

Career Employer

HESI A2 Cheat Sheet

MATHEMATICS

Order of operations

The order of operations in math problems is always: Parentheses, Exponents, Multiplication, Division, Addition, Subtraction.

Roman numerals

I = 1; V = 5; X = 10; L = 50; C = 100; D = 500; M = 1,000.

To form numbers, Roman numerals should always be arranged using the greatest value first and then moving down towards the least value.

Example: DCLXV = 500 + 100 + 50 + 10 + 5 = 665.

Subtraction is used to steer clear of adding four of the same numeral in a row.

So if a smaller value Roman numeral is placed before a larger one, it should be subtracted.

Example: CDLIX = 500 - 1000 + 50 + 10 - 1 = 459.

Military time to civilian time conversion

The time is a.m. if the number shown is less than twelve hundred. Example, 1140 is 11:40 a.m.

The time is p.m. if the number shown is more than twelve hundred. Example, 1240 is 12:40 p.m.

Subtract 1200 from the time if the number shown is thirteen hundred or more. Example, 16:22 is 4:22 p.m.

Metric system

Learn these metric prefix equivalents:

- Mega = 1,000,000
- Kilo = 1,000

- Hecto = 100
- Deca/Deka = 10
- Deci = 1/10 (0.1)
- Centi = 1/100 (0.01)
- Milli = 1/1,000 (0.001)
- Micro = 1/1,000,000 (0.000001)

English to metric conversion and opposite

- Multiply by 0.394 for centimeters to inches
- Multiply by 2.54 for inches to centimeters
- Multiply by 2.205 for kilograms to pounds
- Multiply by 0.454 for pounds to kilograms
- Celsius to Fahrenheit: (degrees Celsius x 1.8) + 32 = degrees Fahrenheit
- Fahrenheit to Celsius: (degrees Fahrenheit - 32) / 1.8 = degrees Celsius

Abbreviations

- M = mega-
- k = kilo-
- h = hecto-
- da = deca-/deka-
- d = deci-
- c = centi-
- m = milli-
- mc = micro-

Length abbreviations

- mm = millimeter
- cm = centimeter
- dm = decimeter
- dam = decameter/dekameter
- m = meter
- in. = inch
- ft. = foot

Weight abbreviations

- dr. = dram
- g = gram
- gr. = grain
- kg = kilogram

- lb. = pound
- mcg = microgram
- mg = milligram
- oz. = ounce

Fluid abbreviations

- cL = centiliter
- daL = decaliter/dekaliter
- dL = deciliter
- fl. Dr. = fluid dram
- fl. Oz. = fluid ounce
- gal. = gallon
- gtt. = drop
- hL = hectoliter
- kL = kiloliter
- L = Liter
- mL = milliliter
- pt. = pint
- qt. = quart
- Tbsp. = tablespoon
- tsp. = teaspoon

Fraction multiplication

Always remember to first multiply the numerators and then the denominators.

$$\text{Example: } \frac{1}{4} \times \frac{12}{5} = \frac{12}{20}$$

Here both the numerator and denominator are divisible by 4 so the fraction can be simplified to:

$$\frac{3}{5}$$

$$\frac{3}{5}$$

Fraction division

All the numbers should be written in fraction form. This includes mixed and whole numbers.

$$\text{Example: } 3 \div 1$$

7 4

In the example above, they are already in fraction form.

Now by inverting the fraction, you can write the reciprocal of the second fraction. This means moving the denominator to the top and the numerator to the bottom.

$$\text{This leaves: } \frac{3}{7} \div \frac{4}{1}$$

Now first multiply the numerators followed by the denominators which equals:

$$\frac{12}{7}$$

The fraction can now be written in reduced form:

$$\text{Example: } \frac{12}{7} = 1 \frac{5}{7}$$

Fractions: Converting to decimals

To do this, simply divide the numerator by the denominator.

$$\text{Example: } \frac{3}{4} = 3 \div 4 = .75$$

Decimals: Converting to fractions

To do this, first write the decimal divided by 1. Now for every after the decimal point, multiply the numerator and the denominator by 10. Lastly, reduce the fraction.

$$\text{Example: } \frac{.75}{1} = \frac{75}{100} = \frac{3}{4}$$

Ratios and proportions

The comparison between the quantity of one item compared to another is called a ratio. So if the ratio between apples and oranges is 7:3, for every seven apples there are three oranges.

Divide the total number of items by the sum of the numbers in the ratio and then multiply each number in the ratio by the answer to determine how many of each item there are.

Example: How many days did it rain in November if the ratio of days it rained to the number of days it didn't rain is 4:1. We know that November has 30 days, so divide that by the sum: $30 \div (4+1) = 6$. Now multiply the answer by 4, as we know that this is the number that corresponds to the days that it rained, so $6 \times 4 = 24$.

Word problems

Word problems can be tough, but you should always keep the following in mind when dealing with them.

Try to work out exactly what the question wants. If you can, you can then work backwards from that point to find the correct answer.

If possible, try to break the problem down into smaller pieces and by solving them individually, you can get to the final answer.

- **Addition word problems example:** Bob went to the library 3 out of 7 days this week. He went 5 days last week. In the last two weeks, how many times has Bob been to the library? Answer: $3 + 5 = 8$.

Make sure you look at some examples of word problems covering subtraction, multiplication and division as well.

READING COMPREHENSION

Types of questions

These are the types of questions you can expect.

- **Regarding the author:** These will include their thoughts, opinions and attitude. Because the answer might not be explicitly stated, always look for clues regarding overall context.
- **Facts about the passage:** Note the difference between what is opinion and what is fact. You may need to be able to study the passage to find specific information.
- **Added information:** Information can be missing from a passage, or could be added to it regarding the overall direction thereof, a statement in it, or to weaken or strengthen something specific. There might also be fill-in-the-blank options.

Strategies

Keep the following in mind:

- Always look at the answer choices before you even tackle the relevant passage. This helps you identify what to be on the lookout for.
- To increase your chance of finding the right answer, answers that are obviously incorrect should be eliminated.
- Correct answers are very rarely negative statements.

Types of passages

- **Narrative writing:** This could be a play, short story, or even a novel in which a story is being told.
- **Expository writing:** Using facts and examples usually from articles found in magazines or newspapers, this writing can inform, explain or take the form of a how-to.
- **Technical writing:** This can include directions, or a product manual, for example, and usually explains something.
- **Persuasive writing:** This attempts to make the reader behave, think or feel in a certain way by portraying strong opinions.
- **Primary source:** Describing events, this writing is written by people involved in them and is normally unaltered.
- **Secondary source:** This also deals with a described event but the writer is not directly involved but instead is providing extra commentary about the event.

Text structure

Text can be structured in various ways.

- **Problem and solution:** Gives a specific problem and then provides a solution to it.
- **Compare and contrast:** Here, the idea is to look for similarities as well as differences.
- **Cause and effect:** The reasons why something particular occurred and what it was that did occur.

Main idea

- **Topic:** What is the passage about? Is it about a place, a person, an issue, or something else? Ask yourself, "What or who am I reading about in this passage?"
- **Theme:** This you can find by looking at a concept or idea that the author keeps returning to.
- **Main idea:** The reason why the author has written the piece. Look at the topic and then the main argument they are making about it.

We can break this down further. The author's viewpoint on the main idea will be broken down into the top sentences.

The passage will be summed up and the main idea as well as the key evidence presented by the author will be found in the summary sentence.

Sometimes, ideas are not clearly stated but implied. To infer the main idea, look at the tone and word choice of the author.

By analyzing language, looking at the tone used, seeing who the intended audience is, and studying the point of view of the author, you can identify the purpose of the author.

Supporting details

The author's viewpoint pertaining to the main idea is supported by these details and signal words will be used to introduce them.

Examples of signal words include some, in particular, for instance, furthermore, in addition, and specifically.

Opinions vs. Facts

When an author states a fact, the statement used can be proven to be true. With an opinion, this isn't based on fact at all but is an assumption. In other words, unlike a fact, it cannot be proven to be true.

So if we say Friday comes after Thursday, that's a fact, because we can prove it to be true by simply looking at a calendar.

An opinion, however, like saying a person needs eight hours of sleep a night cannot be proved or disproved, so it isn't fact.

Inferences

If you don't understand the meaning of a particular word, you can look for context clues.

VOCABULARY

Question types

- Choose the correct term or definition
- Choose the best term or definition for the sentence
- From the sentence, infer the best definition
- Choose the term's synonym
- Choose the term that is incorrectly spelled

Context clues

- **Restatement clues:** In the sentence, the definition of the word is clearly stated.
- **Positive/negative clues:** These will indicate a positive or negative meaning to the sentence
- **Contrast clues:** These show the opposite meaning of a word
- **Specific clue details:** As a way to help understand meaning, these will show precise detail

Word list

Abate: To lower in amount or intensity
Abdicate: To leave or give up

Adverse: Harmful to a person's interests
Anecdote: Recalling a short account of a certain event
Assiduous: Hardworking and very careful
Bilateral: Something having two sides
Boisterous: Unruly, rough, rowdy
Brazen: Unrestrained or bold
Capacious: Large in capacity or size
Cast: Supports broken bones, a protective device
Cavity: Hollow area
Concave: An outline that curves inwards
Contour: A figure's outline
Copious: Plentiful or abundant
Defecate: Movement of the bowels
Deleterious: Deadly or harmful
Diagnosis: Analyzing a patient's present condition
Dilate: Make larger, or expand
Dilute: Adding water or another mixture to weaken something
Distend: Expanded, or dilated
Elevate: Lift or raise up
Empathy: Understanding the feelings of another person
Endogenous: When something is produced in the body
Flaccid: Flabby and soft
Impetuous: Without thought of the consequence and carried out with undue haste
Innocuous: Harmless
Labile: Unstable
Languid: Slow and tired
Occluded: Absorbed or closed
Precipitous: Uncontrolled
Prudent: Making use of good judgment
Sagacity: Knowledge that is sound
Sublingual: Underneath the tongue

GRAMMAR

Parts of speech

Noun: This is a thing, person, or place, for example, girl, library, and peak cap.

- Proper noun: A specific thing, place or person, for example, Bob or Texas.
- Common noun: A general thing, place, or person, for example, girl or police station.
- Compound noun: When a noun is created by two or more words, for example, sailboat
- Countable noun: A noun that you are able to count, for example, colored pencil.
- Uncountable noun: A noun that you cannot count, for example, rain or friendship.
- Collective noun: Describes a group, for example, team or family.
- Concrete noun: These nouns can be smelled, tasted, felt, seen, or heard, for example, dog or boy.
- Abstract noun: These nouns cannot be smelled, tasted, felt, seen, or heard, for example, hatred or hatred.

Pronoun: These can be divided into the following.

- Personal pronoun: Used in place of a noun, this refers to an object/subject of a sentence or clause, for example, we, they, them, us, you and I.
- Subject pronoun: The clause or sentence subject, for example, she, it, they, we, he, you and I.
- Object pronoun: The clause or sentences object, for example, you, them, us, him, her or me.
- Possessive pronoun: Ownership is shown through their use, for example, mine, theirs, yours, his and hers.

Verb: These are words describing action, for example, drive or jump.

- Linking verbs: The subject of the noun, adjective, predicate, or pronoun are linked by this verb, for example, seem, appear, look, been, being, were, was, are, is, or am.

Adjective: Pronouns or nouns are described through these, for example, tiny or massive.

Adverb: Adjectives, verbs, or other adverbs are described through these, for example, quiet, loud, or quickly.

Preposition: Shows a relationship between a word in a sentence and a noun/pronoun, for example, towards, onto, at, except, before or from.

Conjunction: Parts of sentences are connected through these, for example, for, before, but, and, or so.

Interjection: These are used as a way to express an emotion, for example, wow!

Objects

Direct object: The action of the verb is directly applied to this noun or pronoun. Asking "whom" or "what" after the verb can be used to identify the direct object.

Indirect object: The action of the verb is indirectly applied to this noun or pronoun. By asking "to whom," "for whom," "to what" or "for what" after the verb, the indirect object can be identified.

Subject verb agreement

It's in number that both verbs and subjects must agree. In other words, a plural verb will have a plural subject and a singular verb a singular one.

When it is not clear if the subject is singular or plural, errors can occur.

Clauses

Clauses take on the form of word groups that include a subject as well as a verb and these can be dependent or independent.

With an independent clause, you will find a completed sentence that's able to stand on its own.

With a dependent clause, to form a complete sentence, an independent clause is necessary.

For example, "I am going to the shop because I need to buy bread". Here, the independent clause is "I am going to the shop" and the dependent clause is "because I need to buy bread".

Simple sentence: This sentence type won't have a dependent clause, but only one independent clause, for example, I walked.

Compound sentence: This sentence has no dependent clause but will have at least two independent clauses. The two independent clauses are separated by a coordinating conjunction (and, so, yet, or, but, nor, for) or a comma/semicolon.

Complex sentence: This sentence type will have at least one dependent and one independent clause, for example, When Pete and Tom got home from the library, Tom realized he had lost his house keys.

Compound-complex sentence: This sentence will have at least one dependent clause but two or more independent clauses, for example, When Tom realized he had lost his house keys, he went back to the library with Pete, and they found it.

Run-on sentence

With a run-on sentence, there is no punctuation (known as a fused sentence) between two or more independent clauses, or the punctuation is incorrect (known as a comma splice).

Comma use

When two independent clauses are joined by a coordinating conjunction, a comma should be used.

For example: We need to buy nails, screws, and wood glue.

Apostrophes

These replace a letter that's left out for a contraction, for example, do not becomes don't and it is becomes it's.

When plural nouns end in an s, as a way to indicate possession, an apostrophe can be added, for example, the girls' game.

Homophones

Here are examples of various homophones.

- Accept/except
- Affect/effect
- A while/awhile
- Its/it's
- Loose/lose
- No/know
- Than/then
- There/their/they're
- To/too/two
- We're/where/were
- Weather/whether
- Whose/who's
- Your/You're

BIOLOGY

Biology molecules

Used during metabolic processes, organic compounds contain carbon. They can take the form of polymers that are created by repeated monomers, for example, guanine, triacylglycerol, and glucose.

Typically taking the form of minerals, there is no carbon to be found in inorganic compounds, for example, iron and sodium.

Carbon, hydrogen, and oxygen make up carbohydrates (sugars) and it's as a source of energy that these are used. Carbohydrates have a basic formula of CH_2O and most are multiples thereof.

Hydrogen, carbon, and a small amount of oxygen make up lipids which consist of a head and tail. The head of a lipid is either polar or hydrophilic and it forms from three groups: phosphates, carboxylic acid, and another functional group. A hydrocarbon chain makes up the tail. The molecule becomes more unsaturated dependent on the number of double bonds found in the tail.

Proteins are critical to all living cells and comprise at least one long chain of amino acids. Amino acids are made up of three parts: Amino group, Carboxyl group, R group.

Nucleic acids help in protein production by storing the necessary information to do so. They come about through nucleotides which themselves are made up of a nitrogenous base, a phosphate group, and a 5-carbon sugar. Four nucleotides make up DNA: Thymine, cytosine, guanine, and adenine. In RNA, Uralic replaces thymine.

Basics of a cell

The most basic unit of life is the cell and these were first observed under a microscope which was invented by Robert Hooke.

One of the pioneers in the field of microscopy was Antony van Leeuwenhoek.

In the human body, there are two types of major cells:

Prokaryotic cells: These include archaea and bacteria.

- They have no nucleus
- The nucleoid contains their DNA
- Most are unicellular in nature
- Because they produce through binary fission, they are asexual

Eukaryotic cells: These are found in plants, animals, and fungi, for example.

- They do have a nucleus and it's here where DNA is contained
- They are multicellular in nature
- Can be both sexual or asexual in nature

There are flagella, organelles, cytoplasm, plasma membranes, and cell walls found in both these types of cells.

Both make protein through ribosomes.

The process that takes place within the cell needs organelles:

- **Mitochondria:** Within the cell, this produces ATP
- **Vacuole:** Materials are transported within the cell as well as out of it
- **Nucleus:** All genetic information is held here.
- **Endoplasmic reticulum:** mRNA is translated into proteins
- **Ribosome:** Creates amino acids after reading mRNA.

Cells are surrounded by a cell membrane, and this is tasked with carrying out various functions.

Compounds known as phospholipids make up this membrane and across its entirety transmembrane proteins can be found.

With cells, there are two main types of transportation:

- **Active transport:** Here bulky molecules are imported/exported or moved against a concentration gradient using ATP.
- **Passive transport:** No energy is required with this form of transport. Along the cell membrane, molecules are allowed to passively diffuse.

Osmosis is in response to a concentration gradient and sees a net flow of a solvent across a semi permeable membrane.

Tonicity deals with cells and the concentration of solutes found within them. The overall chemiosmotic potential is affected by that. In other words, it affects the water that enters or exists and makes it equal across the membrane.

- In an **isotonic environment**, both within and out of the cell, the same concentration of solutes exists.
- In a **hypertonic environment**, the cell loses water as the concentration of solutes is higher outside of it.
- In a **hypotonic environment**, the cell gains water as the concentration of solutes is higher within it.
- **Cyclic AM:** For example, when epinephrine binds to a cell, signaling molecules occur.
- **Neurotransmitters:** This also deals with signaling molecules including melatonin, serotonin, aspirate, glycine, acetylcholine, and dopamine.
- **Local/direct signaling:** This is communication between two cells either next to or near each other.

Enzymes

These act as a catalyst and take the form of large proteins. Enzymes are broken down into:

- Those for copying DNA known as DNA polymerase.
- Those for glycolysis known as pyruvate kinase.
- Those that aid in the cellulose breakdown of bacteria and fungi known as endoglucanase.

The area of protein that can bind with a reactant in certain functional groups is known as an active site.

Cellular metabolism

- **Metabolism:** These are chemical reactions not only make energy but also the molecules that are needed for cellular activity.
- **Catabolism:** This is the process through which molecules break down.
- **Anabolism:** Cells use this process to create more complicated molecules.
- **Adenosine triphosphate (ATP):** Of all the energy molecules, this is the most common
- **Aerobic respiratory pathway:** This sees the production of ATP through a catabolic process.
- **Glycolysis:** When sugars are broken down, this is the first step in that process.
- **Citric acid cycle:** This takes place in the eukaryotic cell, specifically in the mitochondria matrix.
- **Electron transport chain:** This is also found in the eukaryotic cell, but in the inner mitochondria thereof.

- **Alcohol fermentation:** Of the fermentation process, this is the most common type. In anaerobic conditions, it's an alternative process to generate ATP.
- **Lactic acid fermentation:** In a process that is slightly different from alcohol fermentation, here lactic acid results when pyruvate is directly fermented into it.

The Cell cycle

Growth phase 1

- **Synthesis phase:** Here DNA replication occurs
- **Meiosis:** Sees the formation of sperm and egg cells. Here, diploid cells undergo DNA replication first and then cell division on two occasions. The result of this is four haploid sex cells. These cells include a single set of chromosomes.

Growth phase 2

- **Mitotic phase:** Here after the cell goes through mitosis, it breaks into two cells.
- **Mitosis:** In this cellular process, chromosomes are replicated which leads to two nuclei that are identical as part of the preparation for cell division. Straight after, the cell nuclei and other cell contents are divided equally, producing two daughter cells.
- **Histones:** DNA is organized around this protein.
- **Chromatin:** DNA complex and histones
- **Chromosomes:** Made of protein and nucleic acids, these thread-like structures are found within most living cells, in the nucleus specifically.
- **Apoptosis:** This helps to determine when a cell dies and is an elaborate cellular signaling mechanism.

DNA replication

In this process, it is within the cell that a copy of DNA is created.

It starts with **initiation** in which a protein initiator binds the origin sites of the DNA.

That leads to the creation of new strands of DNA in a process known as **elongation**.

The new strands are the leading strand and the lagging strand.

In biology, a method can be used to replicate DNA artificially and this is known as a **polymerase chain reaction (PCR)**.

Translation and transcription

The process in which messenger RNA is created from a DNA strand is known as DNA transcription.

- **Condon:** This is an amino acid. In the nucleotide sequence, a set of three base pairs represent it.
- **Translation:** During this procedure, it is into useable protein that mRNA transcripts are converted.
- **Mutation:** This is when a gene changes structure. As a result of this, it turns into a variant form that can be transmitted to generations that follow.

Genetics

- **Genes:** These work as instructions and molecules, called proteins, are made through them. They are basic functional and physical units of heredity.
- **Allele:** These are one of two or more gene versions. Two alleles from each gene are inherited by individuals with each parent supplying one.
- **Homozygote:** This describes someone who, for a particular trait, received two of the same alleles.
- **Heterozygote:** This describes someone who, for a particular trait, inherited two different alleles.
- **Phenotype:** This refers to height, eye color, and other observable/biochemical characteristics of an individual.
- **Genotype:** An organism or cell's genetic makeup
- The idea that parents pass down genes to their children was first conceived by **Gregory Mandel**.
- **Law of segregation:** This says that each parent passes only a single allele to their child and that genes come in allele pairs.
- **Law of independent assortment:** This says that when it comes to different traits and the genes responsible for them, they are passed independently.
- **Law of dominance:** This states that there are both dominant and recessive alleles.
- **Punnet square:** Used to predict a parent's offspring outcome, this takes the form of a table-based diagram.

Evolution

Evolution looks at a population over multiple generations and describes the change in its genetic composition.

Much of this is based on Charles Darwin's theories in his book, *On the Origin of Species*.

Some concepts include:

- **Natural selection:** In this process, organisms living within a specific

environment that adapt better to it will not only survive better than others but also make more offspring.

- **Speciation:** When organisms evolve and turn into a new species, speciation is the name given to the process.
- **Species:** This describes species in a specific group in which fertile offspring are produced by two hybrids.
- **Allopatric specialization:** This is when there is no longer interbreeding between a population because they become geographically separated.
- **Perapatric evolution:** When a small portion of a population is isolated, a new species forms.
- **Parapatric speciation:** While they are mostly separated, this describes populations that do overlap in a small area.
- **Divergent evolution:** This describes two species that have different traits even though they descended from the same ancestor.
- **Convergent evolution:** This describes similar traits found in two unrelated species.
- **Parallel evolution:** This describes the same traits that are developed independently in two related species.

Phylogeny and species classification

- **Phylogeny:** This describes how, over time, species have evolved.
- **Phylogenetic tree:** This shows how different organism groups are related.
- **Taxonomy:** This describes how species are placed into related groups.
- **Order:** Kingdom, Phylum, Class, Order, Family, Genus, Species
- **Homologous structure:** This describes a structure of phenotypes that, due to genetic relatedness, are similar.
- **Analogous structure:** This structure type is neither based on shared ancestry or DNA similarity.

Bacteria

- **Bacteria and archaea:** These are either single cell or unicellular prokaryotes.
- **Gram-positive bacteria:** In their cell walls, these will have peptidoglycan.
- **Gram-negative bacteria:** There is no peptidoglycan in their cell walls.
- **Nucleoid:** Freely arranged DNA is found within the cytosol in these structures.

Viruses

A virus is an organism that by its very nature, is infectious.

The protein coat of a virus's structure is known as the **capsid**.

A **bacteriophage** is a specific type of virus that is able to infect bacteria.

When using a host's cell energy and resources to reproduce, a virus is taking part in a **lytic cycle**.

Plants

- **Roots:** It's within soil that most root systems are found. They are tasked with absorbing not only water for a plant to live but minerals too.
- **Stem:** Other than providing overall stability to a plant, water, and nutrients are moved through the stem after the roots have collected them.
- **Leaves:** The vast majority of the chlorophyll in a plant is found in its leaves.
- **Cell types:** There are three main cell types within plants: parenchyma cells, collenchyma cells, and sclerenchyma cells.
- **Vascular tissue:** This transports water and sugar all over the plant
- **Xylem:** These hollow cell structures help to transport water from the roots to a plant's flowers or leaves.
- **Phloem:** Tasked with transporting sugars, this is living tissue found near the outside of the stem.
- **Meristems:** These are cells that divide quickly and are undifferentiated.
- **Root apical meristem:** It's here that new root cells originate with each having a root cap (a hard layer of tissue).
- **Shoot apical meristem:** Shoot growth occurs here.
- **Floral meristems:** Flower growth occurs here.
- **Primary growth:** It is in the meristems that this occurs while when the stem expands outwards, this is secondary growth.
- **Cambium:** This is found on the stem's outer edges and is a layer of high growth cells.
- **Epidermis:** Surrounded by the cuticle, this is the outer layer of leaf cells. This is important to the photosynthesis process as it allows for the exchange of oxygen and carbon dioxide.
- **Mesophyll:** Necessary for photosynthesis, these are parenchyma cells that hold chlorophyll in large amounts.
- **Palisade mesophyll:** These layers of parallel cells are found on the upper portion of a leaf.
- **Spongy mesophyll:** These cells are loosely organized and provide space for both oxygen and carbon dioxide.
- **Gymnosperms:** These are seeds that either grow on the surface of leaves or in cones.

- **Angiosperms:** These are seed types that are found with fruit around them.
- **Sepals:** Found at the base of the flower, this is a protective structure.
- **Female organs:** These are the ovary, style, and stigma.
- **Male organs:** Consists of the anther and filament and collectively known as the stamen.
- **Pollen:** Male gametophytes
- **Pollination:** The process in which there is a pollen transfer from the anther of one flower to another's ovaries.
- **Endosperm:** This surrounds the zygote and takes the form of a nutritious layer

Photosynthesis

This process sees sugars formed from light energy that plants absorb.

When organisms produce their own sustenance, they are said to be **autotrophs**.

- **Chloroplasts:** These contain chlorophyll and take the form of small organelles that are found in the tissue of a plant. There are two structures found here, the stoma and the thylakoids and it is here that light reactions take place.
- **Calvin cycle:** After each round of synthesis, the recycling of an intermediate compound takes place.

Ecology

- **Population:** This describes groups of individuals within a species.
- **Carrying capacity:** This describes the number of individuals a specific environment is able to provide support to.
- **R-selected:** This describes when a species have offspring in large amounts but with little investment from parents which therefore leads to high mortality rates.
- **K-selected:** This describes a species that invest more in its offspring, and as a result, they produce fewer numbers.
- **Community:** This describes a geographical area in which populations of many species live.
- **Competition:** When the same resources are competed for by various species
- **Predation:** When it's for sustenance that one individual consumes another with the food web a place where these interactions can be mapped out.
- **Mutualism:** Both species benefit from an interaction between them
- **Ecosystem:** Climate defines an ecosystem in a geographic area that includes all biotic and abiotic components.

CHEMISTRY

The Atom

- **Atom:** Containing elemental properties, this is the smallest unit of matter.
- **Protons:** Nuclear particles that are positively charged.
- **Element:** There are more than 100 known elements that take the form of various substances. These cannot be divided into any smaller substances.
- **Neutrons:** Nuclear particles that are uncharged.
- **Nucleus:** Containing neutrons and protons, this is the dense center of an atom that is positively charged.
- **Electrons:** Found outside the nucleus, these are negative particles.
- **Atomic theory:** Made up of atoms, an element has unique properties that make it distinct from others. No physical changes can create, destroy or transform an atom. The definition of a compound is when a specific ratio of atoms combine with each other.
- **Orbitals:** These are electron clouds found surrounding the nucleus.
- **Valence:** This describes the outermost part of an electron shell.
- **Periodic table:** Various elements are organized on this table. Groups describe the columns found on the table while rows are known as periods.
- **Mass number:** In the nucleus, this is the sum of the neutrons and protons found there.
- **Mass:** This is measured in grams and relates to the quantity of matter.
- **Isotopes:** These are an element in two different forms. While they will have the same number of protons, they won't have the same number of neutrons.

Chemical bonding

- **Molecule:** When two or more atoms bond together, they form a molecule.
- **Compound:** Two or more chemical elements are present in a substance composed of identical molecules.
- **Ionic bond:** When there is a loss of electrons from one atom to another that results in an atom that is positively charged and another that is negatively charged.
- **Covalent bond:** When two atoms share electrons equally.
- **Polarity:** This describes a charge imbalance.
- **Dipole:** A small charge
- **Dipole-dipole interaction:** When there is an interaction between a small charge on atoms in a polar molecule and other polar molecules.
- **Intermolecular forces:** These are forces between molecules that are either attractive or repulsive.

- **Hydrogen bonding:** This is when electronegative atoms have hydrogen bonded to them.
- **Van der Waals forces:** This describes interactions between molecules but not in covalent, ionic, or hydrogen bonds, but specifically the sum of the small force interactions that play out.
- **London dispersion force:** This describes dipoles temporarily created by the normal movement of electrons.

Naming molecules

- **Chemical formula:** A compound or molecule's chemical composition is described by its formula. Numbers of each atom are represented by elemental symbols and integers in doing so.
- **Cation:** When an electron is lost relative to a neutral atom or molecule, this is the positive ion that forms.
- **Anion:** When an electron is gained relative to the neutral molecule or atom, this is the negative ion formed.

States of matter

The various states of matter are as follows:

- Solid
- Liquid
- Gas
- Plasma

The relationship between phases, temperature, and a particular substance's pressure is conveyed by a phase diagram.

Acids and bases

An acid will produce hydrogen ions when it ionizes in an aqueous solution.

A base will produce hydroxide ions when it ionizes in an aqueous solution.

We use the pH scale as a representation numerically of acidity with a reading of less than 7 showing an acid, and a base above 7.

A neutral solution will have a pH level of 7.

When an acid and base react with each other, producing water and salt as a result of that reaction, neutralization is said to have occurred.

Solutions

- **Homogenous mixture:** Here, there is an even distribution of substances.
- **Heterogeneous mixture:** Here, there isn't even distribution of substances.
- **Solution:** Could comprise not only liquids but solids and gases too and

take on a uniform physical mixture thereof.

- **Solvent:** This involves the dissolving of a solute.
- **Precipitation:** This refers to when a compound comes out of a solution.
- **Concentration:** In a volume of solution, this refers to a quantity of another substance in it.
- **Saturated solution:** When the maximum amount of solute that could go into a solution is found in it.
- **Unsaturated solution:** There is capacity for this type of solution to take more solute.
- **Supersaturated solution:** This contains more solute that is normally able to be dissolved.

Reactions

- **Chemical reaction:** When the chemical makeup of a substance is altered, it is said to have gone through a chemical reaction.
- **Reactants:** A chemical substance is changed into another set, which is then referred to as the product.
- **Completion:** This describes when all the reactants have been used up in a reaction.
- **Limiting reactant:** The use of one or more reactants is limited by another reactant.
- **Yield:** A reaction product that's yielded and the amount thereof.
- **Oxidized:** When an electron is lost by a species.
- **Reduced:** When an electron is gained by a species.

Chemical equilibrium

In reversible reactions, this is a state that is reached where the rate of forward reaction and the rate of reverse reaction are equal.

We also have to mention Le Chatelier's principle here. This deems that when a chemical reaction is in equilibrium, when there are changes in concentration, pressure, volume, or temperature, it will respond to those changes. It does so by the reaction shifting so equilibrium can be reestablished.

Chemical kinetics

- **Collision theory:** This states that it's only when molecules that can react collide with one another that a chemical reaction will take place. If not, it won't.
- **Catalysts:** The activation energy of a reaction is reduced by substances known as catalysts.
- **Enzyme:** This is a catalyst in a biological form.

- **Homogenous catalyst:** In relation to reactants, this is in the same phase.
- **Heterogeneous catalysts:** In relation to the reactants, this is not in the same phase.

Law of thermodynamics

Thermodynamics deals with physical processes associated with work and heat and this law deals with whether heat is released or absorbed when a reaction takes place.

- **Endothermic reaction:** For this to occur, heat is necessary
- **Exothermic reaction:** During the course of the reaction, heat is released.
- **Isothermic reaction:** This type of reaction has neither an energy net input or output.

Nuclear chemistry and radioactivity

- **Radioactive decay:** This deals with particle and energy emissions from radioactive objects. The energy released is in the form of radiation.
- **Alpha particles:** These are made up of two neutrons and two protons
- **Gamma radiation:** This is electromagnetic radiation that has a high frequency.
- **Half-life:** This is measured as the time it takes for the decay of half a sample of a radioactive substance.

PHYSIOLOGY AND ANATOMY

Important terminology

- **Superior (cranial):** This relates towards the head of a body structure or body; also it could mean above another body part
- **Inferior (caudal):** This relates towards the body's lower end, or the lower end of a body structure; also it could mean below another body part
- **Ventral (anterior):** In front of another part of the body, or body structure; or towards the body's front
- **Dorsal (posterior):** At the back of the body, or behind a certain body part or structure.
- **Proximal:** Near the trunk of the body.
- **Distal:** A point further away from the body's trunk
- **Medial:** Near the middle of the body; also an area on the inner sides of a body structure, or part.
- **Lateral:** Near one side of the body; also an area on the outer sides of a body structure or part.

Circulatory system

This system is tasked with carrying gases, nutrients, and other substances around the body, while it also removes waste.

- **Heart:** The epicardium, myocardium, and endocardium are the three layers of this cone-shaped muscle. It also has four chambers (right and left atria, right and left ventricles) as well as one-way atrioventricular and semilunar valves.
- **Pericardial cavity:** This is where the heart is found
- **Arteries:** Blood is moved away from the heart through these blood vessels.
- **Aorta:** This is the biggest artery found in our body. It branches off into three sections: left subclavian, left common carotid, and brachiocephalic.
- **Arterioles:** These are small arteries that move off the main ones. Their task is to move blood through to the capillaries.
- **Pulmonary artery:** This moves blood to the lungs from the right ventricle.
- **Veins:** These are smaller blood vessels that help return blood to the heart from all over the body.
- **Venules:** These small veins connect to capillaries.
- **Blood:** The body uses blood to transport substances through itself.
- **Red blood cells:** Also called erythrocytes, they are tasked with making red bone marrow, while through modification, they can also transport oxygen.
- **White blood cells:** Also called leukocytes, these are a critical part of the immune system in the body.
- **Platelets:** Also called thrombocytes, these help blood clot.
- **Plasma:** This is the name given to the liquid component of blood.

Respiratory system

This is tasked with the intake of oxygen into the body.

It consists of:

- **Upper respiratory tract:** Larynx, epiglottis, pharynx, mouth, olfactory membranes, nasal cavity, and nose are all included here.
- **Lower respiratory tract:** Muscles that aid breathing, lungs, bronchi, and trachea all make up part of this system.
- **Respiration muscles:** Intercostal muscles and the diaphragm are included here.

Skeletal system

- **Axial skeleton:** This is along the midline axis of the body and includes 80 bones.
- **Appendicular skeleton:** This part of the skeleton is found in the pelvic and

pectoral girdles, as well as the upper and lower limbs, and consists of 126 bones.

- **Long bone types:** There are five in total: sesamoid, irregular, flat, short, and long.
- **Skull:** This provides protection for our sense organs as well as our brain.
- **Vertebral column (spine):** This runs from the base of the skull, down the trunk and middle back, and ends at the tailbone (coccyx).
- **Sternum:** Also known as the breastbone, this runs along the thoracic region midline.
- **Ribs:** These 12 bones form part of the thoracic cage. The main job of the ribs is to provide protection to the lungs and heart.
- **Joints:** Where bones come into contact with one another, you will find these articulations. Joints are broken down into three types: synovial, fibrous, and cartilaginous.

Muscular system

Muscle is divided into three types:

- **Visceral muscle:** This is also called smooth muscle and is found in blood vessels, intestines, and the stomach. It is the weakest muscle type.
- **Cardiac muscle:** This is found in the heart where it works to make it contract and by doing so, pump blood.
- **Skeletal muscle:** Through voluntary action, this muscle relaxes and contracts.

Muscles are controlled by motor neurons.

Nervous system

This consists of sensory organs, nerves, the spinal cord, and our brains.

It's further divided into:

- **Central nervous system (CNS):** This includes the spinal cord and the brain and here information is both stored and processed.
- **Peripheral nervous system:** Information is gathered by this part of the nervous system and then transported to the CNS. In turn, any commands from the CNS are transported to the relevant organ through this system, which is divided into two parts, the somatic nervous system, and the autonomic nervous system.
- Spinal cord

Digestive system

Various organs within the digestive system help process food we take in as well as remove waste.

- **Gastrointestinal tract:** Food passes through this
- **Pharynx:** This tube allows both air and food to travel further into our bodies
- **Esophagus:** Ends at the stomach after starting at the pharynx. It includes two sphincter muscles.
- **Small intestine:** 22 feet in length, this is attached to the abdomen wall.
- **Gall bladder:** Stores bile and releases it when necessary
- **Large intestine:** Absorbs leftover vitamins as well as water.

Endocrine system

This system is made up of numerous glands that send signals to molecules that move in the bloodstream. These glands also secrete hormones that allow organs to communicate as well as cells and tissue.

- **Pituitary gland:** Here, the hormone that deals with certain sexual functioning aspects, as well as controlling growth, is produced.
- **Hypothalamus:** The pituitary gland is controlled by this.
- **Pineal gland:** Melatonin is released by this gland
- **Thyroid gland:** The way the body uses energy, as well as protein production, is controlled by this gland.
- **Parathyroid gland:** Parathyroid hormone is produced here
- **Pancreas:** Controls digestion and blood sugar levels by releasing a specific hormone
- **Adrenal glands:** Two sets of hormones are produced by these glands
- **Testes:** Maturation of sex organs are regulated through this.
- **Ovaries:** Controls secondary sex characteristics but also regulates the menstrual cycle and pregnancy.

Reproductive system

The reproduction of a species is enabled through these organs.

- **Male reproductive system:** Includes sperm, testes, scrotum, semen, Cowper's gland, vas deferens, penis, and prostate gland.
- **Female reproductive system:** Includes uterus, fallopian tubes, corpus luteum, ovule, ovaries, oocytes, zygotes, and menstruation.
- **Placenta:** Nutrients for a fetus are provided by this temporary organ when a woman is pregnant.

PHYSICS

Mechanics

- **Mass:** This is a measurement of the amount of matter in something.
- **Displacement:** From its starting point, this measures just how far something has moved.
- **Velocity:** Over a certain period of time, this is the distance covered by an object.
- **Acceleration:** Over a certain measured time, this is a change in velocity.
- **Vectors:** These have both direction and magnitude.
- **Scalars:** These differ from vectors in the fact that they only have magnitude.
- **Impulse:** This is a momentum change

Forces

- **Force:** An object's motion is either started or stopped by a force, for example, a push to get going. It can include tension, friction, electrical force, and gravity.
- **Centripetal force:** This force makes a circular motion.

Rotational and circular motion

- **Torque:** This is work that takes the form of a circular motion.
- **Circular motion:** This is around a central point that the motion of an object takes place.
- **Centripetal acceleration:** This is towards the center of a circle.

Energy, work, and power

There are various types of energy:

- **Kinetic:** This is energy of motion
- **Thermal:** This is heat energy and it's in relation to temperature
- **Potential:** This is energy that is stored
- **Chemical:** Released during a chemical reaction, this is energy found in atom and molecule bonds.
- **Electrical:** When an electric charge flows through a conductor, this is the energy that results
- **Nuclear:** When nuclear fission or fusion occurs, this is the energy that is released.

Work is when it's over a distance that force is exerted.

Power is a force that's applied over a longer time period.

Thermodynamics

- **Temperature:** This measures the kinetic energy of a substance's molecules or atoms but as an average.

- **Heat:** This is when energy is transferred between substances.
- **Conduction:** This is a transference of heat between molecules that are next to each other.
- **Heat capacity:** This deals with temperature change and the resistance of an object to it.

Fluid mechanics

- **Pressure:** This is when it's over a specific area that a force is applied.
- **Density:** This is the mass per unit volume of an object.
- **Specific density:** This looks at the density of an object, but compares it to water.
- **Buoyancy:** This deals with objects and their chance of floating in a greater density fluid.
- **Bernoulli equation:** Depending on the energy in a fluid, the height of the pipe it is flowing through, as well as pressure this establishes a fluid's rate of flow through that pipe.

Waves

- **Wave:** Energy is carried through matter or space via this periodic motion.
- **Mechanical wave:** These need a mechanical medium to travel through.
- **Electromagnetic waves:** Because they are made up of oscillating magnetic and electric fields, these do not need a medium to travel through.
- **Longitudinal waves:** Particles will vibrate parallel to the wave's movement.
- **Transverse waves:** Particles will vibrate perpendicular to the wave's movement.
- **Wavelength:** This is the distance from one wave peak to the next wave peak.
- **Amplitude:** This is the distance from the top of the wave to the bottom thereof.
- **Period:** This is a measurement of time related to the completion of one oscillation of a wave.
- **Frequency:** In one second, this measures the number of oscillations a wave has
- **Diffraction:** When passing through a slit, this is a wave refracting and bending.

Periodic motion

This describes a specific frequency at which oscillation occurs.

- **Spring:** If not held by a force, this coil of metal will return to its original shape.
- **Pendulum:** Takes the form of a mass that's on the end of a swing. Has the ability to swing back and forth when a force is applied to it.

- **Light:** A type of electromagnetic radiation that includes a small electromagnetic wave spectrum.
- **Refraction:** When passing through another media, this deals with the way light bends.

Electricity

- **Coulomb's law:** There are both attractive and repulsive forces between particles and this helps to predict the overall strength thereof.
- **Current:** This has to do with electron movement
- **Resistor:** When current flows through an electrical circuit, a resistor is something that provides resistance to that flow.
- **Series circuit:** Current in this type of circuit only flows in one direction.
- **Parallel circuit:** Current in this type of circuit can flow in both directions.

Magnetism

Deals with magnetic fields which occur from moving electrical charge. It can also result when subatomic particles in a substance align.