Class 10 Science: Key Formulas, Equations & Diagrams

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1 Chemical Reactions and Equations

Combination	$2\,Mg + O_2 \longrightarrow 2\,MgO$; $CaO + H_2O \longrightarrow Ca(OH)_2$
Thermal decomposition	$CaCO_3 \xrightarrow{heat} CaO + CO_2$ $2\,FeSO_4 \xrightarrow{heat} Fe_2O_3 + SO_2 + SO_3$ $2\,Pb(NO_3)_2 \xrightarrow{heat} 2\,PbO + 4\,NO_2 + O_2$
Electrolytic	$2\,H_2O \xrightarrow{electricity} 2\,H_2 + O_2$ ($H_2 : O_2 = 2 : 1$ by volume)
Photolytic	$2\,AgCl \xrightarrow{sunlight} 2\,Ag + Cl_2$ $2\,AgBr \xrightarrow{sunlight} 2\,Ag + Br_2$
Displacement	$Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$ $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$
Double displacement	$Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4\downarrow + 2\,NaCl$ (white ppt.)
Redox	$CuO + H_2 \xrightarrow{heat} Cu + H_2O$ CuO is reduced (loses O); H_2 is oxidised (gains O)
Respiration (exothermic)	$C_6H_{12}O_6 + 6\,O_2 \longrightarrow 6\,CO_2 + 6\,H_2O$ + energy

Corrosion: rusting of iron needs air and moisture; rust is $Fe_2O_3 \cdot x\,H_2O$. Prevent by painting, oiling, galvanising.

Rancidity: oxidation of fats and oils (bad smell, taste). Prevent with antioxidants, nitrogen flushing, airtight packs.

2 Acids, Bases and Salts

pH scale 0–14: < 7 acidic · 7 neutral · > 7 basic. Tooth decay below pH 5.5.

Neutralisation	$NaOH + HCl \longrightarrow NaCl + H_2O$ (salt + water)
Metal + acid	$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2\uparrow$
Metal + base	$2\,NaOH + Zn \longrightarrow Na_2ZnO_2 + H_2\uparrow$
Carbonate + acid	$Na_2CO_3 + 2\,HCl \longrightarrow 2\,NaCl + H_2O + CO_2\uparrow$ $NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2\uparrow$
Lime-water test	$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3\downarrow + H_2O$ (turns milky)
Metal oxide + acid	$CuO + 2\,HCl \longrightarrow CuCl_2 + H_2O$ (blue-green)
Chlor-alkali	$2\,NaCl + 2\,H_2O \longrightarrow 2\,NaOH + Cl_2 + H_2$ Cl_2 at anode, H_2 at cathode, NaOH near cathode
Bleaching powder	$Ca(OH)_2 + Cl_2 \longrightarrow CaOCl_2 + H_2O$
Baking soda	$NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$ On heating: $2\,NaHCO_3 \xrightarrow{heat} Na_2CO_3 + H_2O + CO_2$
Washing soda	$Na_2CO_3 + 10\,H_2O \longrightarrow Na_2CO_3 \cdot 10\,H_2O$
Plaster of Paris	$CaSO_4 \cdot 2\,H_2O \xrightarrow{373\,K} CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}\,H_2O$ Sets: $CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}\,H_2O \longrightarrow CaSO_4 \cdot 2\,H_2O$

Water of crystallisation: blue $CuSO_4 \cdot 5\,H_2O$ turns white on heating, blue again with water.

3 Metals and Non-metals

Reactivity series: K > Na > Ca > Mg > Al > Zn > Fe > Pb > [H] > Cu > Hg > Ag > Au

Metal + water	$2\,Na + 2\,H_2O \longrightarrow 2\,NaOH + H_2$ + heat $3\,Fe + 4\,H_2O(steam) \longrightarrow Fe_3O_4 + 4\,H_2$
Amphoteric oxide	$Al_2O_3 + 6\,HCl \longrightarrow 2\,AlCl_3 + 3\,H_2O$ $Al_2O_3 + 2\,NaOH \longrightarrow 2\,NaAlO_2 + H_2O$
Ionic bond	$Na \longrightarrow Na^+ + e^-$, $Cl + e^- \longrightarrow Cl^- \rightarrow Na^+Cl^-$ $Mg \longrightarrow Mg^{2+} + 2\,e^- \rightarrow MgCl_2$ (Mg^{2+} + 2 Cl^-)
Roasting (sulphide)	$2\,ZnS + 3\,O_2 \xrightarrow{heat} 2\,ZnO + 2\,SO_2$
Calcination (carbonate)	$ZnCO_3 \xrightarrow{heat} ZnO + CO_2$
Reduction	$ZnO + C \longrightarrow Zn + CO$
Thermite	$Fe_2O_3 + 2\,Al \longrightarrow 2\,Fe + Al_2O_3$ + heat

Electrolytic refining: impure metal = anode, pure metal = cathode, electrolyte = a salt solution of the metal.

4 Carbon and its Compounds

General formulas	Alkane C_nH_{2n+2} · alkene C_nH_{2n} · alkyne C_nH_{2n-2}
Combustion	$CH_4 + 2\,O_2 \longrightarrow CO_2 + 2\,H_2O$ + heat + light
Oxidation	$CH_3CH_2OH \xrightarrow{alk.\ KMnO_4\ +\ heat} CH_3COOH$ (or acidified $K_2Cr_2O_7$ + heat)
Hydrogenation	$R_2C{=}CR_2 + H_2 \xrightarrow{Ni} R_2CH{-}CHR_2$ (oils → fats)
Substitution	$CH_4 + Cl_2 \xrightarrow{sunlight} CH_3Cl + HCl$
Ethanol + Na	$2\,Na + 2\,CH_3CH_2OH \longrightarrow 2\,CH_3CH_2O^-Na^+ + H_2$
Dehydration	$CH_3CH_2OH \xrightarrow[443\,K]{hot\ conc.\ H_2SO_4} CH_2{=}CH_2 + H_2O$
Esterification	$CH_3COOH + C_2H_5OH \xrightarrow{acid} CH_3COOC_2H_5 + H_2O$
Saponification	$CH_3COOC_2H_5 \xrightarrow{NaOH} C_2H_5OH + CH_3COONa$ Ester + alkali → alcohol + salt (how soap is made)
Acid + carbonate	$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$

Functional groups: –Cl/–Br halo · –OH alcohol · –CHO aldehyde · >C=O ketone · –COOH carboxylic acid. Homologues differ by CH_2 (14 u).

5 Life Processes

Photosynthesis	$6\,CO_2 + 12\,H_2O \xrightarrow[sunlight]{chlorophyll} C_6H_{12}O_6 + 6\,O_2 + 6\,H_2O$
Glycolysis	Glucose (6C) → pyruvate (3C) + energy (cytoplasm)
Pyruvate →	No O_2 (yeast): ethanol + CO_2 + energy Lack of O_2 (muscle): lactic acid + energy O_2, in mitochondria: CO_2 + H_2O + much energy

Photosynthesis events: chlorophyll absorbs light · light energy → chemical energy, water split into H and O_2 · CO_2 reduced to carbohydrate.

Digestion: salivary amylase: starch → sugar · stomach: pepsin, HCl, mucus · bile emulsifies fats · pancreas: trypsin (proteins), lipase (fats) · villi absorb.

Transport: double circulation, 4-chambered heart · xylem: water, minerals · phloem: food (translocation) · normal BP 120/80 mm Hg.

Excretion: nephron: glomerulus in Bowman's capsule filters blood; tubule reabsorbs glucose, amino acids, salts, water; urine: ureter → bladder → urethra.

DIAGRAMS TO PRACTISE

- Human digestive system · human heart (section) · excretory system and nephron · stomata (open, closed) · respiratory system

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6 Control and Coordination

Reflex arc	Receptor → sensory neuron → spinal cord (relay) → motor neuron → effector

Brain: forebrain (cerebrum: thinking) · midbrain · hindbrain: cerebellum (balance, posture), medulla (BP, salivation, vomiting), pons

Plant hormones: auxin (growth, phototropism) · gibberellins (stem growth) · cytokinins (cell division) · abscisic acid (inhibits growth, wilting)

Animal hormones: thyroxin (thyroid; needs iodine) · growth hormone (pituitary) · insulin (pancreas) · adrenaline (adrenal)

DIAGRAMS TO PRACTISE

- Neuron · reflex arc · human brain

7 How do Organisms Reproduce?

Asexual: fission (*Amoeba* binary, *Plasmodium* multiple) · fragmentation (*Spirogyra*) · regeneration (*Planaria*) · budding (*Hydra*, yeast) · spores (*Rhizopus*) · vegetative propagation

Flower: stamen (anther, filament) is male; pistil (stigma, style, ovary) is female. After fertilisation: zygote → embryo, ovule → seed, ovary → fruit.

Human: testes make sperm and testosterone; ovaries make eggs and oestrogen. Fertilisation in the oviduct; embryo fed through the placenta.

DIAGRAMS TO PRACTISE

- Binary and multiple fission · budding in *Hydra* · regeneration in *Planaria* · LS of a flower · pollen germination on stigma · male and female reproductive systems

8 Heredity

Monohybrid	TT × tt → F_1 all Tt (tall); F_1 selfed → F_2 Phenotype 3 tall : 1 short · genotype 1 TT : 2 Tt : 1 tt

Dihybrid: RRyy × rrYY → F_1 RrYy (round, yellow) → F_2 9 round yellow : 3 round green : 3 wrinkled yellow : 1 wrinkled green

Sex	Female XX, male XY. The father's X or Y decides the child's sex (50 : 50).

9 Light – Reflection and Refraction

Sign convention (New Cartesian): origin at pole / optical centre; distances along incident light +, against it −; heights above axis +; u is always −.

Mirror	$\frac{1}{v}+\frac{1}{u}=\frac{1}{f},\ f=\frac{R}{2},\ m=\frac{h'}{h}=-\frac{v}{u}$
Lens	$\frac{1}{v}-\frac{1}{u}=\frac{1}{f},\ m=\frac{h'}{h}=\frac{v}{u}$
Sign of f	Concave mirror/lens: −; convex mirror/lens: +
Power	$P=\frac{1}{f}$ (f in m, unit D); $P=P_1+P_2+\cdots$
Refractive index	$n=\frac{c}{v},\ n_{21}=\frac{v_1}{v_2}$; Snell: $\frac{\sin i}{\sin r}=n_{21}$

m **negative:** real, inverted · m **positive:** virtual, erect. Convex mirror and concave lens: always virtual, erect, diminished.

OBJECT (CONCAVE MIRROR)	IMAGE	SIZE
At infinity	At F	Point-sized
Beyond C	Between F and C	Diminished
At C	At C	Same size
Between C and F	Beyond C	Enlarged
At F	At infinity	Highly enlarged
Between P and F	Behind mirror	Enlarged, **virtual, erect**

All real and inverted except the last. Convex lens: same pattern with F_1, $2F_1$ (object side) and F_2, $2F_2$ (image side).

DIAGRAMS TO PRACTISE

- Ray diagrams for every object position: concave mirror, convex lens · convex mirror, concave lens · refraction through a glass slab

10 The Human Eye and the Colourful World

Normal eye: near point 25 cm, far point infinity; ciliary muscles change focal length (accommodation).

DEFECT	IMAGE FORMS	CORRECTION
Myopia	In front of retina	Concave lens
Hypermetropia	Behind retina	Convex lens
Presbyopia	Near point recedes (age)	Bifocal lens

- **Dispersion:** prism splits white light into VIBGYOR; violet bends most, red least. Rainbow: dispersion, refraction and internal reflection in raindrops.
- **Atmospheric refraction:** stars twinkle; sun seen ~2 min before sunrise and after sunset.
- **Scattering:** Tyndall effect; sky is blue (fine particles scatter blue more); danger signals are red (red is scattered least by fog and smoke).

DIAGRAMS TO PRACTISE

- Human eye · myopia and hypermetropia with correction · dispersion by a prism · refraction through a prism

11 Electricity

Current, p.d.	$I=\frac{Q}{t},\ V=\frac{W}{Q};\ e=1.6\times10^{-19}\ \text{C}$
Ohm's law	$V=IR;\ R=\rho\frac{l}{A}$ (ρ in Ω m)
Series	$R_s=R_1+R_2+R_3$ (same current)
Parallel	$\frac{1}{R_p}=\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}$ (same voltage)
Joule heating	$H=I^2Rt=VIt$
Power	$P=VI=I^2R=\frac{V^2}{R};\ 1\ \text{kWh}=3.6\times10^6\ \text{J}$

Ammeter in series, voltmeter in parallel. 1 unit of electricity = 1 kWh.

12 Magnetic Effects of Electric Current

- **Field lines:** N → S outside a magnet, S → N inside; closed, never cross; crowded where the field is strong.
- **Right-hand thumb rule:** thumb along current, curled fingers give field direction.
- **Fleming's left-hand rule:** forefinger = field, middle finger = current, thumb = force. Force is greatest when $I \perp B$.
- **Domestic circuit:** live (red), neutral (black), earth (green); 220 V. Fuse in series guards against overloading and short-circuit; earth wire protects metal-body appliances.

DIAGRAMS TO PRACTISE

- Field lines: bar magnet · straight wire · circular loop · solenoid · domestic circuit

13 Our Environment

Food chain	Grass → grasshopper → frog → snake → eagle
10% law	~10% of energy passes to the next level: 10 000 J → 1000 J → 100 J → 10 J
Ozone	$O_2 \xrightarrow{\text{UV}} O+O;\ O+O_2 \longrightarrow O_3$ (CFCs deplete it)

Biological magnification: non-biodegradable chemicals (e.g. DDT) build up at each trophic level.

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