H1 Definition Checklist

1.	Systematic error	An error which causes measurements to be either, always larger than the true value, or always smaller than the true value.
2.	How to reduce systematic error?	Cannot be reduced by taking the average of repeated measurements but can be eliminated by checking the instrument in which the error is suspected, against a known reliable instrument.
3.	Accuracy	Refers to the degree of agreement between the result of a measurement and the true value of the quantity.
4.	Random error	An error which causes measurements to be sometimes larger than the true value and sometimes smaller than the true value.
5.	How to reduce random error?	Can be reduced by taking the average of repeated readings.
6.	Precision	Refers to the degree of agreement [scatter, spread] of repeated measurements of the same quantity. Is a measure of the magnitude of the random errors present; high precision implies a small random error.
7.	Base units	Base units are units by which all other units are expressed.
8.	Derived units	Derived units are expressed as a product and/or quotient of the base units.
9.	Scalar & Vectors	A scalar quantity is a quantity which has only magnitude but no direction. A vector quantity has both magnitude and direction.
10.	Distance	Distance travelled is the total length covered irrespective of the direction of motion.
11.	Speed	Speed is defined as the rate of change of distance travelled.
12.	Explain why it is incorrect to define speed as distance per second	Distance is a physical quantity while second is a unit. The physical quantity speed should be defined in terms of quantities, and not a mixture of a quantity and a unit. The correct definition for speed is the distance travelled per unit time.
13.	Displacement	Displacement is defined as the distance moved in a specific direction.
14.	Velocity	Velocity is defined as the rate of change of displacement.
15.	Acceleration	Acceleration is defined as the rate of change of velocity.
16.	2 conditions for equations of motion	1) motion in a straight line 2) magnitude of the acceleration is constant

17.	Equation of motion (1) $v = u + a\,t$	derived from definition of acceleration: $a = (v - u) / t$
18.	Equation of motion (2) $s = ½ (u+v)t$	derived from the area under the v-t graph
19.	Equation of motion (3) $(v^2 = u^2 + 2as)$	derived from equations (1) and (2)
20.	Equation of motion (4) $s = ut + ½ at^2$	derived from equations (1) and (2)
21.	Field of force	A region of space within which a force is experienced.
22.	Gravitation field	A region of space in which a mass experiences an attractive force due to the effect of another mass.
23.	Electric field	A region of space where an electric charge experiences an (attractive or repulsive) force due to the effect of another charge.
24.	Magnetic field	A region of space in which a moving electric charge or a current-carrying conductor experiences a force (that is perpendicular to the magnetic field).
25.	Hooke's law	If the limit of proportionality is not exceeded, the extension is directly proportional to the force/ load applied.
26.	2 conditions for static equilibrium	1) The resultant force acting is zero. {translational equilibrium} 2) The resultant moment about any point equals zero. {rotational equilibrium}
27.	3 forces in equilibrium	If a mass is acted upon by 3 forces only and is in equilibrium, then the lines of action of the 3 forces must pass through a common point.
28.	Principle of moments	For a body to be in rotational equilibrium, the sum of all the anticlockwise moments about any point must be equal to the sum of all the clockwise moments about that same point.
29.	Moment of a force	The product of the force and the perpendicular distance of its line of action from the pivot/ axis of rotation.
30.	Torque of a couple	The product of one of the forces of the couple and the perpendicular distance between the lines of action of the forces.
31.	Couple	A Couple is a pair of equal and opposite forces, whose lines of action do not coincide. (Hence it tends to produce rotation only.
32.	Define centre of gravity	Centre of gravity of an object is defined as that single point through which the entire weight of the object may be considered to act.
33.	Newton's first law	Every object continues in a state of rest or constant speed in a straight line unless a net (external) force acts on it.
34.	Newton's second law	The rate of change of momentum of a body is (directly) proportional to the net force acting on the body, and the (rate of) change of momentum takes place in the direction of the force.

35.	Newton's third law	When body X exerts a force on body Y, object Y exerts a force of the same type that is equal in magnitude and opposite in direction on object X.
36.	Action-reaction pairs	Always act on different objects, hence they cannot cancel each other out. They are of the same type of force.
37.	Linear momentum	Linear momentum of a body is defined as the product of its mass and velocity.
38.	Impulse of a force	Impulse of a force is defined as the product of the force and the time during which it acts.
39.	Principle of conservation of linear momentum	When objects of a system interact, their total momentum before and after interaction are equal if no net external force acts on the system,
40.	Mass	Mass is a measure of the inertia a body (which is the property of a body which resists change in motion).
41.	Weight	Weight is the force experienced by a mass in a gravitational field.
42.	Apparent weightlessness	A body is said to be experiencing apparent weightlessness if the resultant force acting on it is its weight (mg) and its acceleration, a, is equal to g.
43.	Work done by a constant force	Work done by a constant force is defined as the product of the force and displacement in the direction of the force.
44.	Define energy	Energy is the ability to do work. It exists in many possible forms: Mechanical (i.e. Kinetic, potential energies), Chemical, Sound, Thermal, Internal, Radiation (photon), Nuclear energies.
45.	Potential energy (PE)	PE is defined as the stored energy available to do work.
46.	Principle of conservation of energy	Total energy of an isolated system remains constant; energy may be transferred from one form to another, but never created nor destroyed.
47.	Gravitational Potential Energy (GPE)	GPE is the potential energy possessed by a mass due to its position {or height or distance} in the field of another mass
48.	Elastic potential energy (EPE)	EPE of a system is due to its deformation {or stretching or compression}.
49.	Derive $KE = ½ mv^2$	We can infer the formula for kinetic energy from the amount of work that is done by an external force to bring a body from rest to its state of motion. $\rightarrow KE = F s$ By Newton's second law: $\rightarrow KE = (ma)s$ Using the equations of motion for uniform acceleration: $KE = ma (ut + ½ at^2) = ma (½at^2) = ½ma^2t^2$ Sub $a = (v-u)/t$ and let u = 0 $\rightarrow KE = ½ mv^2$
50.	Derive $GPE = mgh$	Mathematically, we can form an equation as follows,

		Increase in GPE = Work done by force exerted on box by person, → $W = F_{ext}\, h = mgh$ (Since there is no acceleration at equilibrium) Hence, Increase in G.P.E. = mgh
51.	Power	Power is defined as the work done per unit time.
52.	Derive $P = Fv$	Consider a force F that acts on a body for a small time interval Δt. The body moves a small displacement Δx in the direction of the force. Work done by the force F during Δt, → $\Delta W = F\, \Delta x$ Power delivered by that force F during the time interval → $P = \Delta W / \Delta t = (F\, \Delta x) / \Delta t = F(\Delta x/\Delta t) = Fv$ Where v is the instantaneous velocity of the body.
53.	Angular displacement	Angular displacement of a body is the angle in radians through which a point revolves around a centre.
54.	Define 1 radian	1 radian is the angle (subtended) at the centre of a circle by an arc equal to the radius of the circle.
55.	Angular velocity	ω is defined as the rate of change of angular displacement.
56.	Linear/tangential velocity	Tangential velocity is the instantaneous velocity at any point in its circular path.
57.	Centripetal force	Centripetal force refers to the resultant of all the forces that act on a system in circular motion.
58.	Explain why a person in a satellite orbiting earth experiences "weightlessness" although the gravitation field strength at that height is not zero	Since the person and the satellite would both have the same acceleration; hence the normal reaction on the person is zero. {To elaborate: the sensation of weight is due to the normal reaction exerted on the object. When the person & the floor of the satellite have the same acceleration, the contact force between them is zero, hence the normal reaction is zero. This is the state of "weightlessness".}
59.	Why is velocity constant for an object in horizontal circular motion?	For uniform circular motion, there is no work done by the centripetal force since the direction of the force is always perpendicular to the direction of displacement. Hence, KE of the object remains constant.
60.	Use newton's laws to explain why an object moving with constant speed in a circle experiences a resultant force towards the centre of the circle.	Since object experiences a constant change in direction of motion, by N1L, there must be a resultant force on it. • Given that the tangential speed remains constant by N2L, there must not be any component of force in the tangential direction. • Hence resultant force must act perpendicular to the velocity, in the radial direction, towards the centre of the circle.

61.	Geostationary satellites	Geostationary satellites are always above a certain point on the Earth as the Earth rotates about its axis.
62.	Requirements for geostationary orbit	1) have a period = period of Earth's rotation {24 hours} 2) rotate from west to east 3) be at a fixed height from the Earth's surface (r = 4.23 × 107 m) 4) have only one orbital speed 5) lie in equatorial plane of Earth
63.	Newton's Law of gravitation	Newton's Law of gravitation states that the gravitational force of attraction between two point masses is proportional to the product of their masses & inversely proportional to the square of their separation.
64.	Gravitational field strength	Gravitational field strength at a point is defined as the gravitational force per unit mass at that point.
65.	Explain why apparent weight at equator is more than at the poles	Resultant of the gravitational force and the normal reaction $N_{equator}$, provides the centripetal force to keep the body in a circular motion.
66.	Current	Electric current (I) is the rate of flow of charge.
67.	Emf (in terms of energy)	Emf is defined as the energy transferred per unit charge from other forms of energy into electrical energy by a source when charge is moved round a complete circuit.
68.	Potential difference (in terms of energy)	The potential difference between 2 points in a circuit is the energy converted from electrical energy to other forms of energy per unit electric charge moved between the 2 points
69.	Resistance	Resistance R of a circuit component is defined as the ratio of the potential difference across the component to the current flowing through it,
70.	Metallic ohmic resistor at constant temperature (sketch and explain)	Magnitude of vibration of lattice ions remains the same. Hence, rate of collision with lattice ions is constant. Thus, resistance is constant so ratio of V to I is constant.
71.	Semiconductor diode (sketch and explain)	Conducts well in one direction, but badly in other direction. An ideal diode has no resistance in forward-bias and infinite resistance in reverse-bias.
72.	Filament lamp (sketch and explain)	Resistance increases with increasing temperature (when I and V are larger) due to more frequent collisions between free electrons and lattice atoms which vibrate more vigorously at higher temperatures. There is no change in number of charge carriers.
73.	NTC Thermistor (sketch and explain)	Resistance decreases with increasing temperature due to large increase in number of charge carriers at high temperature (it is a semiconductor material). This effect overwhelms the increase in lattice vibrations.

74.	Resistivity	Resistivity ρ is defined as the resistance of a material of unit cross-sectional area and unit length.
75.	Characteristic of Light-dependent resistor	LDR is a semiconductor whose resistance decreases as light intensity falling on them increases.
76.	Characteristic of thermistor	Most thermistors have a negative temperature coefficient (NTC), hence resistance decreases with increasing temperature due to an increase in number of mobile charge carriers.
77.	Electric field	An electric field is a region of space where any charged particle in it experiences an electric force.
78.	Electric field strength	E at a point is defined as the electric force per unit positive charge acting on a small positive (test) charge placed at that point.
79.	Magnetic field	Magnetic Field: a region (of space) where a magnetic force is experienced by a current-carrying conductor {or moving charged particle or a permanent magnet}.
80.	Direction of a magnetic field line	The Direction of a magnetic field line defines the direction of the magnetic force on a north pole placed there.
81.	Magnetic flux density	Magnetic flux density is defined as the force acting per unit current in a wire of unit length placed at right-angles to the field.
82.	Fleming's left hand rule	Direction of the magnetic force is always perpendicular to the plane containing the current I and B
83.	How does a ferrous core change the field lines?	The magnetic domains in the soft iron causes the magnetic field to strengthen, so the number of field lines increase due to ferrous core.
84.	Describe circular motion for charged particle in B field	From FLHR, we conclude that the direction of F_B is always perpendicular to the direction of v. Hence the moving charge moves in a uniform circular path where centripetal force is provided by the magnetic force.
85.	Describe charged particle in velocity selector	A setup whereby an E-field and a B-field are perpendicular to each other such that they exert equal & opposite forces on a moving charge & hence causes no deflection of the particle.
86.	Infer results from Rutherford's scattering experiment	Most of the α-particles which passed through the metal foil were deflected by very small angles, • A very small proportion was deflected by more than 90°, some of these approaching 180°. • From these observations, it can be deduced that: the nucleus occupies only a small proportion of the available space {i.e. the atom is mostly empty space} • & that it is positively charged since the positively-charged α-particles are repelled/deflected.

87.	Isotope	Atoms with the same proton number, but different number of neutrons in the nuclei.
88.	Nucleon	A particle within the nucleus; can be either a proton or a neutron.
89.	Nuclide	An atom with a particular number of protons and a particular number of neutrons.
90.	Nuclear stability	The higher the binding energy per nucleon, the more stable the nucleus is.
91.	Binding energy in nucleus	Energy that must be supplied to completely separate a nucleus into its individual particles; Or, the energy released {not: lost} when a nucleus is formed from its constituent nucleons.
92.	Explain by reference to the Binding energy per nucleon graph, how, in both nuclear fusion and fission, energy is released	• The products have higher B.E. per nucleon {due to shape of BE per nucleon vs nucleon number graph}; • Hence the products are more stable. This must mean that energy is released. (The source of the energy release is the mass "loss" during these processes.)
93.	Binding energy per nucleon number	B.E. per nucleon is a measure of the stability of the nucleus.
94.	Fusion	Process where 2 light nuclei are combined to produce a heavier nucleus.
95.	Fission	Process where a heavy nucleus disintegrates into 2 lighter nuclei with the release of energy.
96.	Radioactivity	Radioactivity is the spontaneous and random decay of an unstable nucleus, with the emission of an alpha or beta particle, and usually accompanied by the emission of a gamma ray photon.
97.	Spontaneous	The decay occurs without the need of an external trigger & is not affected by factors outside the nucleus such as temperature, pressure, etc. {must give at least 1 example}
98.	Random	It cannot be predicted when the next emission will occur even though the probability of decay per unit time of a nucleus is constant. {Evidence: the fluctuations in count-rate}

99.		Notation	Charge	Mass	Nature	Penetrating Ability
	Nature of Alpha particles	${}_{2}^{4}He$ ${}_{2}^{4}\alpha$	+2e	4u	Particle	Can be stopped by a few cm of air or a thin sheet of paper.
	Nature of Beta particles	${}_{-1}^{0}e$	-e	$\frac{1}{2000}$ u	Particle	Can be stopped by a few mm of aluminium or ≈ 1 m of air.
	Nature of Gamma particles	${}_{0}^{0}\gamma$	0	0	EM	Can be stopped by a few cm of lead or 1 m of concrete.
100.	Activity	Activity is the rate at which the nuclei are disintegrating.				
101.	Decay constant	Decay constant is defined as the probability of decay of a nucleus per unit time, or, the fraction of the total no. of undecayed nuclei which will decay per unit time.				
102.	Half-life	Half-life is defined as the average time taken for half the number {not: mass or amount} of undecayed nuclei in the sample to disintegrate.				
103.	Ionizing radiation	Ionizing radiation with sufficient energy so that during an interaction with an atom, it can remove electron from the atom, causing it to be charged or ionized.				
104.	Background radiation	Background radiation refers to radiation from sources other than the source of interest.				
105.	Direct effect of ionizing radiation on cells	Radiation interacts directly with DNA molecules, or some other cellular component critical to the survival or the cell. DNA might be broken or have sections removed.				
106.	Indirect effect of ionizing radiation on cells	Radiation interacts with other molecules, e.g. water, producing ions and radicals which can then attack cells and DNA. They can also combine to form toxic substances like H_2O_2.				