GR 12 DEFINITIONS
Paper 1: Physics

Newton's laws and application of Newton's laws

Different kinds of forces: weight, normal force, frictional force, applied force (push, pull), tension (strings or cables)

Normal force, N,	is the force or the component of a force which a surface exerts on an object with which it is in contact, and which is perpendicular to the surface.
Frictional force, f,	is the force that opposes the motion of an object and which acts parallel to the surface.
Static frictional force, f_s,	is the force that opposes the tendency of motion of a stationary object relative to a surface.
Kinetic frictional force, f_k	is the force that opposes the motion of a moving object relative to a surface.
Weight	is the gravitational force the Earth exerts on any object on or near its surface.

Newton's laws

Newton's first law of motion:	A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it.
Newton's second law of motion:	When a resultant/net force acts on an object, the object will accelerate in the direction of the force at an acceleration directly proportional to the force and inversely proportional to the mass of the object.
Newton's third law of motion:	When one body exerts a force on a second body, the second body exerts a force of equal magnitude in the opposite direction on the first body.
Newton's Law of Universal Gravitation:	Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres.

Momentum and Impulse

Momentum	i s the product of an object's mass and its velocity.
Newton's second law of motion in terms of momentum	The resultant/net force acting on an object is equal to the rate of change of momentum of the object in the direction of the resultant/net force.
Impulse	is the product of the resultant/net force acting on an object and the time the resultant/net force acts on the object.
The impulse-momentum theorem	$F_{net}\Delta t = m\Delta v$.
A *closed/an isolated system* (in Physics),	a system on which the resultant/net external force is zero (A closed/an isolated system excludes external forces that originate outside the colliding bodies, e.g. friction. Only internal forces, e.g. contact forces between the colliding objects, are considered)
The principle of conservation of linear momentum:	The total linear momentum of a closed system remains constant (is conserved).

Projectile Motion in One Dimension (1D)

A *projectile*	an object upon which the only force acting is the force of gravity

Work, Energy and Power

Work	The work done on an object by a constant force F is $F\Delta x\cos\theta$, where F is the magnitude of the force, Δx the magnitude of the displacement and θ the angle between the force and the displacement.
The work-energy theorem:	The net/total work done on an object is equal to the change in the object's kinetic energy OR the work done on an object by a resultant/net force is equal to the change in the object's kinetic energy. In symbols: $W_{net} = \Delta K = K_f - K_i$.
A *conservative force*	is a force for which the work done in moving an object between two points is independent of the path taken. Examples are gravitational force, the elastic force in a spring and electrostatic forces (coulomb forces).
A *non-conservative force*	is a force for which the work done in moving an object between two points depends on the path taken. Examples are frictional force, air resistance, tension in a chord, etc.
The principle of conservation of mechanical energy:	The total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant. (A system is isolated when the resultant/net external force acting on the system is zero.)
Power	*is* the rate at which work is done or energy is expended

Doppler Effect (relative motion between source and observer)

The Doppler effect	is the change in frequency (or pitch) of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation.

Electrostatics and Electric field and Electric Circuits

Coulomb's law:	The magnitude of the electrostatic force exerted by one point charge (Q_1) on another point charge (Q_2) is directly proportional to the product of the magnitudes of the charges and inversely proportional to the square of the distance (r) between them.
An electric field.	is a region of space in which an electric charge experiences a force. The direction of the electric field at a point is the direction that a positive test charge would move if placed at that point
The electric field at a point	The electric field at a point is the electrostatic forceexperienced per unit positive charge placed at that point
Ohm's law:	The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature.
Rms for an alternating voltage or an alternating current	The rms value of AC is the DC potential difference/current which dissipates the same amount of energy as AC

Optical Phenomena and Properties of Materials

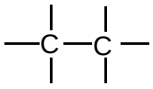
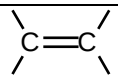
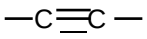
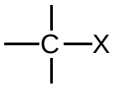
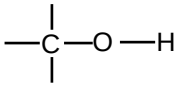
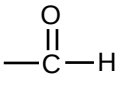
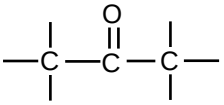
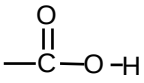
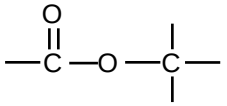
Photo-electric effect

The *photoelectric effect*	*i*s the process whereby electrons are ejected from a metal surface when light of suitable frequency is incident on that surface.
T*hreshold frequency*, f_o,	as the minimum frequency of light needed to emit electrons from a certain metal surface.
Work function, W_o	is the minimum energy that an electron in the metal needs to be emitted from the metal surface.

Emission and absorption spectra

An atomic absorption spectrum	is formed when certain frequencies of electromagnetic radiation that passes through a medium, e.g. a cold gas, is absorbed
An atomic emission spectrum	is formed when certain frequencies of electromagnetic radiation are emitted due to an atom's electrons making a transition from a high-energy state to a lower energy state

GENERAL THEORY

Homologous series	Structure of functional group	
	Structure	**Name/Description**
Alkanes		Only C-H and C-C single bonds
Alkenes		Carbon-carbon double bond
Alkynes		Carbon-carbon triple bond
Haloalkanes	 (X = F, Cℓ, Br, I)	Halogen atom bonded to a saturated C atom
lcohols		Hydroxyl group bonded to a saturated C atom
Aldehydes		Formyl group
Ketones		Carbon l group bonded to two C atoms
Carboxylic acids		Carboxyl group
Esters		

Molar volume of gases	1 mole of any gas occupies 22,4 dm^3 at 0 °C (273 K) and 1 atmosphere (101,3 kPa).

Dfferent intermolecular forces (Van der Waal's forces):	Dipole-dipole forces: Induced dipole forces or London forces Hydrogen bonding	Forces between two polar molecules Forces between non-polar molecules Forces between molecules in which hydrogen is covalently bonded to nitrogen, oxygen or fluorine – a special case of dipole-dipole forces

Boiling point	The stronger the intermolecular forces, the higher the boiling point.
Melting point:	The stronger the intermolecular forces, the higher the melting point.
Vapour pressure	The stronger the intermolecular forces, the lower the vapour pressure.

Rates and equilibrium

$\Delta H > 0$	for endothermic reactions, i.e. reactions in which energy is released.
$\Delta H < 0$	for exothermic reactions, i.e. reactions in which energy is absorbed.
factors that affect the rate of chemical reactions, ,	nature of reacting substances, surface area, concentration (pressure for gases), temperature the presence of a catalyst
catalyst	increases the rate of a reaction by providing an alternative path of lower activation energy. It therefore decreases the net/total activation energy.
the factors that influence the position of an equilibrium	pressure (gases only), concentration temperature.
outo-ionisasie van water	die reaksie van water met water self om H_3O^+-ione en OH^--ione te vorm.dws $2H_2O \rightleftharpoons H_3O^+ + OH^-$

Definitions
Organic Chemistry

Boiling point	The temperature at which the vapour pressure of a substance equals atmospheric pressure
Melting point:	The temperature at which the solid and liquid phases of a substance are at equilibrium.
Vapour pressure	The pressure exerted by a vapour at equilibrium with its liquid in a closed system.
Organic molecules	are molecules containing carbon atoms.
Molecular formula	A chemical formula that indicates the type of atoms and the correct number of each in a molecule.
Structural formula	A structural formula of a compound shows which atoms are attached to which within the molecule. Atoms are represented by their chemical symbols and lines are used to represent ALL the bonds that hold the atoms together.
Condensed structural formula	This notation shows the way in which atoms are bonded together in the molecule, but DOES NOT SHOW ALL bond lines.
Hydrocarbon:	Organic compounds that consist of hydrogen and carbon only
Homologous series	A series of organic compounds that can be described by the same general formula OR in which one member differs from the next with a CH_2 group
Saturated compounds	Compounds in which there are no multiple bonds between C atoms in their hydrocarbon chains.
Unsaturated compounds :	Compounds with one or more multiple bonds between C atoms in their hydrocarbon chains.
Functional group	A bond or an atom or a group of atoms that determine(s) the physical and chemical properties of a group of organic compounds.
Structural isomer	Organic molecules with the same molecular formula, but different structural formulae.
Chain isomers	Same molecular formula, but different types of chains
Positional isomers	Same molecular formula, but different positions of the side chain, substituents or functional groups on the parent chain
Functional isomers	Same molecular formula, but different functional groups
Hydrohalogenation:	The addition of a hydrogen halide to an alkene
Halogenation	The reaction of a halogen (Br_2, $C\ell_2$) with a compound
Hydration	The addition of water to a compound
Hydrogenation	The addition of hydrogen to an alkene

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Dehydrohalogenation of haloalkanes:	The elimination of hydrogen and a halogen from a haloalkane
Dehydration of alcohols:	Elimination of water from an alcohol
Cracking of alkanes:	The chemical process in which longer chain hydrocarbon molecules are broken down to shorter more useful molecules.
Hydrolysis	The reaction of a compound with water
Macromolecule	A molecule that consists of a large number of atoms
Polymer:	A large molecule composed of smaller monomer units covalently bonded to each other in a repeating pattern
Monomer:	Small organic molecules that can be covalently bonded to each other in a repeating pattern
Polymerisation	A chemical reaction in which monomer molecules join to form a polymer
Addition polymerisation :	A reaction in which small molecules join to form very large molecules by adding on double bonds
Addition polymer :	A polymer formed when monomers (usually containing a double bond) combine through an addition reaction
Condensation polymerisation	Molecules of two monomers with different functional groups undergo condensation reactions with the loss of small molecules, usually water
Condensation polymer	A polymer formed by two monomers with different functional groups that are linked together in a condensation reaction in which a small molecule, usually water, is lost

RATES AND EQUILIBRIUM

heat of reaction (ΔH)	the energy absorbed or released in a chemical reaction.
exothermic reactions	reactions that release energy.
endothermic reactions	reactions that absorb energy.
activation energy	the minimum energy needed for a reaction to take place.
activated complex	the unstable transition state from reactants to products.
reaction rate	ange in concentration of reactants or products per unit time.
positive catalyst	a substance that increases the rate of a chemical reaction without itself undergoing a permanent change
a catalyst	increases the rate of a reaction by providing an alternative path of lower activation energy. It therefore decreases the net/total activation energy.
open system	continuously interacts with its environment, while a closed system is isolated from its surroundings.
reversible reaction:	A reaction is reversible when products can be converted back to reactants.
Chemical equilibrium	a dynamic equilibrium when the rate of the forward reaction equals the rate of the reverse reaction

Le Chatelier's principle:	When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance.

Acids and Bases

Arrhenius theory An acid	is a substance that produces hydrogen ions (H^+)/hydronium ions (H_3O^+) when it dissolves in water.
A base	is a substance that produces hydroxide ions (OH^-) when it dissolves in water.
Lowry-Brønsted theory An acid	is a proton (H^+ ion) donor.
A base	is a proton (H^+ ion) acceptor.
Strong acids	ionise completely in water to form a high concentration of H_3O^+ ion
Weak acids	ionise incompletely in water to form a low concentration of H_3O^+ ions.
Strong bases	dissociate completely in water to form a high concentration of OH^- ions.
Weak bases	dissociate/ionise incompletely in water to form a low concentration of OH^- ions
Concentrated acids/bases	contain a large amount (number of moles) of acid/base in proportion to the volume of water
Dilute acids/bases	contain a small amount (number of moles) of acid/base in proportion to the volume of water.
Conjugate acid-base pairs	the acid, HA, loses a proton, its conjugate base, A^-, is formed. When the base, A^-, accepts a proton, its conjugate acid, HA, is formed.
ampholyte or amphiprotic substance	a substance that can act as either a s a n acid or a s a base.
Hydrolysis	ction of a salt with water.
Equivalence point of a titration	oint at which the acid /base has completely reacted with the base/acid.
Endpoint of a titration	oint where the indicator changes colour.
K_w	uilibrium constant for the ionisation of water or the ionic product of water or the ionisation constant of water, i.e. $K_w = [H_3O^+][OH^-] = 1 \times 10^{14}$ by 298 K.
auto-ionisation of water	the reaction of water with itself to form H_3O^+ ions and OH^- ions.

Electrochemical Reactions

Galvanic cell	a cell in which chemical energy is converted into electrical energy. A galvanic (voltaic) cell has self-sustaining electrode reactions
Electrolytic cell	a cell in which electrical energy is converted into chemical energy.
in terms of electron (e^-) transfer Oxidation	a loss of electrons.
Reduction	a gain of electrons.
terms of oxidation numbers: Oxidation:	An increase in oxidation number
Reduction	A decrease in oxidation number
Oxidising agent	A substance that is reduced/gains electrons.
Reducing agent	A substance that is oxidised/loses electrons.
Anode	The electrode where oxidation takes place
Cathode	The electrode where reduction takes place
an *electrolyte*	a solution/liquid/dissolved substance that conducts electricity through the movement of ions
Electrolysis	The chemical process in which electrical energy is converted to chemical energy OR the use of electrical energy to produce a chemical change.

Chemical Industry

The fertiliser industry (N, P, K)

eutrophication	is the process by which an ecosystem, e.g. a river or dam, becomes enriched with inorganic plant nutrients, especially phosphorus and nitrogen, resulting in excessive plant growth. As plant growth becomes excessive, the amount of dead and decaying plant material increases rapidly.

4. GENERAL INFORMATION

4.1 Quantities, symbols and units

The most common quantities, symbols and SI units used in introductory Physics are listed below.
A quantity should not be confused with the units in which it is measured.

Quantity	Preferred symbol	Alternative symbol	Unit name	Unit symbol
mass	m		kilogram	kg
position	x, y		metre	m
displacement	$\Delta x, \Delta y$	s	metre	m
velocity	v_x, v_y	u, v	metre per second	$m{\cdot}s^{-1}$
initial velocity	v_i	u	metre per second	$m{\cdot}s^{-1}$
final velocity	v_f	v	metre per second	$m{\cdot}s^{-1}$
acceleration	a		metre per second per second	$m{\cdot}s^{-2}$
acceleration due to gravity	g		metre per second per second	$m{\cdot}s^{-2}$
time (instant)	t		second	s
time interval	Δt		second	s
energy	E		joule	J
kinetic energy	K	E_k	joule	J
potential energy	U	E_p	joule	J
work	W		joule	J
work function	W_0		joule	J
power	P		watt	W
momentum	p		kilogram metre per second	$kg{\cdot}m{\cdot}s^{-1}$
force	F		newton	N
weight	w	F_g	newton	N
normal force	N	F_N	newton	N
tension	T	F_T	newton	N
friction force	f	F_f	newton	N
coefficient of friction	μ, μ_s, μ_k		(none)	
torque	τ		newton metre	N·m
wavelength	λ		metre	m
frequency	f	ν	hertz or per second	Hz or s^{-1}
period	T		second	s
speed of light	c		metre per second	$m{\cdot}s^{-1}$
refractive index	n		(none)	
focal length	f		metre	m
object distance	s	u	metre	m
image distance	s'	v	metre	m
magnification	m		(none)	
charge	Q, q		coulomb	C
electric field	E		newton per coulomb or volt per metre	$N{\cdot}C^{-1}$ or $V{\cdot}m^{-1}$
electric potential at point P	V_P		volt	V
potential difference	$V, \Delta V$		volt	V
emf	**E**	ε	volt	V
current	I, i		ampere	A
resistance	R		ohm	Ω
internal resistance	r		ohm	Ω
magnetic field	B		tesla	T
magnetic flux	Φ		tesla·metre^2 or weber	$T{\cdot}m^2$ or Wb