

Glossary

A

absorption process in which matter takes in energy, e.g. when an atom takes in energy from an electromagnetic wave

acceleration rate at which an object speeds up, calculated from change in velocity divided by time; symbol a , unit metres per second squared, m/s^2

accuracy how close a measurement is to its true value

activity the rate at which unstable nuclei decay in a sample of a radioactive material; unit becquerel, Bq

air resistance force produced by the collision of molecules in air with a moving object; the force acts to oppose the direction of movement

alternating current (a.c.) electric current that continually changes direction

alpha particle a particle (two neutrons and two protons, same as a helium nucleus) emitted by an atomic nucleus during radioactive decay

ammeter device that measures electric current

ampere SI unit of electric current, symbol A; an electric current of 1 A is equal to 1 C of charge passing through a point in a circuit in 1 s

amplitude maximum displacement of a wave or oscillating object from its rest position

angle of incidence the angle between the incident ray and the normal

angle of reflection the angle between the reflected ray and the normal

atmospheric pressure force per unit area produced by the weight of air; it decreases as you go higher in the atmosphere

atomic number number of protons in the nucleus of an atom of an element

average speed distance travelled by an object over a measured time interval

B

background radiation nuclear radiation that is present in the environment as a result of the radioactive decay of certain elements; it is produced from natural sources (e.g. from radon gas in the Earth's crust) and from artificial sources (e.g. as a result of testing nuclear weapons)

becquerel unit of activity for a radioactive isotope, symbol Bq

beta particle fast-moving electron that is emitted by an atomic nucleus in some types of radioactive decay

boundary line or surface between two different media (e.g. the surface between air and glass), across which light may be refracted or reflected

braking distance distance travelled by a vehicle after the brakes have been applied before coming to a complete stop

C

cancer disease in which uncontrolled division of cells takes place, forming a tumour; some types of cancer are caused by the effects of ionising radiation on cells

cell (electric circuits) circuit component that stores energy in the form of chemical energy; a number of electric cells may be joined to form a battery

cell (living things) smallest structural unit of a living organism; cells may be damaged by some types of ionising radiation

centre of mass a single point where the weight of an object can be considered to act

chain reaction occurs when the neutrons released by a nucleus undergoing fission go on to split more nuclei

change of state process in which one state of matter changes to another, e.g. solid melting to form liquid, or gas condensing to form liquid

circuit diagram visual representation of electrical components connected by wires, using standard symbols

circuit symbol visual representation of an electrical component; a standard symbol exists for each type of electrical component

closed system system that is not acted upon by any external forces and does not exchange energy with its surroundings

commutator (split-ring) electrical connector consisting of two semi-circular metal contacts, which is connected to a rotating coil in a dynamo (to produce direct current) or a motor (to use direct current)

compass (magnetic) device that shows the direction of a magnetic field in which it is placed; typically a compass is made from a magnetised needle or pointer that is free to rotate

components (forces) the result of breaking down or resolving a single force into two separate forces acting in perpendicular directions, often horizontally and vertically

compress squash something into a smaller volume; liquids are incompressible – they cannot be squashed

compression a region of a sound wave where the particles are closer together

conclusion section at the end of a report on an experiment that summarises how the results support or contradict the original hypothesis

conductivity (thermal) quantity that measures the rate at which thermal energy is conducted through a material; the higher the thermal conductivity, the higher the rate of thermal energy transfer

conductor material or object that allows electric charge to flow through it

conservation of electric charge a fundamental principle of physics: electric charge cannot be created or destroyed, only transferred from one object to another; the total electric charge of a system is constant

conservation of energy a fundamental principle of physics: energy cannot be created or destroyed, only transferred, stored or dissipated. This means that the total energy of a closed system is constant

conservation of mass a fundamental principle of physics: mass cannot be created or destroyed by physical changes or chemical reactions; the total mass of a system is constant

conservation of momentum a fundamental principle of physics: the total momentum of a system of objects after a collision is the same as the total momentum before the collision

contact force force that acts at the point of contact between two objects (e.g. friction or the normal reaction)

contamination (radioactivity) the unwanted presence of materials containing radioactive atoms

control variable quantity in an experiment that is kept constant while the independent variable is changed and the dependent variable is measured

coulomb SI unit of electric charge, symbol C

count rate the number of decays recorded each second by a detector (e.g. Geiger-Muller tube)

CT (or CAT) scan scan that takes many X-ray images from different directions to build up a 3D image of the body

current (electric) flow of electric charge; the size of the electric current is the rate of flow of electric charge; symbol I , unit amps (A)

D

data measurements of quantities in an experiment; data can be recorded in a table and used to produce graphs

decay (radioactive) process in which the nucleus of an atom breaks apart and emits radiation

deceleration negative acceleration, when an object slows down

degrees Celsius unit of temperature, symbol °C; 1 °C is $\frac{1}{100}$ of the temperature difference between the melting point and boiling point of water

density measure of the amount of substance per unit volume; symbol ρ , unit kilograms per metre cubed, kg/m³

dependent variable quantity in an experiment that is measured for each change in the independent variable

diode circuit component with a low resistance if it is connected one way around in a circuit, or a very high resistance if it is connected the other way around; a diode allows current in one direction only

direct current (d.c.) flow of electric charge in one direction only

directly proportional relationship a relationship of the form y is proportional to $(\propto) x$; plotting a graph of y against x will produce a straight line through the origin

displacement distance moved in a particular direction; it is a vector quantity and is equal to the area under a velocity–time graph; symbol s , unit metres, m

dissipation the spreading out of energy into the environment, so that it is stored in less useful ways

distance quantity that measures how far an object moves but not the direction; it is a scalar quantity; symbol s , unit metres, m

distance–time graph graph with distance on the y -axis and time on the x -axis; the gradient of a distance–time graph is equal to the speed

dose (radiation) quantity that is a measure of the amount of ionising radiation received (e.g. by a human body); measured in sieverts (Sv)

E

earth (electrical) electrical connection between the metal case of an electrical appliance and the ground, used as a safety device to prevent the case becoming charged if touched by a live wire

echo reflection of a sound or ultrasound wave

efficiency useful output energy transfer divided by the total input energy transfer (or useful power)

output divided by the total power input) – may be expressed as a percentage or as a decimal

elastic deformation process in which an object (e.g. a spring) is stretched by a force and returns to its original size or length when the force is removed

elastic potential energy energy that is stored in an object as a result of the object being stretched or compressed

electric charge fundamental property of matter that results in an electric field around an object; objects can be electrically positive, negative or neutral (no overall charge); symbol Q , unit coulomb, C

electric current flow of electric charge; the size of the electric current is the rate of flow of electric charge; symbol I , unit amps, A

electrical power amount of energy transferred each second; symbol P , unit watts or joules per second, W or J/s

electromagnet magnet formed by an electric current flowing through a solenoid (coil of wire) with an iron core – the magnetic field of an electromagnet can be switched on and off by switching the current on and off

electromagnetic (EM) spectrum electromagnetic waves ordered according to wavelength and frequency – ranging from radio waves to gamma rays

electron a particle that orbits the nucleus in all atoms; electrons have a negative electric charge

emission process in which energy or a particle are given out by an atom (e.g. in beta particle emission, a high-speed electron is given out)

energy level stable state of a physical system, e.g. electrons orbiting the nucleus of an atom can exist in only particular energy levels and be moved between them

energy store the energy associated with fuel (chemical energy store), a heated object (thermal energy store), a moving object (kinetic energy store), a stretched spring (elastic potential energy store) and an object raised above ground level (gravitational potential energy store)

energy transfer process in which energy is moved from one store to another

equilibrium situation in which there is no resultant force acting on an object; any forces that are acting balance each other in magnitude and direction

estimate best guess of the value of a quantity that cannot be measured precisely, based on scientific knowledge and observation

extension the increase in length of an object when a force is applied

F

filter (optical) thin coloured sheet of material that allows only particular wavelengths of light through it

Fleming's left-hand rule shows which way a current-carrying wire tries to move when placed in a magnetic field – First finger shows Field, second finger shows Current, thumb shows Movement

fluid substance that is a liquid or gas

force 'push' or 'pull' on an object that can cause the object to accelerate

free body (force) diagram drawing showing the magnitude and direction of all the forces acting on an object, and in which the object is represented by a point

frequency number of waves passing a set point in one second

friction force acting at points of contact between objects moving over each other, to resist the movement

G

gamma radiation ionising electromagnetic radiation with shortest wavelengths in the electromagnetic spectrum

gas state of matter in which all the particles of a substance are separate and move about freely

global warming increase in the mean surface temperature on Earth

gradient the slope of a graph = $\frac{\text{change in y-axis values}}{\text{change in x-axis values}}$

gravitational field strength quantity that is a measure of the 'pull' of the force of gravity on each kilogram of mass; symbol g , unit newtons per kilogram, N/kg

gravitational potential energy energy that an object has because of its position; e.g., increasing the height of an object above the ground increases its gravitational potential energy

gravity, force due to attractive force acting between all objects with mass; gravity pulls objects downwards on Earth and keeps planets and satellites in orbit

H

half-life the average time it takes for half of all the nuclei present in a sample of a radioactive element to decay, or the time it takes for the count rate (or activity) to halve

hazard anything that may cause injury (e.g. the risk of contamination by radioactive materials when they are used in a scientific experiment)

hertz a unit of frequency, equivalent to one cycle per second

hypothesis an idea for, or explanation of, a phenomenon in science that can be tested through study and experimentation

I

incident ray a ray of light that strikes a surface or boundary between two media

independent variable quantity in an experiment that is changed or selected by the experimenter

induced magnet material that is magnetic only when it is placed in the magnetic field of another magnet, e.g. the iron core within a solenoid

induced potential difference potential difference that arises between the ends of a conducting wire placed in a magnetic field when the wire is moved so that it cuts across magnetic field lines

inelastic deformation process in which an object (e.g. a spring) is stretched by a force and permanently deformed so that it does not return to its original size or length when the force is removed

inertia natural tendency of objects to resist changes in their velocity

inertial mass measure of how difficult it is to change the velocity of an object

infrared radiation electromagnetic radiation with a range of wavelengths longer than visible light but shorter than microwaves; emitted in particular by heated objects

insulator (electrical) material that does not allow electric charges to pass through it (e.g. wood)

insulator (thermal) material that does not easily allow the transfer of thermal energy

intercept point at which the line of a graph crosses one of the axes

internal energy total kinetic energy and potential energy of all the particles in a system

inversely proportional relationship a relationship of the form $y \propto 1/x$

inverted an inverted image is upside down compared with the object

ionisation process in which electrons split away from their atoms; some radiation is harmful to living cells because it is ionising

irradiation process in which an object is exposed to radiation; this does not make the object itself radioactive

isolated system physical system so far removed from other systems that it does not interact with them

isotopes atoms of an element containing the same number of protons but different numbers of neutrons

J

joule SI unit of energy, symbol J

K

kilogram SI unit of mass, symbol kg; 1 kg is the amount of mass equal to that of the standard platinum–iridium cylinder that is stored near Paris, France

kinetic energy energy an object has because of its movement; kinetic energy is greater for objects with greater mass or higher speed

L

latent heat energy needed for a substance to change state without a change in temperature (e.g. the latent heat of vaporisation is the energy needed to turn a sample of liquid water into gas)

lever device that uses the moment of a force to move an object

light-dependent resistor (LDR) electric circuit component with a resistance that decreases as the intensity of the light falling upon it increases

light-emitting diode (LED) electric circuit component that glows when a potential difference is applied to it

limit of proportionality the point beyond which the extension of an elastic object is no longer proportional to the force applied

line of best fit line on a graph that most closely matches all the data points to show a trend or pattern

linear relationship relationship between quantities in which increases in one quantity result in proportional increases or decreases in the other quantity; a graph of a linear relationship produces a straight line

liquid state of matter in which the particles of a substance are close together and attract each other but have a limited amount of movement; a liquid has a definite volume but will spread out to fill its container

live wire conducting wire connection that carries the alternating current from the supply

longitudinal wave wave motion in which the vibrations of the particles of the medium are parallel to the direction of energy transfer (e.g. sound waves)

M

magnet object containing material that produces its own magnetic field and so will attract other magnetic materials such as iron

magnetic field area around a magnet or current-carrying wire, where there is a force on magnetic materials or current-carrying wires

magnetic flux density quantity that measures the amount of magnetic flux (field lines) in an area perpendicular to the direction of the magnetic flux; symbol B , unit tesla, T

magnitude size of a quantity

mass quantity that measures the amount of matter in an object; symbol m , unit kilogram, kg

mass number total number of neutrons and protons in the nucleus of one atom of an element

medium (pl. media) material through which light or other types of wave travel

metre SI unit of distance, symbol m; 1 m is defined as the distance travelled by light in a vacuum in $\frac{1}{299\,792\,458}$ s (you do not need to remember this definition)

micrometer device adjusted by a rotating screw thread, which measures small distances to high precision

microwave electromagnetic radiation with a range of wavelengths longer than infrared but shorter than radio waves; used to cook food in microwave ovens, and for satellite communication

moment turning effect of a force – moment is increased by increasing the force or the perpendicular distance between the line of action of the force and the pivot; symbol M , unit newton-metre, Nm

momentum the product of mass and velocity of an object, symbol p , unit kilogram metres per second, kg m/s

motor effect interaction between a magnetic field due to a magnet and a current-carrying wire that causes a force on the wire and so causes movement of the wire

N

National Grid network of cables and transformers that links power stations to consumers across the country

net decline the ratio of the final value of the activity of a radioactive substance to the initial value in a given number of half-lives

neutral wire conducting wire connection that allows electric charge to return to its source

neutron a particle inside the nucleus in the atoms of nearly all elements; neutrons have no electric charge

newton SI unit of force, symbol N; 1 N is the force needed to give an object of mass 1 kg an acceleration of 1 m/s^2

Newton's first law if the resultant force acting on an object is zero, a stationary object will remain stationary and a moving object will keep moving at a steady speed in a straight line

Newton's second law a resultant force on an object produces an acceleration in the same direction as the force that is proportional to the magnitude of the force and inversely proportional to the mass of the object; in equation form $F = ma$

Newton's third law whenever two objects interact, the forces they exert on each other are equal, opposite and of the same type

Newton's laws of motion three fundamental physical laws that describe how objects and forces interact

newtonmeter device used to measure force

non-contact force force that acts at a distance between two objects that are separated (e.g. force due to an electric, gravitational or magnetic field)

nonlinear relationship any relationship between two variables which when plotted on a graph does not produce a straight line

non-renewable resource source of energy used by humans that will eventually run out (e.g. fossil fuels are non-renewable fuels)

non-uniform motion movement in which the speed of an object changes

nuclear decay reaction in which the numbers of protons and/or neutrons in the nucleus of one or more atoms change

nuclear equation equation that uses symbols to show the elements involved in a nuclear decay, including the atomic numbers and mass numbers

nuclear model model of the atom with a small central nucleus surrounded by orbiting electrons

nucleus very small volume at the centre of an atom that contains all the protons and neutrons, and so concentrates nearly all the mass of an atom

O

ohm SI unit of electrical resistance, symbol Ω ; a component with a resistance of 1Ω allows a current of 1 A to flow when a potential difference of 1 V is applied

Ohm's law a resistor obeys Ohm's law if the current in the resistor (at a constant temperature) is directly proportional to the potential difference across it

ohmic resistor any resistor that obeys Ohm's law at a constant temperature

order of magnitude description of a quantity in terms of powers of ten; e.g. a distance of 100 m ($= 10^2 \text{ m}$) is two orders of magnitude larger than a distance of 1 m

oscilloscope device with screen to show how the amplitude and frequency of an input wave varies – also called a cathode ray oscilloscope

P

parallel (circuit) electric circuit in which the current divides into two or more paths before combining again

particle model model in which all substances contain large numbers of very small particles (atoms, ions or molecules); it is used to explain the different properties of solids, liquids and gases

pascal SI unit of pressure, symbol Pa ; 1 Pa of pressure arises when 1 N of force is applied over an area of 1 m^2

peer review process in which scientific experiments, writings and theories are checked and evaluated by other scientists

penetrating power measure of how far different types of radiation can pass into different types of material

period time taken for one complete cycle of an oscillation

permanent magnet object or material that produces its own magnetic field even if it is not within the magnetic field of another object

pivot point around which a lever or a seesaw turns

plum pudding model early model of the structure of an atom, which suggested that an atom was a solid sphere of positive electric charge with negatively charged electrons in it

pole (magnetic) point in an object to or from which magnetic field lines point; magnetic poles always appear in pairs: one north, one south

potential difference (p.d.) a measure of the energy transferred per unit charge as charges move

between two points in a circuit – also called the voltage between two points

potential energy energy associated with an object because of its position or the arrangement of the particles of the system, e.g. the amount by which a material is stretched (elastic potential energy)

power (of ten) number of times that ten is multiplied by itself in a quantity, e.g. ten to the power two $= 10^2 = 10 \times 10 = 100$

power (energy transfer) the rate at which energy is transferred or the rate at which work is done; an energy transfer of 1 J/s is equal to a power of 1 W

precision how closely grouped a set of repeated measurements are

prediction statement that forecasts what would happen under particular conditions, based on scientific experiment and knowledge (e.g. if a ball is held above the ground and released, it will fall with an acceleration that is predictable based on knowledge of the Earth's gravity)

prefix letter added before the symbol for a unit to show how many powers of ten a quantity contains; e.g. $1 \text{ MW} = 10^6 \text{ W} = 1\,000\,000 \text{ W}$, where the prefix M (mega) means 10^6

pressure pressure at any point is the force acting at that point divided by the area over which the force acts; pressure increases if force increases or area decreases

proton a particle inside the nucleus in all atoms; protons have a positive electric charge

R

radiation energy given out in the form of electromagnetic waves or as moving particles; e.g. in radioactive beta decay a nucleus emits high-speed electrons, and the Sun radiates electromagnetic waves including visible light

radioactivity process in which particles or energy are produced by the reactions of unstable atomic nuclei

radiotherapy the use of ionising radiation to kill cancer cells or reduce the size of a tumour

radio waves electromagnetic radiation with a range of wavelengths longer than microwaves; used for long-distance communication

random (radioactive decay) process in which the time of each particular event cannot be predicted, although a trend or average can be measured across many events; e.g. the decay of a radioactive element

random error estimated amount by which a measurement or calculated quantity is different

from the true value, due to results varying in unpredictable ways

rarefaction a region of a sound wave where the particles are further apart

ray diagram line diagram showing how rays of light travel

reaction time time it takes a vehicle driver to respond to a danger on the road; the 'thinking distance' is the distance the vehicle travels during this reaction time

real image image that can be projected onto a screen or a light sensor

reflection process in which a surface does not absorb any energy, but instead bounces it back towards the source; e.g. light is reflected by polished surfaces

refraction change of direction of a wave when it hits a boundary between two different media at an angle, e.g. when a light ray passes from air into a glass block

renewable resource source of energy that can be replaced or reused over a short time, e.g. biofuels from crops that can be grown again from seed

resistance ratio of the potential difference across an electrical component to the current through the component; symbol R , unit ohms, Ω

resistor electrical component that produces a desired amount of resistance to the current within it when a potential difference is applied across it

resolution (forces) splitting a single force into two components acting in different directions, to simplify a calculation

resultant force the single force that would have the same effect on an object as all the forces that are acting on the object

S

satellite any natural or artificial object orbiting around a larger object

scalar quantity measurable quantity that has only a magnitude, not a direction (e.g. mass)

scattering process in which particles or electromagnetic waves are deflected or reflected in a number of different directions; e.g. the reflection of light off a rough, matt surface (diffuse reflection)

second SI unit of time, symbol s ; defined as the duration of 9 192 631 770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium-133 atom (you do not need to remember this definition)

series (circuit) electrical circuit in which all components are connected one after the other in a single line

SI unit standard units of measurement, one per quantity, used by all physicists; all SI units are derived from seven 'base' units that have precise definitions

sievert SI unit of radiation dose, symbol Sv

significant figures digits within a measured quantity that have meaning. For example a measurement made using a 30 cm long ruler with divisions marked in millimetres can only have three significant figures, such as 17.4 cm; it is meaningless to state 17.42 cm because the ruler is not that precise (note: it may be possible on some rulers to estimate a measurement to the nearest 0.5 mm)

slope see gradient

soft iron core laminated core of soft iron around which the coils of a transformer are wound; the current in the primary coil causes a magnetic field in the soft iron core

solenoid a coil of current-carrying wire that generates a magnetic field

solid state of matter in which the particles are held together in a fixed structure by bonds

specific heat capacity the energy needed to raise the temperature of 1 kg of a substance by 1 °C; symbol c , unit $J/kg^{\circ}C$

specific latent heat the energy needed to change 1 kg of a substance completely from one state to another state without any change in temperature; symbol L , unit J/kg

specific latent heat of fusion the energy needed to change 1 kg of a substance completely from solid to liquid without any change in temperature

specific latent heat of vaporisation the energy needed to change 1 kg of a substance completely from liquid to gas without any change in temperature

speed the distance travelled by an object per unit of time; unit metres per second, m/s

speed of light speed at which electromagnetic radiation travels through a vacuum; 300 000 000 m/s

spring constant quantity that tells you how much an object (such as a spring) will stretch by if a force is applied to it, as long as the object obeys Hooke's law; symbol k , unit newtons per metre, N/m

state of matter form that particles of a substance take depending on temperature; different states include solid, liquid and gas

step-down transformer transformer that changes an alternating potential difference across the

primary coil to a lower potential difference across the secondary coil

step-up transformer transformer that changes an alternating potential difference across the primary coil to a higher potential difference across the secondary coil

stopping distance total distance a vehicle travels before coming to a complete stop; stopping distance = thinking distance + braking distance

stretching process in which a force pulls the particles of a material further apart, causing the material to extend

systematic error consistent amount by which a measurement differs from the true value each time it is measured, due to the experimental technique or the set-up, e.g. an instrument not correctly calibrated, or background radiation in the measurement of radioactive decay

T

temperature measure of the hotness or coldness of an object or environment

tension force that pulls or stretches

terminal velocity constant velocity that occurs when the gravitational force acting downwards on a body falling through a fluid is exactly balanced by the upwards force due to the resistance of the fluid

tesla SI unit of magnetic flux density, symbol T

thermal conductivity measure of the ability of a material to conduct thermal energy from a hotter place to a colder place

thermal energy internal energy present in a system due to its temperature, which itself is due to the random motion of the particles within the system

thermistor electric circuit component with a resistance that decreases as its temperature increases

thermometer device used to measure temperature

thinking distance distance a vehicle travels during the time it takes a vehicle driver to respond to a danger on the road

time period time taken for one complete oscillation of a wave, symbol T

tracer a radioactive substance that is put into the body or fluid (such as in a pipe) so that the path of the substance can be followed by monitoring the radiation it emits

transformer device used to increase (step up) the potential difference of an alternating signal or decrease it (step down)

transmission movement of energy or information from one position to another; e.g., microwaves are used to transmit mobile phone signals to and from an aerial (signal mast)

transverse wave wave motion in which the vibrations of the particles of the medium are perpendicular to the direction of energy transfer (e.g. water waves or electromagnetic waves)

U

ultraviolet radiation electromagnetic radiation with a range of wavelengths shorter than visible light but longer than X-rays; emitted in particular by the Sun

uncertainty the uncertainty of a measurement is half the range of values recorded, from maximum to minimum; uncertainty is reduced when accuracy and precision are increased

uniform motion movement of an object in a straight line at a constant speed

V

vector quantity measurable quantity that has both a magnitude and a direction (e.g. velocity)

velocity speed at which an object is moving in a particular direction; symbol v , unit metres per second, m/s

velocity–time graph graph with velocity on the y -axis and time on the x -axis; the gradient of a velocity–time graph is equal to the acceleration; the area under a velocity–time graph is equal to the displacement

Vernier calipers device adjusted by moving one calibrated scale over another, which measures small distances to high precision

visible light electromagnetic radiation with a range of wavelengths shorter than infrared but longer than ultraviolet; detectable with the human eye

volt SI unit of potential difference, symbol V; 1 V is the potential difference between two points on a conducting wire when an electric current of 1 A dissipates 1 W of power between those points

voltage see potential difference

voltmeter device that measures potential difference

W

watt SI unit for power, symbol W; a power of 1 W is equal to 1 J of energy transferred in 1 s

wave a disturbance (oscillation) that transfers energy or information from one point to another

wavelength distance between a point on one wave to the equivalent point on the adjacent wave

weight measure of the force of gravity on an object

work done work is done when a force acts on an object and the object moves along the line of action of the force; symbol W , unit joules, J or newton-metres, Nm

X

X-ray ionising electromagnetic radiation with a range of wavelengths shorter than ultraviolet and can have similar wavelengths to gamma rays; used in X-ray photography to generate pictures of bones or teeth and in CT scans