب الوزن الجزيئي للمركب المضوى الاعلى ٠
- (٢٠) أذيب ٢٥٥٥ من مادة عضوية وزنها الجزيئي ٨٠٠٥ في ٥٠٠٠ فم من سائل مسلم فانخفضت درجة انجماد ذلك السائل المذيب بمقدار ٢٥٥٥، وعند اذاب ان مادة ثانية في ١٢٥ فم من نفس السائل المذيب انخفضت درجة انجماده بمقدار ٨٥٠، م احسب من ذلك الوزن الجزيئي للمادة المذابة الثانية .

(يتبخ)



EXPERIMENTAL PROOF OF ARCHIMEDES' PRINCIPLE :-

A very good method of demonstrating the truth of the principle is by using the bucket-and-cylinder. The apparatus consists of a small brass bucket into which a solid cylinder can just fit; thus the cylinder is of the same volume as the inside of the bucket. The cylinder can also be taken out of the bucket and attached to the bottom of the latter by means of a hook. Attach the cylinder to the bottom of the bucket, and suspend the while from the hook of the beam of a balance. Flace weights in the right hand pan to secure an accurate balance. Then bring a beaker of water resting on a bringe under the

just completely immersed. The right-hand side will now be heavier than the left owing to the upthrust of the water on the cylinder, but without distributing the weights on the pan, equilibrium can be restored by gently pouring water into the bucket. The two sides will exactly balance when the bucket is completely full of water, therefore the apparent 1 as in weight is equal to the weight of water displaced, in accordance with the principle of Archimedes. In this experiment there is no need to find the actual value of the weights in the right-hand pan.

Applications of Archimedes Frinciple 1-

1. To find the S.G. of a solid :-

The G G. of a body is defined as the ratio of its

weight to the weight of an equal volume of water. Since a submerged body displaces a volume of water equal to its own volume, however irregular it may be :-

. Specific G. of body = Weight of water displaced

Consider the following example :-

of Ch

- Q. A platinum ball weighs 330 gm. in air, 315 gm. in water; find the S.G. of platinum?
- A. Weight of displaced water = 330 315 = 15 gm.; and this weight of water hus the same volume as the platinum ball.

.. S.G. of pleting Weight of platings = 350 = 22

(cont'd.P.12)

The Principle of ARCHIMEDES :-

Cork and wood float on water. When we swim, our bodies are held up almost entirely by the water. Even an object that sinks, such as a large stone, may be carried more easily when under water. A man in a bath tube can support his whole weight by pressing lightly against the bottom with his fingers. These phenomena illustrate the bucyant force of the liquid, or the force which tends to push the body upward when it is put in the liquid. This behaviour of the liquid is referred to as BUOYANGY.

Let us now consider the following problem :-

Q. A rectangular block of metal measuring 15cms x 6cms x 4cms is suspended vertically in water so that its top surface

is 5cms below the water surface. Calculate

(t) The forces acting on the top of the body,

(ii) On the base of the body,

(iii) The weight of the water displaced.

A. Because the top of the body is Some below the surface, : . P = d x h

= 1x5 = 5gms/sq.

Down ward thrust = P x A

= 5 x 6 x 4 m 120 gms.

The base of the body is $20\,\mathrm{cms}$ (15+5) below the surface :-

dxb=q.:

= 1 x 20 = 20 cm/sq.cms.

Howard throat = 20 x 6 x 4 = 480ccs.

:. The net force acting on the body :-

= 480 - 120 = 360gms., which is the buoyant force.

Volume of body = 15 x 6 x 4 = 360 0.0.

Wt. of displaced water = V x d.

= 360 x 1 = 360 gms.

From the above example we can see that the weight of the displaced water is equal to the buoyant force, or it is equal to the weight of the body, which had been lost, when it was immersed in the water. This is known as Archimedes' Principle, which usually states:-

" WHEN A BODY IS IMMERSED IN A LIGHT, THE UPTARD THRUST IS EQUAL TO THE

REIGHT OF THE LIQUID DISTLACED V

of the displaced liquid." (cont'd. P.17).......

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- \underline{A} . Weight of displaced water = 330 315 = 15 gm.; and this weight of water has the same volume as the platinum ball.
 - .*. S.G. of platinum Weight of platinum $= \frac{330}{15} = \frac{22}{15}$

(cont'd.P.12).....

The Principle of ARCHIMEDES :-

Cork and wood float on water. When we swim, our bodies are held up almost entirely by the water. Even an object that sinks, such as a large stone, may be carried more easily when under water. A man in a bath tub, can support his whole weight by pressing lightly against the bottom with his fingers. These phenomena illustrate the bucyant force of the liquid, or the force which tends to push the body upward when it is put in the liquid. This behaviour of the liquid is referred to as BUOYANCY.

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= 1x5 = 5gms/sq.

10 -

Down ward thrust = P x A

= 5 x 6 x 4 = 120 gms.

The base of the body is 20cms (15 + 5) below the surface :-

:. P = d x h

 $= 1 \times 20 = 20 \text{ gm/sq.cms.}$

Upward thrust = $20 \times 6 \times 4 = 480 \text{gms}$.

:. The net force acting on the body :-

= 480 - 120 = 360 gms., which is the buoyant force.

Volume of body = $15 \times 6 \times 4 = 360 \text{ c.c.}$

Wt. of displaced water = V x d.

$$= 360 \times 1 = 360 \text{gms}.$$

From the above example we can see that the weight of the displaced water is equal to the buoyant force, or it is equal to the weight of the body, which had been lost, when it was immersed in the water. This is known as Archimedes' Principle, which usually states:-

" WHEN A BODY IS IMMERSED IN A LIQUID, THE UPWARD THRUST IS EQUAL TO THE WEIGHT OF THE LIQUID DISPLACED."

or: ANY BODY IMMERSED IN A LIQUID APPARENTLY LOSES A WEIGHT EQUAL TO THE WEIGHT OF THE DISPLACED LIQUID." (cont'd. P.11).........