Non-Exhaustive List of CIE IGCSE Physics Definitions from 2001 to (March) 2022
(Most up-to-date responses in the mark scheme are shown.)

Key

(20xx) The year indicates the most recent year this definition was asked.
( ) This definition does not appear to have been asked from 2001—2022, but seems to be a reasonable definition to query.
(**2023**) This definition is part of the (new) 2023—2025 syllabus, and has thus not yet been asked.
† In the interest of clarity and/or syllabus updates, the given CIE response has been slightly modified.

Note: The order of definitions mirrors the syllabus ordering, not necessarily that of the textbook or in-class notes.

Motion, Forces, Energy

State some **scalar quantities**.
(2020)† mass, charge, time, temperature

State the factors which completely **describe a vector quantity**.
(2012) (1) magnitude
(2) direction

State some **vector quantities**.
(2020)
- position
- displacement
- velocity
- acceleration
- force
- momentum
- gravitational field strength
- electric field strength

Distinguish between **scalar and vector** quantities.
(2021)† (1) vectors have a direction
(2) scalars do not

Define **speed**.
( ) (1) distance travelled
(2) per unit time

Define **velocity**.
( ) (1) speed
(2) in a given direction

Distinguish between **speed and velocity,** using the words vector and scalar.
(2016) (1) speed is a scalar; velocity is vector
(2) speed has magnitude/size/value (**only**)
(3) velocity has magnitude/size/value **AND** direction
OR velocity has direction; speed does not

Define **acceleration**.
(2019)† Rate of change of velocity
OR change of velocity / time
OR $\boldsymbol{\Delta v/t}$

State the name given to negative **acceleration**.
(2016) deceleration

Explain what is meant by **deceleration**.
(2017) decrease of speed
OR slows/slowing down

State and explain which feature of a position-time graph shows **velocity**.
( ) (1) gradient
(2) (gradient =) change of position / time

State and explain which feature of a speed-time graph shows **acceleration**.
(2020) (1) gradient
(2) (gradient =) change of speed / time

State and explain which feature of a speed-time graph shows **displacement**.
( ) area under the curve

Explain what is meant by **mass**.
(2017)† (measure of) quantity/amount of matter

State what is meant by the term **weight**.
(2017)† (1) (gravitational) force
(2) on an object that has mass

Explain what is meant by **gravitational field strength**.
(**2023**) (1) (gravitational) force
(2) per unit mass

State some ways in which **weight differs from mass**.
(2017) · weight has direction / mass does not
· weight is a vector / mass is not
· weight varies / mass does not
· mass is amount of matter
· weight is a force / mass is not

State the equation linking the **density** of a substance with its mass and volume.
(2012)† (1) $\rho = m/V$
(2) ρ, m, and V, are density, mass, and volume, respectively

State three ways in which a **force may change the motion** of the object.
(2019) (1) accelerate / decelerate / change speed
(2) change direction
(3) causes rotation

State why **force is a vector** quantity.
(2016) force/vector has size/magnitude **AND** direction

Explain what is mean by the **elastic solid**.
(**2023**) (1) a solid that returns to its original shape
(2) once the load is removed

Explain what is meant by the term **limit of proportionality** of a spring.
(2021)† (1) extension is proportional to load
(2) up to this limit

Explain what is mean by the **drag force**.
(**2023**) (1) friction that acts on an object
(2) as it moves through a fluid (liquid, gas)

State the name that is given to the **turning effect of a force**.
(2012) moment

Define the **moment of a force**.
(2021) force × perpendicular distance from a pivot

State the two factors on which the **turning effect of a force** depends.
(2006) (1) (magnitude of) force
(2) distance (from fulcrum)

Explain what is meant by **centre of gravity**.
(**2023**) (1) point at which whole weight of a body
(2) may be considered to act

State the two conditions required for any object to be in **equilibrium**.
(2019) (1) no resultant/net force
OR forces are balanced
OR all forces in opposite directions are equal
OR forces cancel
(2) no resultant moment / torque / turning effect
OR (sum of) clockwise moment(s) = (sum of) anticlockwise moment(s)

State the word equation that defines **momentum**.
(2017) momentum = mass × velocity

State and explain whether **momentum** is a vector or scalar quantity.
(2016) vector **AND** has direction/is related to velocity

Explain why **momentum is a vector quantity**.
(2017) momentum has direction
OR momentum depends on velocity **AND** velocity is a vector

Define **impulse** in terms of force and time.
(2020) force × time the force acts
OR $\boldsymbol{F \times \Delta t}$

State an expression for the **kinetic energy** of an object of mass m that is moving with a speed $\boldsymbol{v}$.
(2016) $\boldsymbol{E_k = \frac{1}{2}mv^2}$

State and explain whether **kinetic energy** is a scalar quantity or a vector quantity.
(2016) (1) scalar
(2) direction does not matter

State the word used to describe the **energy stored in a stretched or compressed spring**.
(2016)† strain (potential energy)
OR elastic (potential energy)

Explain what is meant by the term **energy conservation**.
( ) (1) in any energy transfer
(2) the total amount of energy before and after the transfer is constant

Briefly explain a **Sankey diagram**.
( ) (1) a flow diagram representing energy conservation
(2) arrow width is proportional to energy
(3) total arrow width remains constant

In terms of force and energy, what is meant by **work done**?
(2021)† (1) product of force and displacement
(2) displacement in the direction of the force
(3) work done is equal to energy transferred

State an example of a fuel in which **chemical energy is stored**.
(2013) food **OR** coal **OR** oil/diesel/petrol **OR** gas

State what is meant by **bio-fuel**.
(**2023**) (1) material, derived from recently living organisms
(2) that can be used as fuel

State what is meant by **fossil fuel**.
(**2023**) (1) material, derived from long-dead organisms
(2) that can be used as fuel

Give some examples of **bio-fuels**.
(**2023**) · wood
· animal dung
· bio-gas, generated by rotting vegetable matter

Give some examples of **fossil fuels**.
(**2023**) · oil
· coal
· natural gas

Explain what is meant by **renewable energy source**.
(2013) continuously regenerated/not used up/everlasting supply

Describe the difference between a **renewable energy source** and a **non-renewable energy source**.
(2011) non-renewable sources are finite/get used up

Name one **renewable energy source**.
(2021) · solar/sun/sunlight
· wind
· waves
· tidal
· hydroelectric
· geothermal
· biomass

Name one **non-renewable energy source**.
(2011) fossil fuel/coal/oil/petrol/(natural) gas/peat/nuclear/lignite

State the name of the process which **releases energy in the Sun**.
(2017) (nuclear) fusion

State two **energy resources not derived from the Sun**.

(2021) · geothermal
· nuclear
· tidal

State some similarities and differences between **nuclear fission and fusion**.

( ) **differences**: · fission—a large nucleus divides into small nuclei
· fusion—small nuclei join to make a larger nucleus
similarities: both processes release energy

State the main form of **energy transferred from the Sun to the solar cells** for generating electrical energy.

(2019) light

Describe how the energy stored in the coal is used in a **coal-fired power station** to generate electrical energy.

(2021) (1) coal is burned
(2) resulting thermal energy used to boil water
(3) steam is produced
(4) steam turns/spins/moves turbine
(5) turbine turns/spins/moves generator

State one environmental advantage and disadvantage of using a **fission reactor to generate electrical energy** in a power station.

(2018) **advantage**: no CO2/SO2/greenhouse gases/acid rain
disadvantage: nuclear waste (disposal)
OR leaks of radioactive material
OR risk of radiation in case of accident

Give one environmental reason for using a **wind turbine**.

(2020) · less pollution
· reduced carbon (dioxide) emissions (compared to fossil fuels)

Discuss three factors to consider when installing a **wind turbine**.

(2020) · output expected from wind turbine
· energy use by factory
· wind is intermittent
· whether location has suitable amount of wind
· cost / time to recoup cost of turbine
· whether location / noise will cause nuisance to neighbours

State some **advantages/disadvantages** of a geothermal **energy plant** or heating water in a solar panel versus a coal-burning boiler.

(2021)† **advantage**: renewable
OR no air pollution/carbon dioxide/sulphur dioxide/nitrous oxide
OR low running costs
OR no named polluting gas
OR no greenhouse effect
OR no mining for fuel
disadvantage: expensive to install
OR not available at night
OR visual pollution
OR needs a suitable (roof) space

State some **advantages/disadvantages** of a hydroelectric **energy plant** versus a coal-burning boiler.

(2022) **advantage**: renewable (form of energy)
OR no greenhouse gases **OR** CO2 produced (during operation)
OR no SO2 **OR** nitrous oxides produced OR acidic gases produced (during op.)
OR no fuel to transport
OR power output adjustable to meet demand
OR creates lakes for recreation / tourism
disadvantage: large area of land flooded / needed
OR damage to wildlife habitats
OR population displacement
OR limited number of suitable sites
OR changes to water provision (downstream)
OR (output) can be affected by lack of rain/drought
OR expensive to install

What is meant by **geothermal energy**?

(**2023**) (1) energy stored in hot rocks
(2) underground

State what is meant by the **efficiency of a power station**.

(2008)† ratio of energy out to energy in
OR ratio of power out to power in

Define **power**.
(2015)† work (done) / time (taken)
OR energy (transferred) / time (taken)
OR rate of doing work
OR rate of supplying energy

Define **pressure**.
(2013) force/area **OR** force per unit area
OR $\boldsymbol{F/A}$, where $\boldsymbol{F}$ and $\boldsymbol{A}$ are force and area, respectively

Write an expression for change in (hydrostatic) **pressure in a fluid in terms of change in depth**.
( ) (1) $\boldsymbol{\Delta p = \rho g \Delta d}$
(2) $\boldsymbol{p}$, $\boldsymbol{g}$, $\boldsymbol{\rho}$, and $\boldsymbol{d}$ are pressure, gravitational field strength, density, and depth, respectively

Thermal Physics

Name the state of matter just before a substance **melts**.
(2008) solid

State what is meant by the term **melting point**.
(2011) (1) temperature at which
(2) change between solid and liquid (or vice-versa)

Name the state of matter just before a substance **boils**.
(2008) liquid

State two ways in which the **particulate structure** of a **gas** differs from that of a **liquid**.
(2013)† (1) (gas) particles further apart
(2) (gas) greater/more positive potential energy
(3) (gas) particles move in straight lines

Distinguish between **solids and liquids**, in terms of **particles**.
(2017)† **solids**: · particles of solid arranged in lattice/in organised pattern/without gaps/orderly/fixed structure
· particles in regular positions/regular structure/fixed shape
· particles unable to move around/fixed positions/vibrate
· (average) separation of particles less/closely packed
· more interparticle bonds/stronger bonds/greater forces

Explain, in terms of composing particles, why **liquids are very difficult to compress** .
(2021)† · particles are (already very) close / touching
· (repulsive) forces (very) large

Explain, in terms of composing particles, why it is possible to **compress a gas**, but not a liquid.
(2016)† (1) gas particles (very) far apart
OR empty space between gas particles
(2) particles of liquid (very) close together/compact
OR are touching (each other)

Distinguish between **particle arrangement in ice and liquid water**.
(2016)† **ice**: particles in fixed positions
water: in water, positions change

Distinguish between the **motion of particles composing ice and liquid water**.
(2016)† **ice**: particles vibrate
water: particles move around (and vibrate)

Describe the **movement of particles composing a solid**.
(2018)† (particles) vibrate

Describe the **movement of particles composing a gas**.
(2018)† random/haphazard/in all directions

Explain, in terms of momentum, how **particles composing a gas exert a force on a wall** of a container.
(2020) (1) they / particles collide with walls
(2) change of momentum causes force (to be exerted on walls)
(3) pressure = force / area (so pressure is exerted on walls)

In terms of particles, explain how a **gas causes a pressure on the walls** of its container.
(2022)† (1) particles/atoms moving/vibrating/have kinetic energy
(2) particles/atoms collide . . .
(3) . . . with container walls
(4) exert force/change of momentum/bounce off over an area

State/explain, in terms of composing particles, **changes in gas pressure** when its volume is reduced at constant temperature.

(2019)† (1) pressure increases
(2-3) particles travel shorter (average) distance between collisions with walls
(2-3) particles hit walls more often
OR more collisions (per unit area) with walls
(2-3) greater force / greater (rate of) change of momentum of particles per unit area on walls

State what happens to the **particles composing a gas in a sealed container** when the temperature of the gas is increased.

(2016)† particles move faster/have more kinetic energy/momentum
OR particles hit walls more often/more frequently
OR particles hit walls with greater force/impulse/harder

Explain what is meant by **thermal expansion** of solids or liquids.

( ) (1) the increase in volume of a material
(2) when its temperature rises

In terms of composing particles, explain why **gases expand when they are heated** at constant pressure.

(2008)† (1) (average) speed/energy of particles/atoms greater
(2) (average) separation of particles/atoms greater
OR particles/atoms take up more space
OR increased pressure causes container to get bigger

In terms of particles, explain why **solids expand when they are heated**.

(2012)† (1) heating makes particles vibrate more energetically
(3) particles take up more space
(2) solid expands in all directions

In terms of particles, explain why **liquids expand when they are heated**.

(2021)† (1) particles / they speed up or gain kinetic energy
(2) particles move further apart or push others away

Explain, in terms of particles, why **liquids expand more than solids** when heated.

(2021)† (1) forces between liquid particles weak(er than in solids)
(2) less energy / work done to separate molecules
OR greater separation for same work done / same increase in energy

State one **everyday occurrence of thermal expansion**.

(2021) bridges buckle

State, in terms of atoms, what is meant by **internal energy**.

(2017) (1) kinetic energy/potential energy/total energy (of atoms/molecules/particles)
(2) kinetic **added** to potential energy (of atoms/molecules/particles)

State, in terms of composing particles, what is meant by an **increase in internal energy**.

(2021) particles speed up or gain kinetic energy
particles move further apart or push others away

State what is meant by the **specific heat capacity** of a substance.

(2015) (1) energy/heat required to increase temperature
(2) of **1 kg/1 g**/unit mass (of the substance)
(3) by **1°C/1 K**/unit temperature

Explain how **heat is related to temperature**.

( ) (1) energy transfer from a hotter to colder place
(2) because of a temperature difference between them

Describe what happens to the **particles composing a substance during boiling**.

(2008)† (1) particles gain energy/move faster (not vibrate)
(2) particles become gaseous/break free

Explain, in terms of the behaviour of composing particles, **evaporation**.

(2013) (1) particles escape
(2) leave the liquid
(3) form gas or vapour

In terms of composing particles, how is **evaporation rate of water** affected by a reduction in wind speed.

(2014) (1) reduced
(2) no / fewer evaporated particles removed by wind
OR greater humidity / vapour pressure

In terms of composing particles, how is **evaporation rate of water** affected by an increase in water temperature.
(2014) (1) increases
(2) particles move faster / have more energy
OR more molecules have energy to escape

State some ways in which **evaporation differs from boiling**.
(2017) **evaporation**:
· at surface **OR** no bubbles form
· at any temperature **OR** no heat needed
· affected by draught / surface area
boiling:
· throughout liquid **OR** bubbles form
· at specific temperature **OR** heat needed
· not affected by draught / surface area

Give some example of **state changes** not involving boiling or evaporation.
(2017) · condensation / change from gas to liquid
· freezing or solidification / change from liquid to solid
· melting / change from solid to liquid

Explain the **melting of a solid** in terms of **particles and energy**.
(2020)† (1) particles must be separated
OR (interparticle) bonds must be broken
(2) work done (against bonds)
OR energy is required / needed

Explain, in terms of energy, the process which takes place as a solid at its **melting point** changes into a liquid at the same temperature.
(2015)† · particles composing a liquid are not in fixed positions/can move about/move past each other
OR particles composing a solid have a fixed position
· particles composing a liquid have random arrangement
OR particles composing a solid are arranged regularly/in patterns/layers/lattice
· liquid particles are (slightly) further apart (than solid particles) (OR *vice versa*)

Explain, in terms of particles, why **energy** must be supplied for a **solid to become a liquid**.
(2016)† work done against forces
OR work done separating particles
OR energy to break bonds
OR potential energy of particles increases

State the word we use to describe materials that are poor **conductors** of heat.
(2004) insulators

State the name for the **transfer of thermal energy through a metal**.
(2022) conduction

State how **thermal energy is conducted in metals**.
(2021)† · atoms (touching the hotplate) / lattice vibrate (faster)
· atoms pass on energy / vibration to neighbouring atoms / to other atoms by collision
· atoms pass on energy to electrons
· electrons hit distant atoms or electrons move (through lattice)

What is meant by **natural convection**?
( ) (1) energy transfer in liquid and gases
(2) due to differences in density

State the process by which **thermal energy** is transferred from Sun to Earth.
(2006) radiation

State the conditions necessary for an **object to remain at constant temperature**.
(**2023**) (1) energy transfer energy rate away from the object
(2) should equal energy transfer energy rate towards the object

Explain why **houses in hot countries** are often painted white.
(2017) · the sun is a source of energy
· (thermal / heat / IR / electromagnetic) radiation
· white (or clearly implied) surfaces absorb less or don't absorb
· white (or clearly implied) surfaces reflect more
· to keep house cooler OR to reduce thermal energy / heat transferred to house

Waves and Rays

State what is meant by the **frequency of vibration** of a vibrating object.
(2013)† number of (complete) vibrations/oscillations/unit time

Explain what is meant by **transverse wave**.
(2014) oscillation/vibrations of particles/molecules perpendicular to direction of travel (of wave)

Give some examples of **transverse waves**.
( ) · waves on a rope
· water waves
· seismic S-waves
· vibrating beams

Explain what is meant by a **longitudinal wave**.
(2017) vibration/oscillation parallel to direction of travel **OR** compressions and rarefactions

Give some examples of **longitudinal waves**.
( ) · sound
· seismic P-waves
· compression waves in a spring

State how a **longitudinal wave** differs from a **transverse wave**.
(2020) (1) **transverse**: oscillation at right angles to the direction of propagation / travel / energy transfer (of the wave)
OR longitudinal: oscillation parallel to / in the direction of propagation / travel / energy transfer (of the wave)
(2) **longitudinal**: has compressions **AND** rarefactions

State what is meant by the **amplitude of a transverse wave**.
(2013) displacement/distance/height/depth
OR half peak to trough distance/distance from mean position

State what is meant by the **amplitude of a longitudinal wave**.
( ) distance from the equilibrium position of the medium to a compression/rarefaction

State what is meant by **frequency** of a wave.
(2017)† number of wavefronts (generated/produced/passing a point) in 1 sec/per sec/in unit time

Distinguish between **seismic P and S waves**.
(**2023**) (1) both are waves caused by earthquakes
(2) P are fast moving longitudinal
(3) S are slow moving transverse

Define **wave refraction**.
( ) (1) the changing of the direction of travel of waves
(2) as they pass from one medium to another
(2) where the different media support different wave speeds

State the name of the process by which **waves spread out** after passing a gap, barrier, or edge.
(2017) diffraction

State the effect on **diffraction of an increasing gap** width.
(2017) wavefronts have smaller angular width
OR do not extend as far as dashed lines
OR less (angular) spread

Explain why the quantity **refractive index** does not have a unit.
(2017) sines have no unit
OR sines are ratio of two lengths
OR ratio of two speeds (whose units cancel)
OR units cancel

State what is meant by **critical angle**.
(2016) angle of incidence when angle of refraction = 90°

Explain what is meant by **critical angle,** in terms of refraction.
(2016) the greatest angle of incidence (in the material) at which refraction occurs
OR the angle of incidence (in the material) at which the refracted ray travels along the boundary
OR angle of refraction is 90°
OR the angle of incidence/(in the material) above which total internal reflection occurs

Explain what is meant by **total internal reflection**.
(2016) reflection in a more dense material where there is no refracted ray
OR all light in a more dense material is reflected

Explain, in terms of the behaviour of light rays, what is meant by **principal focus** for a thin converging lens.
(2021) (1) (point) where (parallel) rays (of light) meet
(2) after passing through lens)
OR
(1) (point) through which rays (of light) that emerge parallel pass
(2) before reaching lens

State what is meant by the **focal length** of a lens.
(2021) (1) distance between principal focus / focal point
(2) and optical centre / lens

State what is meant by a **converging (convex) lens**.
( ) a lens which is thicker at its middle than at its edges

State what is meant by a **diverging (concave) lens**.
(**2023**) a lens which is thinner at its middle than at its edges

Distinguish between **converging and diverging lenses**.
(**2023**) (1) lenses that cause rays of light initially parallel to the principle axis
(2) **converging**: to converge at the focus
diverging: to diverge at the focus

State what is meant by **real image**.
(2011) image can be formed on a screen
OR is formed by rays of light meeting
OR is formed on the opposite side of the lens from the object

State what is meant by **virtual image**.
( ) (1) the location at which light rays appear to come
(2) cannot be projected onto a screen

State what is meant by **enlarged image**.
( ) (1) an image produced by a lens
(2) the image appears larger than the object

State what is meant by **diminished image**.
( ) (1) an image produced by a lens
(2) the image appears smaller than the object

State what is meant by **monochromatic light**.
(2013) light of (only) one wavelength **OR** frequency **OR** colour

State the name of the process that **separates the colours in white light**.
(2018) dispersion

Explain the **mechanism behind dispersion**.
( ) (1) the separation of different wavelengths of light
(2) because they are refracted through different angles

State the **speed in a light in air**.
(2019) $\approx \mathbf{3.0 \times 10^8\ m{\cdot}s^{-1}}$

State the **speed of microwaves in vacuum**.
(2020) $\approx \mathbf{3.0 \times 10^8\ m{\cdot}s^{-1}}$

State the **speed of x-rays in vacuum**.
(2020) $\approx \mathbf{3.0 \times 10^8\ m{\cdot}s^{-1}}$

State the **speed at which all electromagnetic waves** travel in vacuum.
(2016) $\approx \mathbf{3.0 \times 10^8\ m{\cdot}s^{-1}}$

State the region of the **electromagnetic spectrum** that has the **shortest wavelength**.
(2003) gamma-rays/$\boldsymbol{\gamma}$**−rays**

State which of the components of the **electromagnetic spectrum** has the **lowest frequency**.
(2016) radio (waves)

State the nature of $\boldsymbol{\gamma}$**−rays**.
(2017) (1) electromagnetic (waves/rays/radiation)
(2) high frequency/energy
OR short wavelength

State two types of radiation, other than visible light, that are part of the **electromagnetic spectrum**.
(2010) gamma/x-rays/UV/IR/microwaves/radio/TV

State some **uses for radio wave radiation**.
(**2023**) · broadcast radio and television signals
· radio astronomy
· radio frequency identification (RFID) chips

State some **uses for microwave radiation**.

(**2023**)
- satellite television broadcasting
- transmit mobile phone (cellphone) signals
- WIFI communication
- cooking

State why **microwave ovens** are designed only to work with the door closed.

(2018)
(1) microwaves harmful/dangerous (to humans)
(2) microwaves would pass through open door

State two **uses for infrared radiation**.

(2020)
- remote controls
- (infrared) sensors / alarms
- specific electrical appliances
- thermal imaging
- astronomy

State some **uses of optical fibres**.

(2018)
- to carry (telephone) signals / communications
- for medical diagnosis / imaging
- specified artistic (display)
- specified lighting

Describe one use of **optical fibres in communication** technology.

(2017)
(1) information/message/music/sound/signal/data (encoded as pulses of light) sent
(2) light (travels along fibre) or infra-red (radiation)
(3) light detected (at far end) or message decoded or total internal reflection mentioned

State some **uses for visible electromagnetic radiation**.

(**2023**)
- eyesight
- optical instruments such as cameras, telescopes and microscopes
- photosynthesis

State some **uses for ultraviolet radiation**.

(**2023**)
- forensic science
- security marking of valuable equipment and banknotes
- sterilize water, medical instruments, food utensils

Suggest some **uses for x-rays or x-ray radiation**.

(2022)
- imaging / scanning bones / internal organs
- treating cancer
- bone density measurements
- security scans (of baggage / parcels / freight at port / airport)
- space telescopes

Describe one **medical use of x-rays**.

(2021)
(1) **use**: treating cancer / X-ray shadow-graph / sterilizing equipment
(2) **effect**: absorbed by tumour / absorbed by bones / absorbed by bacteria
(3) **consequence**: tumour killed / photograph produced / bacteria killed

State one reason why it is necessary to take **safety precautions when x-rays are used**.

(2022)
- ionising radiation
- can cause burns
- can cause cell mutation
- can cause cell damage
- can cause tumours
- can cause cancer
- can damage DNA

Suggest and explain some **precautions for the safe use of x-rays**.

(2020)
- shielding of operator behind screen / lead apron / out of room **AND** to absorb radiation
- shielding of other parts of patient with lead / shielding of other parts of patient **AND** to absorb radiation
- distance from source **AND** reduces intensity / amount of radiation / exposure
- limit time of exposure / not too frequent / max number of x-rays per year **AND** to limit dose
- limit strength / intensity of X-ray beam **AND** to limit dose

State one precaution taken by the technicians who operate **x-ray machines**.

(2011)
(1) photographic film badges
(2) behind screen when operating x-ray machine
(3) protective clothing
(4) minimise exposure

State some **practical and scientific uses of $\gamma-$ray radiation**.

(**2023**)
- cancer tumour detection
- kill/damage cancer cells
- sterilize instruments

State how **analogue and digital signals differ**.
(**2023**) (1) **analogue** signals vary continuously
(2) **digital** signals vary discretely

Explain why **sound waves** are described as longitudinal.
(2014) particles/molecules/atoms oscillate/vibrate
OR pressure variation/compressions/rarefactions/ displacements move

State what is meant by a **compression** in terms of sound.
(2020) composing particles closer together than normal

State what is meant by a **rarefaction** in terms of sound.
(2020) composing particles further apart than normal

Explain how a **compression** differs from a **rarefaction**.
(2015) **compression**: region of higher pressure
OR region where air layers/particles/molecules are closer

Explain, in terms of **compression,** what is meant by the wavelength of a sound.
(2015) distance between (two successive/adjacent) compressions

Explain, in terms of **compression,** what is meant by the frequency of a sound.
(2015) number of compressions (passing a point) per second/unit time
OR number of compressions emitted per second/unit time

State a possible **frequency for an ultrasound wave**.
(2020) $\mathbf{> 20 \times 10^3\ Hz}$

List some **applications of ultrasound**.
(**2023**) · sonar
· material testing
· medical scans

State what is meant by the **echo of a sound**.
(2012) reflection/sound coming back/sound heard for 2nd time off an object

State how **sound speed depends on material state**.
( ) (1) generally increases with material density
(2) $\boldsymbol{v_{solid} > v_{liquid} > v_{gas}}$

List some **advantages of digital vs analogue signal transmission**.
( ) · speed
· reliability
· can be regenerated
· less noisy

Electricity and Magnetism

State what is meant by the **pole of a magnet**.
( ) (1) an imaginary region in space from which magnetic field lines
(2) appear to emanate from ("north")
OR terminate towards ("south")

State what is meant by the **north pole of a magnet**.
(2006) (1) end/point on magnet
(2) ⟨*idea of pointing N (when freely suspended), etc.*⟩

Explain what is meant by **magnetic field**.
( ) region where magnetic poles experience a force

State what is meant by the **direction of a magnetic field**.
( ) (1) the direction that the north pole of a second magnet
(2) would point when in that field

State what is meant by the **magnitude of a magnetic field**.
( ) a measure of the density of magnetic field lines

Explain how **iron filings** could be used to map magnetic field strength.
( ) (1) sprinkle the filings in a region surrounding a magnet
(2) regions where filings are concentrated indicate high field strength

Suggest a **metal from which magnets are made**.
(2018) steel, nickel, cobalt

Distinguish between **permanent (steel) and temporary (soft iron) magnets**.
(**2023**) **permanent:** · produce their own magnetic field
· does not decay over time
temporary: · can be magnetized
· can be easily demagnetized

State the unit in which **electric charge** is measured.
(2020) coulomb

Suggest how a plastic rod may be given an **electrostatic charge**.
(2012) (1) rub/rubbing
(2) with dry cloth

Explain the mechanism of **charging by friction**.
(**2023**) (1) friction can cause one material to lose electrons
(2) transferring them to another material
(3) (both) materials thus become (oppositely) charged

State the law of **attraction and repulsion between electrostatic charges**.
(2010) (1) same/like/similar charges repel
(2) unlike/opposite/different charges attract

State what is meant by an **electric field**.
(2019)† region where (stationary) electric charges experience a force

State what is meant by the direction of an **electric field** at a point.
(2016) direction of the force acting on a positive charge

State how **electrical conductors and insulators differ**.
( ) **conductor:** materials allowing electric charge or thermal energy conduction
insulator: materials not allowing electric charge or thermal energy conduction

State, in terms of their structure, why metals are good **conductors of electricity**.
(2018) (metals) contain free/mobile electrons/delocalised electrons

Explain why **insulators** do not conduct electricity.
(2014) (1) (current is) flow/movement of free electrons
(2) insulators contain no free electrons

In terms of a simple electron model, describe the **differences between conductors and insulators**.
(2018) **conductors:** free / delocalised electrons
OR electrons move
insulators: no free / delocalised electrons
OR electrons / charges cannot move
OR electrons fixed in place

List some **examples of electrical conductors and insulators**.
( ) **conductors:** metals
insulators: glass, plastic, amber

State what an **electric current** consists of.
(2011) (1) charges/electrons
(2) moving/flowing

Define **electric current**.
( ) rate at which electric charge passes a point (in a circuit)

Describe the **movement of charge** in an electric circuit.
(2017) (1) electrons / negative particles
(2) move from negative (terminal) to positive (terminal of battery)

State what is meant by **the direction of conventional current**.
( ) (1) the direction in which charge flows
(2) the charge is positive
OR the direction opposite to the motion of electrons

State what an **ammeter** measures.
(2006) electric current/amps/amperes

Explain how **alternating and direct currents** differ.
(2020) alternating current changes direction
OR direct current is in one direction only

State what is meant by **electromotive force (EMF)**.
(**2023**) (1) electrical work done by a source
(2) in moving a charge around a complete circuit

State an **equation relating EMF, work, and charge**.
( ) (1) $\boldsymbol{E = W/Q}$
(2) where $\boldsymbol{E}$, $\boldsymbol{W}$, and $\boldsymbol{Q}$ are **EMF**, work, and charge, respectively

State the **unit in which electromotive force (EMF) is measure**.
( ) volts

State what is meant by **potential difference**.
( ) (1) work done by a unit charge
(2) passing through an electrical component

State an **equation relating potential difference, work, and charge**.
( ) (1) $\boldsymbol{\Delta V = W/Q}$
(2) where $\boldsymbol{\Delta V}$, $\boldsymbol{W}$, and $\boldsymbol{Q}$ are potential difference, work, and charge, respectively

State the **unit in which potential difference is measure**.
( ) volts

State the name of the instrument needed to **measure potential difference**.
(2006) voltmeter/multimeter set to volts

Explain what is meant by **electrical resistance**.
( ) a measure of the difficulty of electric current to flow through an electrical component
OR potential difference across a component ÷ electric current passing through it

State the relationship between the **resistance** $\boldsymbol{R}$ and the length $\boldsymbol{l}$ of a wire of constant cross-sectional area.
(2014) $\boldsymbol{R \propto l}$ (or equivalent words)
OR directly proportional
OR *e.g.* $\boldsymbol{R}$ doubles when $\boldsymbol{l}$ doubles

State the relationship between the **resistance** $\boldsymbol{R}$ and the cross-sectional area $\boldsymbol{A}$ of a wire of constant length.
(2014) $\boldsymbol{R \propto A^{-1}}$ (or equivalent words
OR inversely proportional
OR *e.g.* $\boldsymbol{R}$ doubles when $\boldsymbol{A}$ halves

State what is meant by **ohmic resistance**.
( ) (1) (electrical) resistor
(2) where current is proportional to potential difference

Explain what is meant by **electrical energy**.
( ) energy derived from the movement of electrical charge
OR energy derived from position of electrical charges in an electric field

Define **electrical power**.
( ) (1) rate of transfer
(2) of electrical energy

Define one **kilowatt-hour**.
(**2023**) (1) a unit of energy
(2) equal to power in kilowatts multiplied by time in hours

In terms of electrical circuits, explain a **cell**.
( ) (1) a device providing an **EMF**
(2) via chemical reactions

In terms of electrical circuits, explain a **battery**.
( ) (1) several cells
(2) connected in series

State the purpose of a **potential divider**.
( ) (1) part of a circuit containing two or more resistors in series
(2) used to obtain an output voltage smaller than input voltage

State the function of a **diode**.
(2017) to allow flow (of current) in one direction

Describe how **light-emitting-diodes** function in electrical circuits.
( )

How do **resistances of ohmic devices, filaments, and diodes** compare?
( ) · **ohmic:** constant resistance
· **filaments:** resistance increases with potential difference
· **diodes:** infinite resistance at low potential difference; very low resistance at high potential difference

List some **electrical safety concerns**.
(**2023**) · damaged insulation
· excessive overheating
· overloaded (parallel) adaptors
· moisture

List some **electrical safety precaution devices**.
( ) · fuses
· trip switches
· heavy insulation
· earthed wires

Describe how a **fuse** protects an electric circuit.
(2010) (1) current too large
(2) fuse wire melts

Describe how a **trip switch** protects an electric circuit.
( ) (1) current in a circuit is interrupted
(2) when current exceeds a certain value

Explain why **fuses and circuit breakers** are installed in electrical circuits connected to mains.
(2020) (1) protects components / appliances / circuit / wires / user / mains supply
OR prevents electrical supply overheating / fires / electrocution / shocks
(2) excess current / power in circuit / wires OR fuse melts / blows OR circuit breaker opens

Explain what is meant by an **earthed circuit**.
( ) (1) part of a circuit is electrically connected to ground
(2) meant to help prevent electrical shocks

State what an **electromagnet** is.
(2020) magnet which operates when there is a current
OR coil wrapped round iron bar

Describe the **magnetic field of a line current**.
( ) field encircles the line current

Describe the **magnetic field of a solenoid**.
( ) field is parallel to the solenoid axis

Explain the **operation of a moving-coil loudspeaker**.
( ) (1) a time-varying current flows through wire coil
(2) coil in situated in a magnetic field
(3) magnetic force on wire makes coil vibrate
(4) coil in connected to a diaphragm, which thus vibrates

State the **function of an electric generator**.
( ) converts mechanical energy to electrical energy

State the **function of an electric motor**.
( ) converts electrical energy to mechanical energy

Explain the purpose of **split-ring commutators** in D.C. motors.
(2019) (1) keeps coil rotating (in the same direction)
(2) by changing direction of current (in the coil)
(3) every half cycle/180 degrees

Explain what is meant by **electromagnetic induction**.
( ) production of **EMF** across an electrical conductor
resulting from relative motion between the conductor and a magnetic field

Name one device that makes use of **electromagnetic induction**.
(2008) transformer/induction coil/generator/dynamo/microphone/alternator/computer

Explain how a **transformer** works, using **alternating current**.
(2014) (1) changing (magnetic) flux
(2) induces **EMF** in secondary
(3) no change of flux with constant supply voltage / D.C.

Explain some functions of **iron in a transformer**.
(2020) · links magnetic fields of coils / primary and secondary
· stronger magnetic field in secondary
· better induction

Explain why high voltages are used to **transmit electrical power** over long distances.
(2019) (1) high voltage gives low (transformer) current
(2) low current reduces thermal energy losses
(3) low current can use thinner / lighter / cheaper transmission cables and infrastructure

Nuclear Physics

State how **atoms can become ions**.
( ) by losing or gaining electrons

Explain why an **α−particle and a gold nucleus repel** each other.
(2015) both have positive charge

Define what is meant by **nucleon**.
( ) a particle that resides inside the nucleus (of an atom)

Name **two types of nucleons**.
( ) (1) proton
(2) neutron

State the unique types of **atomic constituents and their electric charges**.
( ) (1) electrons; charge=-e
(2) protons; charge=+e
(3) neutrons; charge=0

Define the **atomic number (proton number) of a nucleus**.
( ) the number of protons in the nucleus

Define the **mass number (nucleon number) of a nucleus**.
(**2023**) the number of nucleons in the nucleus

State the meaning of the **nucleon number** of a nuclide.
(2013) number of protons plus neutrons
OR (total) number of particles in the nucleus
(see also **mass number**)

State, in terms of the particles in each nucleus, how nuclei of two **isotopes** of the same element are different.
(2015) different number of neutrons (in the nucleus)
OR different neutron number

State what is meant by **nuclear fission**.
(2018) splitting of a nucleus into (2) parts/light(er)nucleus

State the meaning of **nuclear fusion**.
(2020) (1) nuclei join together
(2) to produce energy and a different element

State two differences between **nuclear fission and fusion**.
(2020) (1) **fission**: nucleus / atom splits (into two)
(2) **fusion**: two nuclei / atoms join together

Explain what is meant **ionising radiation**.
(2014)† (can result in) atoms/molecules (**NOT** particles) lose/gain electrons
OR become charged

State what is meant by **background radiation**.
(2005) radiation due to surroundings

Suggest two naturally occurring sources of **background radiation**.
(2016)† · rocks (buildings/earth/ground/wood/stone/minerals)
· space (Sun/stars/galaxies/cosmic rays)
· radon
· food/drink

In terms of radioactive decay, explain the meaning of **count rate**.
( ) the number of decaying radioactive atoms detected each second (minute, hour)

State the type of **radioactive emission** that causes the proton number of a nuclide to decrease by 4.
(2018) **α** particles

State the nature of **α-particles**.
(2015) 2 protons and 2 neutrons
OR helium nucleus

State the type of **radioactive emission** that causes the proton number of a nuclide to increase by 1.
(2018) **β** particles

State the nature of a **β particle** and where it is produced.
(2017) (1) an electron
(2) in/from/by the nucleus

State the type of **radioactive emission** that causes no change in either the proton or nucleon number of a nuclide.
(2018) **γ** particles

Describe the path of **γ-rays** in a magnetic field.
(2015) not deflected

State some **examples of ionising radiation**.
( ) · UV rays
· x-rays
· gamma rays
· high energy **α** or **β** radiation

State which type of **radiation**, alpha, beta or gamma, is the **most penetrating**.
(2022) gamma rays **OR** **γ**-rays

State some **differences between β and γ emission**.
(2019) **$\beta-$emission**: · particles / electrons
· (negatively) charged
· has mass
· shorter range in air
· stopped by a few **mm** of aluminium
· higher ionization (of air)
· proton number changes
· deflected in electric / magnetic field
$\gamma-$emission: · electromagnetic radiation / travels at the speed of light
· uncharged
· no mass
· long range in air
· stopped by many **cm** of lead / very penetrating
· low ionization (of air)
· leaves proton number unchanged
· not deflected in electric / magnetic field

What is meant by **radioactive decay**?
(2020) (1) (spontaneous/random) break up of unstable nuclei
(2) emission of ionizing radiation (**α**/**β**/**γ**)
· results in new element/particles OR nucleus changes

What is meant by **spontaneous decay**?
( ) (1) random emission of radiation
(2) not affected by environmental conditions

What might happen to a nucleus with a **neutron excess**?
(**2023**) (1) is will be unstable
(2) will most likely undergo radioactive decay

State what happens to the nucleus of an atom undergoing **radioactive decay**.
(2002) mass number decreases by 4/atomic number changes/gamma-ray emission

Explain what is meant by the term **half-life**.
(2017) time for activity/count rate/number of nuclei/ number of atoms to halve

List some **applications of radioactive decay**.
(**2023**) · smoke detectors
· thickness measurements / fault detection
· medicine / cancer treatment
· food irradiation
· sterilization
· tracers

List some **applications of radioactive alpha decay**.
(**2023**) · smoke detectors
· bone cancer treatment
· thermoelectric generators

List some **applications of radioactive beta decay**.
(**2023**) · thickness measurements
· fault detection
· radiocarbon dating

List some **applications of radioactive gamma decay**.
(**2023**) · sterilization
· cancer treatment
· medical diagnosis

Suggest some **harmful effects of ionising radiation**.
( ) · cell damage, mutation, death
· material degradation

Suggest why a **nuclear reactor** is surrounded by thick concrete walls.
(2018) (1) (fission involves production of) ionising radiation OR radiation dangerous/harmful (to humans)
(2) (thick concrete walls) absorb/stop the radiation (and so protect workers)

In the interest of safety, describe how **radioactive materials** should be stored and handled.
(2018) **stored**: in box / cupboard with lead walls
handled: (long) tongs
OR remote-controlled device
OR from a distance
OR wearing lead gloves
OR wearing lead suit
OR avoid lengthy time exposure

Space Physics (2023—)

State what is meant by **Earth's axis**.
(**2023**) imaginary line between Earth's north and south poles

Explain the origin of **day and night**.
(**2023**) (1) as Earth rotates on its axis
(2) different parts of the surface are illuminated by the Sun

How much time is required for Earth to **rotate once about its axis**?
(**2023**) approximately 24 hours

State what is meant by an **hemisphere**.
(**2023**) half of a sphere

Explain the origin of the **seasons**.
(**2023**) (1) as Earth revolves around the Sun
(2) due to the tilt of Earth's axis
(3) the Sun's energy is spread out unevenly over the northern and southern hemispheres
(4) Northern summer occurs when Earth's north pole is tilted towards the Sun

State what is meant by the **equator**.
(**2023**) an imaginary line drawn around the Earth halfway between the north and south poles

What is meant by **phases of the moon**.
(**2023**) the monthly variation in the moon's appearance as seen from Earth

State what is meant by an **orbit**.
(**2023**) the path of an object as it moves around a larger object

How much time is required for the **Moon to revolve once about Earth**?
(**2023**) approximately 1 month

State what is meant by the **Solar System**.
(**2023**) (1) consists of the Sun and Sun-orbiting objects
(2) planets, moons, asteroids, comets

Define **accretion**.
(**2023**) (1) the coming together of matter under the influence of gravity
(2) to form larger bodies

Define **accretion disc**.
(**2023**) a rotating disc of matter formed by accretion

Define **ellipse**.
(**2023**) a squashed circle

Define **eccentricity**.
(**2023**) measure of how elliptical an orbit is

Define **orbital radius**.
(**2023**) the average distance of a planet from its host star

Define **orbital period**.
(**2023**) the time required for a planet to complete one full revolution around its host star

State a **relation between a body's orbital radius, period, and speed**.
(**2023**) (1) $\boldsymbol{v = 2\pi R/T}$
(2) where $\boldsymbol{v}$, $\boldsymbol{R}$, and $\boldsymbol{T}$ are speed, orbital radius, and period, and speed, respectively

For a body in **elliptic orbit, state how its speed varies**.
(**2023**) (1) speed is greatest when closest to the central mass
(2) speed is least when farthest from the central mass

State a **relation between orbital period and radius**.
(**2023**) (1) the square of the orbital period
(2) is proportional to the cube of the radius

How much time is required for **Earth to revolve once about the Sun**?
(**2023**) approximately 1 year

Define **planet**.
(**2023**) (1) a large (roughly) spherical object orbiting a star
(2) has no nearby similar objects

Define **minor planet**.
(**2023**) (1) an object that orbits a star
(2) not large or isolated enough to be called a planet

In order of distance from the Sun **name the rocky and gaseous planets**.
(**2023**) **rocky:** Mercury, Venus, Earth, Mars
gaseous: Jupiter, Saturn, Uranus, Neptune

Define **asteroids or meteoroids**.
(**2023**) non-planet-like lumps of rock orbiting the sun

Define **comet**.
(**2023**) (1) a ball of ice, dust, and gas
(2) high eccentricity orbit about the Sun

How does the **mass of the Sun compare to that of the Solar System**?
(**2023**) $\boldsymbol{M_\odot / M_{ss} \approx 99.9\%}$

State how a planet's **gravitational field strength relates to its mass and radius**.
(**2023**) (1) field strength increases with mass
(2) field strength decreases with radius (squared)

State the value of **one light year**.
(**2023**) the distance travelled by light in one year
OR $\boldsymbol{\approx 9.5 \times 10^{15}}$ **m**

State, for two planets, an approximate **distance in light minutes from the Sun to the planets**.
(**2023**)
- **Mercury**: **3.2 lm**
- **Venus**: **6.0 lm**
- **Earth**: **8.3 lm**
- **Mars**: **13 lm**
- **Jupiter**: **43 lm**
- **Saturn**: **79 lm**
- **Uranus**: **159 lm**
- **Neptune**: **249 lm**

State the **composition of the Sun**.
(**2023**) (1) 75% hydrogen
(2) 24% helium
(3) trace amounts of heavier elements

State the value of **one solar mass**.
(**2023**) (1) a mass equal to the mass of the sun
(2) $\boldsymbol{M_\odot \approx 2 \times 10^{30}}$ **kg**.

State the three main forms of **electromagnetic radiation emitted by the Sun**.
(**2023**) (1) ultraviolet
(2) visible
(3) infrared

State what is meant by **absorption spectrum**.
(**2023**) (1) dark lines in a spectrum
(2) produced when light passes through a cool gas

What is meant by **plasma**?
(**2023**) (1) a completely ionized gas
(2) excessive temperature prevents electron-ion recombination

What reaction provides the outward **radiation pressure of a star**?
(**2023**) fusion, such as hydrogen to helium

What is meant by a **stable star**?
(**2023**) (1) a star that is neither continuously collapsing nor expanding
(2) (inward pull of) gravity is balance by (outward) radiation pressure

What is an **interstellar cloud**?
(**2023**) (1) a cloud of dust and gas
(2) occupying the space between stars

What is a **molecular cloud**?
(**2023**) (1) an interstellar gas cloud
(2) containing mostly hydrogen **molecules**
(3) is cold and dense enough to initiate stellar formation

What is a **proto-star**?
(**2023**) (1) a young star
(2) still gathering mass from its parent molecular cloud

What is meant by **radiation pressure**?
(**2023**) an outward force due to a star's high temperature

Define **scatter graph**.
(**2023**) a method of displaying two sets of data in order to determine correlations

What is meant by a **red giant star**?
(**2023**) (1) a star less than 8 solar masses
(2) inner core burns helium
(3) hydrogen shell has expanded and cooled

What is meant by a **main sequence star**?
(**2023**) a stable star with a hydrogen-burning core

What is meant by a **white dwarf star**?
(**2023**) (1) the final stage of a less than 8 solar mass star
(2) after using up all its fuel

What is meant by a **planetary nebula**?
(**2023**) (1) a bubble of gas derived from the hydrogen shell of a red giant star
(2) gas surrounds a white dwarf

What is meant by a **red super-giant star**?
(**2023**) (1) similar to red giants, but with masses in excess of 8 solar masses
(2) hydrogen fusion (burning) continuous in the outer shells

What is meant by a **supernova**?
(**2023**) (1) an exploding star that began life with more than 8 solar masses
(2) has lost all its fuel

What is meant by a **neutron star**?
(**2023**) (1) a collapsed star originally of more than 8 solar masses
(2) composed almost entirely of neutrons

What is meant by a **black hole**?
(**2023**) (1) final stage of a greater than 8 solar mass star
(2) enough mass remains post supernova to allow gravitational collapse
(3) gravitational field is strong enough to prevent light from escaping

What is meant by a **galaxy**?
(**2023**) a collection of billions of stars (and their solar systems)

State the approximate **dimensions of the Milky Way Galaxy**.
(**2023**) (1) **100,000 ly** diameter
(2) **1,000*s* ly** thick

State what is meant by **redshift** in terms of astronomical observations.
(**2023**) (1) an increase in observed wavelength of electromagnetic radiation from a star
(2) when it is moving away from us

State and explain what can be deduced from the **galactic red-shift of distant galaxies**.
(**2023**) · wavelength from distant galaxy is measure/compared with wavelength on Earth
· wavelength from distant galaxy is longer / red-shifted
· distant galaxy is receding / moving away from Earth

Describe the **Big Bang Theory**.
(**2023**) (1) the universe was created at a single point
(2) approximately 13.8 billion years ago
(3) has since been expanding

What is meant by **Cosmic Microwave Background Radiation**?
(**2023**) (1) radiation leftover from the Big Bang
(2) roughly uniform, but with notable variations

Describe **Hubble's Law**.
(**2023**) (1) distance galaxies are moving away from Earth
(2) with a speed proportional to their distance

What is meant by the **Hubble Time**?
(**2023**) (1) the inverse of the Hubble Constant
(2) giving an estimate for the age of the Universe

Removed from Latest Syllabus

State what is meant by **thermionic emission**.
(2010) (1) emission of electrons/charges/charged particles
(2) by means of heat

In terms of temperature, state what is meant by a **linear scale**.
(2015) same distance moved (by thread) for same temperature change

State **Hooke's Law**.
(2017) extension of a spring is (directly) proportional to load/force/weight
OR $\boldsymbol{F = ke}$, where $\boldsymbol{e}$ is extension

State an approximate value for the speed of **sound** in water.
(2016) $\mathbf{1300 < v < 1700\ m \cdot s^{-1}}$

State the term used to describe **energy** stored in a battery.
(2016) chemical
OR potential

Suggested Additions