SCISOFT

EDUCATIONAL SOFTWARE

PHYSICS

"Physics" is a comprehensive package for pupils undertaking courses in the subject in the 13-17 year age range. The package consists of :

1. Hints on revision
2. A set of revision notes
3. Multiple choice questions on equations
4. Basic problems with an almost infinite variation in the data provided

Hints on revision

Program name ; "REVISION"

This contains advice gathered from many years of teaching experience. The comments apply to both pupils starting early and to those panicking at the last minute (Which type are you?). Each page of advice waits for you to read it - pressing any key to continue.

Revision notes

You will gain far more benefit by producing your own revision notes tailormade to your requirements, however much of this time will be spent redrawing diagrams straight from books and extracting sections of text. A minimum of time being spent actually learning and understanding the work.

To help you make your work time more time effective we have produced a set of revision notes with a minimum of text but with over 250 diagrams. In the text we have noted the pertinent points; we do expect you to add to this booklet and thus build up a set of notes to suit <u>your</u> needs.

You are advised to read a section of the notes that your instructor has helped you to produce, to read the appropriate section in a standard text book and then to supplement our notes. An example is given in the program "REVISION"

Physics problems

Physics involves a great deal of mathematical manipulations and any revision programme must involve a high input of such problems. These two programs are designed for this purpose. The problems are supplemented with graphics. The unknown quantity is randomized and thus provides practice in manipulating equations. The correct answer can be requested after an initial attempt and the original question can be reselected.

Program names : "PROBLEMS 1"
"PROBLEMS 2"

A score is given after every 5 attempts. The problems include : Snell's law, the gas laws, linear expansivity, Ohm's law and moments.

Multiple choice equations

These are divided into four programs covering the equations required in the following sections :

Mechanics	Program name	"EQMECH"
Electricity	"	"EQELEC"
Heat/pressure	"	"EQHEAT"
Light/sound	"	"EQLIGHT"

Twenty equations are used in each section. After every ten equations a point score is given based upon the number of correct responses. When 100 points is reached in a particular section then knowledge of the equations in that section can be considered to be adequate. If a wrong response is given then the correct answer is supplied. All equations used in the program can also be displayed.

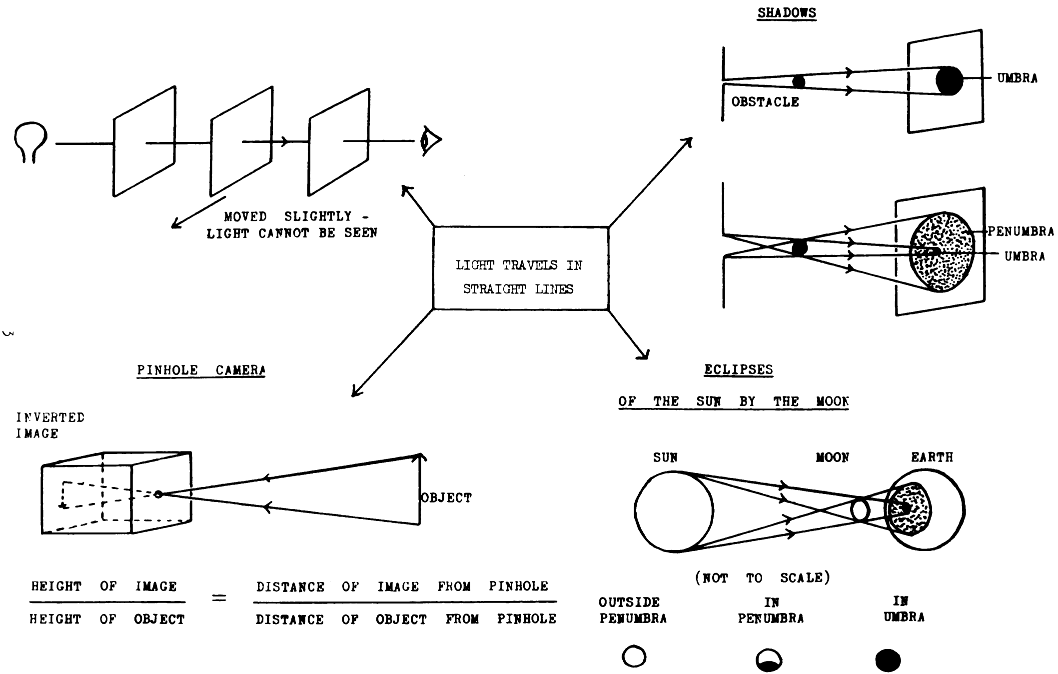
Multiple choice units

Program name : "EQUNIT"

23 SI units are tested. After ten questions a point score is given based upon the number of correct responses.

The pupil, parent or teacher should check with the syllabus that the child is following to ensure that all components of our packages are relevant. Some boards will not require knowledge of all that our pack contains. Provided that it is used in conjunction with the work set by the subject teacher, then it should provide a useful aid towards passing the examination.

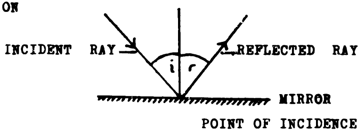
Details of other programs in this series and of other educational programs can be obtained from your software supplier or from :
SCISOFT 5 Minster Gardens, Newthorpe, Eastwood, NOTTS. NG16 2AT


SHADOWS
OBSTACLE
UMBRA
PENUMBRA
UMBRA
MOVED SLIGHTLY -
LIGHT CANNOT BE SEEN
LIGHT TRAVELS IN
STRAIGHT LINES
PINHOLE CAMERA
INVERTED
IMAGE
OBJECT
ECLIPSES
OF THE SUN BY THE MOON
SUN
MOON
EARTH
(NOT TO SCALE)
OUTSIDE
PENUMBRA
IN
PENUMBRA
IN
UMBRA
HEIGHT OF IMAGE / HEIGHT OF OBJECT = DISTANCE OF IMAGE FROM PINHOLE / DISTANCE OF OBJECT FROM PINHOLE

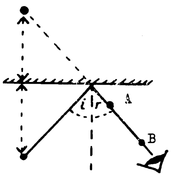
PLANE MIRRORS

LAWS OF REFLECTION

1. THE INCIDENT RAY, THE REFLECTED RAY AND THE NORMAL AT THE POINT OF INCIDENCE, ALL LIE IN THE SAME PLANE
2. THE ANGLE OF INCIDENCE IS EQUAL TO THE ANGLE OF REFLECTION



TO VERIFY THE LAWS OF REFLECTION OF LIGHT



PINS (A & B) PLACED AS FAR APART AS POSIBLE.

LINE THROUGH

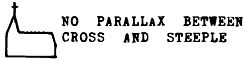
NORMBL CONSTRUCTED.

ANGLES i AND r MEASURED.

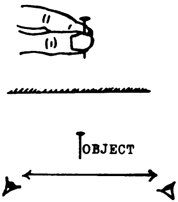
REPEATED WITH THE EYE IN A NUMBER OF POSITIONS.

$i = r$

PARALLAX



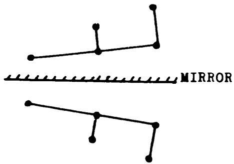
TO LOCATE AN IMAGE BY NO-PARALLAX



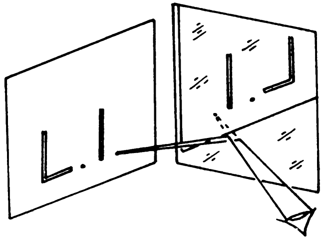
THE IMAGE IN A PLANE MIRROR IS;-

1. The same size as the object.
2. Laterally inverted.
3. Virtual.
4. The same distance behind the mirror as the object is in front.

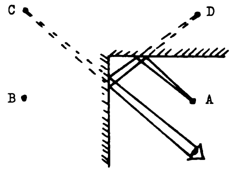
NATURE OF IMAGE FORMED



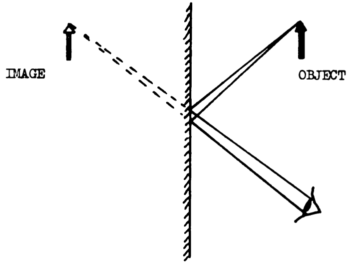
PLANE MIRRORS



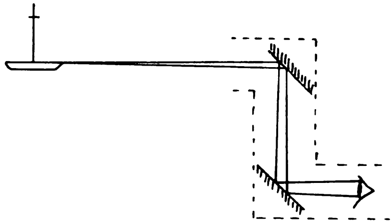
TWO MIRRORS AT 90°



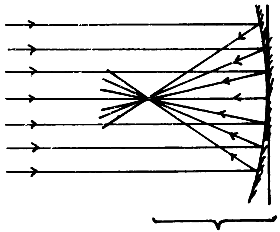
Distances AB = CD ; AD = BC



PERISCOPE



CONCAVE MIRRORS



FOCAL LENGTH

PRINCIPLE AXIS - The line from the centre of the mirror (Pole) to the centre of curvature.

RADIUS OF CURVATURE - Distance from the pole to the centre of curvature.

PRINCIPLE FOCUS - Point on the principle axis where all the rays that are originally parallel converge.

FOCAL LENGTH - Distance from the pole to the principle focus

RAY DIAGRAMS

If the position of either of the image or the object and the height of either is known then by scale diagrams it is possible to find the unknowns using four simple rules :

1. A ray passing through the centre of curvature is reflected back along its own path.
2. A ray passing through the principle focus is reflected back parallel to the principle axis.
3. A ray parallel to the principle axis is reflected back through the principle focus.
4. A ray striking the pole of the mirror is reflectedback making the same angle with the principle axis.

VARIOUS TYPES OF RAY DIAGRAMS

OBJECT BETWEEN F AND P

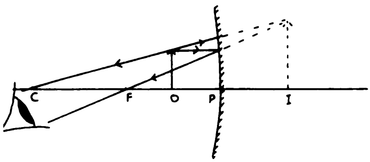


IMAGE : BEHIND MIRROR (VIRTUAL), ERECT, LARGER THAN OBJECT.

OBJECT AT F

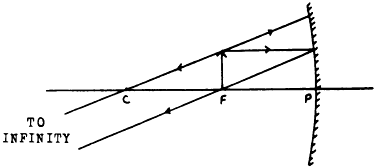


IMAGE: AT INFINITY.

OBJECT BETWEEN F AND C

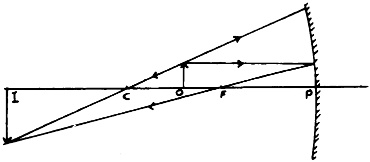


IMAGE : BEYOND C, REAL, INVERTED, LARGER THAN OBJECT

OBJECT AT C

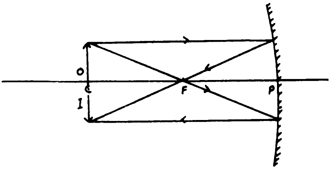


IMAGE : AT C, REAL, INVERTED, SAME SIZE AS OBJECT

OBJECT BEYOND C

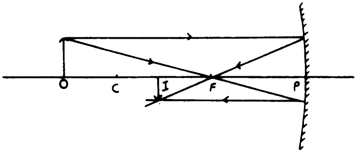


IMAGE : BETWEEN F AND C, REAL, INVERTED, SMALLER THAN OBJECT

OBJECT AT INFINITY

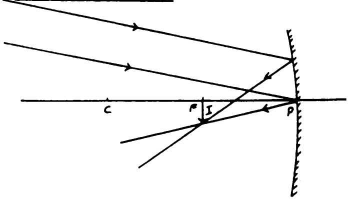
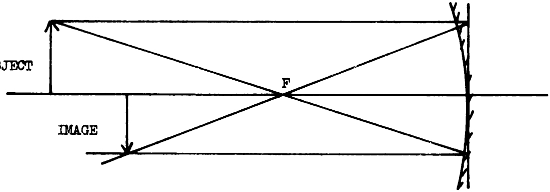


IMAGE : AT F, REAL, INVERTED SMALLER THAN OBJECT

ACCURATE CONSTRUCTION OF RAY DIAGRAMS

Example : Concave mirror of focal length 96mm An object 20mm high is placed 22cm from the mirror. Find the position, size and nature of the image.

Use graph paper Scale 1mm = 2mm



Result Image between F and C, real, inverted, smaller than the object. 3.2mm high, 174mm from the mirror.

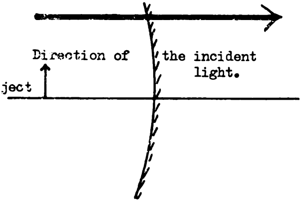
$1/v + 1/u = 1/f$ Where v = image distance from pole

u = object distance from pole

f = focal length

NEW CARTESIAN CONVENTION

Method for mathematically finding out the information above. Uses the following rules 1. All the measurements begin at the pole.



2. If the measurements are against the incident light then they are negative if with the incident light then they are positive

eg $1/v + 1/u = 1/f$

$1/v + 1/{-220} = 1/{-96}$

$1/v + -0.00455 = -0.0104$

$1/v = -0.0104 - -0.00455$

$1/v = -0.00585$

$v = 171\text{mm}$

MAGNIFICATION

$$m = \frac{\text{HEIGHT OF IMAGE}}{\text{HEIGHT OF OBJECT}} = \frac{\text{IMAGE DISTANCE}}{\text{OBJECT DISTANCE}}$$

EXAMPLE

HEIGHT OF OBJECT = 10mm

IMAGE DISTANCE = 43.1mm

OBJECT DISTANCE = 54mm

$$m = \frac{\text{HEIGHT OF IMAGE}}{10\text{mm}} = \frac{43.1\text{mm}}{54\text{mm}}$$

$$m = \frac{43.1\text{mm}}{54\text{mm}} = 0.798\text{mm}$$

$$m = \frac{\text{HEIGHT OF IMAGE}}{10\text{mm}}$$

$$0.798\text{mm} = \frac{\text{HEIGHT OF IMAGE}}{10\text{mm}}$$

$$0.798 \times 10\text{mm} = \text{HEIGHT OF IMAGE}$$

$$7.98\text{mm} = \text{HEIGHT OF IMAGE}$$

****

$$f = \frac{uv}{u + v}$$

EXAMPLE

$$f = \frac{54\text{mm} \times 43.1\text{mm}}{54\text{mm} + 43.1\text{mm}}$$

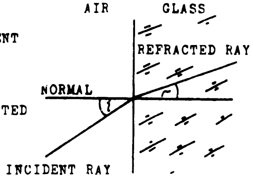
$$f = \frac{2327.4\text{mm}}{97.1\text{mm}}$$

$$f = 23.97\text{mm}$$

REFRACTION

ANGLE OF INCIDENCE (i) IS THE ANGLE BETWEEN THE INCIDENT RAY AND THE NORMAL

ANGLE OF REFRACTION(r) IS THE ANGLE BETWEEN THE REFRACTED RAY AND THE NORMAL.

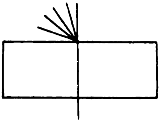


LAWS OF REFRACTION

1. THE INCIDENT AND REFRACTED RAYS ARE ON OPPOSITE SIDES OF THE NORMAL AT THE POINT OF INCIDENCE AND ALL THREE ARE IN THE SAME PLANE

2. THE RATIO OF THE SINE OF THE ANGLE OF INCIDENCE TO THE SINE OF THE ANGLE OF REFRACTION IS A CONSTANT FOR A GIVEN PAIR OF MEDIA. (SNELLS LAW)

TO VERIFY SNELL'S LAW OF REFRACTION



1. A STRAIGHT LINE IS DRAWN AND THE EDGE OF A RECTANGULAR BLOCK OF GLASS IS BROUGHT UP TO IT.

2. A RULER IS PLACED AGAINST THE OPPOSITE EDGE AND THE BLOCK REMOVED. A LINE IS DRAWN ALONG THE RULER.

3. THE NORMAL IS DRAWN AND SEVERAL LINES AT VARIOUS ANGLES ARE DRAWN TO WHERE THE NORMAL INTERSECTS WITH THE RECTANGLE. THE BLOCK IS THEN REPLACED.

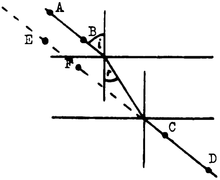
4. TWO PINS A AND B ARE PLACED AS FAR APART AS POSSIBLE ALONG ONE LINE. (THIS IS THE INCIDENT RAY).

5. BY LOOKING THROUGH THE BLOCK TWO PINS C AND D ARE PLACED IN LINE WITH THE IMAGE E AND F OF THE TWO PINS A AND B.

6. THE BLOCK IS REMOVED AND THE LINES DRAWN IN, NORMALS CONSTRUCTED AND THE ANGLE OF INCIDENCE AND REFRACTION MEASURED.

7. THIS IS REPEATED FOR SEVERAL LINES.

8. SINE OF ∠i AND SINE OF ∠r ARE LOOKED UP IN SINE TABLES AND $\sin i/\sin r$ CALCULATED FOR EACH PAIR OF ANGLES. THIS IS A CONSTANT - **THE REFRACTIVE INDEX**



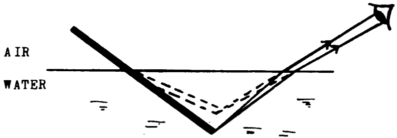
REFRACTIVE INDEX (n)

THE VALUE OF THE CONSTANT $\sin i/\sin r$ FOR A RAY PASSING FROM ONE MEDIUM TO ANOTHER. N.B. It is always the refractive index of the 2nd medium with respect to the 1st.

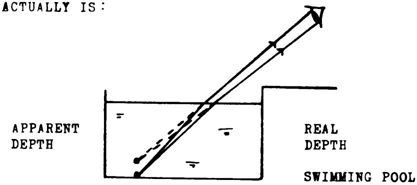
n FOR WATER IS 1.33 n FOR GLASS IS ABOUT 1.52

SOME EFFECTS OF REFRACTION

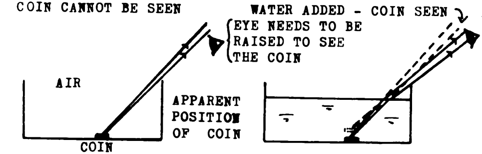
1. APPARENT UPWARD BENDING OF A



2. A SWIMMING POOL APPEARS SHALLOWER THAN IT ACTUALLY IS:

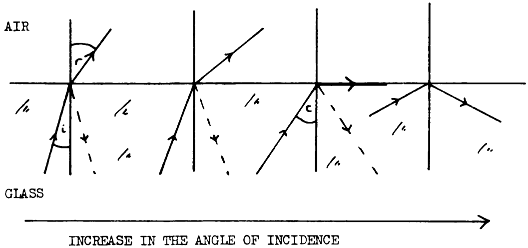


3. AN OBJECT HIDDEN FROM VIEW IN AN EMPTY BOWL CAN BE SEEN WHEN FILLED WITH WATER



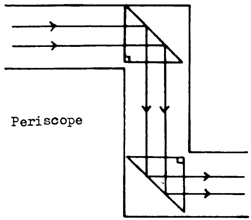
REFRACTION

TOTAL INTERNAL REFLECTION AND CRITICAL ANGLE



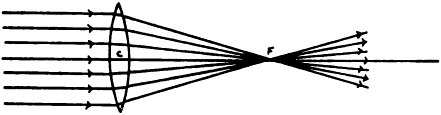
i = angle if incidence r = angle of refraction c = critical angle

TOTAL INTERNAL REFLECTION IN PRISMS

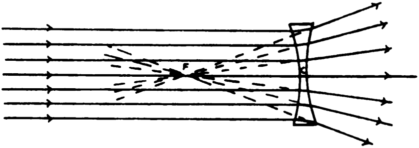


CONVERGING AND DIVERGING LENSES

CONVERGING LENS



DIVERGING LENS



PRINCIPLE AXIS - The line from the centre of curvature, through the centre of the lens to the centre of curvature of the other lens surface.

FOCAL LENGTH - Distance from the centre of the lens to the principle focus

PRINCIPLE FOCUS - Point on the principle axis through which or from which rays parallel to the axis , pass after being refracted by the lens.

RAY DIAGRAMS (see also curved mirrors)

Rules : 1. A ray passing through the optical centre of the lens continues straight through.

2. A ray parallel to the principle axis refracted through the principle focus.

3. A ray passing through the principle focus is refracted parallel to the principle axis.

IMAGE FORMED BY A DIVERGING LENS

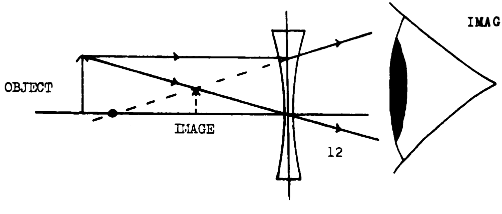


IMAGE : VIRTUAL, ERECT, SMALLER THAN OBJECT

FORMATION OF IMAGES BY A CONVERGING LENS

OBJECT BETWEEN LENS AND F

MAGNIFYING GLASS

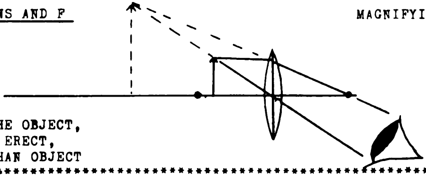


IMAGE : BEHIND THE OBJECT,
VIRTUAL, ERECT,
LARGER THAN OBJECT

OBJECT AT F

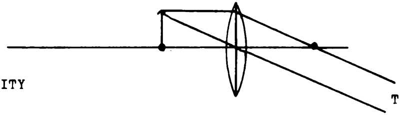


IMAGE : AT INFINITY

TO IMAGE AT INFINITY

OBJECT BETWEEN F AND 2F

PROJECTION LENS

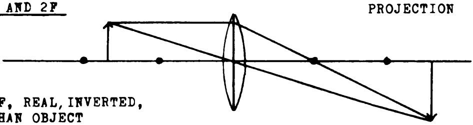


IMAGE : BEYOND 2F, REAL, INVERTED,
LARGER THAN OBJECT

OBJECT AT 2F

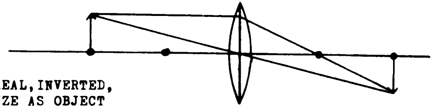


IMAGE : AT 2F, REAL, INVERTED,
SAME SIZE AS OBJECT

OBJECT BEYOND 2F

SIMPLE CAMERA LENS

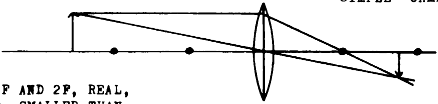


IMAGE : BETWEEN F AND 2F, REAL,
INVERTED, SMALLER THAN
OBJECT

OBJECT AT INFINITY

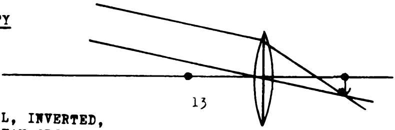
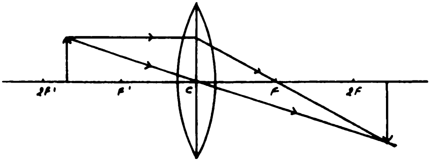


IMAGE : AT F, REAL, INVERTED,
SMALLER THAN OBJECT

ACCURATE CONSTRUCTION OF RAY DIAGRAMS

EXAMPLE

AN OBJECT 12mm HIGH STANDS VERTICALLY ON THE PRINCIPAL AXIS OF A CONVERGING LENS OF FOCAL LENGTH OF 20mm AND AT A DISTANCE OF 34mm FROM THE LENS. FIND THE POSITION, SIZE AND NATURE OF THE IMAGE.



RESULT

IMAGE : BEYOND 2F, REAL, INVERTED AND LARGER THAN THE OBJECT
16mm HIGH, 49mm FROM THE OPTICAL CENTRE OF THE LENS.

$1/v \ - \ 1/u \ = \ 1/f$ (see also curved mirrors N.B. difference in formulae)

NEW CARTESIAN CONVENTION

Method for mathematically finding out the information above. Uses the following rules

1. All the measurements begin at the optical centre.
2. If the measurements are against the incident light then they are negative, if with the incident light then they are positive.

ABOVE EXAMPLE

v = UNKNOWN u = -34 f = +20

$^{1}/_{v} - ^{1}/_{u} = ^{1}/_{f}$

$^{1}/_{v} - ^{1}/_{-34} = ^{1}/_{20}$

$^{1}/_{v} - -0.0294 = 0.05$

$^{1}/_{v} = 0.05 + -0.0294$

$^{1}/_{v} = 0.0206$

$^{1}/_{v} = 48.5$

THEREFORE THE IMAGE IS REAL, ON THE OPPOSITE SIDE OF THE LENS TO THE OBJECT.

MAGNIFICATION

$$\text{MAGNIFICATION (m)} = \frac{\text{HEIGHT OF IMAGE}}{\text{HEIGHT OF OBJECT}} = \frac{\text{DISTANCE OF IMAGE FROM LENS}}{\text{DISTANCE OF OBJECT FROM LENS}}$$

$$m = \frac{v}{u}$$

EXAMPLE

HEIGHT OF OBJECT = 12mm

IMAGE DISTANCE = 48.5mm

OBJECT DISTANCE = 34mm

$$m = \frac{\text{HEIGHT OF IMAGE}}{12\text{mm}} = \frac{48.5\text{mm}}{34\text{mm}}$$

$$m = \frac{48.5\text{mm}}{34\text{mm}} = 1.43$$

$$m = \frac{\text{HEIGHT OF IMAGE}}{12\text{mm}}$$

$$1.43 = \frac{\text{HEIGHT OF IMAGE}}{12\text{mm}}$$

$1.43 \times 12 =$ HEIGHT OF IMAGE

HEIGHT OF IMAGE = 17.2mm

****

$$f = \frac{uv}{u + v}$$

$$f = \frac{34\text{mm} \times 48.5\text{mm}}{34\text{mm} + 48.5\text{mm}}$$

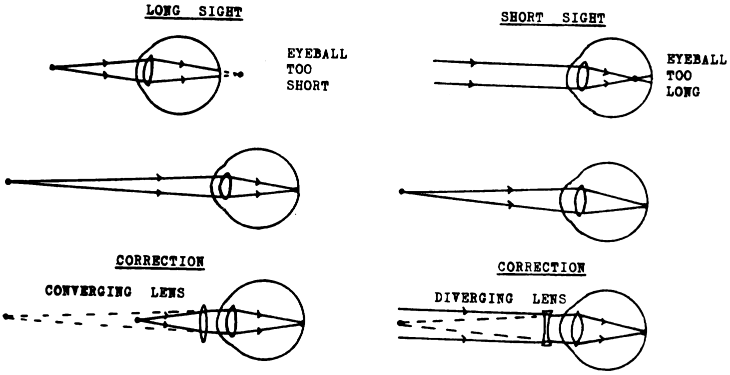
$$f = \frac{1649\text{mm}}{82.5\text{mm}}$$

$$f = 19.99\text{mm}$$

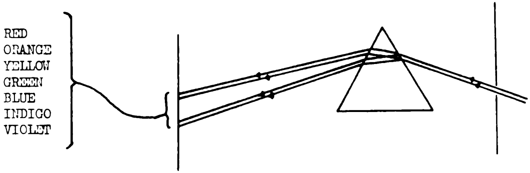
CAMERA/EYE

SIMILARITIES	EYE	CAMERA
LENS	CARTILAGENOUS	GLASS OR PLASTIC
DIAPHRAGM	IRIS	IRIS DIAPHRAGM
DIAPHRAGM ADJUSTMENT	MUSCULAR CONTRACTION	MOVEMENT OF METAL SHEETS
LIGHT SENSITIVE SURFACE	RETINA	PHOTOGRAPHIC FILM
ALTERATION IN FOCAL LENGTH	THICKENING OF LENS	MOVEMENT OF LENS
CASE		
CASE	SCLEROTIC	PLASTICM METAL ETC.

DEFECTS IN VISION

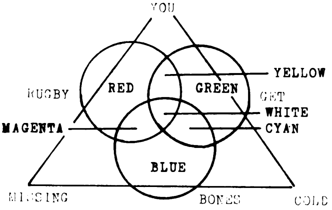


COLOURS



Richard Of York Gave Battle In Vain

MIXTURE OF THE PRIMARY COLOURS



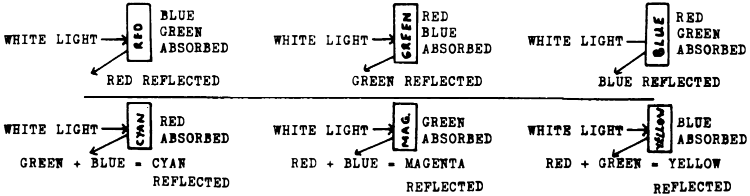
YOU GET COLD BONES MISSING RUGBY.

PRIMARY COLOURS : RED, BLUE, GREEN.

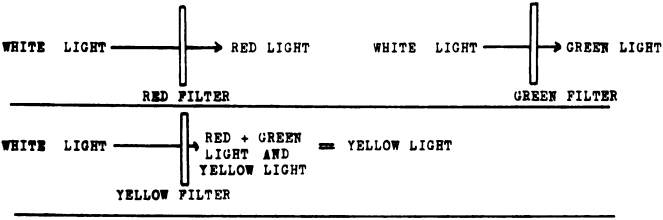
RED + GREEN = YELLOW
RED + BLUE = MAGENTA
BLUE + GREEN = CYAN
RED + BLUE + GREEN = WHITE

COMPLEMENTARY COLOURS

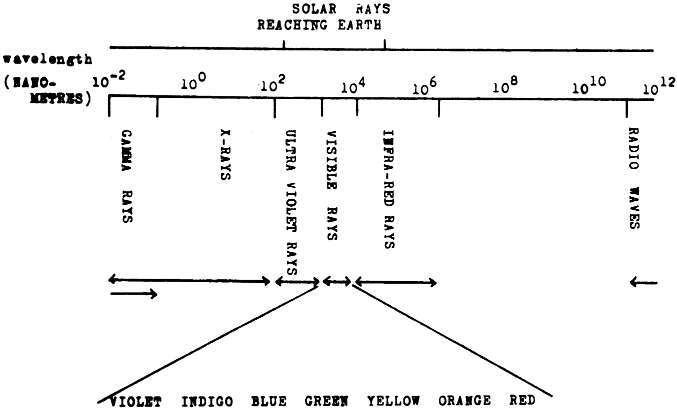
GREEN + MAGENTA = WHITE
RED + CYAN = WHITE
BLUE + YELLOW = WHITE



FILTERS



ELECTROMAGNETIC SPECTRUM



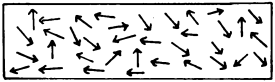
INFRA-RED DETECTED BY IT'S HEATING EFFECT ON A THERMOPILE CONNECTED TO A GALVANOMETER

ULTRA VIOLET DETECTED BY CAUSING E.G. QUININE SULPHATE TO FLUORESCE

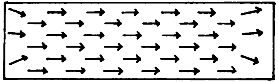
MAGNETISM

DOMAIN THEORY

NON-MAGNETIC



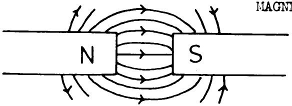
MAGNETIC

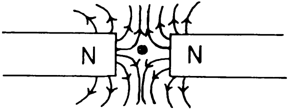


SUPPORTING EVIDENCE

1. BREAKING A MAGNET IN TWO
2. SATURURATION OF MAGNETIC STRENGTH
3. DEMAGNETIZATION
4. MAGNETIZATION IN THE EARTH'S FIELD

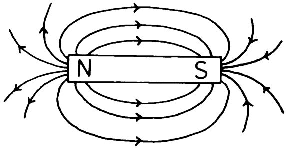
MAGNETIC FIELDS





● NO MAGNETIC FIELD (NEUTRAL POINT)

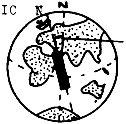
IRON FILINGS OR PLOTTING COMPASSES



MAGNETIC FIELD OF THE EARTH

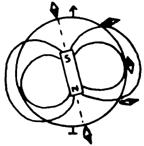
OF THE EARTH

MAGNETIC N



MAGNETIC S

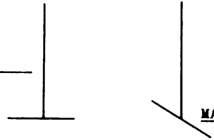
ANGLE OF DECLINATION



ANGLE OF INCLINATION

COTTON

STEEL NEEDLE SUSPENDED AT IT'S CENTRE OF GRAVITY



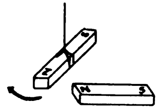
UNMAGNETISED

MAGNETIC

S ⟷ N

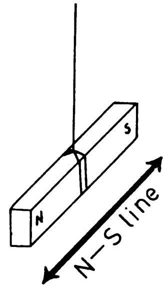
MAGNETISM

LIKE POLES REPEL
UNLIKE POLES ATTRACT



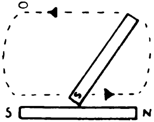
TEST FOR POLARITY

POLE	RESPONSE	CONCLUSION
N	REPELS	N
N	ATTRACTS	S or NON-MAGNETIC
S	REPELS	S
S	ATTRACTS	N or NON-MAGNETIC

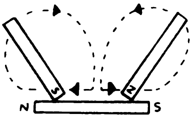


TO MAGNETISE

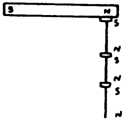
ONE MAGNET



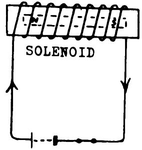
TWO MAGNETS



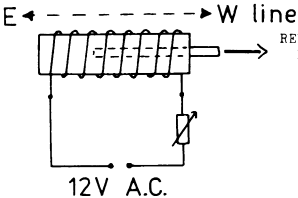
INDUCED



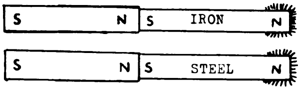
ELECTRICALLY



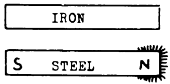
TO DEMAGNETISE



MAGNETIC PROPERTIES OF IRON AND STEEL



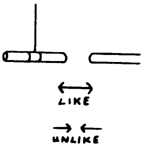
BAR MAGNET

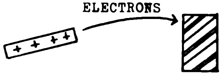


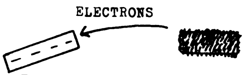
BAR MAGNET REMOVED

ELECTROSTATICS

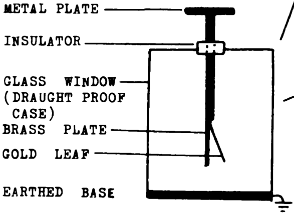
LIKE CHARGES REPEL
UNLIKE CHARGES ATTRACT







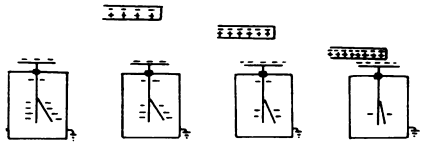
ATOMIC STRUCTURE



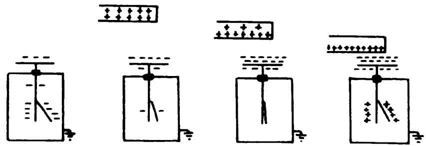
GOLD LEAF ELECTROSCOPE

TO TEST FOR THE SIGN OF A CHARGE ON A MATERIAL

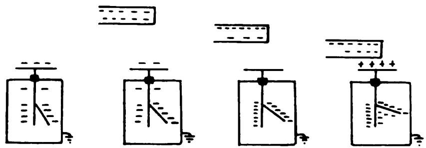
1. THE MATERIAL IS UNCHARGED



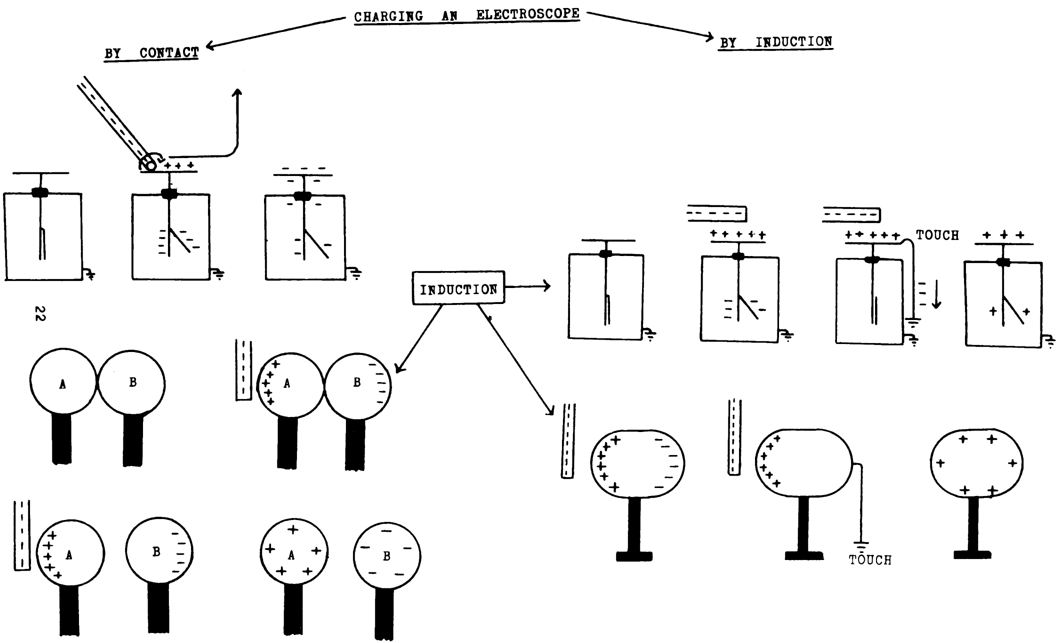
2. THE MATERIAL IS OF THE OPPOSITE CHARGE



3. THE MATERIAL IS OF THE SAME CHARGE

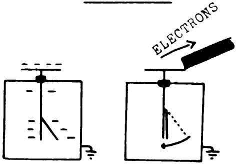


ELECTROSTATICS



ELECTROSTATICS

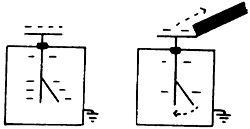
CONDUCTORS



CHARGED ELECTROSCOPE — CLOSES RAPIDLY

eg METALS, CARBON, WATER.

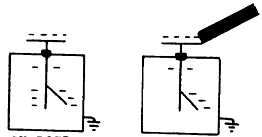
POOR INSULATORS or POOR CODUCTORS



CHARGED ELECTROSCOPE — CLOSES SLOWLY

PAPER, WOOL, COTTON.

INSULATORS

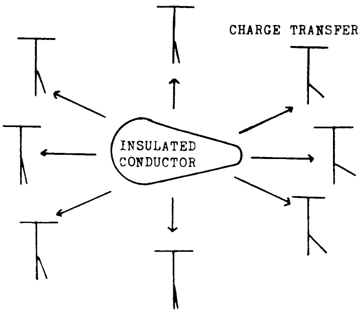


CHARGED ELECTROSCOPE — REMAINS APART

PARAFFIN WAX, POLYTHENE, QUARTZ, SULPHUR.

DISTRIBUTION OF CHARGE

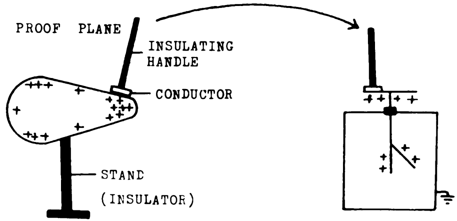
CHARGE TRANSFERRED USING A PROOF PLANE



THEREFORE

PROOF PLANE

CHARGE TRANSFERRED

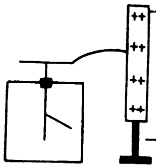


CHARGE CONCENTRATED WHERE THE SURFACE IS SHARPLY CURVED.

CAPACITANCE

PARALLEL PLATE CAPACITOR

1.



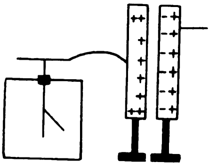
FLAT METAL PLATE

\+ CHARGE BY INDUCTION

LEAF DIVERGENCE INDICATES POTENTIAL OF THE PLATE

INSULATING STAND

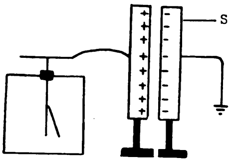
2.



SECOND VERTICAL PLATE

LEAF DROPS - POTENTIAL DECREASES, THEREFORE CAPACITANCE INCREASED

3.

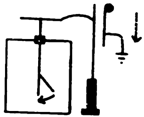


SECOND PLATE EARTHED

LEAF DROPS FURTHER THEREFORE CAPACITANCE FURTHER INCREASED

FACTORS AFFECTING CAPACITANCE

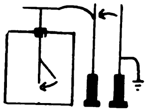
1. AREA OF PLATE



BLIND UNROLLED

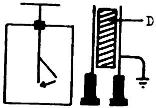
DIVERGENCE DECREASES

2. DISTANCE BETWEEN PLATES



DISTANCE BETWEEN PLATES REDUCED - DIVERGENCE DECREASES

3. DIELECTRIC

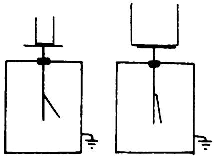


DIELECTRIC eg EBONITE

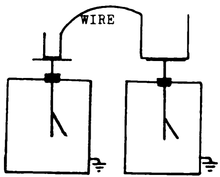
DIVERGENCE DECREASES WHEN DIELECTRIC INSERTED BETWEEN PLATES

CAPACITANCE

EQUAL CHARGES
INTO EACH VESSEL

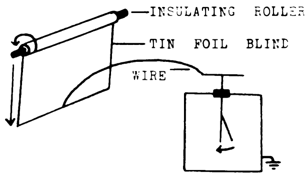


THE SMALLER THE CAPACITANCE, THE GREATER THE DEFLECTION.



THE DEFLECTION BECOMES THE SAME - THE POTENTIALS ARE THE SAME

AREA OF THE CONDUCTOR



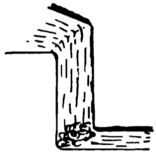
AS THE BLIND IS UNROLLED LEAF DIVERGENCE DECREASES - POTENTIAL DECREASES AND THUS CAPACITANCE INCREASES.

CAPACITANCE OF A CONDUCTOR IS THE RATIO OF ITS CHARGE TO ITS POTENTIAL

$$\text{CAPACITANCE (FARADS F)} = \frac{\text{CHARGE(COULOMBS C)}}{\text{POTENTIAL(VOLTS V)}}$$

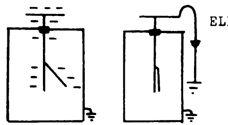
POTENTIAL DIFFERENCE

HEAT FLOWS



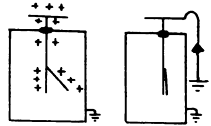
WATER FLOWS

NEGATIVE POTENTIAL



ELECTRONS FLOW

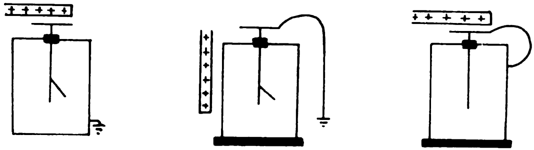
POSITIVE POTENTIAL



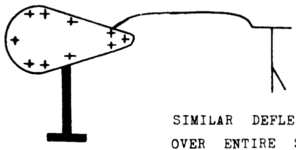
ELECTRONS FLOW

POTENTIAL GRADIENT

GOLD LEAF ELECTROSCOPE

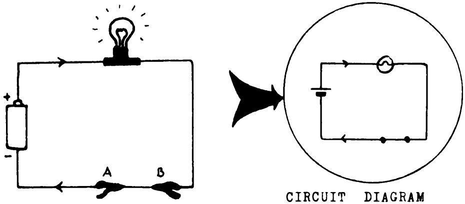


OVER THE SURFACE OF A CHARGED CONDUCTOR



SIMILAR DEFLECTION OVER ENTIRE SURFACE

CONDUCTORS AND INSULATORS



CIRCUIT DIAGRAM

BULB LIGHTS WHEN MATERIAL HELD BETWEEN CROCODILE CLIPS IS A CONDUCTOR BUT DOES NOT IF AN INSULATOR

INSULATORS : AIR, PLASTIC, RUBBER, DRY WOOD, PURE WATER, ORGANIC ACIDS.

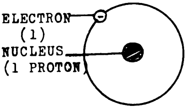
CONDUCTORS : METALS, SALTS, INORGANIC ACIDS

SEMI-CONDUCTORS : SILICON, GERMANIUM

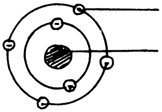
ELECTRONS

ATOM :- ELECTRONS, PROTONS, NEUTRONS.

HYDROGEN ATOM



CARBON ATOM

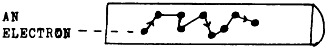


URANIUM ATOM

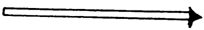
92 ELECTRONS, 92 PROTONS, AND 146 NEUTRONS.

ELECTRIC CURRENT

NO CURRENT FLOWING

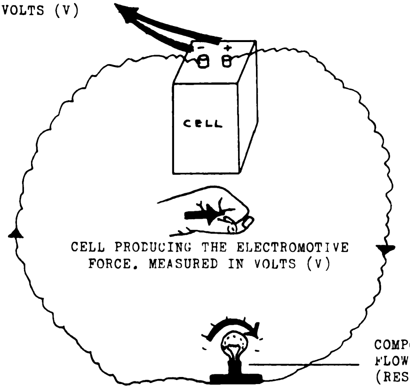


CURRENT FLOWING



CURRENT ELECTRICITY

DIFFERENCE IN POTENTIAL
MEASURED IN VOLTS (V)



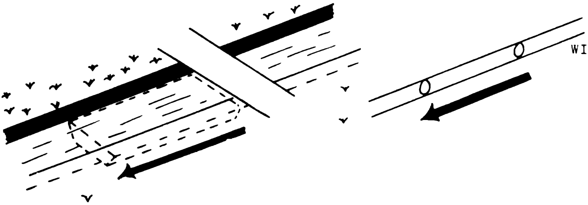
CELL PRODUCING THE ELECTROMOTIVE FORCE. MEASURED IN VOLTS (V)

CURRENT FLOWING AROUND THE CIRCUIT. MEASURED IN AMPERES (A)

COMPONENTS PREVENTING THE FLOW OF THE CURRENT (RESISTANCE). MEASURED IN OHMS (Ω)

ELECTRIC CURRENT

RIVER FLOWING



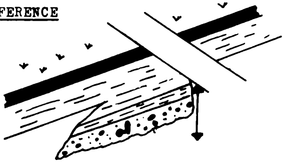
WIRE

WATER CURRENT - THE QUANTITY OF WATER WHICH FLOWS UNDER THE BRIDGE IN 1 SECOND.

ELECTRIC CURRENT - THE QUANTITY OF ELECTRONS WHICH FLOW IN 1 SECOND.

POTENTIAL DIFFERENCE

1.



2.

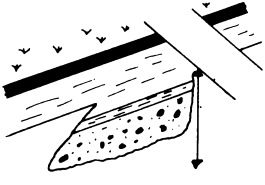
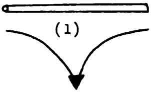


DIAGRAM 2. IS TWICE AS STEEP AS DIAGRAM 1. AND THUS THE CURRENT IS TWICE AS FAST

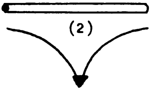
CURRENT ELECTRICITY

POTENTIAL DIFFERENCE P.D.

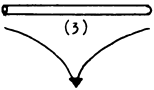
COPPER WIRE



P.D. = 0V
THEREFORE NO FLOW OF ELECTRONS.



P.D. = 5V.
THEREFORE FLOW OF ELECTRONS.

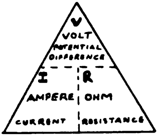


P.D. = 10V
THEREFORE TWICE AS MANY ELECTRONS FLOW THAN IN DIAGRAM (2)

OHMS LAW

Providing that the physical conditions remain constant, the current flowing through a wire is directly proportional to the potential difference between the ends of the wire.

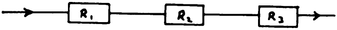
$$\frac{\text{POTENTIAL DIFFERENCE (VOLT)}}{\text{CURRENT (AMPERE)}} = \text{A CONSTANT (RESISTANCE - OHMS)}$$



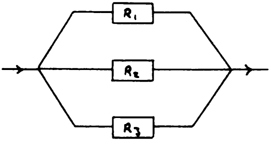
$V = IR$ $\quad$ $I = V/R$ $\quad$ $R = V/I$

ONE OHM IS THE RESISTANCE OF A WIRE WHEN A POTENTIAL DIFFERENCE OF 1VOLT ACROSS IT MAINTAINS A CURRENT OF ONE AMPERE.

RESISTORS IN..........SERIES ....PARALLEL



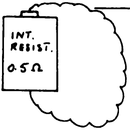
$R_T = R_1 + R_2 + R_3$



$1/R_T = 1/R_1 + 1/R_2 + 1/R_3$

INTERNAL RESISTANCE OF CELLS

DRY CELL



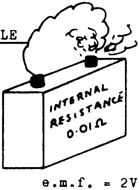
e.m.f. = 1.5V

COPPER WIRE OF NEGLIGIBLE RESISTANCE

$I = V/R$

$I = 1.5/0.5$

$I = 3A$



e.m.f. = 2V

LEAD-ACID ACCUMULATOR

$I = V/R$

$I = 2/0.01$

$I = 200A$ - HENCE SPARKS

THE AMPERE

Current is measured in amperes (A). It is defined as the current flowing in two straight wire of infinite length, 1m apart in a vacuum which produces a force of 2×10^{-7}N per metre.

THE COULOMB

This is ammeasurement of the quantity of electricity. It is defined as the quantity of electricity that flow past a particular point in 1s when a current of 1A is flowing. $Q = It$ COULOMBS = AMPERES x SECONDS

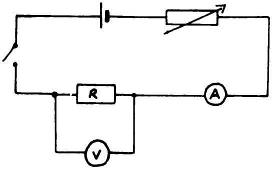
THE VOLT

This is part of the electromotive force that drives the current across a resistance in the circuit. It is defined as : when one joule of work is done per coloumb of electricity passing between two points, then these two points are at a potential difference of 1 volt.

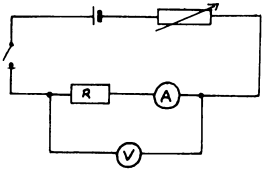
ELECTROMOTIVE FORCE

This is the force produced to drive the current around a circuit. It is the total work done in joules per coulomb of electricity passing around a circuit.

TO MEASURE RESISTANCE - AMMETER-VOLTMETER METHOD



UNKNOWN RESISTANCE LOWER THAN VOLTMETER



UNKNOWN RESISTANCE HIGHER THAN VOLTMETER

THE RHEOSTAT IS THEN ALTERED TO GIVE A SERIES OF VOLTMETER AND AMMETER READINGS

RESISTANCE $= \frac{\text{p.d.}}{\text{CURRENT}}$ $R = \frac{V}{I} = \frac{\text{VOLTMETER READING}}{\text{AMMETER READING}}$ (N.B. MEAN FIGURE TAKEN)

E.G. $V = 0.4V$ $I = 0.3A$ $R = {}^{0.4}/_{0.3} = 1.33$

ERRORS : 1. WRONG CIRCUIT USED FOR HIGH RESISTANCES
2. HIGH CURRENTS CAUSE HEATING OF THE RESISTORS - INCREASE RESISTANCE

CURRENT ELECTRICITY

WORK DONE BY AN ELECTRIC CURRENT

IF A p.d. OF 1V IS APPLIED TO THE ENDS OF A CONDUCTOR AND 1 COULOMB OF ELECTRICITY PASSES THROUGH IT THE WORK DONE IS 1 JOULE.

WORK DONE = VOLTS(V) x COULOMBS(Q)

Q = CURRENT IN AMPERES x TIME IN SECONDS

WORK DONE IN JOULES = VIt

SUBSTITUTING OHMS LAW EQUATION $VIt = I^2Rt$ or $\frac{V^2t}{R}$

ELECTRIC POWER

POWER IN WATTS = RATE OF WORKING IN J/s

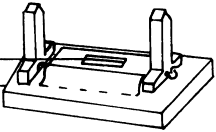
POWER IN WATTS $= \frac{VIt}{t} = VI \quad \frac{I^2Rt}{t} = I^2R \quad \frac{V^2t}{Rt} = \frac{V^2}{R}$

WATTS = VOLTS x AMPERES

KILOWATT HOUR One kilowatt for one hour (or equivalent)

FUSES

MAIN FUSE



FUSE RATING

E.G. Voltage = 240V

Appliance = 1000W

WATTS = VOLTS x AMPERES

1000 = 240 x X

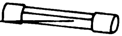
1000/240 = X

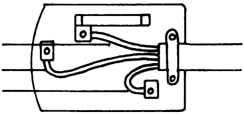
4.2A

The fuse rating should be just above this i.e. 5A

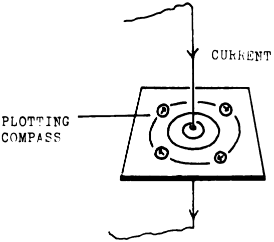
Fuses commonly available 3, 5, 10 & 13A

PLUG FUSE

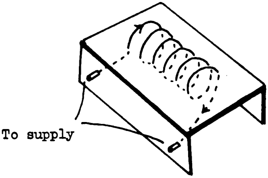


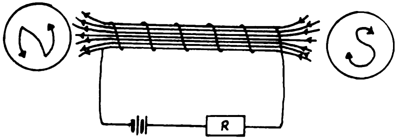


MAGNETIC FLUX PATTERN DUE TO A CURRENT IN A STRAIGHT WIRE



MAGNETIC FLUX PATTERN DUE TO A CURRENT IN A SOLENOID

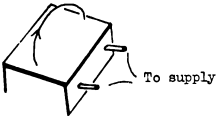




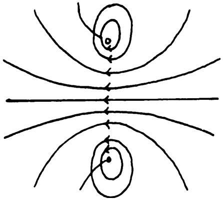
RIGHT-HAND GRIP RULE

To find the direction of magnetic flux grasp the wire with the right hand. Point the thumb along the wire. The direction of the fingers give the direction of the flux.

MAGNETIC FLUX PATTERN DUE TO A CURRENT IN A FLAT CIRCULAR COIL

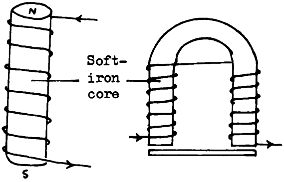


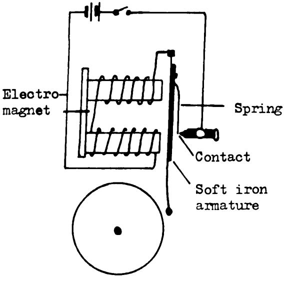
Current going away



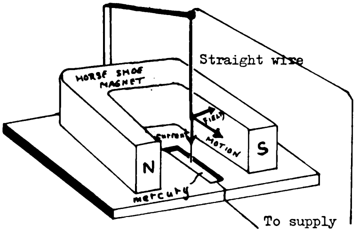
Current coming towards

THE ELECTROMAGNET



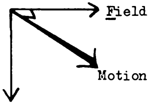


KICKING WIRE EXPERIMENT



FLEMING'S LEFT HAND RULE

First finger, second finger and thumb of the left hand are placed at right angles to one another.

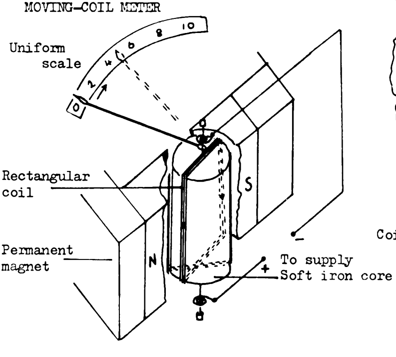


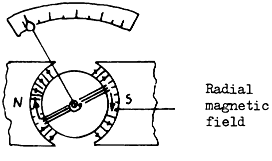
Forefinger points in the direction of the Field

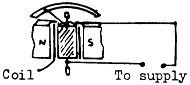
ThuMb points in the direction of the Motion

SeCond finger points in the direction of the Current

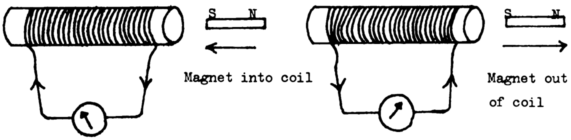
MOVING-COIL METER







ELECTROMAGNETIC INDUCTION



An electromagnetic force is induced whenever there is a change in the magnetic flux linked with a coil.

Strength of the induced current depends upon:

1.. The number ofturns in the coil
2. The strength of the magnet
3. The speed with which the magnet is passed into or out of the coil

The direction of the induced current is always such as to oppose the change producing it. In the above example the coil end nearest the magnet will become a S pole thus opposing the plunging in of the magnet but when the magnet is withdrawn the same end will become N thus opposing the withdrawal of the magnet.

Direction of the induced current in a straight wire

Fleming's right-hand rule

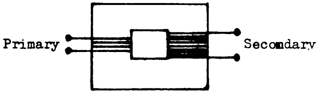
If you extend your thumb, forefinger and second finger so thet they are mutually at right angles to one another then the forefinger points in the direction of the field, the thumb points in the direction of the motion and the second finger in the direction of the current.

TRANSFORMERS

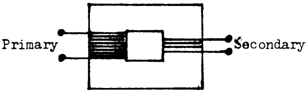
$$\frac{\text{Secondary e.m.f.}}{\text{Primary e.m.f.}} = \frac{\text{Number of turns in the secondary}}{\text{Number of turns in the primary}}$$

Secondary power output = Primary power output (if energy losses are negligible)

Step-up transformer



Step-down transformer



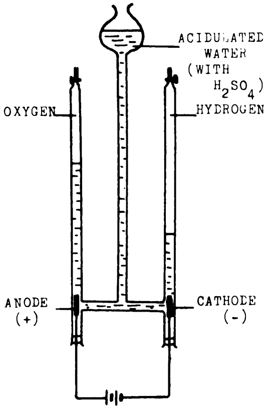
THE CHEMICAL EFFECT OF AN ELECTIC CURRENT

Electrolysis - the process by which a substance is decomposed by the passage of an electic current through it.

Electrolyte - is the substance which undergoes decompostion through which the electric current passes.

Electrodes - are the plates through which the electric current enters and leaves the electrolyte. Enters at the electrode termed the Anode and leaves at the Cathode.

Hofmann's voltameter



Hydrogen to oxygen produced in the ratio of 2:1.

Test for hydrogen - gas burns with a blue flame, droplets of water form on a cold surface held in the flame.

Test for oxygen - relights a glowing splint.

Action at the cathode

$$H^+ + e = H$$

$$H + H = H_2$$

Action at the anode

$$OH^- - e = OH$$

$$OH + OH = H_2O + O$$

$$O + O = O_2$$

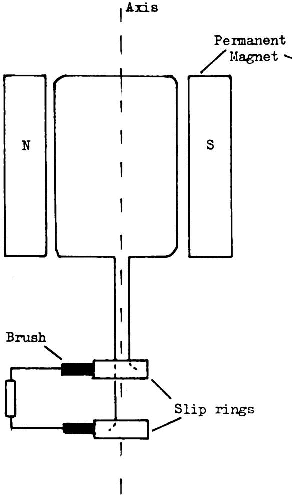
Uses of electrolysis

1. Electrolytic copper - very low electrical resistance. Anode - thin strip of pure copper, Cathode - impure copper Electrolyte - $CuSO_4$

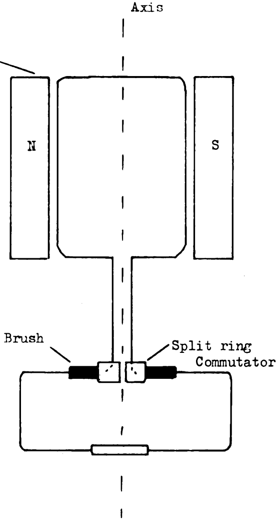
2. Electrolytic extraction of aluminium from bauxite

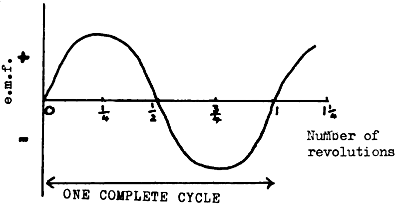
3. Electroplating of brass tableware
Anode - silver. Cathode - brass tableware. Electrlyte - silver cyanide
Nickel and chromium plating is carried out similarly.

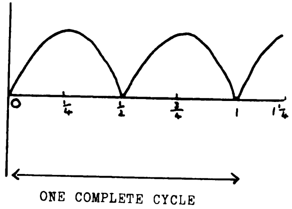
A.C. GENERATOR



D.C. GENERATOR







To increase the e.m.f. obtained from a simple dynamo:

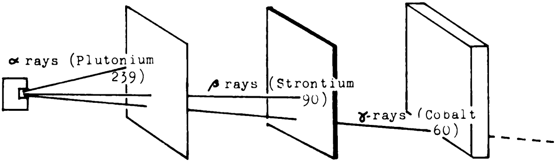
1. Increase the number of windings
2. Wind on a soft iron armature
3. Increase the speed of rotation
4. Increase field strength

RADIOACTIVITY

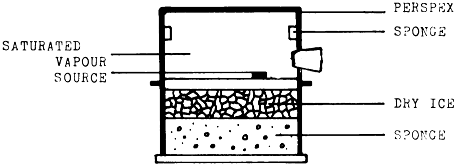
PROPERTIES OF ALPHA, BETA AND GAMMA RAYS

	ALPHA (α)	BETA (β)	GAMMA (γ)
CHARGE	+	-	NONE
PENETRATING POWER	ABOUT 6cm IN AIR VERY THIN PAPER	ABOUT 500cm IN AIR ABOUT 0.3cm Al.	50 000cm IN AIR 4cm LEAD REDUCES 1/10
EXPOSES PHOTOGRAPHIC PAPER	YES	YES	YES
DEFLECTED BY MAGNETIC FIELD	YES (VERY SLIGHTLY)	YES (LARGE)	NO

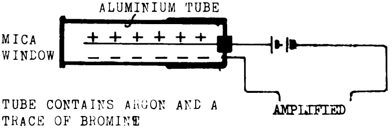
PENETRATION OF AND PARTICLES AND RAYS



CLOUD CHAMBER



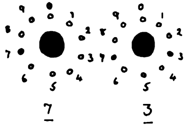
GIEGER-MULLER TUBE



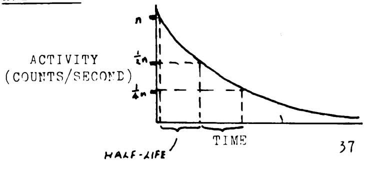
TUBE CONTAINS ARGON AND A TRACE OF BROMINE

TO LOUD SPEAKER, SCALER OR RATEMETER

SCALER

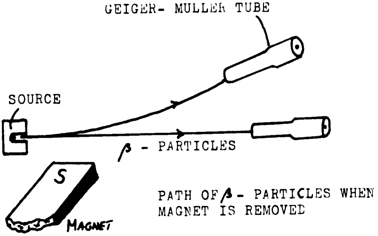


HALF-LIFE



The half-life of a substance is the time taken for half the atoms in a given sample of the substance to decay.

EVIDENCE THAT β- PARTICLES ARE ELECTRONS



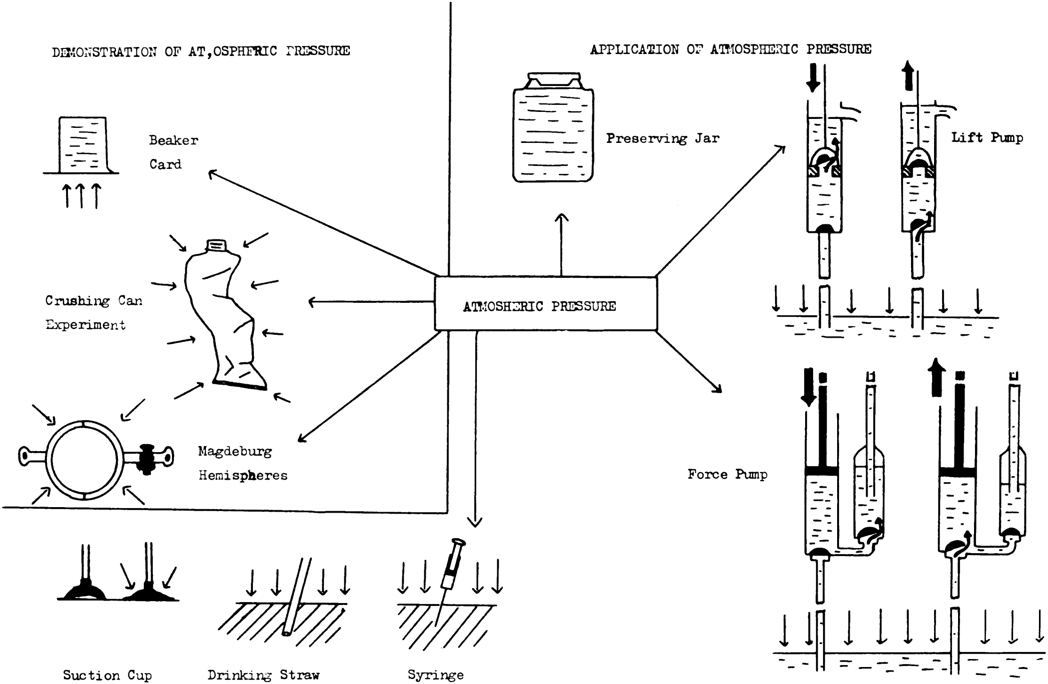
LAWS OF RADIOACTIVE DECAY

EMISSION OF AN α-PARTICLE

The element turns into one with chemical properties of an element two places prior to the original element.

EMISSION OF A β-PARTICLE

The element turns into one with chemical properties of an element one place further on than the original element.


DEMONSTRATION OF AT,OSPHERIC PRESSURE
APPLICATION OF ATMOSPHERIC PRESSURE
ATMOSHERIC PRESSURE
Beaker
Card
Crushing Can
Experiment
Magdeburg
Hemispheres
Suction Cup
Drinking Straw
Syringe
Preserving Jar
Lift Pump
Force Pump

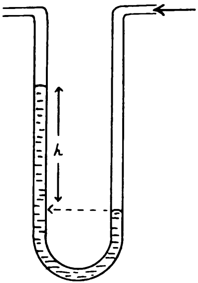
MEASUREMENT OF GAS PRESSURE

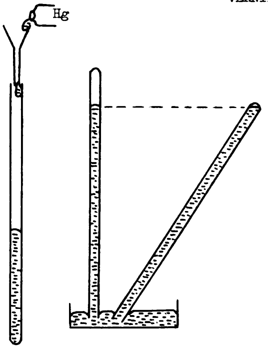
HIGHER OR LOWER THAN ATMOSPHERIC PRESSURE

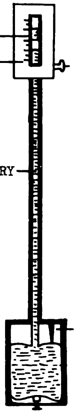
- MANOMETER

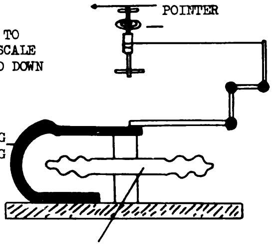
ATMOSPHERIC PRESSURE

- SIMPLE BAROMETER
- FORTIN BAROMETER
- ANEROID BAROMETER









THE GAS LAWS

$vp/T = c \qquad \frac{v_1p_1}{T_1} = \frac{v_2p_2}{T_2}$ Where v = volume p = pressure
T = temperature (K)

Boyles Law

The volume of a fixed mass of gas is inversely proportional to the pressure if the temperature remains constant. $pv = c$ or $p_1v_1 = p_2v_2$

Charles' law

The volume of a fixed mass of gas at constant pressure e.pands by 1/273 of it's volume at 0^oC per Kelvin rise in temperature.

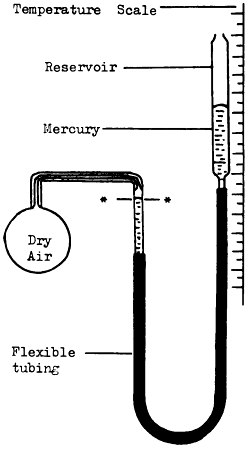
$$v/T = c \quad \text{or} \quad v_1/T_1 = p_2/T_2$$

Pressure law

The pressure of a fixed mass of gas at constant volume increases by 1 273 of it's pressure at 0^oC per Kelvin rise in temperature.

N.B. When using gas law equations, do not forget toconvert from ^oC to K.
S.t.p. is 760mmHg and 0^oC.

Constant volume gas thermometer

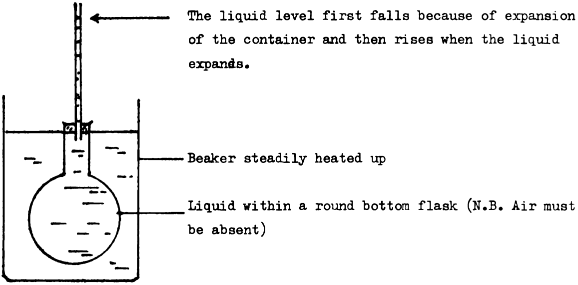


The reservoir is raised or lowered until the constant level *—* is aligned.

The temperature is then read off the temperature scale.

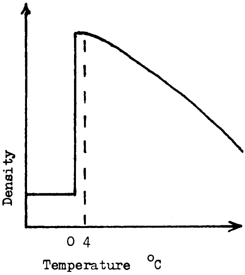
Note the importance of dry air within the flask.

EXPANSION OF LIQUIDS

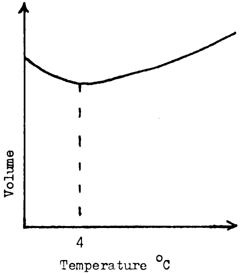


ANOMOLOUS EXPANSION OF WATER

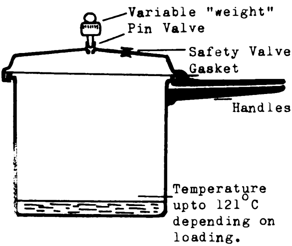
PLOT OF WATER DENSITY AGAINST TEMPERATURE



PLOT OF WATER VOLUME AGAINST TEMPERATURE



THE PRESSURE COOKER



EFFECT OF PRESSURE ON BOILING POINT

INCREASED PRESSURE → BOILING POINT RAISED

REDUCED PRESSURE → BOILING POINT LOWERED

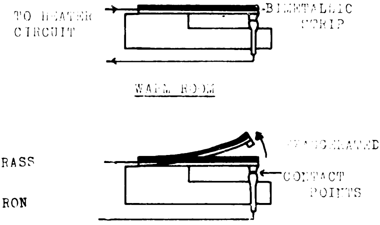
EFFECT OF IMPURITIES ON BOILING POINT AND FREEZING POINT

EXPANSION OF SOLIDS AND LIQUIDS

1. Expansion of railway lines and their correction.

2. Bimetallic strip.

Thermostat



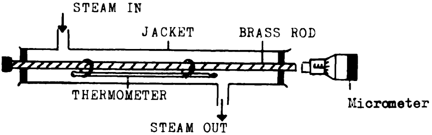
ELECTRICAL CIRCUIT BROKEN - ELECTRICITY DOES NOT FLOW - HEATER OFF

N.B Bimetallic strip on a freezer will be the opposite way round - makes contact on cooling

BEFORE HEATING

AFTER HEATING

3. **Linear expansivity of a solid**



Linear expansivity of a solid:

This is the fraction of it's original length that a rod of the substance expands when the temperature of the rod is raised through one Kelvin.

$$\text{Linear expansivity} = \frac{\text{Expansion}}{\text{Original length x Rise in temperature}}$$

Determined using the apparatus above. Expansion measured using the micrometer N.B. The second reading of the micrometer will be less than the first reading. only use the final reading when two consecutive readings are the same. Temperature difference determined by measuring the temperature before steam is passed through the apparatus and then the final steady temperature.

SPECIFIC HEAT CAPACITY

HEAT CAPACITY

This is the heat required to raise the temperature of a body 1K

Units - joule per kelvin (J/K)

SPECIFIC HEAT CAPACITY

This is the heat required to raise the temperature of unit mass of a substance through 1K

Units - joule per kilogram kelvin (J/kgK)

Heat energy given out = Heat energy taken in

$$mc(T_2 - T_1) = mc(T_1 - T_3)$$

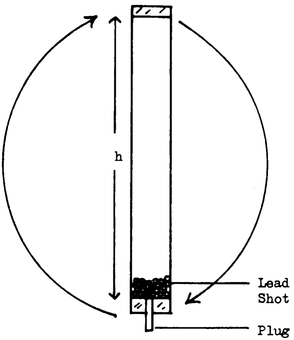
Where m=mass c=specific heat capacity T_1=final temperature

T_2=initial temperature of system which loses heat

T_3= " " " gains "

N.B. When using this formula remember that the final figure within the brackets i.e. difference in temperature is multiplied by everything outside the bracket. Check that you are working throughout in either grams or kilograms and that the respective units of specific heat capacity are also related. J/gK or J/kgK

TO MEASURE SPECIFIC HEAT CAPACITY OF LEAD



Potential energy   Internal molecular energy

Only a rough estimate because:

1. Not all of the shot falls through the whole distance.
2. Heat is lost to the air and the cardboard.

Potential energy = mgh

Internal molecular energy = $mc(T_2 - T_1)$

Thus $mgh = mc(T_2 - T_1)$

$$c = \frac{\not{m}gh \times n}{\not{m}(T_2 - T_1)}$$

Where $T_2 - T_1$ = Temperature difference

m = mass of lead shot

h = distance through which the shot falls

n = number of times tube is inverted

Thermometer inserted before and after invertion.

LATENT HEAT

SPECIFIC LATENT HEAT OF VAPOURIZATION

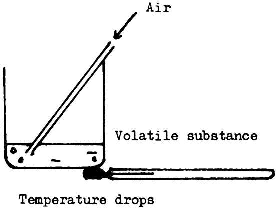
This is the quantity of heat required to change unit mass of a substance from the liquid to the vapour state without a change in temperature,

Units - joule per kilogram (J/kg)

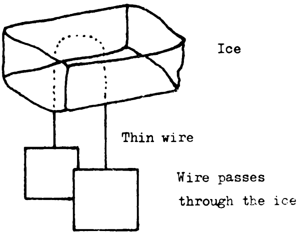
SPECIFIC LATENT HEAT OF FUSION

This is the quantity of heat required to change unit mass of a substance from the solid to the liquid state without a change in temperature.

EVAPORATION OF A VOLATILE SUBSTANCE

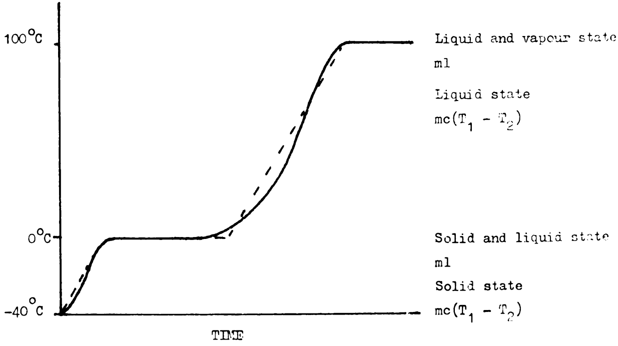


REGELATION



HEATING ICE

Initial temperature -40°C Final temperature 100°C as steam



SPEED VELOCITY AND ACCELERATION

Average speed = Distance/Time

Displacement - Distance moved in a specified direction(Vector)

Velocity - The rate of change of distance moved with time in a specified direction (or rate of change of displacement) (Vector)

Uniform velocity - The rate of change of distance moved with time in a specified direction is constant

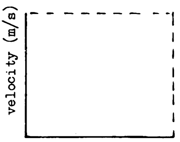
Accleration - Rate of change of velocity with time

Uniform acceleration - The rate of change of velocity with time is constant

Accleration = Change in velocity/Time

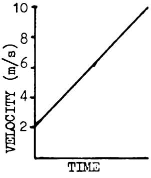
$v = u + at$ Where v = Final velocity u = Initial velocity
a = Rate of acceleration t = time

Velocity time graphs

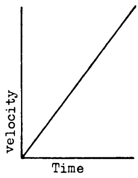


Distance travelled is the area below the curve.

Uniform acceleration

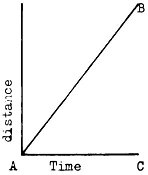


Uniform acceleration from 2 metres per second at a rate of 2 metres per second per second



Acceleration =
Change in velocity/Time

Velocity from distance-time graph



Velocity = Time/Distance
Velocity = BC/AC

WORK ENERGY AND POWER

Work = Force x Distance moved in the direction of the force

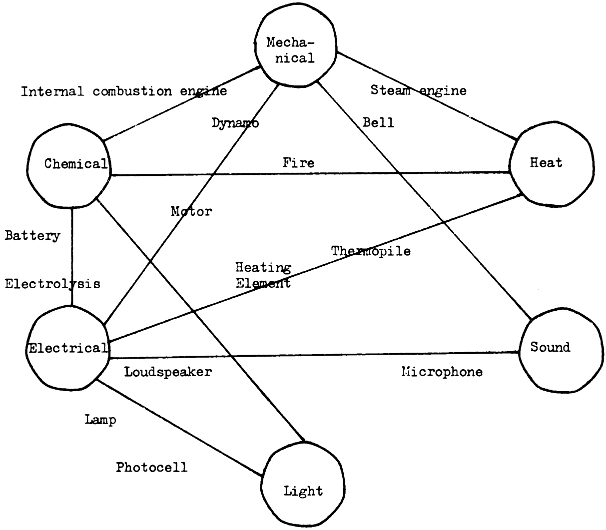
1 joule of work is done when 1 newton is moved a distance of 1 metre

Energy

Capacity to perform work (also measured in joules)

Conservation of energy

Forms of energy



Mechanical energy

Kinetic Potential

Potential - by reason of either a body's state (elastic) or it's position (gravity) P.E. = mgh

Kinetic - by reason of its motion K.E. = $\frac{1}{2}mv^2$

Where m = mass g = force of gravity h = height v = velocity

Pendulum - top of it's swing has maximum potential energy, minimum kinetic energy
- bottom of it's swing has minimum potential energy, maximum kinetic energy

During the swing all of the potential energy is converted to kinetic energy and thence back again.

MECHANICAL ADVANTAGE

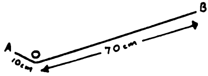
$$\text{MECHANICAL ADVANTAGE (M.A.)} = \frac{\text{LOAD}}{\text{EFFORT}} \ \frac{(L)}{(E)}$$

$\text{M.A.} = \frac{L}{E}$ (MALE) SPANNER > 1 BICYCLE < 1

A MACHINE IS :- A DEVICE BY MEANS OF WHICF A FORCE APPLIED AT ONE POINT CAN BE USED TO OVERCOME A FORCE AT SOME OTHER POINT

MECHANICAL ADVANTAGE OF A LEVER

e.g.



NEGLECTING FRICTION AND WEIGHT OF LEVER

MOMENTS = FORCE x DISTANCE

EFFORT X BO = LOAD X AO

EFFORT X 70cm = LOAD X 10cm

THUS

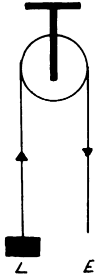
$\text{LOAD}/_{\text{EFFORT}} = 70/_{10} = \text{M.A.}$

M.A. = 7.

PULLEYS

NEGLECTING FRICTION AND WEIGHT OF THE ROPE

FIXED PULLEY

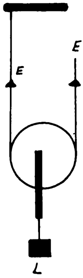


LOAD = EFFORT

THUS :-

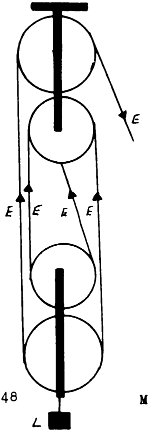
$L/_E = 1.$

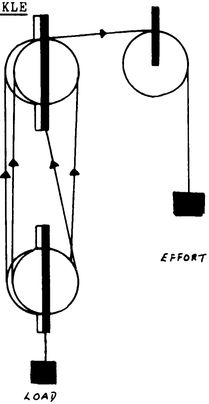
MOVING PULLEY



$\text{M.A} = \frac{L}{E} = \frac{2}{1} = 2.$

BLOCK AND TACKLE





$\text{M.A} = \frac{4E}{E} = 4$

RELATION BETWEEN M.A., V.R. AND EFFICIENCY

$$M.A. = \frac{L}{E} \qquad V.R. = \frac{\text{DISTANCE MOVED BY EFFORT}}{\text{DISTANCE MOVED BY LOAD (IN THE SAME TIME)}}$$

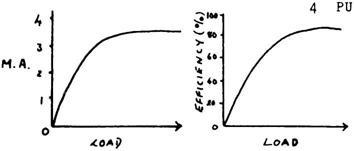
$$\text{EFFICIENCY} = \frac{\text{WORK OUTPUT}}{\text{WORK INPUT}} \times 100\%$$

SINCE WORK = FORCE x DISTANCE

THEN
$$\text{EFFICIENCY} = \frac{\text{LOAD} \times \text{DISTANCE LOAD MOVES}}{\text{EFFORT} \times \text{DISTANCE EFFORT MOVES}}$$

$$= M.A. \times 1/_{V.R.} \quad \text{or} \quad M.A./_{V.R.} \times 100\%$$

M.A. AND EFFICIENCY OF A PULLEY SYSTEM

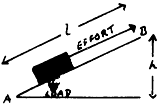


4 PULLEYS

USELESS LOAD BECOMES A SMALLER PROPORTION OF THE TOTAL LOAD.

1. M.A. INCREASES WITH LOAD 2. EFFICIENCY INCREASES WITH LOAD
3. EFFICIENCY NEVER 100%, M.A. WITH 4 PULLEYS NEVER REACHES 4

THE INCLINED PLANE



$$V.R. = \frac{\text{DISTANCE MOVED BY EFFORT}}{\text{DISTANCE MOVED BY LOAD}} = \frac{\text{LENGTH OF PLANE}}{\text{HEIGHT OF PLANE}} = \frac{l}{h}$$

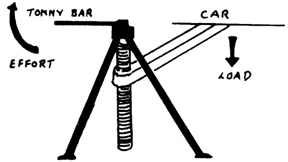
NEGLECTING FRICTION

LOAD x DISTANCE LOAD MOVES = EFFORT x DISTANCE EFFORT MOVES

$$\text{THUS : } M.A. = \frac{\text{LOAD}}{\text{EFFORT}} = \frac{\text{DISTANCE EFFORT MOVES}}{\text{DISTANCE LOAD MOVES}} = \frac{l}{h}$$

THE SCREW

ONE TURN = DISTANCE OF ITS PITCH



IGNORING FRICTION

WORK DONE BY EFFORT = WORK DONE BY LOAD

or EFFORT x DISTANCE (CIRCUMFERENCE OF CIRCLE TRACED OUT BY EFFORT = LOAD x SCREW PITCH