Introduction to Statistics

1 2 3 4 5

* You don't need to remember the formulae for the exam *

→

→

→

↳

↳

↳

↳ →

→

→

→

↳

→

Chi-Squared Test →

Correlation Coefficient →

Student's T-test →

TT

Choosing a Statistical Test

1 2 3 4 5

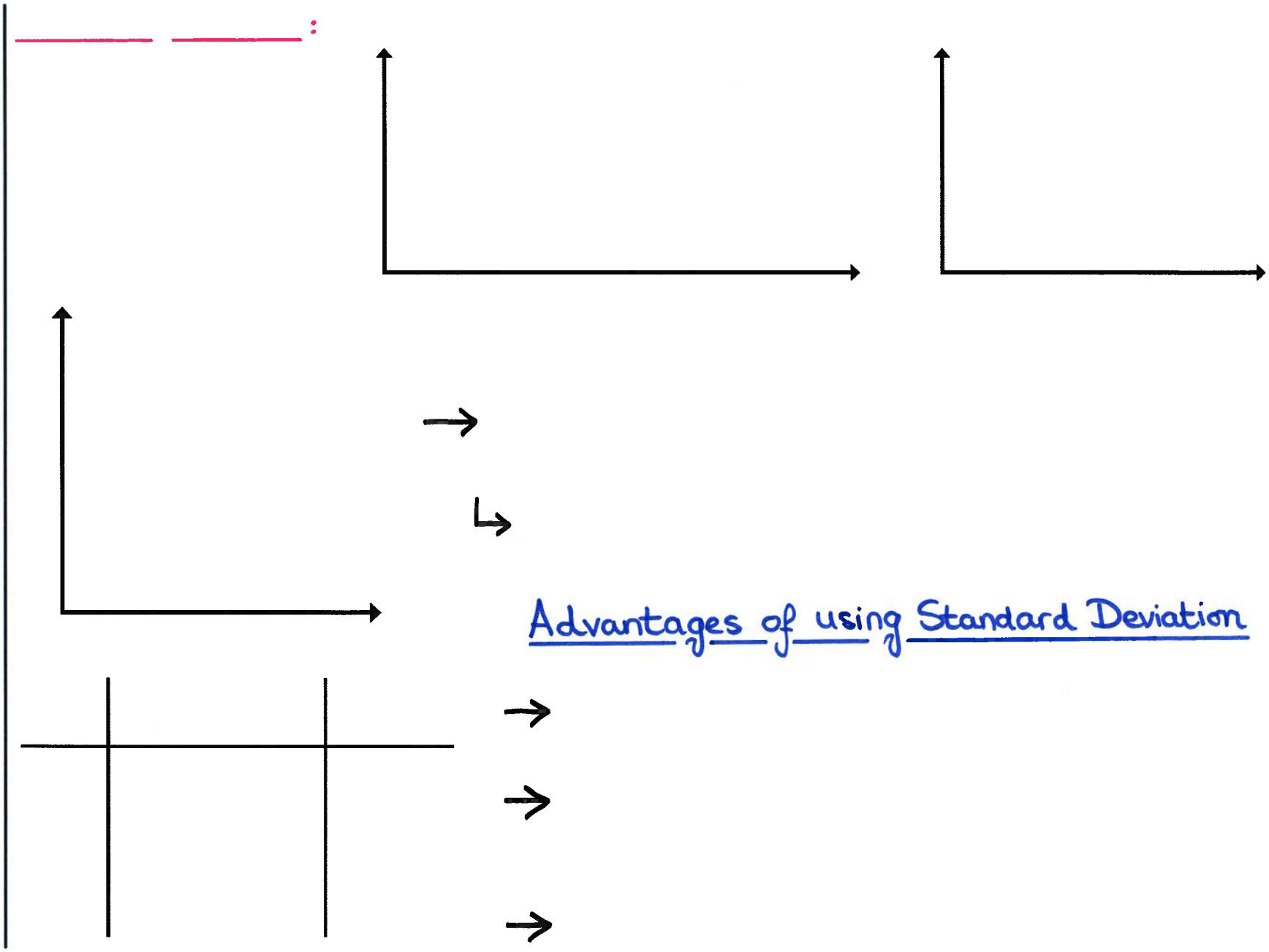
Function			
Reason for Choosing			
Null Hypothesis			
Results			
Degrees of Freedom			

TT

Standard Deviation

Standard Deviation

1 2 3 4 5



Advantages of using Standard Deviation

TT

P-Value

P-Values

1 2 3 4 5

_____:

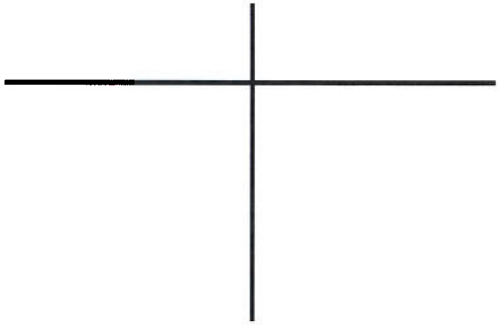
P-value

Chance

Confidence

→

→



→

↳

↳

↳

Appropriate Units

1 2 3 4 5

Area Conversion

Converting Units

→

e.g.

→

→

Volume Conversion

Time :

Temperature :

Calculating Rate

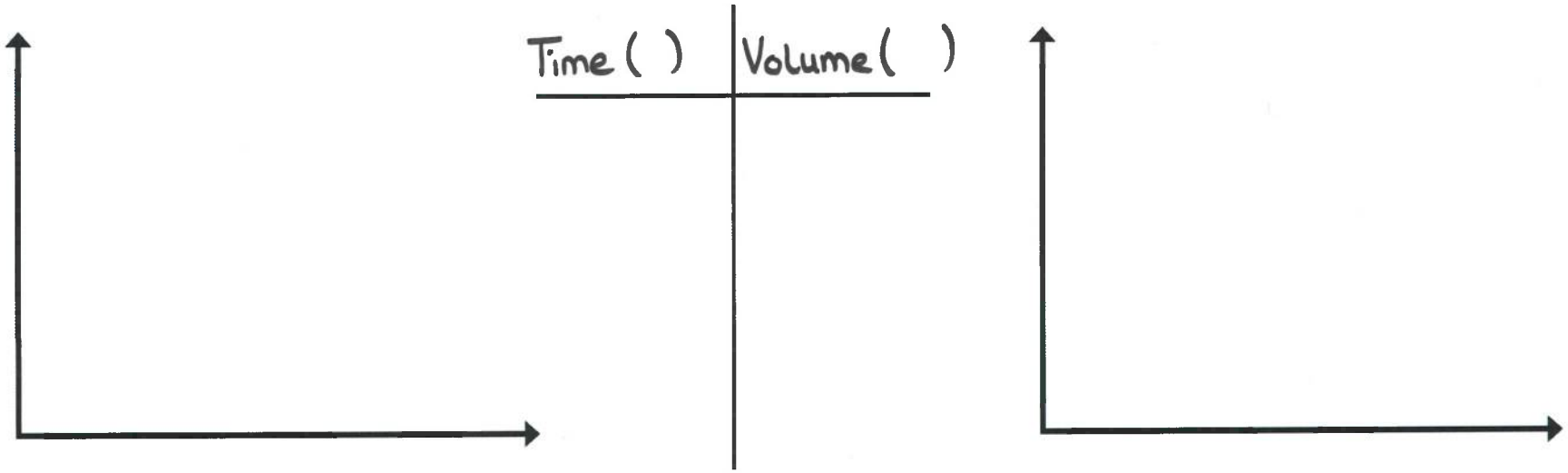
1 2 3 4 5

TT

Rate

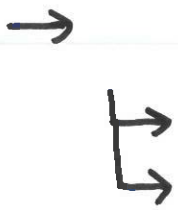
Rate:

e.g.



Decimals & Standard Form

1 2 3 4 5

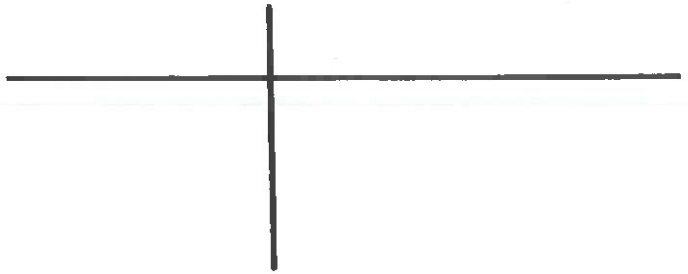


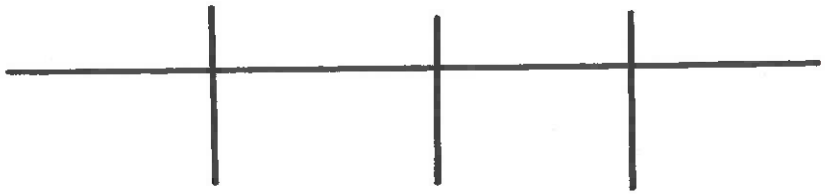
Questions

Standard Form Calculations

Ratios

1 2 3 4 5





Surface Area : Volume

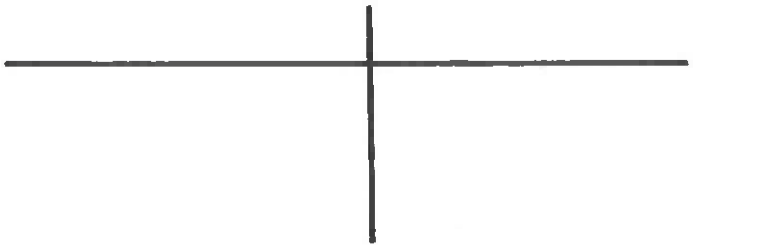
Percentages

1 2 3 4 5

→

→

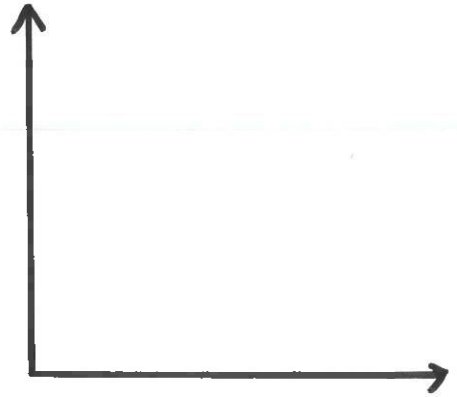
Percentage Change



Calculate the % change in impulse speed as the axon diameter changes

a) 2μm to 3μm

b) 3μm to 1μm



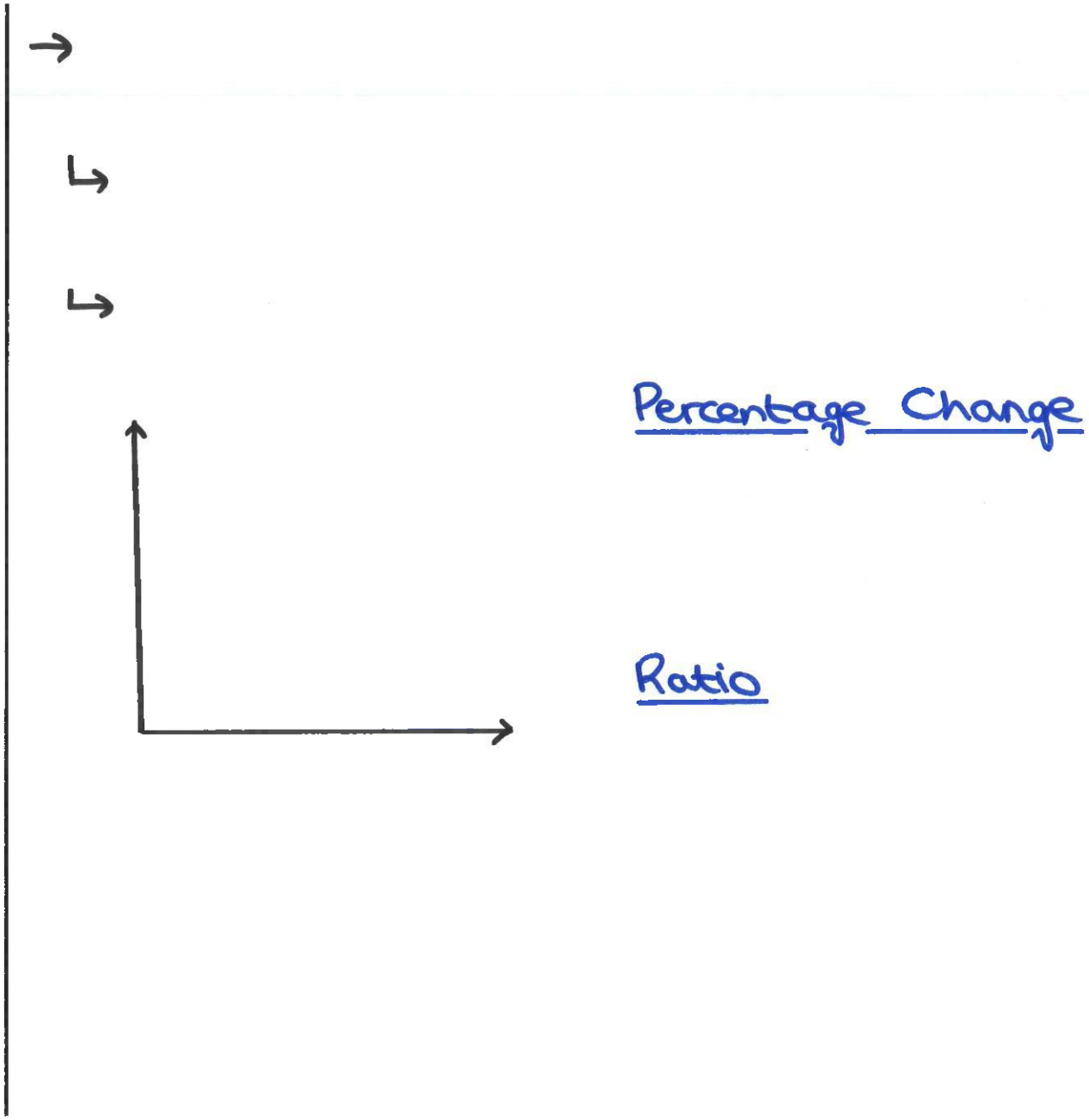
→ Calculate the % decrease between groups A and B at 2 seconds

Percentage Yield

→ Theoretical Yield = 250g
only 212g was produced. Calculate the Percentage Yield.

Estimation

1 2 3 4 5



Using an Appropriate Number of Significant Figures

1 2 3 4 5

Decimal Places & Significant Figures

→

→

✓

✗

Rounding

→

e.g.

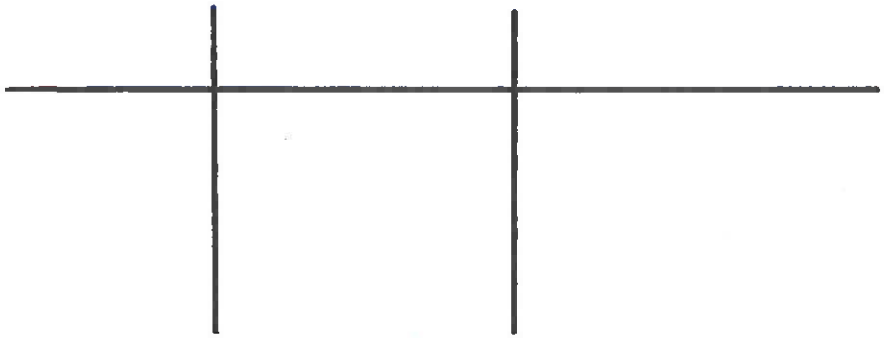
Adding & Subtracting Decimals

→

Multiplying & Dividing Decimals

→

→



TT

Orders of Magnitude

Orders of Magnitude

1 2 3 4 5

Orders of Magnitude :

e.g.

Calculate Differences in Order of Magnitude

→

→

→

e.g.

Averages

1 2 3 4 5

Data Set 1 : 16, 22, 14, 22, 20, 19, 17, 22

(Arithmetic) Mean

(_____) _____ ( ) :

Median

_____ :

→

↳

Mode

_____ :

Data Set 1

Data Set 2 : 12, 8, 6, 9, 8, 13, 6

↳

Range

_____ :

Data Set 1 :

Data Set 2 :

Probability

Stats Tests

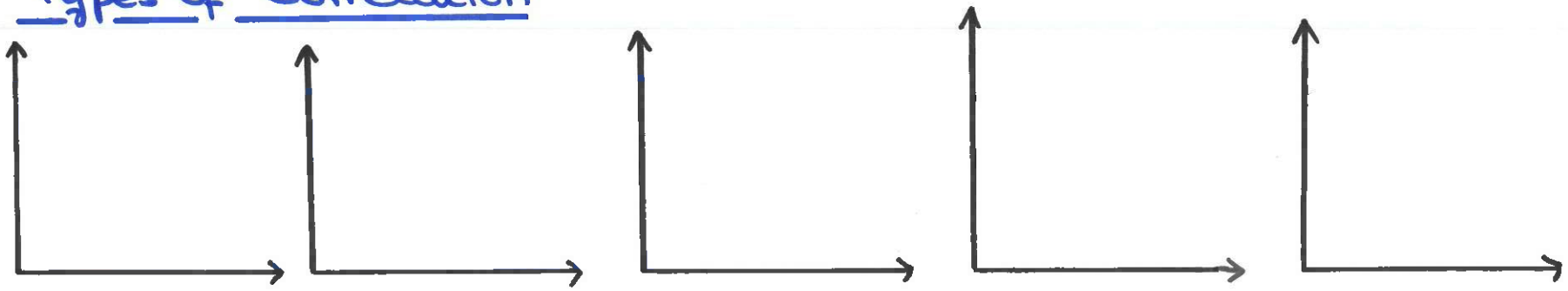
Dice Roll

Inheritance

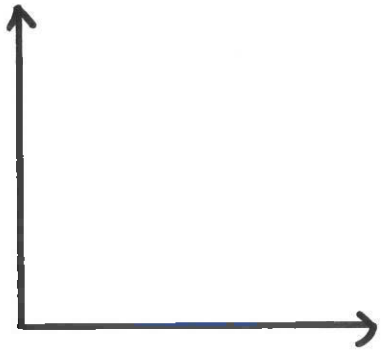
Scatter Diagrams

1 2 3 4 5

Types of Correlation

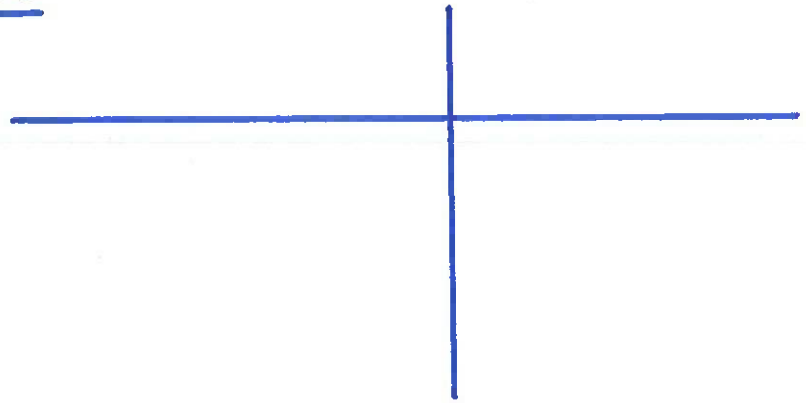


Axes



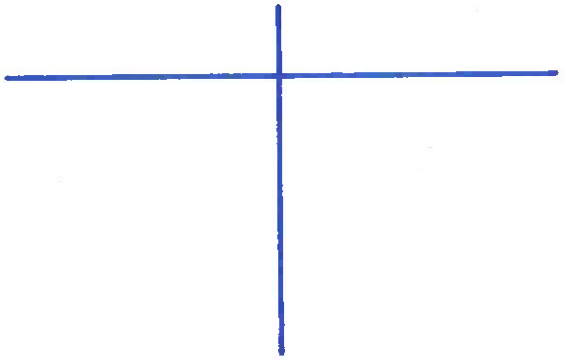
Tables & Bar Charts

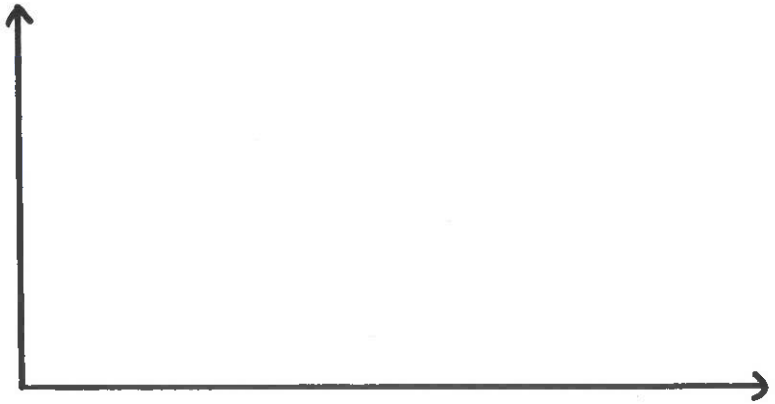
Tables



Bar Charts

e.g.



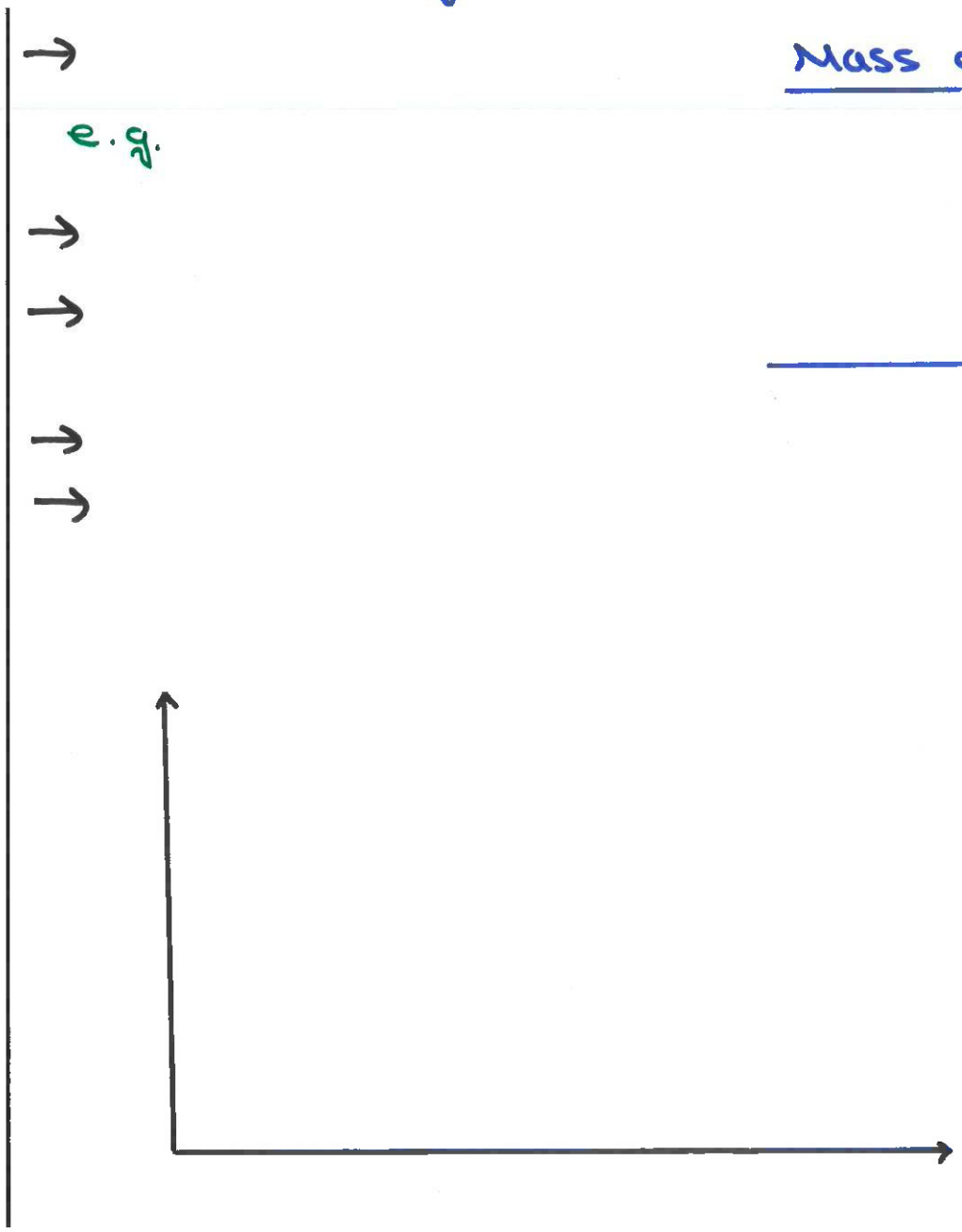


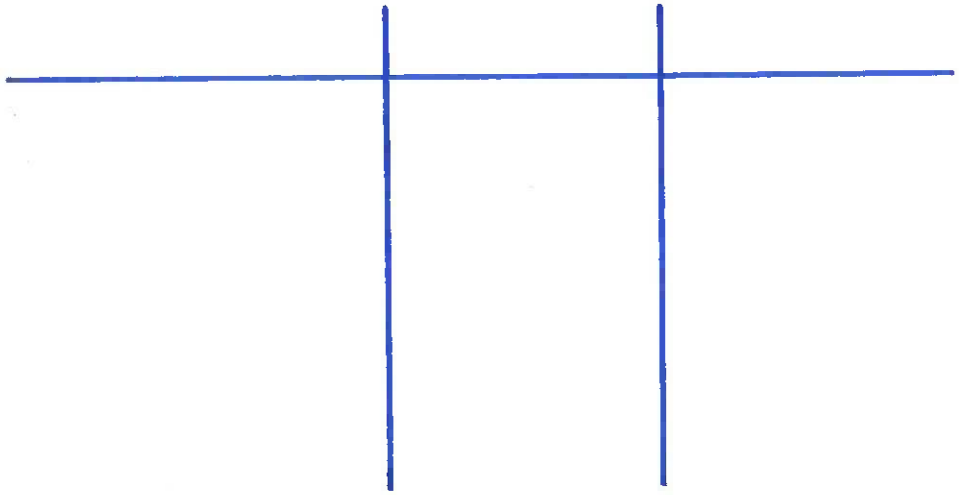
Histograms

1 2 3 4 5

Mass of individual (nearest kg)

e.g.





Uncertainties in Measurement

1 2 3 4 5

Absolute Uncertainity

_____ _____:

e.g.

_____ _____:

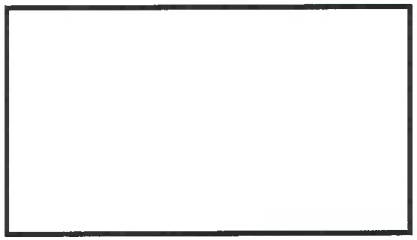
Relative Uncertainity

Adding + Subtracting Uncertainties

e.g.

Multiplying Uncertainties

e.g.



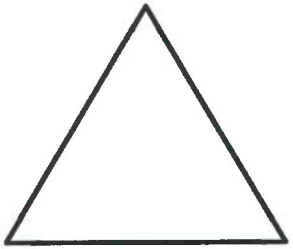
Algebraic Symbols

1 2 3 4 5

Symbol	Meaning	Example

Rearrange Equations

1 2 3 4 5



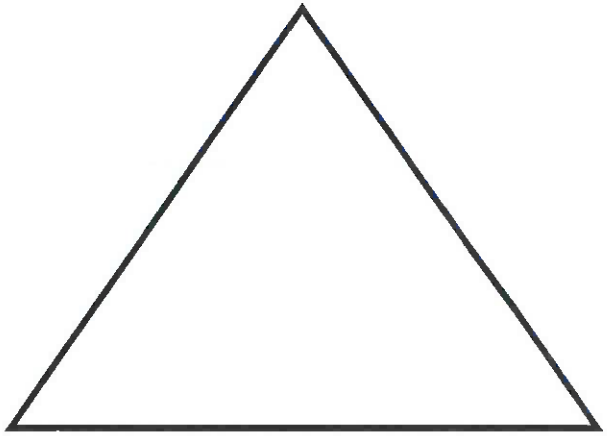
Cylinder

Solve Algebraic Equations

1 2 3 4 5

=

×



Calculate stroke volume after training

Drawing Graphs

1 2 3 4 5

Drawing

-
-
-
  -
-
-

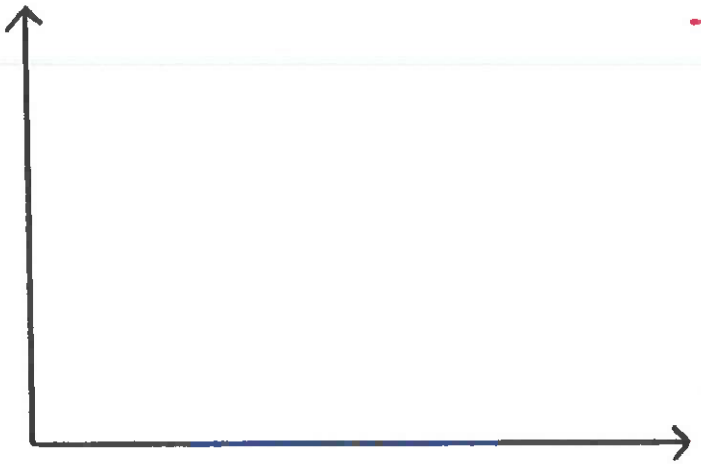
Line of Best Fit

-
  -
-
  -
-

Tangents

1 2 3 4 5

Rate of Reaction



Tangent

Q. Find the initial rate of reaction at 60°c

Method

→

→

Gradient

→

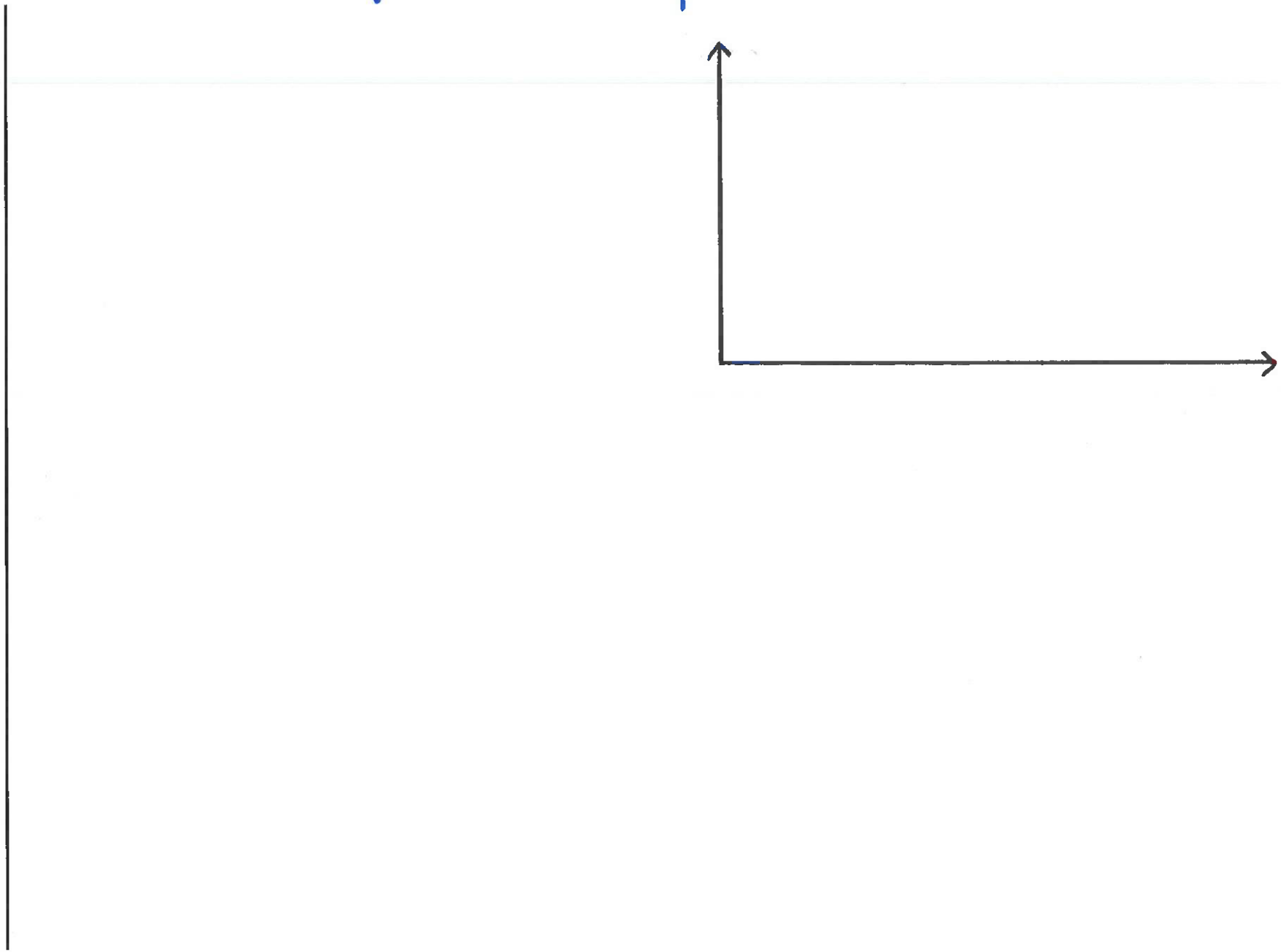
Q. Find the rate of reaction at 28min at 37°c

→

→

Straight Line Graphs

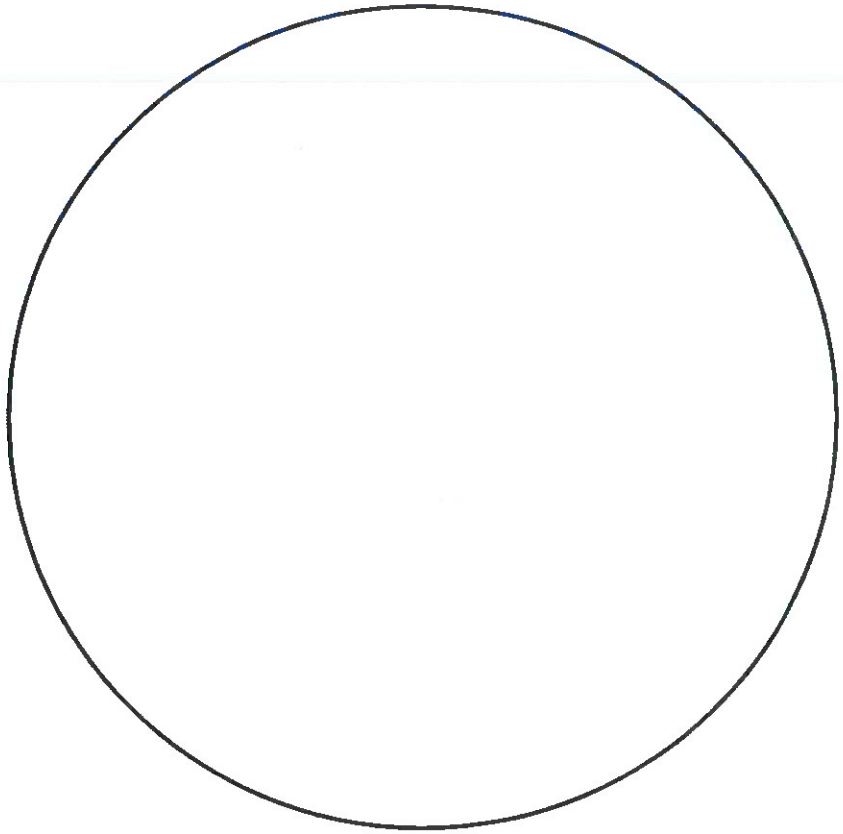
1 2 3 4 5



Circumference & Surface Area of Circles & Spheres

1 2 3 4 5

Circles



Spheres

Rectangular & Cylindrical Prisms

1 2 3 4 5

Rectangular Prism

Volume

Surface Area

Cylindrical Prisms

Surface Area

Volume

Colorimetry & Calibration Curves

1 2 3 4 5

Colorimeter

_____:

Aparatus & Method

→

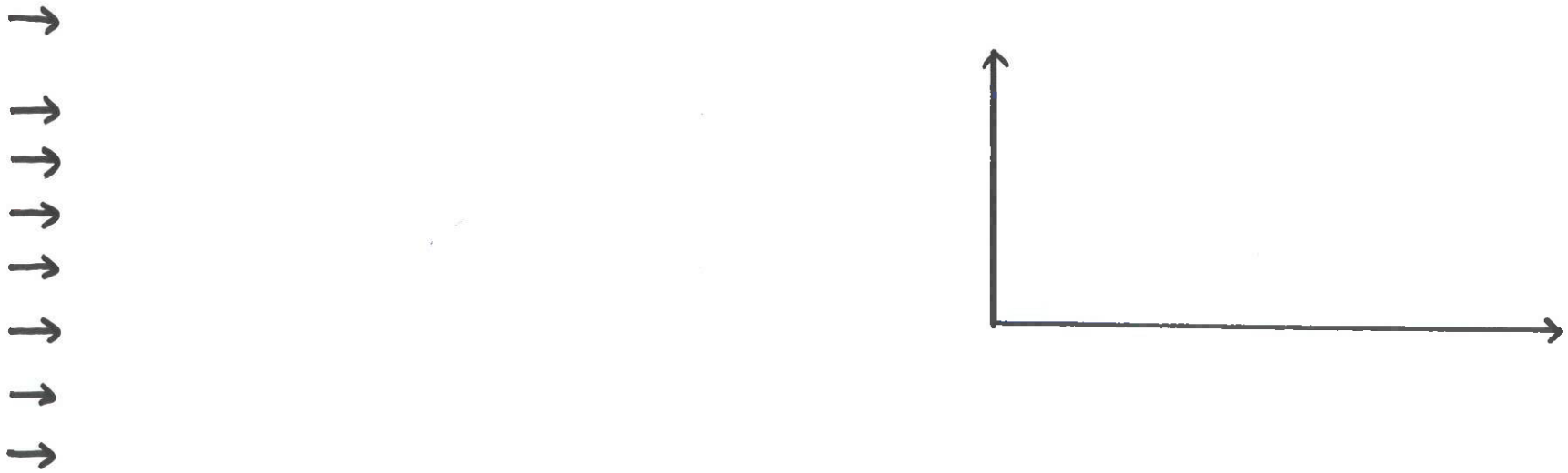
→

→

Calibration Curve

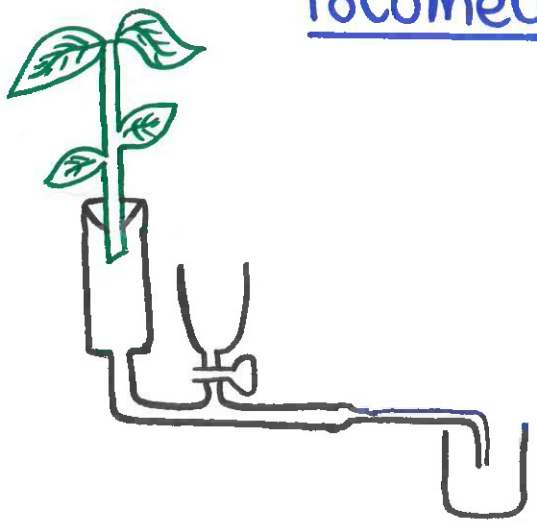
Calibration Curve

_____ ____ (_____ ___):



Potometer

1 2 3 4 5



Explain the Results

Variables to Control

Sources of Error

Calculating the Rate of Transpiration

×

Dilutions

1 2 3 4 5

TT

Serial Dilutions

____ ____ :

e.g.

____ ____ :

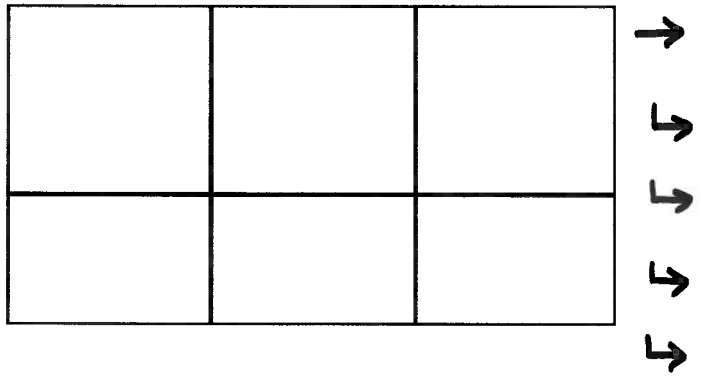
e.g.

Making cm^3 of $nmoldm^{-3}$ From a Solution of $nmoldm^{-3}$

Making cm^3 of $moldm^{-3}$ From a Solution of $moldm^{-3}$

Making a Serial Dilution

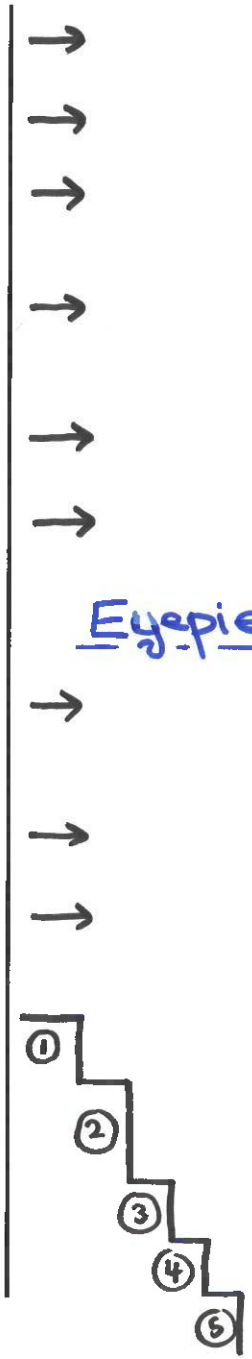
e.g.



Dilution Series

Using a Light Microscope

1 2 3 4 5



Slide Preparation

1 2 3 4 5

Slide Preparation

→

→

↳

→

→

→

→

→

Staining

→

→

→

→

→

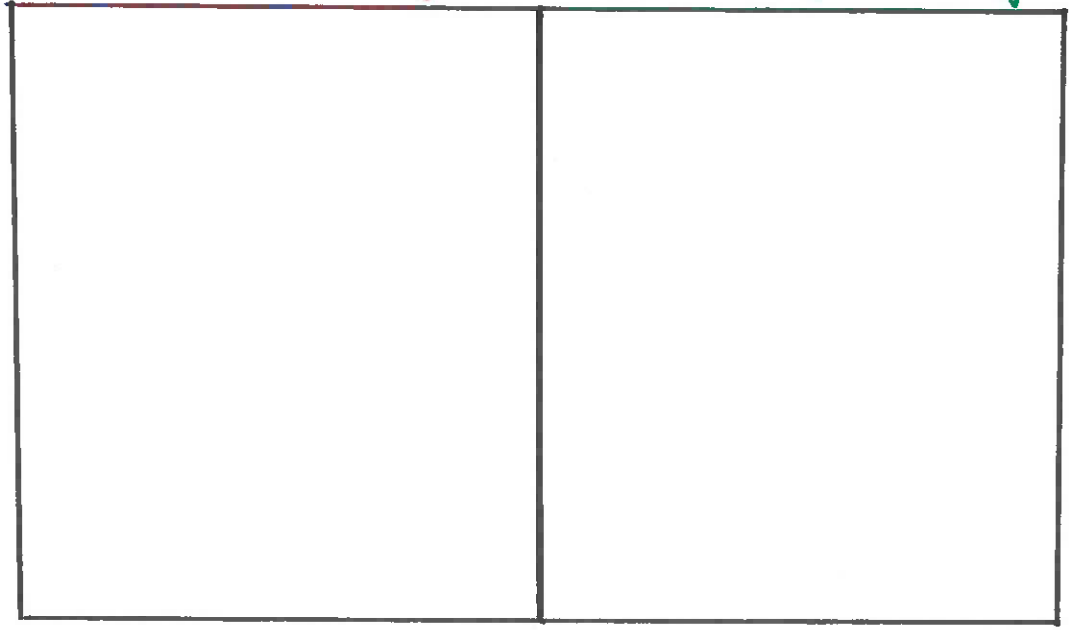
Biological Drawings

1 2 3 4 5

General Principle

Bad Scientific Drawing

Good Scientific Drawing

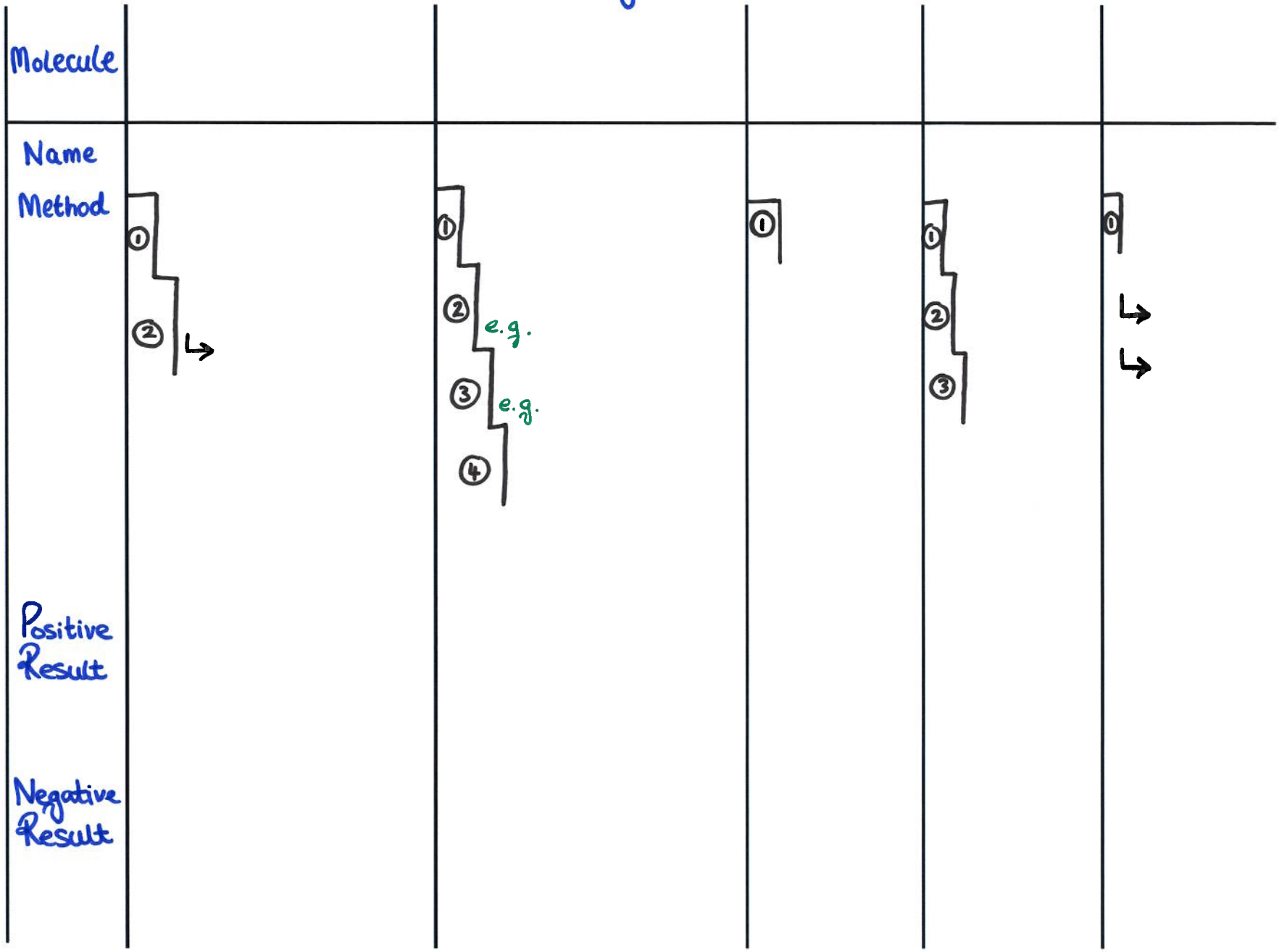


Labelling

e.g. Common Mistakes

Qualitative Tests for Molecules

1 2 3 4 5



Electrophoresis

Electrophoresis _____:

→

→

→

→

→

→

→

Ethical Use of Organisms

Reasons for

Reasons Against

Invertebrates →

e.g.

↳

→

→

→

↳

→

→

→

Vertebrates →

e.g.

→

↳

Relativism / Rationalism

Absolutism

e.g.

Aseptic Technique

1 2 3 4 5

Aseptic Technique

_____ _____:

Importance of Aseptic Technique

→

→

→

→

→

→

Example of Technique

→

→

→

→

→

Investigate the Effect on Enzyme or Substrate Concentration on the Initial Rate of Reaction

1 2 3 4 5

Changing Substrate Concentration

→

→

→

→

e.g.

→

→

→

→

→

→

→

Changing Enzyme Concentration

→

→

Root Tip Squash

Steps in Method	Reason
① →	
→	
② →	
→	
③ →	
↳	
④ →	
↳	
→	

Identifying the Water Potential of Plant Tissue

1 2 3 4 5

Method

1)

2)

3)

4)

5)

6)

7)

8)

Making Serial Dilutions

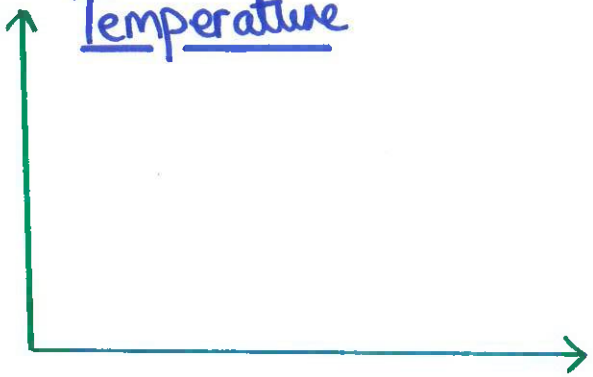
Vol of known conc^{n} (cm^3)	Vol of water (cm^3)	Total Vol (cm^3)	Final Conc^{n} ($mol\ dm^{-3}$)

Q Make $30cm^3$ of $0.75 mol dm^{-3}$ NaCl from a stock solution of $1.8 mol dm^{-3}$

Factors Affecting Membrane Permeability

1 2 3 4 5

Temperature



Solvents

① _____

② _____

③ _____

④ _____ _____

e.g.

Dissection

Safety

Animals

e.g.

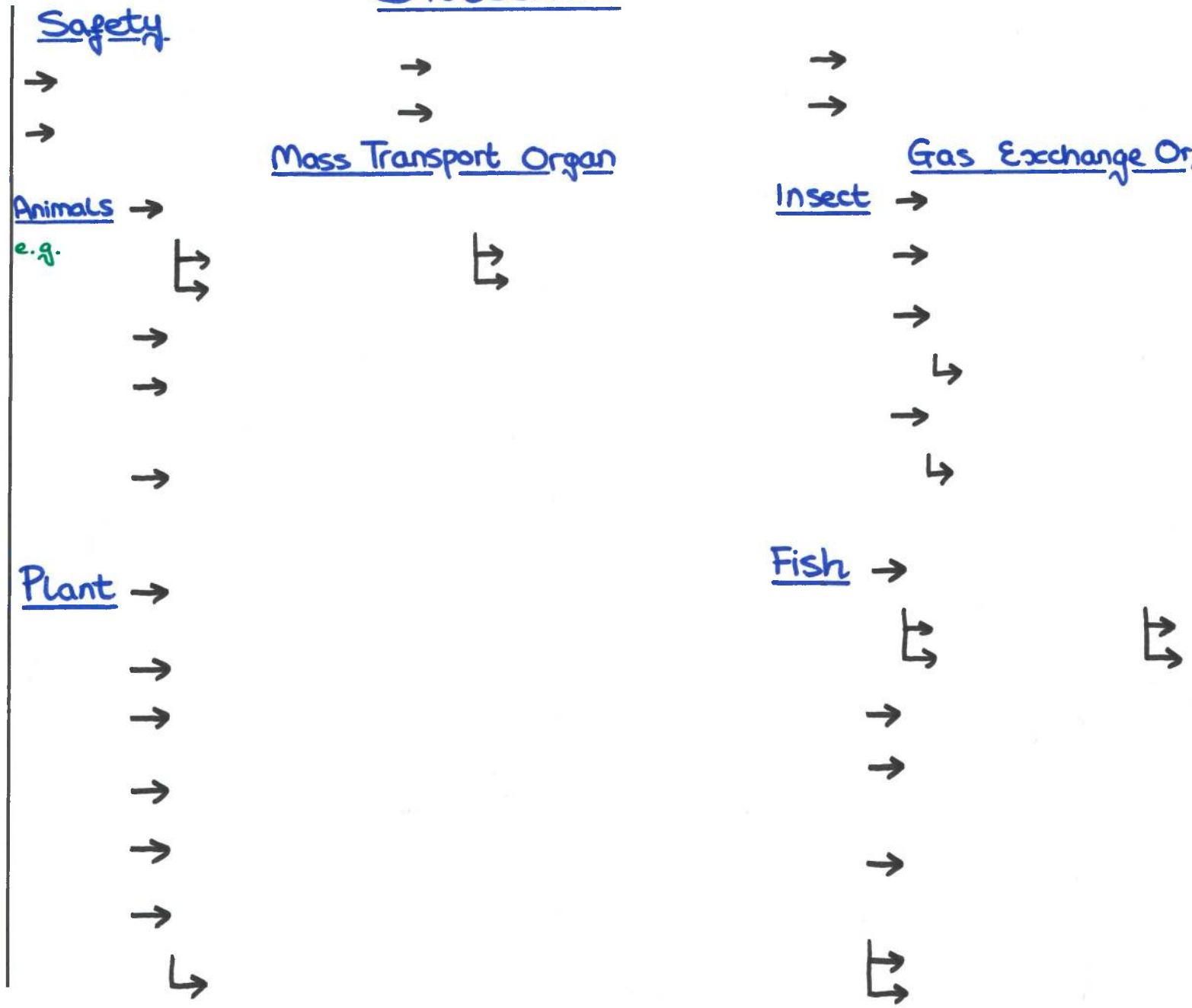
Plant

Mass Transport Organ

Gas Exchange Organ

Insect

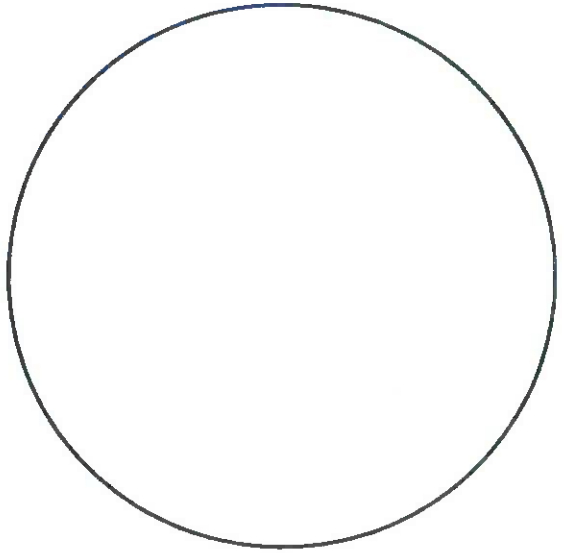
Fish



Investigate the Effect of Antimicrobial Substances on Microbial Growth

1 2 3 4 5

Method



e.g.

e.g.

Clear Zone

TT

1 2 3 4 5

Introduction to the Biological Molecules

Monomer

_____:

_____:

e.g.

Polymer

Polymers

Molecules	Elements	Monomers	Polymers

Not Polymers

Condensation & Hydrolysis Reactions

1 2 3 4 5

Condensation _____:

Hydrolysis _____ :

Monosaccharides & Disaccharides

Glucose

Alpha Glucose

Beta Glucose

Glycosidic Bond

Glucose + Glucose + Glucose + Glucose → _____ _____ :

Alpha Glucose → Beta Glucose

Polymers of Carbohydrates

1 2 3 4 5

Triglycerides

Structure

Saturated Fatty Acids

Functions

Unsaturated Fatty Acids

Phospholipids & Cholesterol

1 2 3 4 5

Structure

Functions

Cholesterol

Introduction to Proteins

Proteins

_____ :

_____ _____ :

Amino Acids

Proteins

→

↳

↳

↳

Types of Proteins

→

→

Protein Structure

1 2 3 4 5

Primary Structure

Secondary Structure

Tertiary Structure

Quarternary Structure

TT

1 2 3 4 5

Enzymes

Enzymes

_____ :

_____ _____ :

_____ _____ :

Active Site

Metabolic Pathway

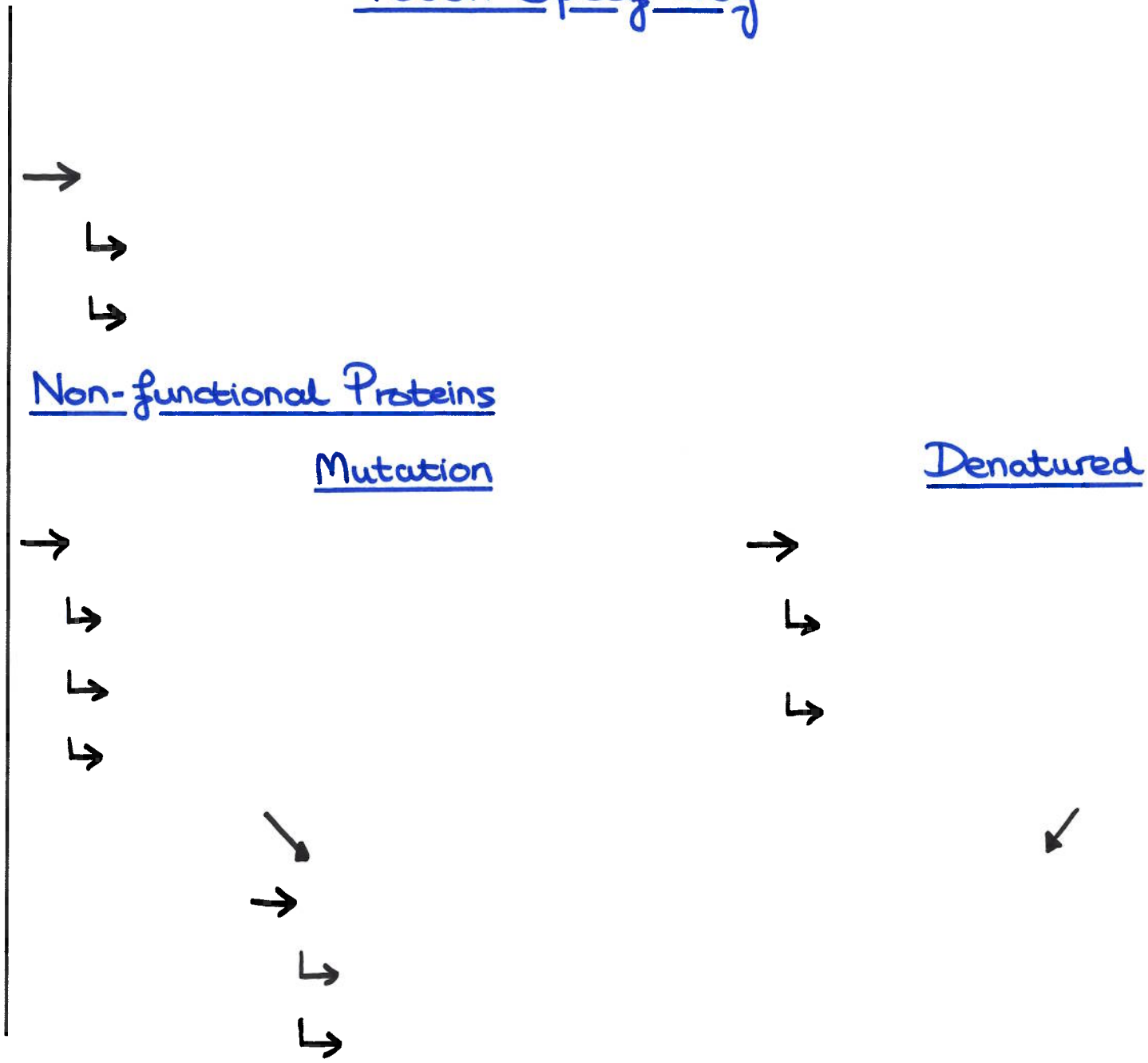
Lock & Key Model

Induced Fit Model

Enzymes

e.g.

Protein Specificity



Enzymes

1)

2)

3)

4)

5)

→

→

1)

Enzyme Activity...

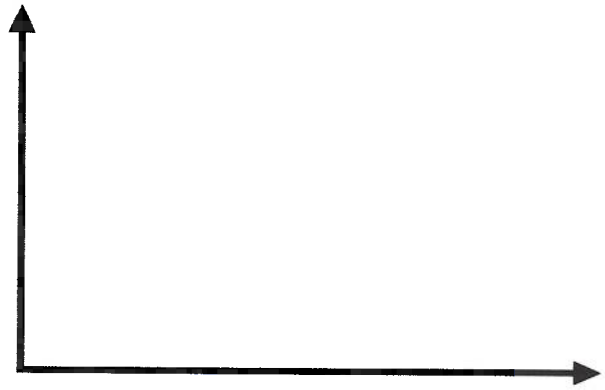
1 2 3 4 5

2) _____ (_____)

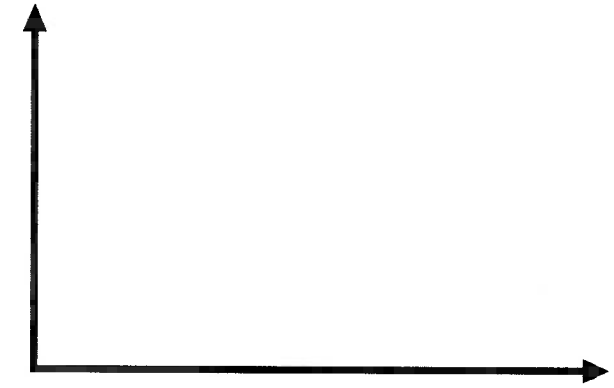
Enzyme & Substrate Concentration

1 2 3 4 5

Enzyme Concentration

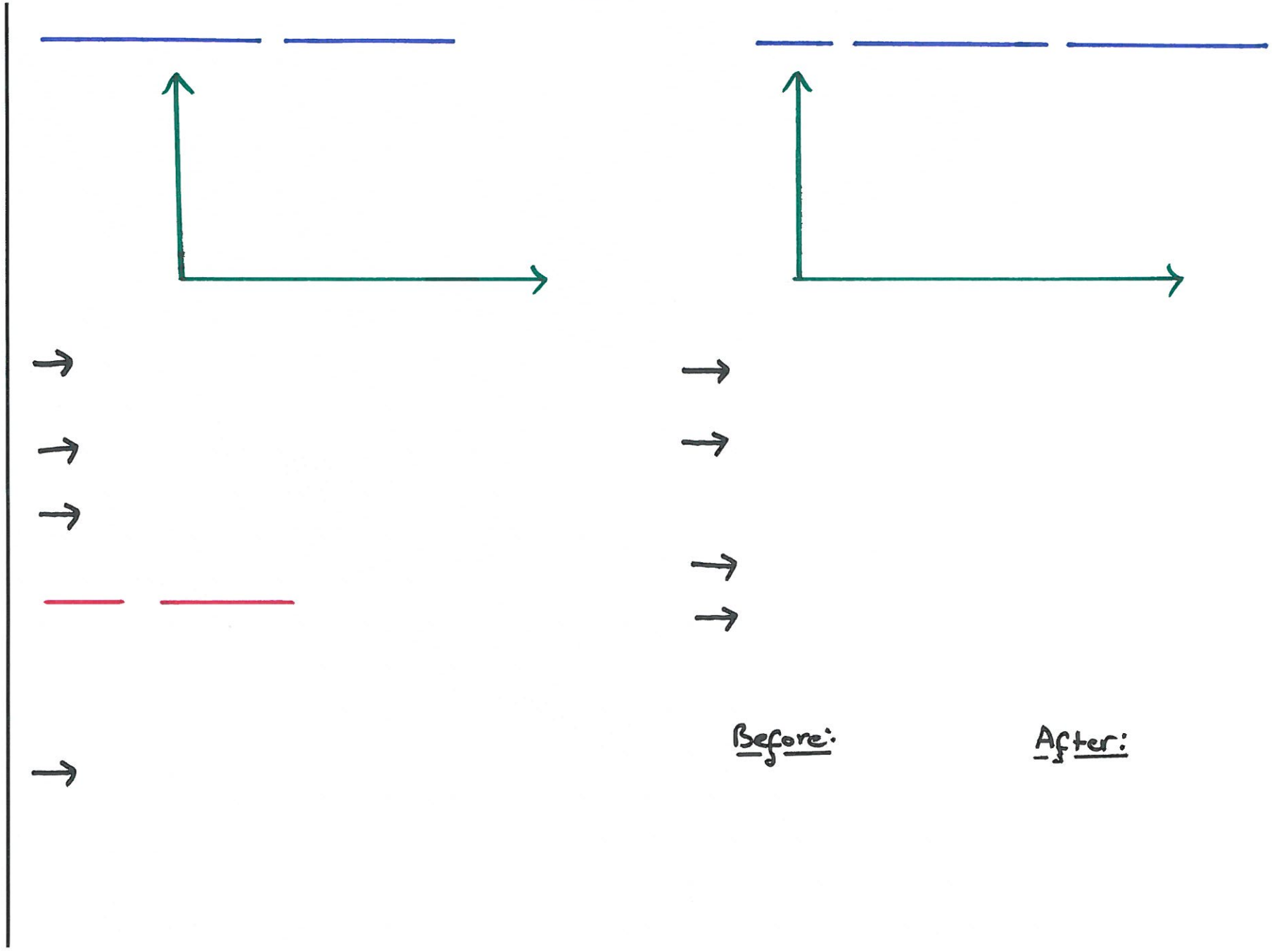


Substrate Concentration



Enzyme Activity...

1 2 3 4 5



Nucleic Acids

1 2 3 4 5

Nucleotides

D.N.A

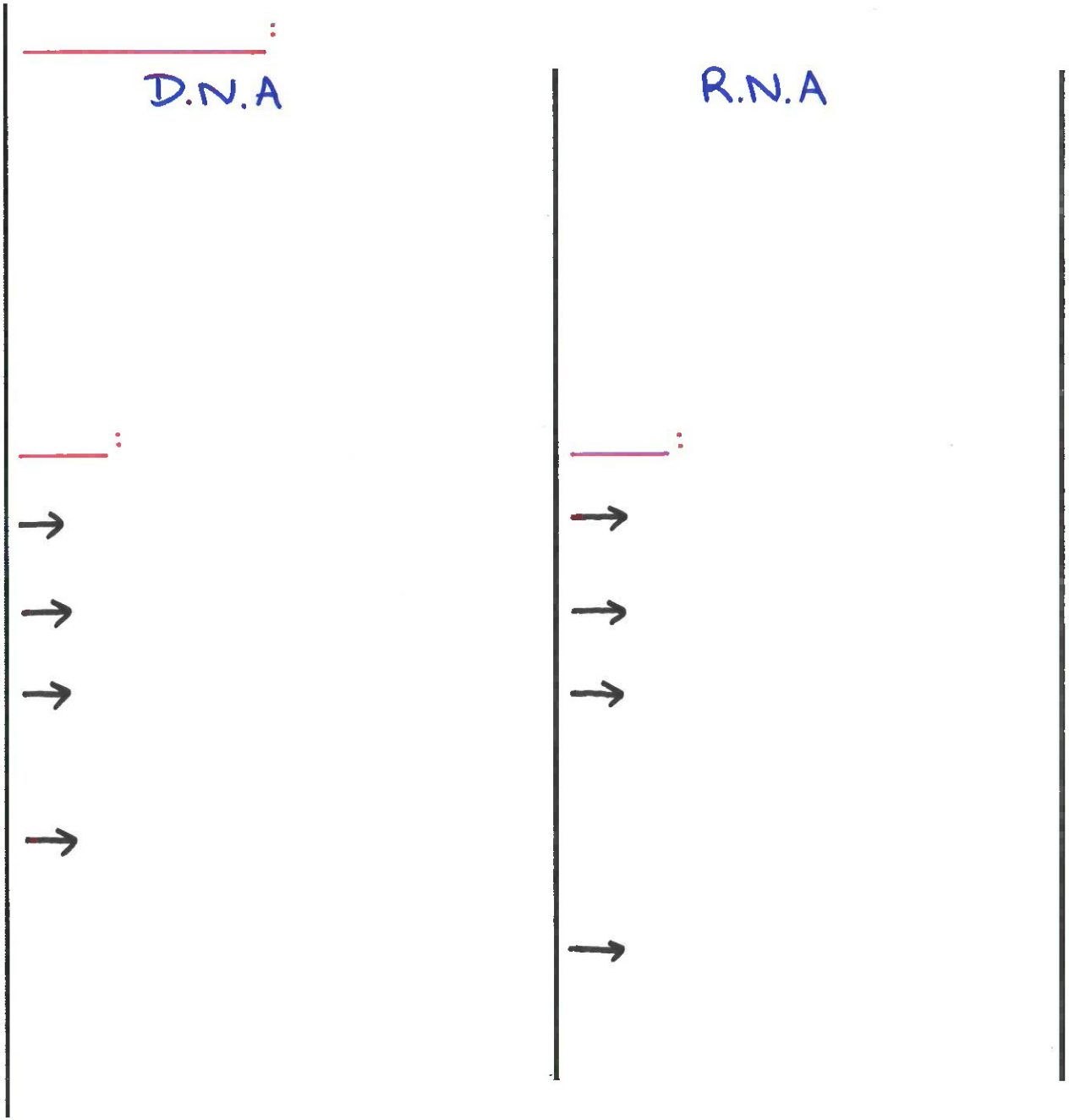
R.N.A

Polynucleotides

DNA

RNA

Phosphodiester Bond



Structure & Function of DNA

Structure	Function
→	
→	
→	
→	
→	
→	
→	

TT

Semi-Conservative DNA Replication

1 2 3 4 5

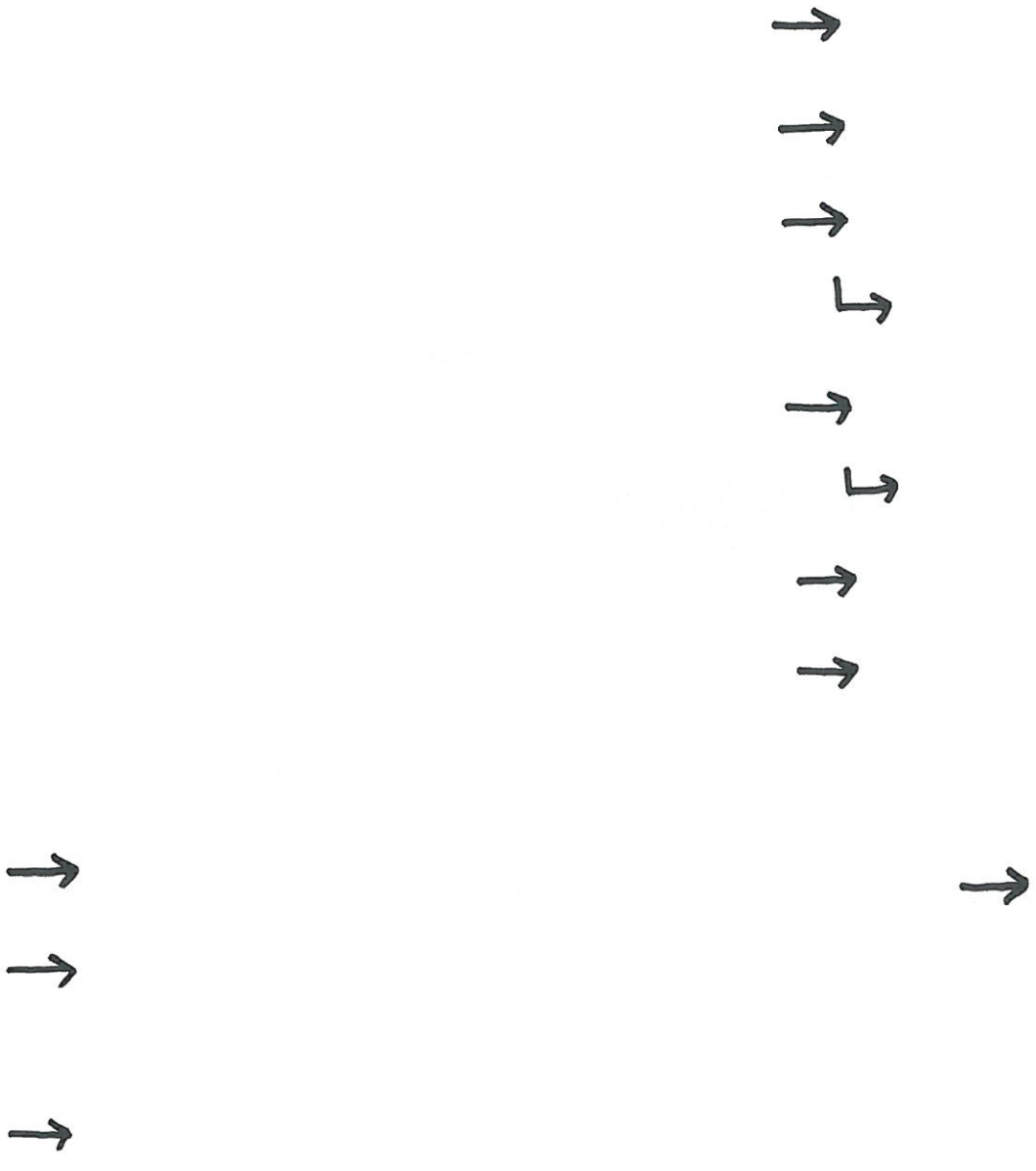
DNA Helicase

Complementary Base Pairing

DNA Polymerase

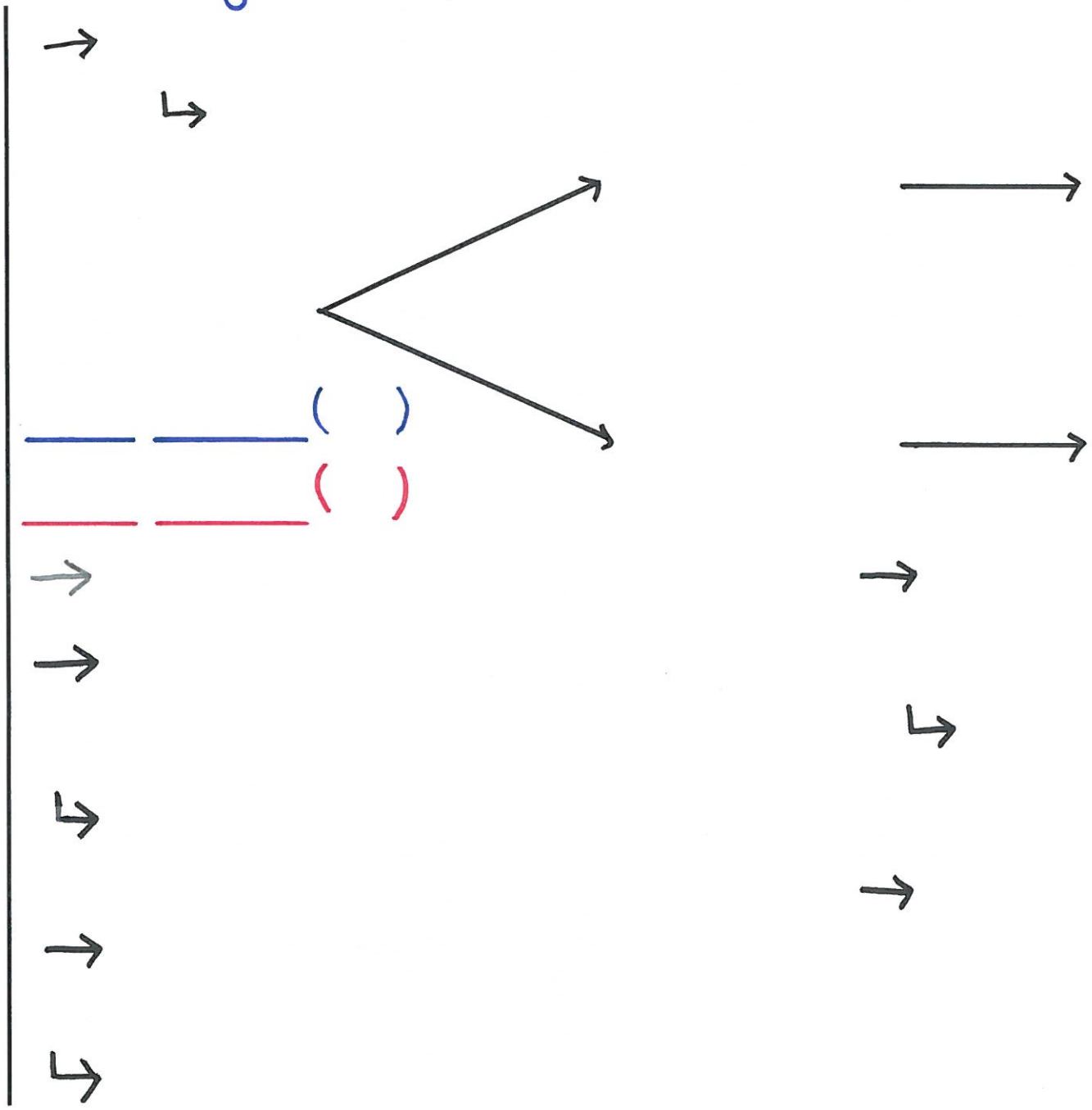
Phosphodiester Bonds

Anti-parallel



Proving DNA Replication is Semi-Conservative

1 2 3 4 5



ATP

1 2 3 4 5

ADP

Pi

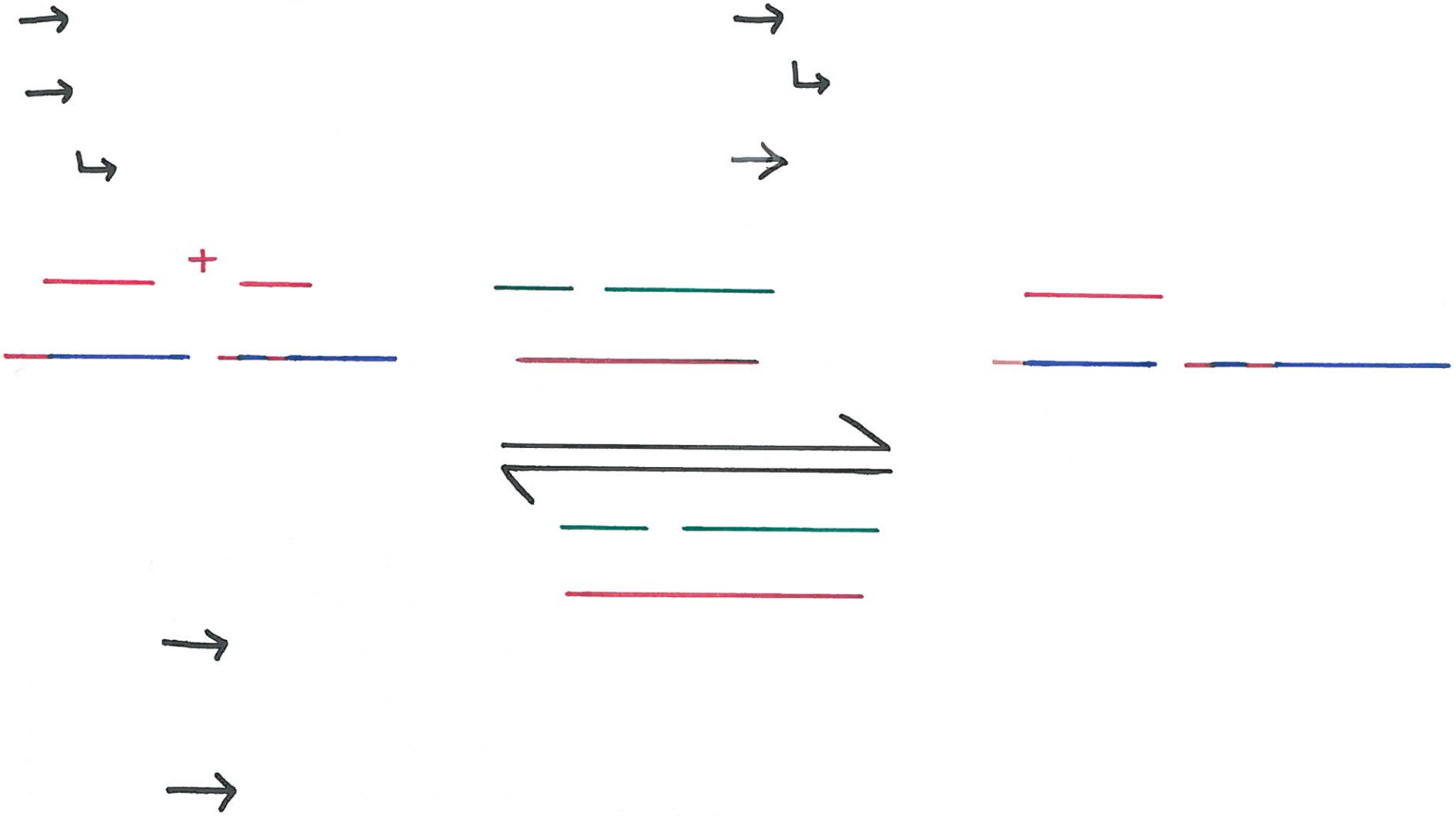
ATP

Condensation

Hydrolysis

Phosphorylate

ATP is useful because:



TT

Water

1 2 3 4 5

Hydrogen Bonds

Structure of H_2O

→

→

→

→

→

Properties of Water

1 2 3 4 5

Property	Importance	Example

Inorganic Ions

1 2 3 4 5

Ion

→

→

→

Ion:

Inorganic

Inorganic:

pH (acidity) (H^+)

→

→

→

Co-transport

Sodium Ions (Na^+)

→

Condensation

→

Iron Ions (Fe^{2+}, Fe^{3+})

→

→

→

Phosphate Ions (PO_4^{3-})

→

→

Eukaryotic Cells

Chitin

Plants

Animal

Algae: →

→

Fungi: →

→

Eukaryotic Cell Organelles 1

1 2 3 4 5

Lysosomal Enzymes / Lysozyes

Nucleus

Rough Endoplasmic Reticulum ( )

Smooth Endoplasmic Reticulum ( )

Golgi Aparatus

Golgi Vesicle

Lysosomes

Eukaryotic Cell Organelles 2

1 2 3 4 5

Mitochondria

Cell Wall

Vacuole

Chloroplast

Ribosome

Eukaryotic Cells

1 2 3 4 5

Cell Organisation

Specialised Cells

_____ _____ : → →

Specialised Cell

Specialised Cell

Tissue

Tissue

Organ

Organ

Organ System

Organ System

Production & Secretion of Proteins

1 2 3 4 5

TT

Transcription

1

↳

2

3

Translation

4

5

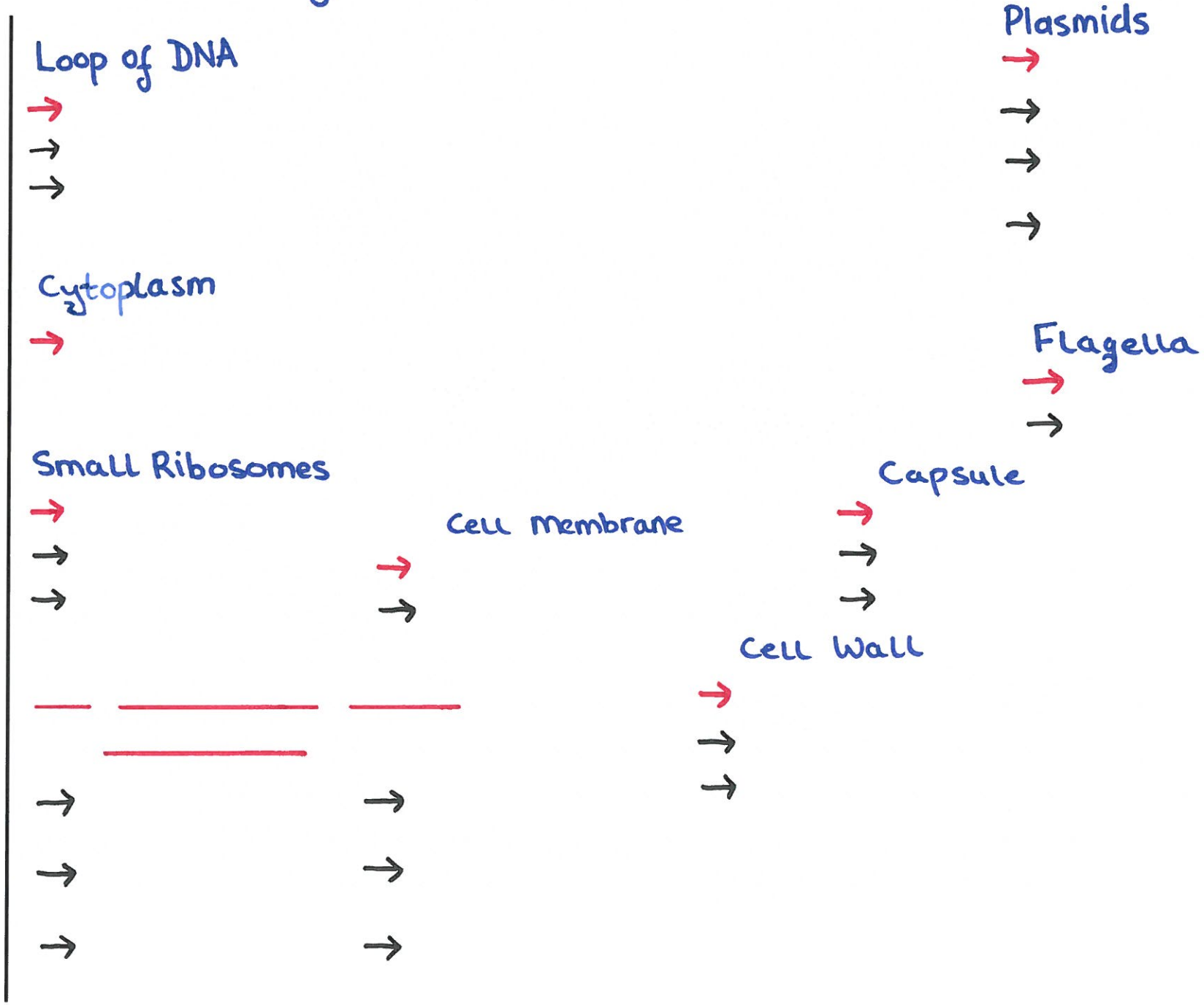
Exocytosis

6

7

Prokaryotic Cell Structure

1 2 3 4 5



Prokaryotes Vs Eukaryotes

1 2 3 4 5

	Prokaryotes	Eukaryotes
→		→
①		①
②		②
③		③
④		④
⑤		⑤
⑥		⑥

TT

Acellular

Viruses

1 2 3 4 5

Reproduction:

Cell Fractionation

TT

Cell Fractionation
- Break cells open

1) ——— ——— ———
↳
↳

Isotonic

2) ——— ———
→

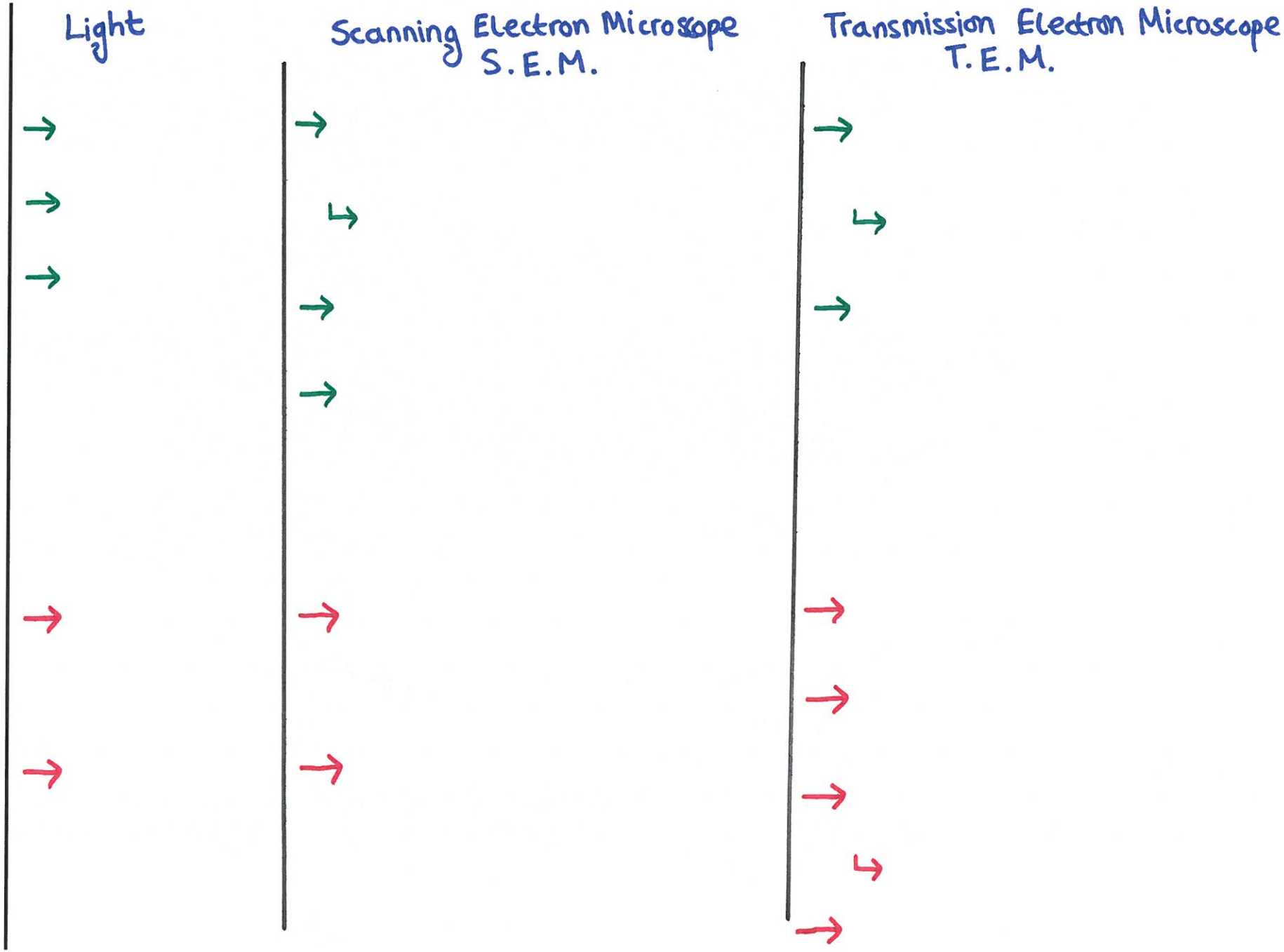
3) ——— ———
→
→
→
→
→
→
→

Filtre Solution

Ultra Centrifugation

Comparing Microscopes

1 2 3 4 5



Order of Magnitude Calculations

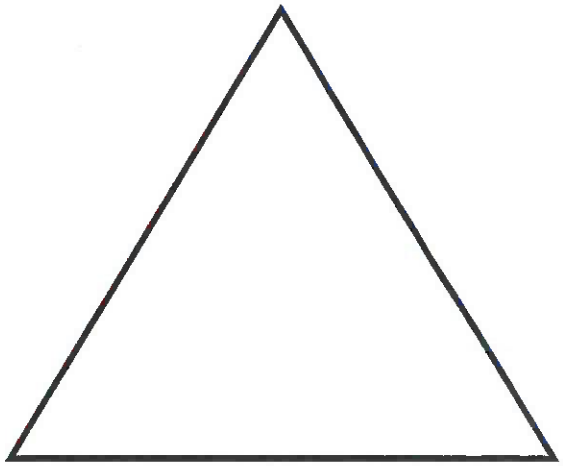
1 2 3 4 5

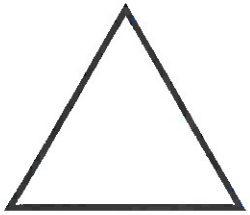
Magnification

_____ :

_____ :

Resolution





TT

Cell Division : Mitosis

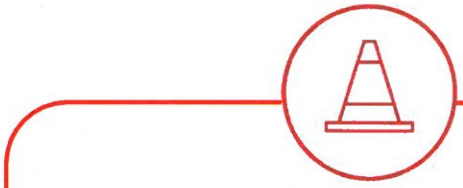
1 2 3 4 5

Centromeres

Chromatides

cytokinesis

Centrioles



WARNING

Be careful not to mix up centrioles with centromeres

Cell Division - Mitosis

1 2 3 4 5

TT

Mitosis

Cancer

PMAT

Mitosis:

→

→

→

→

Cell cycle

Calculate...

→

→

→

Q.

How many minutes do they spend in anaphase?

1)

2)

Cancer

→

→

→

→

→

↳

Treatments

→

→

→

TT

Binary Fission

Binary Fission

1 2 3 4 5

_____ _____ :

→

→

↳

→

→

↳

Cell Membrane

1 2 3 4 5

Glycoprotein

Channel Protein

Glycolipid

Cell Surface Receptor

Carrier Protein

Structure

Function

Transport Across Membranes - Diffusion

TT

Diffusion

1 2 3 4 5

_____ :

→

A B

① Concentration Gradient

→

↳

② Diffusion Distance

→

→

③ Surface Area

→

→

Exam Question

→

↳

→

↳

→

Facilitated Diffusion

Facilitated Diffusion

_____ _____:

Protein Channels

Carrier Proteins

Transport Across Membranes: Active Transport & Co-Transport

1 2 3 4 5

TT

Active Transport

Co-Transport

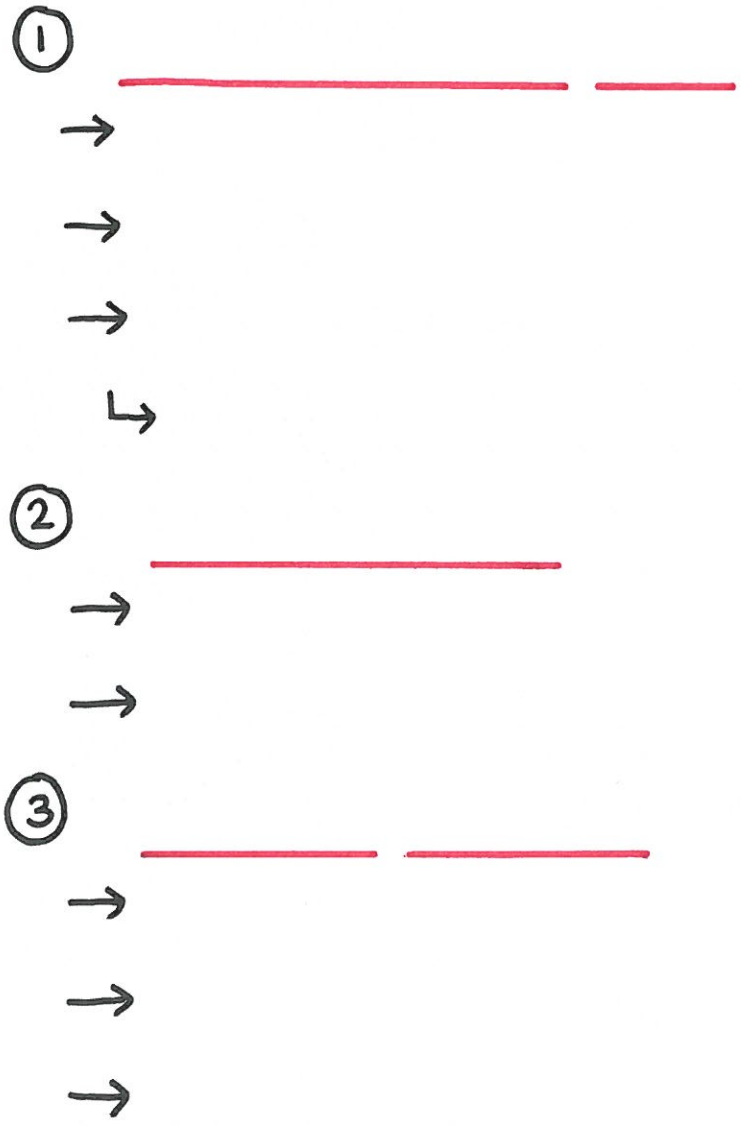
Co-Transport : Absorption of Glucose

1 2 3 4 5

Sodium-Potassium Pump

Co-Transport

Facilitated Diffusion



Transport Across Membranes - Osmosis

1 2 3 4 5

TT

Osmosis

_____ :

_____ _____ _____ _____ _____ _____

High water Potential

Low water Potential

Exam Question

→

→

→

TT TOP TIP

Water potential is opposite to solute concentration

TT

1 2 3 4 5

Introduction to the Immune System

Pathogen

_____ :

↳

↳

_____ :

↳

e.g.

1)

2)

3)

4)

The Immune Response

Antigen

→

↳

↳

↳

↳

↳

↳

↳

_____

→

→

→

_____

→

→

Phagocytosis

1 2 3 4 5

Non-specific Immune Response

Specific Immune Response

e.g.

White Blood Cells

The Immune System

TT

1 2 3 4 5

T_H Cells

T_C Cells

Antibodies

Antigen-Antibody Complex

Plasma Cells

Clonal Selection

Monoclonal antibodies

Agglutination

② T-cells (T-Lymphocytes)

→

→ Types 1) →
2) →

③ B-Cells (B-Lymphocytes)

_____ :

→

→

↳

→

_____ _____ :

④ Plasma Cells

_____ ____ :

→

→

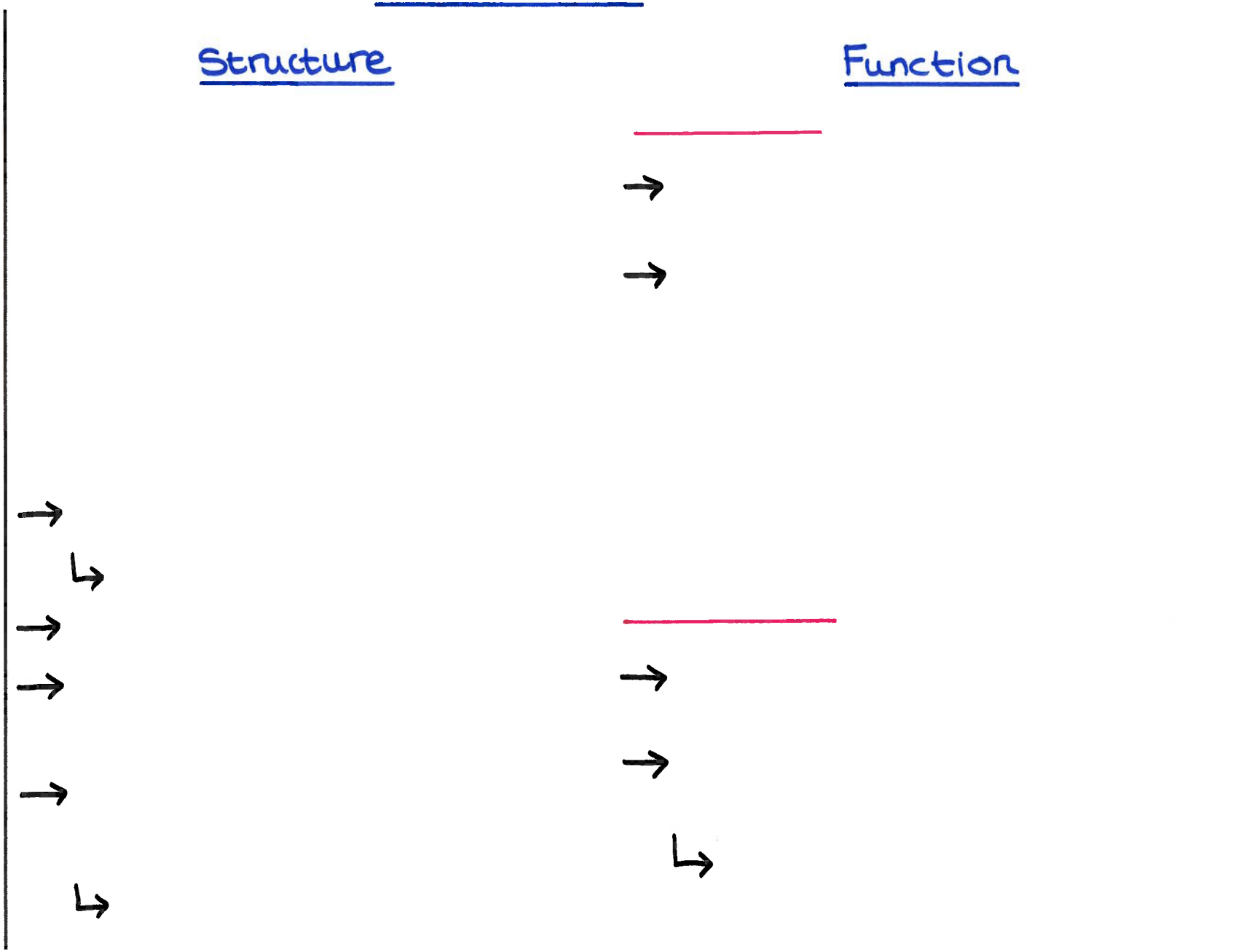
→

→

Antibodies

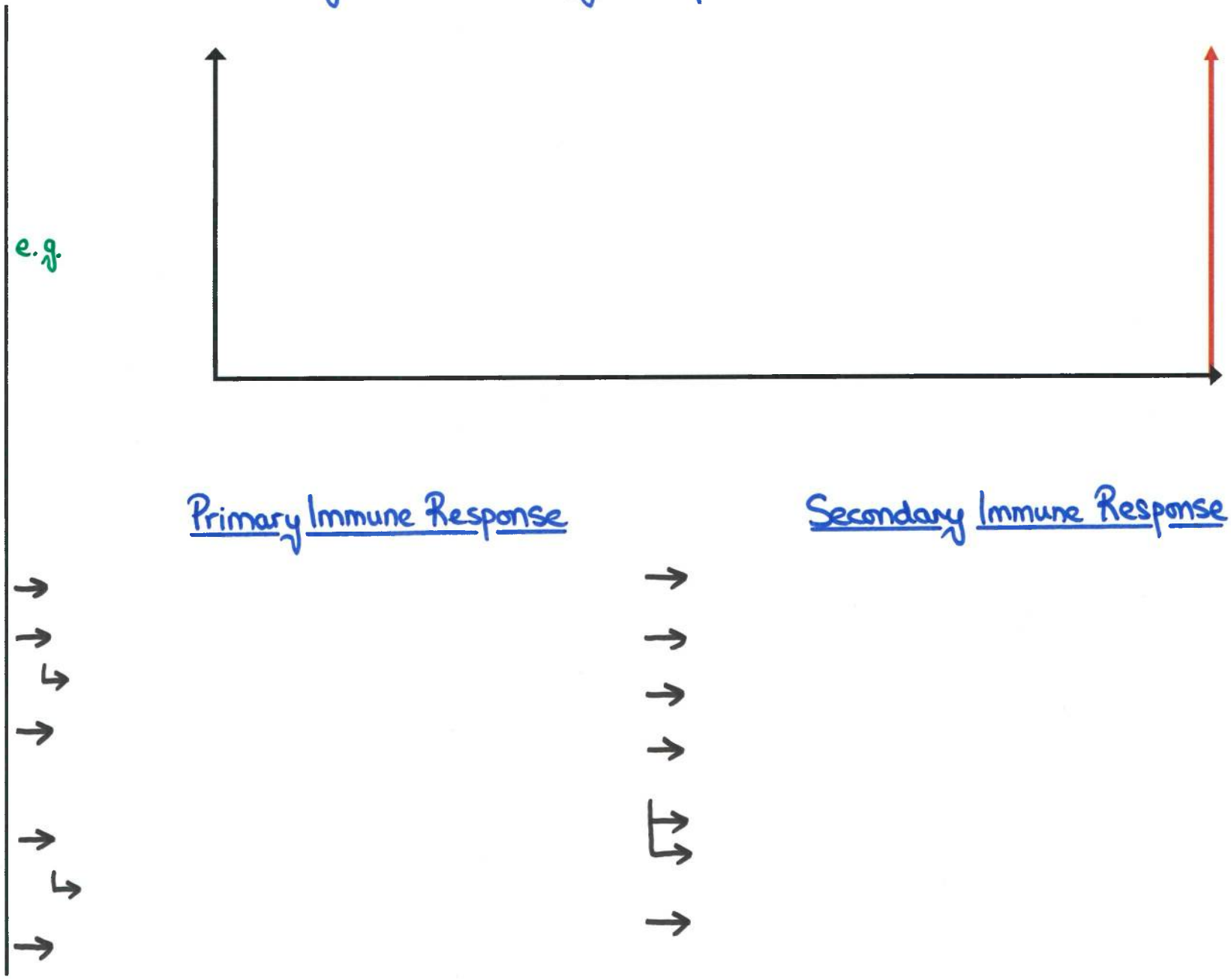
Structure

Function



Primary & Secondary Response

1 2 3 4 5



Monoclonal Antibodies

1 2 3 4 5

TT

Monoclonal Antibodies

_____ _____:

Targeting Medication:

→

→

→

→

→

Antigen-Antibody complex

Medical Diagnosis:

1)

2)

3)

4)

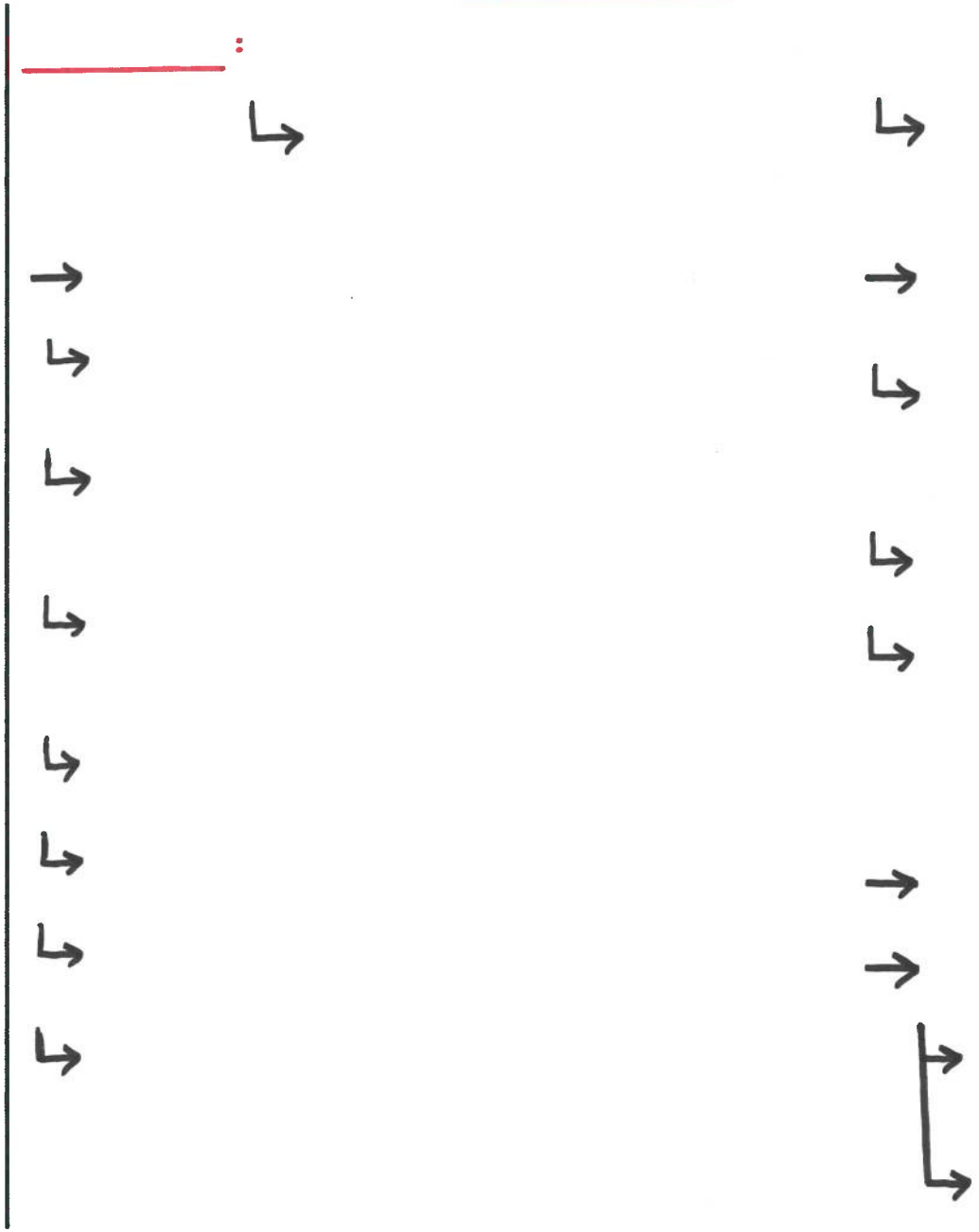
5)

6)

Vaccines

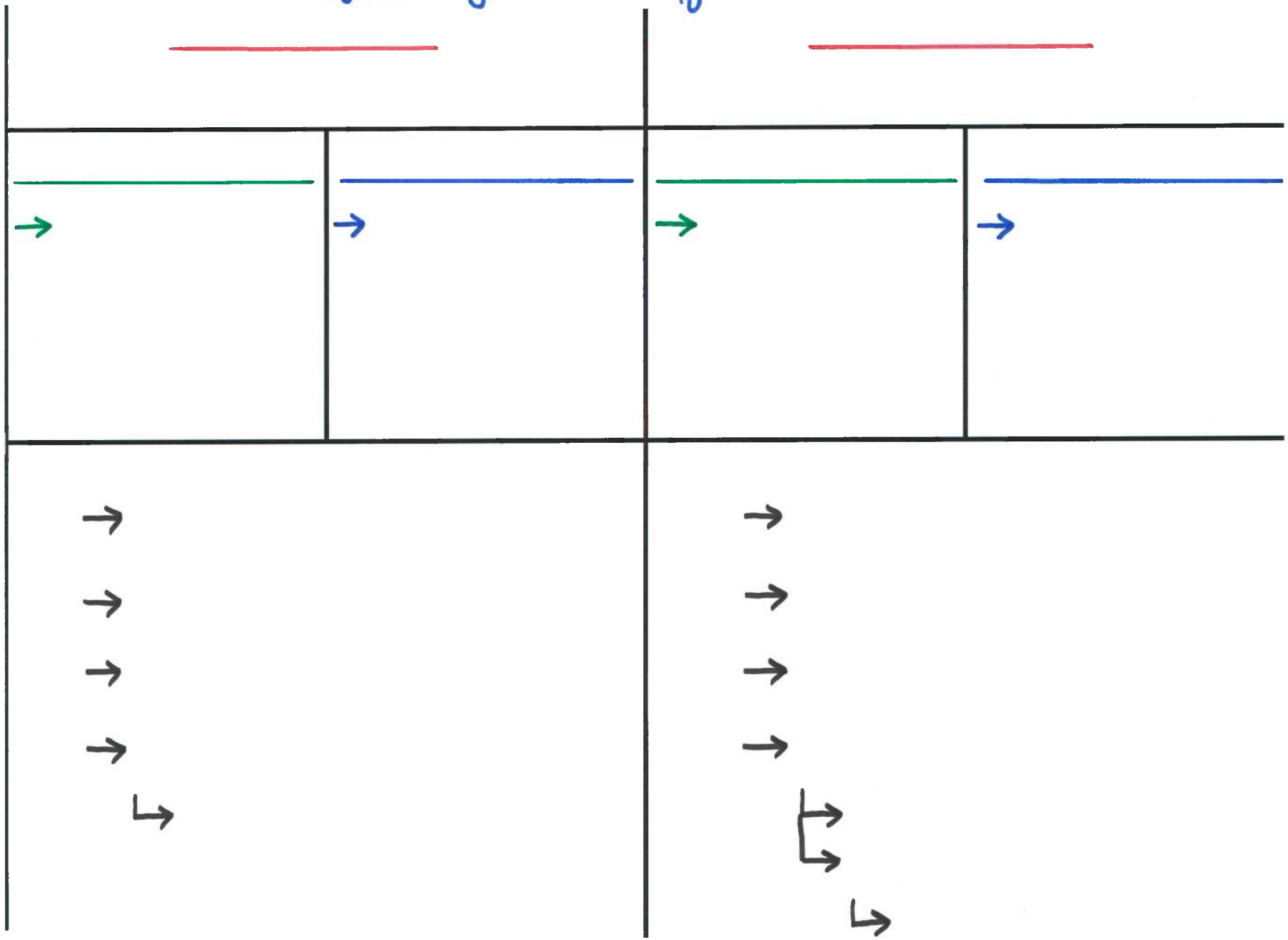
TT

Vaccine



Types of Immunity

1 2 3 4 5



ELISA Test

TT

Elisa

1 2 3 4 5

_____ = _ _ _ _ _

→

→

↳

DIRECT (___ ___ _____)

1)

2)

3)

↳

4)

5)

6)

7)

INDIRECT (___ ___ _____)

1)

2)

3)

4)

5)

6)

HIV & Viruses

1 2 3 4 5

TT

HIV

_____ = _ _ _

→

→

↳

Virus Reproduction

AIDS

1)

2)

3)

4)

5)

6)

TT

Digestion & Absorption

1 2 3 4 5

Digestion

_____ :

Carbohydrates

Polysaccharide → →

Monosaccharide

_____ :

_____ :

Lipids

Micelles + → →

Amylase

_____ :

Maltase

Digestion & Absorption: Proteins

1 2 3 4 5

TT

Endopeptidase

_____ :

_____ :

Exopeptidase

_____ _____ _____ :

Membrane Bound Dipeptidase

Amino Acid Absorption

→

→

→

→

Haemoglobin

1 2 3 4 5

TT

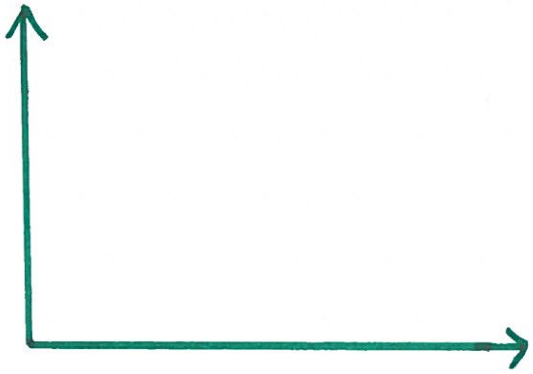
Haemoglobin

_____ :

→

→

Oxyhaemoglobin Dissociation Curve



→

↳

→

The Boh Shift

→

↳

↳

→

→

Comparing Haemoglobin in Different Species

1 2 3 4 5

Benefits of oxyhaemoglobin dissociation curve

→

→

→

Benefit of this oxyhaem. curve

→

→

→

Blood Vessels

1 2 3 4 5

Arteries

→
→
→
↳
↳
→

Veins

→
→
→
→
→

Capillaries

→
→
→

Structure of the Human Heart

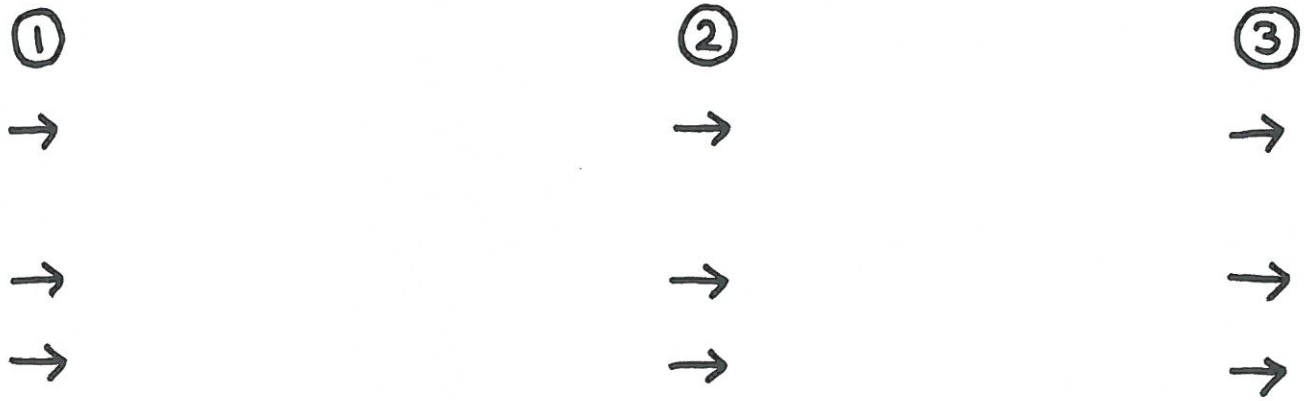
1 2 3 4 5

Right Atrium

Left Atrium

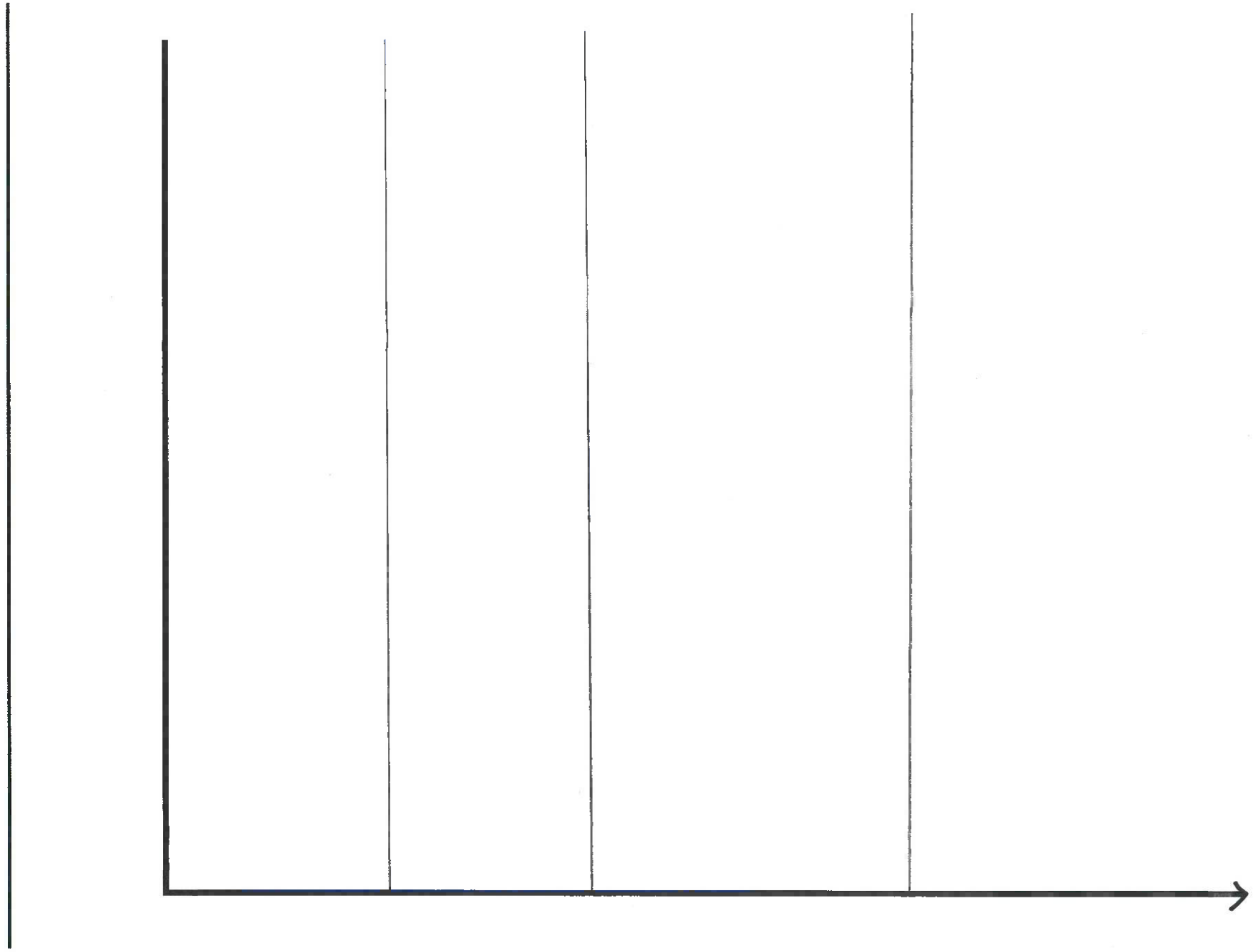
Right Ventricle

Left Ventricle



Cardiac Cycle Graphs

1 2 3 4 5



Cardiovascular Disease + Blood Circulation

1 2 3 4 5

TT

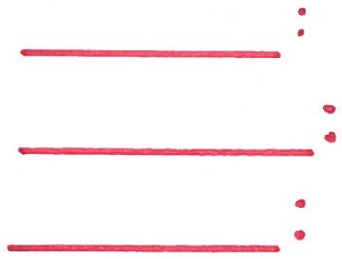
Atheroma

Thrombosis

Aneurysm

Myocardial Infarction

Blood Circulation



Atheroma

Formation & Return of Tissue Fluid

1 2 3 4 5

Transport in Plants: Xylem

1 2 3 4 5

TT

Transpiration

Cohesion

Xylem:

→

→

→

↳

Cohesion - Tension Theory

→

↳

→

→

→

Factors Affecting the Rate of Transpiration

1)

2)

3)

4)

↳

Mass Transport in Plants: Phloem

1 2 3 4 5

Phloem:

→

→

→

1)

2)

Evidence for Mass Flow / Translocation

→ Radioactive Labeling

→

→

→

→ Ringing Experiments

→

→

→

→

↳

However...

→

→

TT

Mass Flow Hypothesis / Translocation

1 2 3 4 5

Source

1)

2)

3)

Sink

4)

Surface Area to Volume Ratio

1 2 3 4 5

Single Celled Organism

Flatworm

Small Mammal

Big Mammal

Gas Exchange

1 2 3 4 5

TT

Spiracles

Trachea

Diffusion

Ventilation

Filaments

Lamellae

Counter Current Flow

Circulation of Blood

1)
2)
3)

Insects

Fish

Water Loss

Gas Exchange in Plants

1 2 3 4 5

Mesophyll

Stomata

Guard Cells

Gas Exchange in Plants

→

↳

→

→

→

Adaptations for Plants

1)

2)

3)

→

→

4)

↳

5)

Stomata Close to Save Water

→

→

↳

Gas Exchange in Humans

1 2 3 4 5

TT

Short Diffusion Pathway

Alveoli

Ventilation

Circulation

Structure:

Adaptations for Efficient Gas Exchange

Surface Area: →

→

→

→

⇨

Diffusion Distance:

→

→

⇨

Concentration Gradient:

→

→

→

⇨

Ventilation

1 2 3 4 5

TT

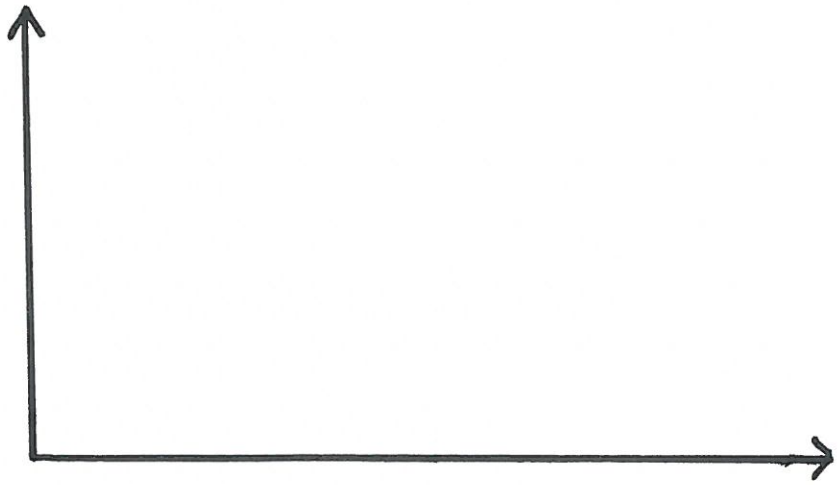
Tidal Volume

Breathing / Ventilation Rate

Pulmonary Ventilation / Respiratory minute ventilation

Oxygen Consumption

Spirometer Trace



= X

_____ _____ :

_____ / _____ _____ :

AQA : _____ _____

Edexcel : _____ _____ _____

_____ _____ :

Effect of Exercise

Tidal Volume :

Breathing Rate :

Pulmonary Ventilation / Respiratory Minute Ventilation :

Oxygen Consumption :

Gas Exchange in Humans - Ventilation

1 2 3 4 5

Inspiration

→
→
→
→
→

Expiration

→
→
→
→
→

Forced Expiration

→
→

DNA is Universal, Non-Overlapping & Degenerate

1 2 3 4 5

TT

Universal

Non-overlapping

Degenerate

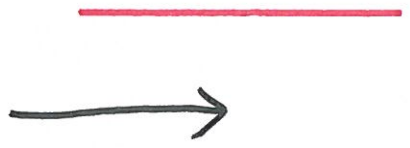
Genome

Proteome

Transcription

Translation

Protein Synthesis



DNA, Genes & Chromosomes

1 2 3 4 5

TT

Gene

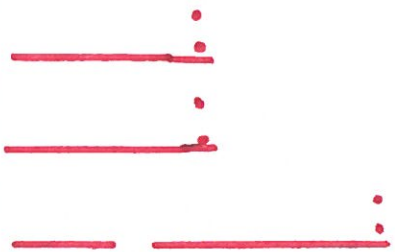
Locus

DNA Triplet

Eukaryotes →

Prokaryotes →

Mitochondria + Chloroplasts



Not all DNA codes for proteins / polypeptides / functional RNA

Protein Synthesis : Transcription

1 2 3 4 5

TT

Exons

Splicing

DNA Helicase

Hydrogen Bonds

Complementary Base Pairing

RNA Polymerase

Prokaryotes vs. Eukaryotes

Prokaryotes: →

→

Eukaryotes :

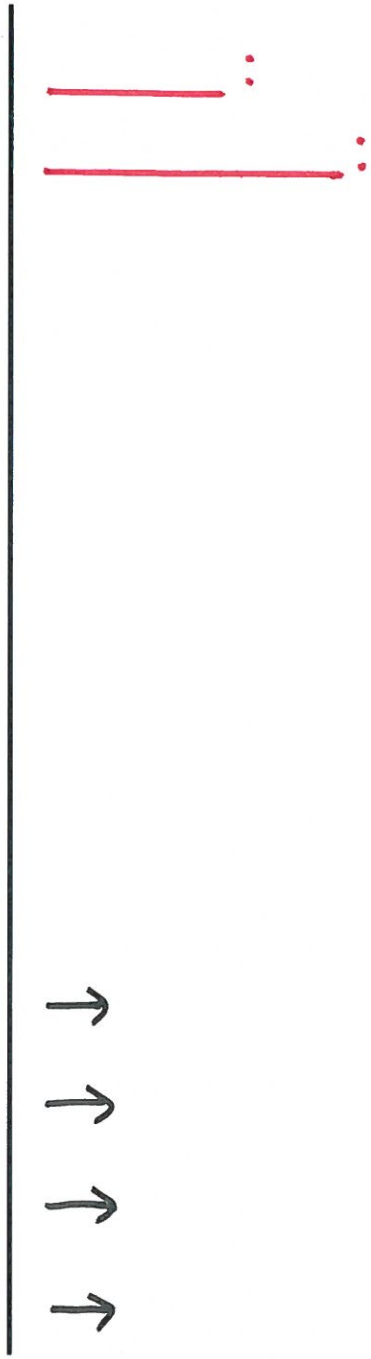
→

Protein Synthesis - Translation

1 2 3 4 5

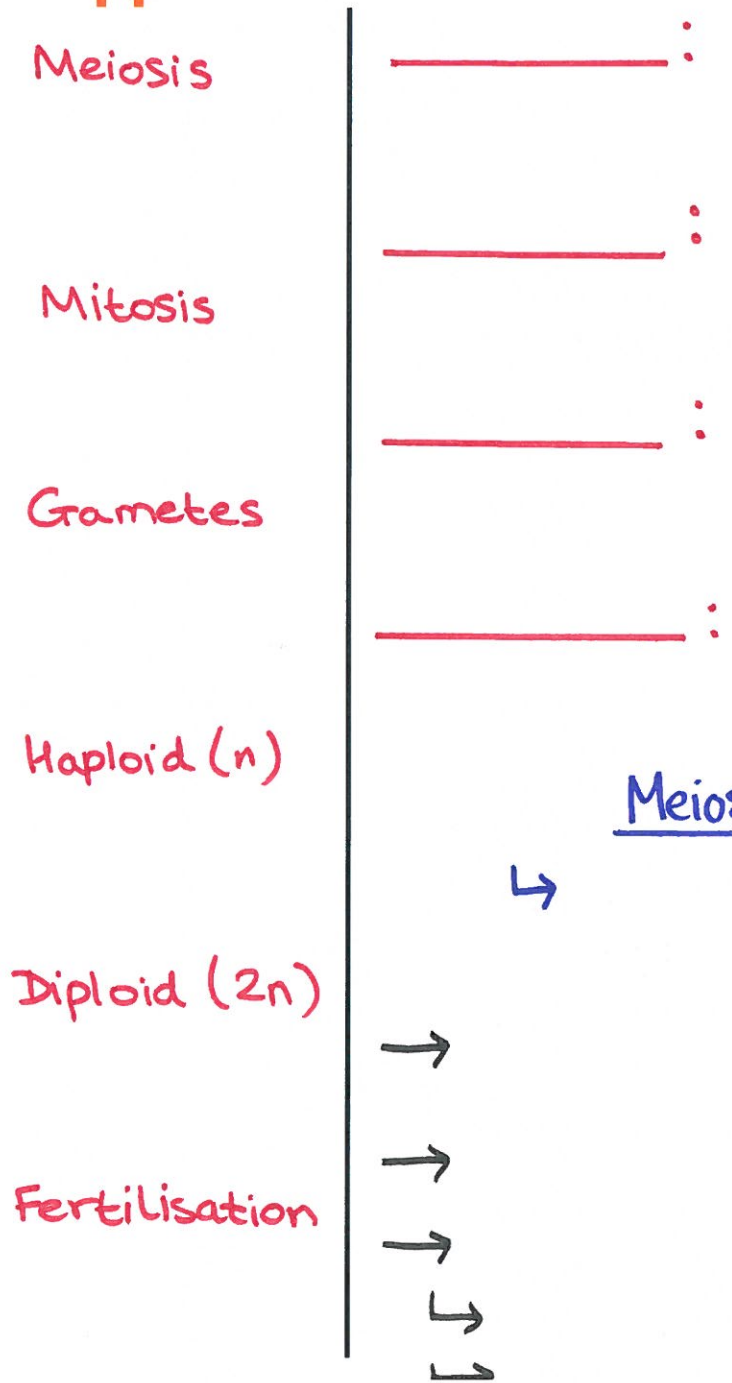
Codon

Anticodon



Introduction to Meiosis

1 2 3 4 5

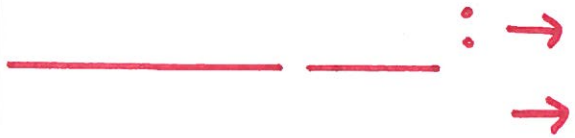


TT

Before Meiosis

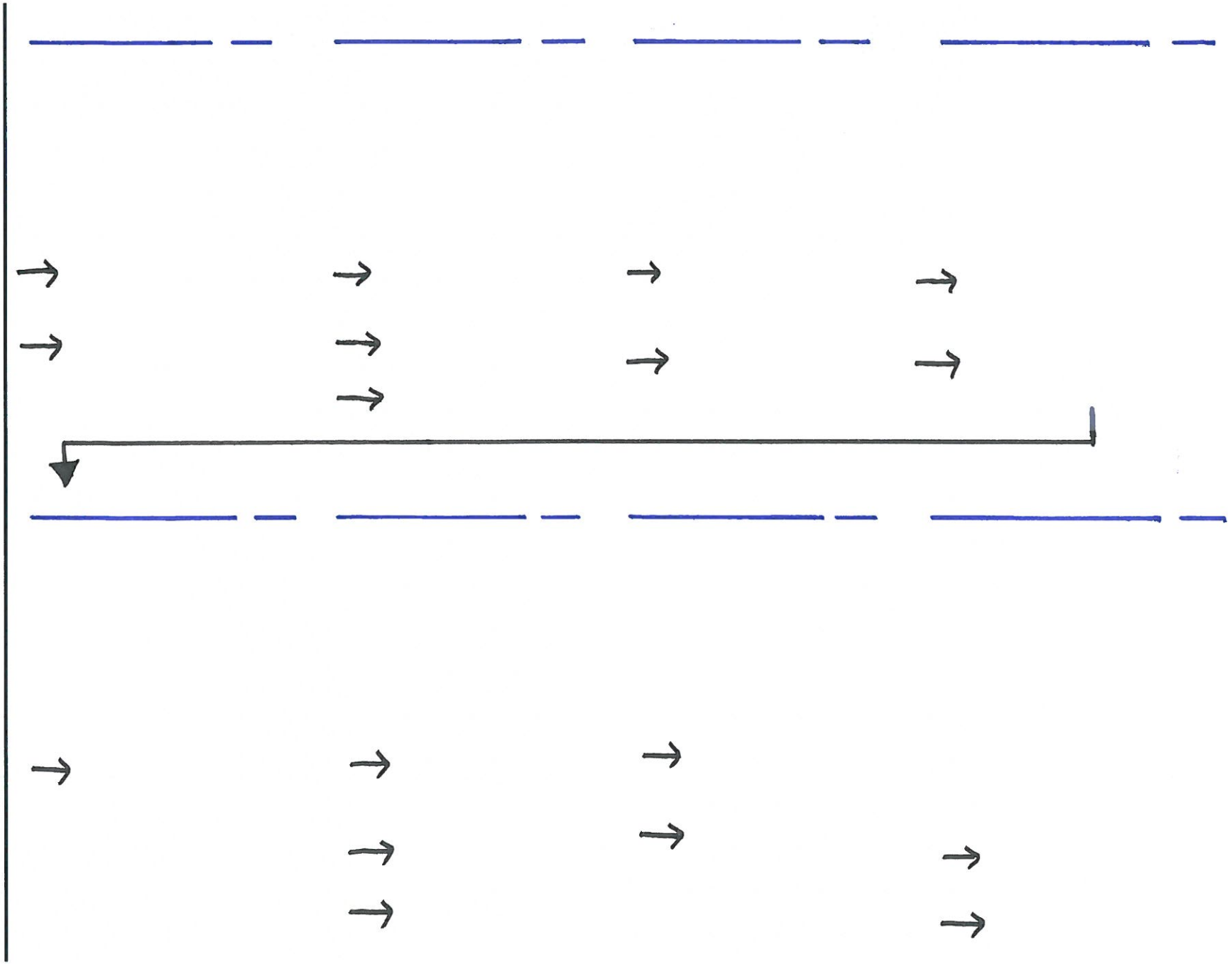
1 2 3 4 5

Homologous Pairs



Meiosis

1 2 3 4 5



Meiosis & Genetic Variation

1 2 3 4 5

Crossing Over

→

→

Independent Segregation

Gene Mutations

1 2 3 4 5

Gene Mutation

Substitution

Deletion

Mutations can cause a non-functional protein

No change to primary structure

TT

Chromosome Mutation

1 2 3 4 5

Chromosome non-disjunction

_____ _____ _____ :

→

→

Genetic Diversity & Adaptation

1 2 3 4 5

Genetic Diversity

_____ _____ :

_____ _____ :

_____ :

Natural Selection

→

→

→

→

Evolution

→

→

Natural Selection

→

→

1)

2)

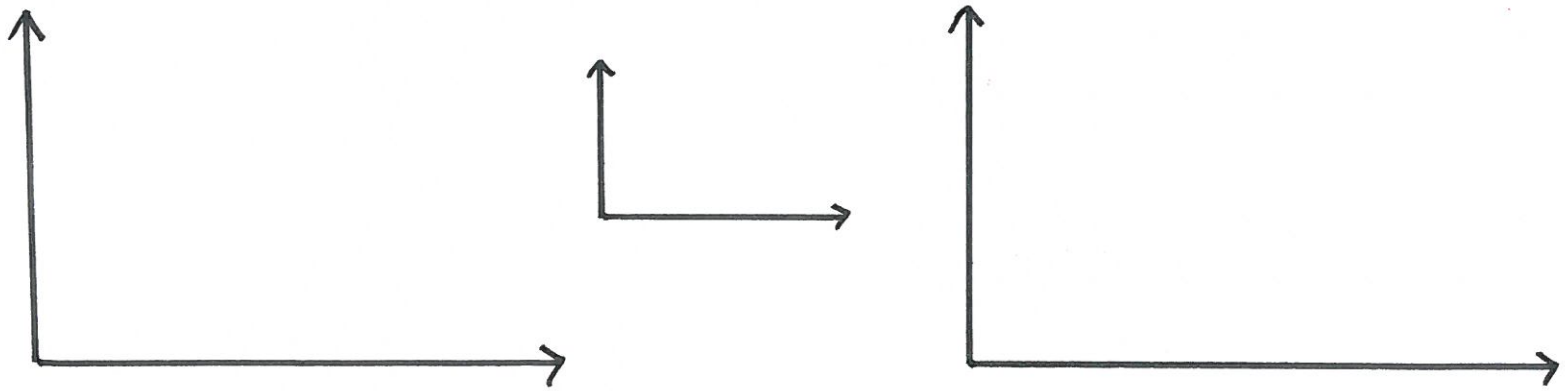
3)

TT

Directional & Stabilising Selection

1 2 3 4 5

Directional Selection



Stabilising Selection

Species & Taxonomy

1 2 3 4 5

TT

Species

_____ :

Courtship Behaviour

→
→
→
→

Phylogenetic Classification

_____ _____ :

→ = → →

Phylogenetics

→
–
–
→
–
–

Taxon

Binomial Naming System

Biodiversity

1 2 3 4 5

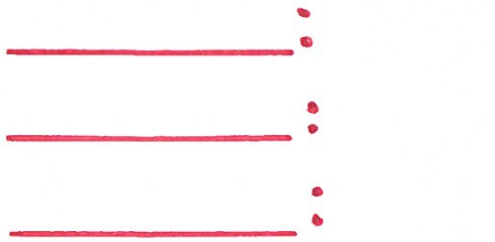
Population

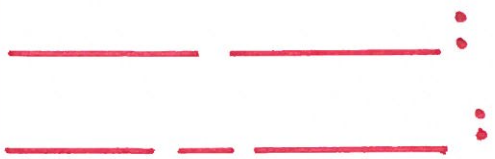
Community

Biodiversity

Species Richness

Index of Diversity





Species	Number of individuals
A	
B	
C	
D	

Farming, Biodiversity & Conservation

1 2 3 4 5

Effects of farming on Biodiversity

→

→

→

→

↳

↳

↳

↳

Conservation

→

→

→

TT

Investigating Diversity

1 2 3 4 5

Intraspecific

Comparing Genetic Diversity

→

→

Diversity/Variation

Can be caused by

→

→

Interspecific

Standard Deviation

→

Sampling a Population

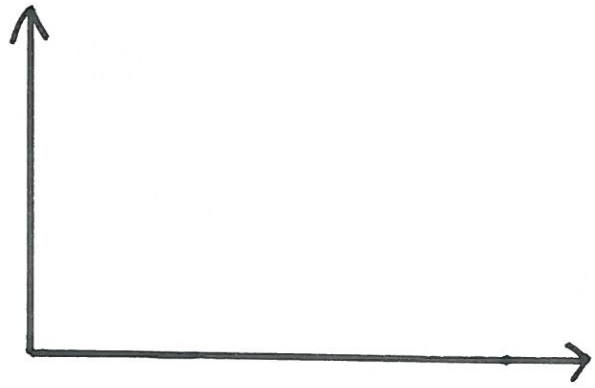
→

Large Sample Size

→

Selected at Random

→



Investigating Populations: Sampling

Sampling

Non-Random Sampling

e.g.

How many samples to do?

Random Sampling