



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 →



Choosing a Statistical Test

1 2 3 4 5

Function

Reason for
Choosing

Null
Hypothesis

Results

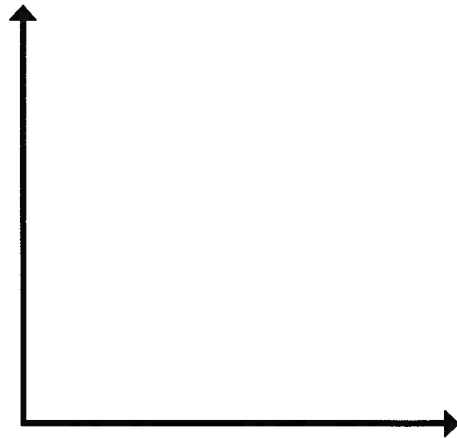
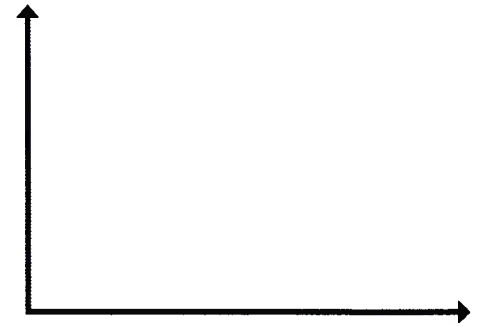
Degrees of
Freedom



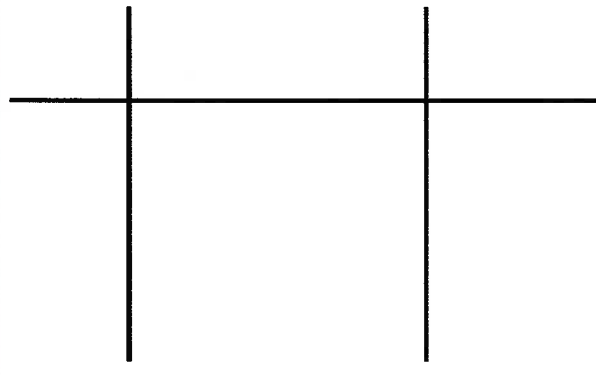
Standard Deviation

1 2 3 4 5

_____ :



Advantages of using Standard Deviation





P-Value

P-Values

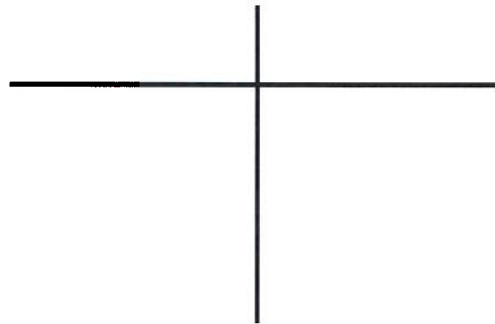
1 2 3 4 5

_____:

P-value

Chance

Confidence





Appropriate Units

1 2 3 4 5

Area Conversion

Converting Units

→

e.g.

→

→

Time :

Temperature :

Volume Conversion



Calculating Rate

e.g.

1 2 3 4 5

Rate:

[illegible]



Decimals & Standard Form

1 2 3 4 5



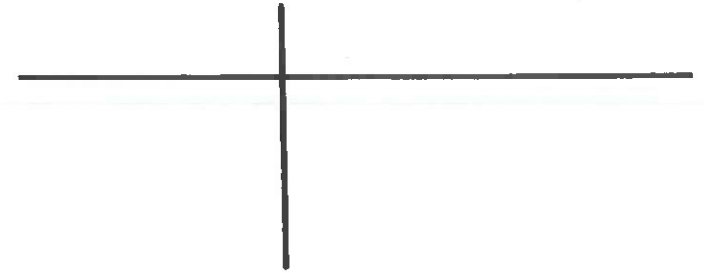
Questions

Standard Form Calculations



Ratios

1 2 3 4 5



Surface Area : Volume





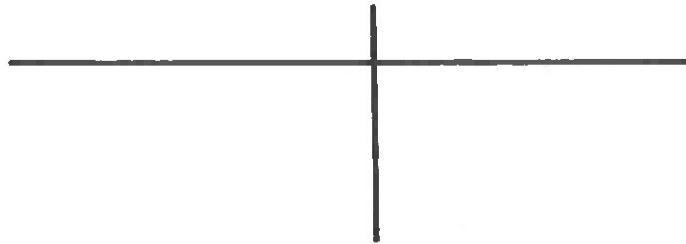
Percentages

1 2 3 4 5

→

→

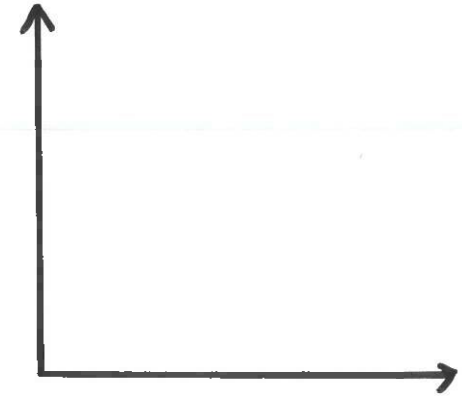
Percentage Change



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

a) $2\mu\text{m}$ to $3\mu\text{m}$

b) $3\mu\text{m}$ to $1\mu\text{m}$



→ 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



Percentage Change

Ratio



Using an Appropriate Number of Significant Figures

1 2 3 4 5

Decimal Places & Significant Figures

Adding & Subtracting Decimals

→

→

✓

✗

Rounding

→

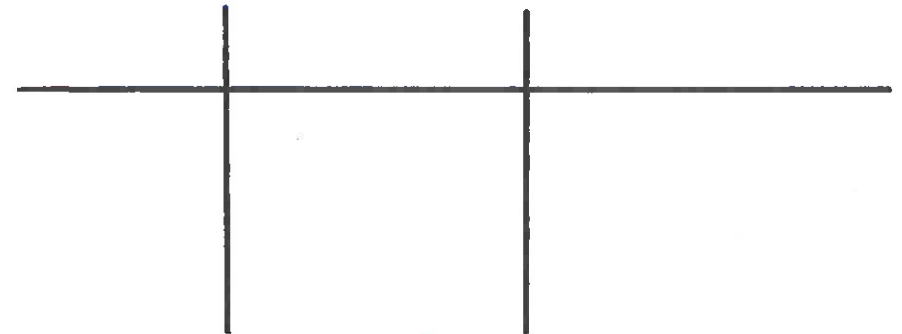
e.g.

→

Multiplying & Dividing Decimals

→

→





Orders of
Magnitude

Orders of Magnitude

1 2 3 4 5

_____ :

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

1 2 3 4 5

Stats Tests

Dice Roll

Inheritance

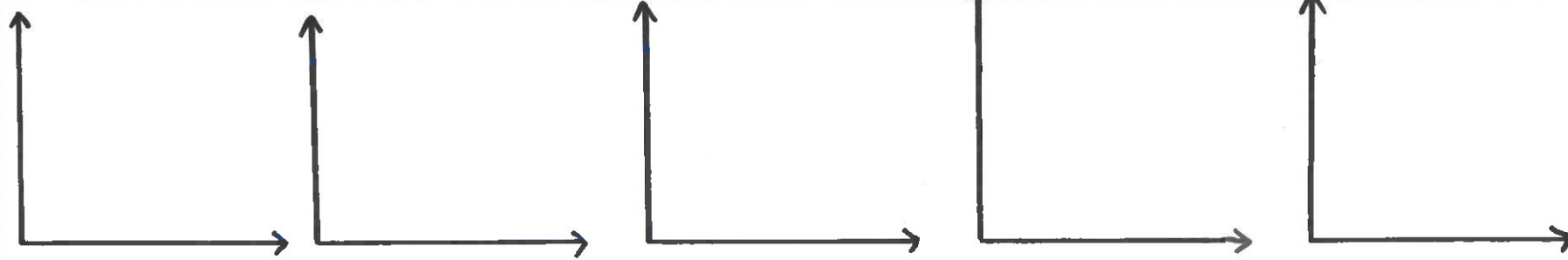




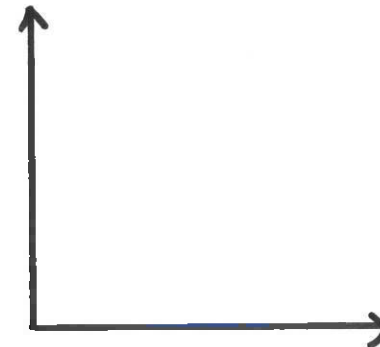
Scatter Diagrams

1 2 3 4 5

Types of Correlation



Axes





Tables & Bar Charts

1 2 3 4 5

Tables

→

→

→

Bar Charts

→

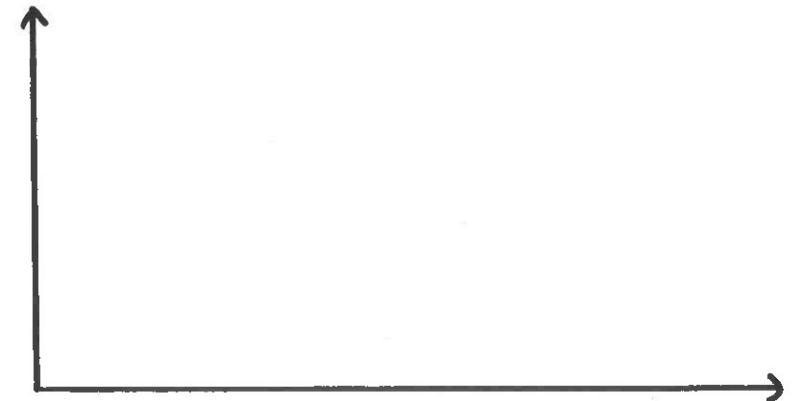
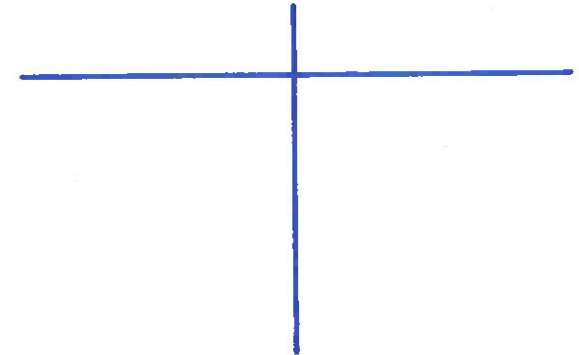
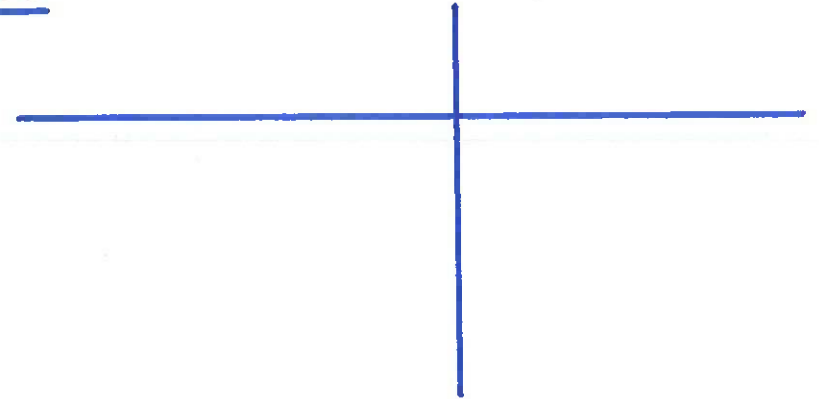
e.g.

→

→

→

→

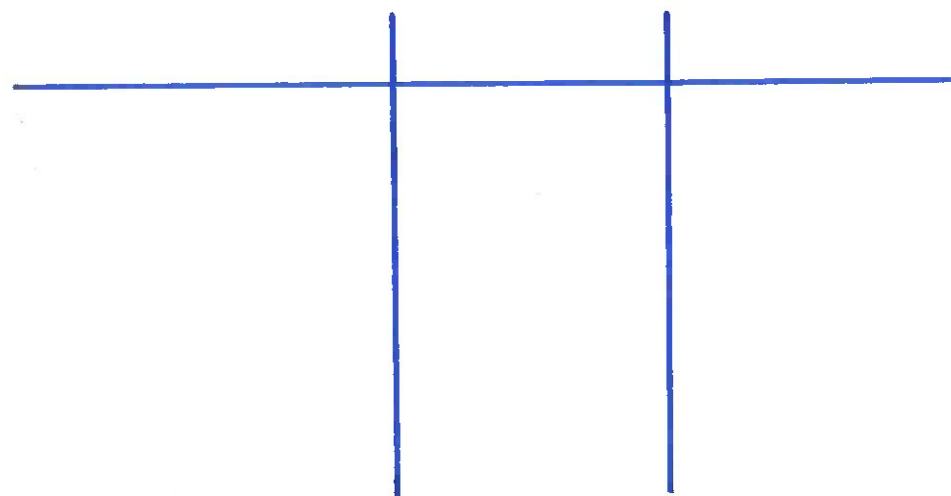
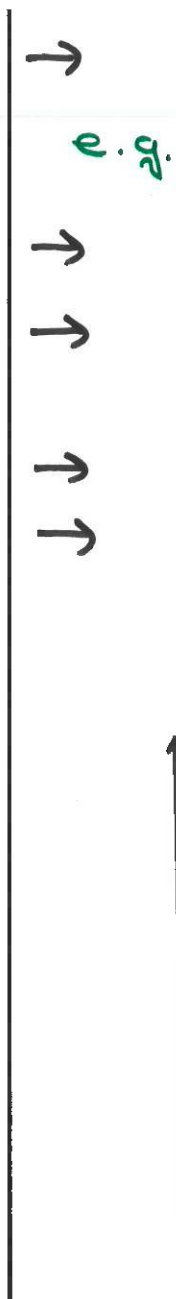




Histograms

1 2 3 4 5

Mass of individual (nearest kg)





Uncertainties in Measurement

1 2 3 4 5

Absolute
Uncertainty

_____ :

e.g.

_____ :

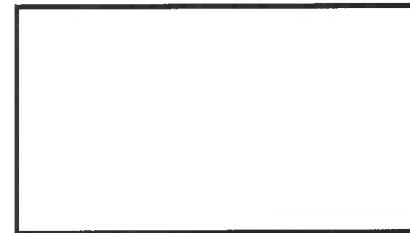
Relative
Uncertainty

Adding + Subtracting Uncertainties

e.g.

Multiplying Uncertainties

e.g.





Algebraic Symbols

1 2 3 4 5

Symbol

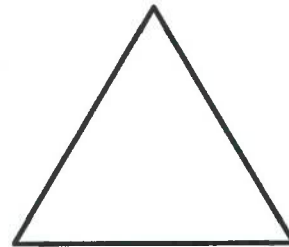
Meaning

Example



Rearrange Equations

1 2 3 4 5



Cylinder

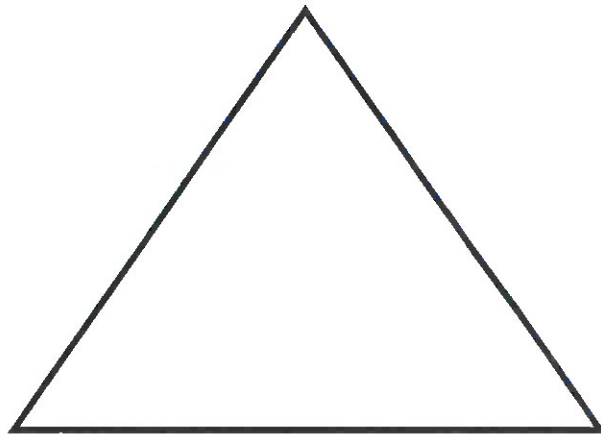


Solve Algebraic Equations

1 2 3 4 5

=

x



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

→

→

→

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

→

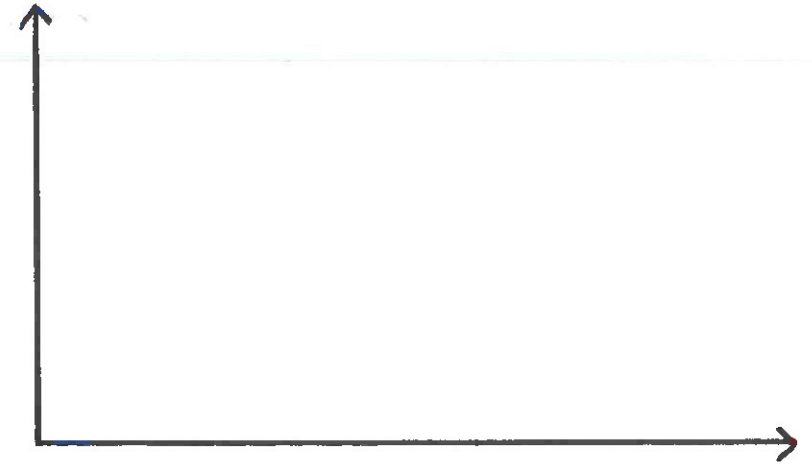
→

Gradient



Straight Line Graphs

1 2 3 4 5





Circumference & Surface Area of Circles & Spheres

1

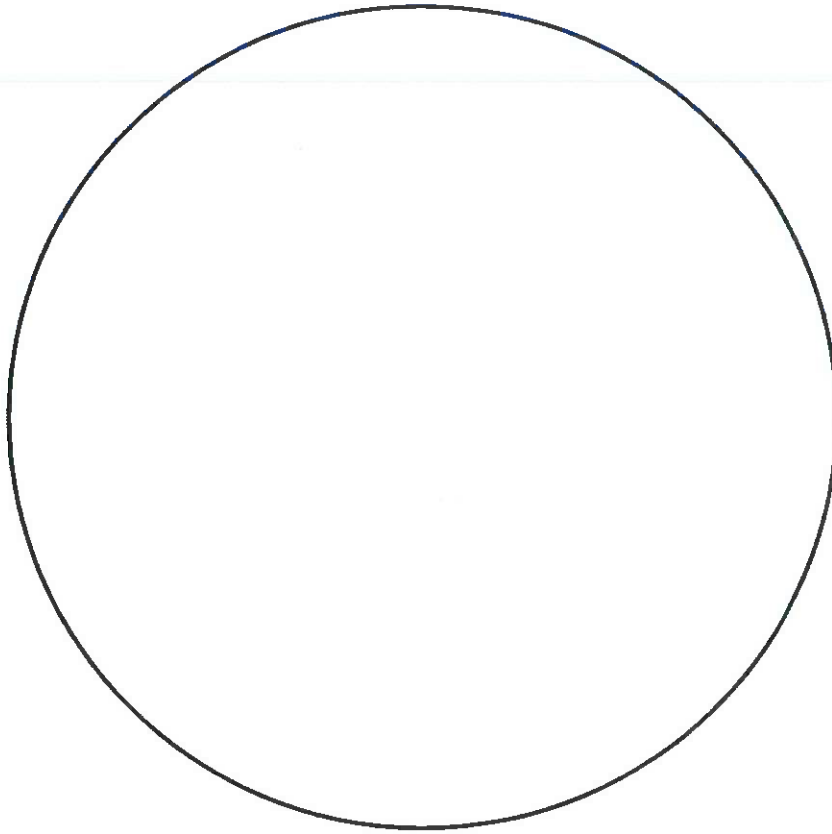
2

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

_____ (_____):

→

→

→

→

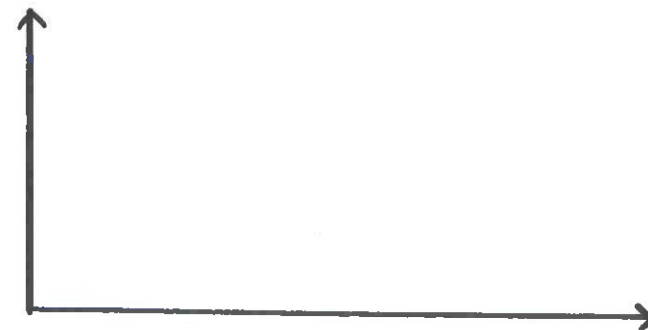
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→

→

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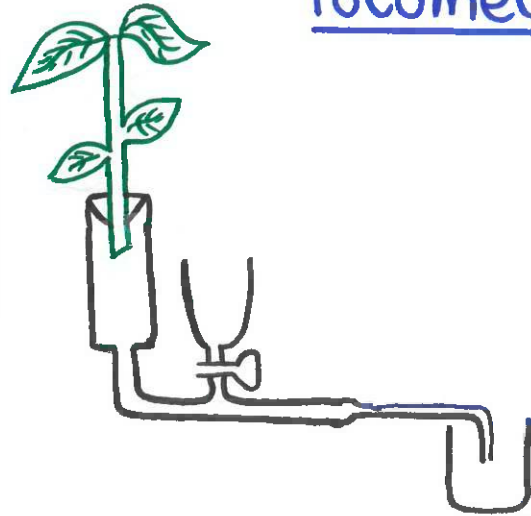
→





Potometer

1 2 3 4 5



Explain the Results

Variables to Control



Calculating the Rate of Transpiration

x



Sources of Error





Serial
Dilutions

Dilution
Series

Dilutions

1 2 3 4 5

_____ :

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.

			→
			↵
			↵
			↵
			↵
			↵



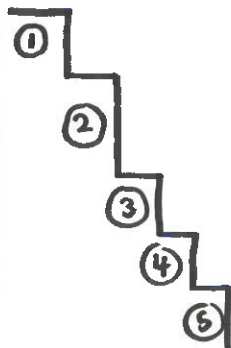


Using a Light Microscope

1 2 3 4 5



Eye-piece Graticule & Stage Micrometer





Slide Preparation

1 2 3 4 5

Slide Preparation

→

→

→

→

→

→

→

→

Staining

→

→

→

→

→



Biological Drawings

1 2 3 4 5

General Principle

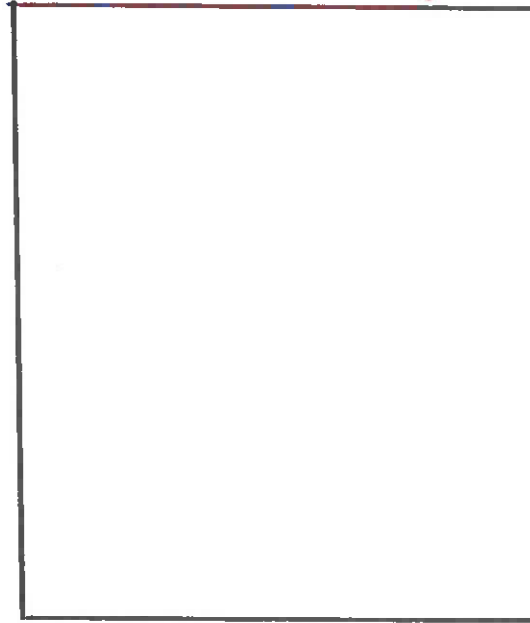
-
-
- ↳
-
-
- ↳
-
-
-
-
-
-
-
-

e.g.

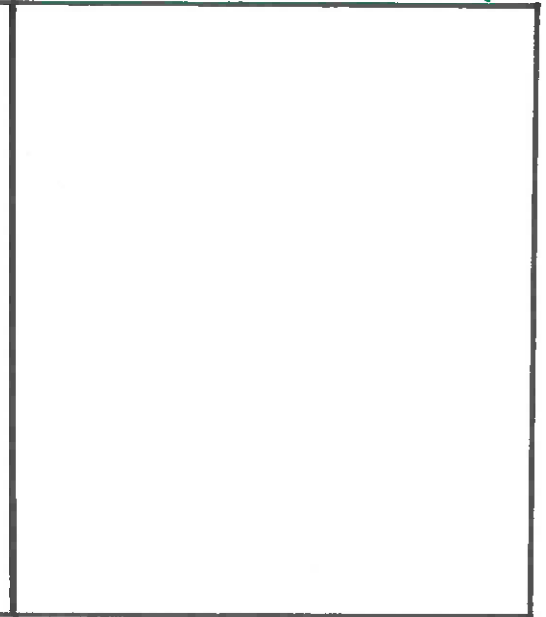
Common Mistakes

-
-

Bad Scientific Drawing



Good Scientific Drawing



Labelling

-
-
-
-
-
-



Qualitative Tests for Molecules

1 2 3 4 5

Molecule					
Name					
Method	① ② →	① ② e.g. ③ e.g. ④	①	① ② ③	① → →
Positive Result					
Negative Result					



Electrophoresis

1 2 3 4 5

Electrophoresis

_____:





Ethical Use of Organisms

Reasons for

Reasons Against

Invertebrates

→

→

e.g.

↳

→

→

→

↳

→

→

Vertebrates

→

→

e.g.

↳

Relativism / Rationalism

Absolutism

e.g.



Aseptic
Technique

Aseptic Technique

1 2 3 4 5

Importance of Aseptic Technique

→

→

→

→

→

Example of Technique

→

→

→

→

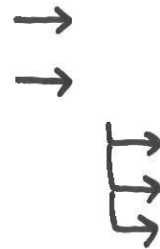
→



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

1 2 3 4 5

Changing Substrate Concentration



Changing Enzyme Concentration





Root Tip Squash

1 2 3 4 5

Steps in Method

Reason

①



②



③



④





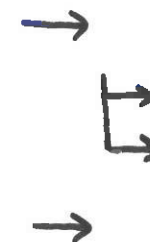
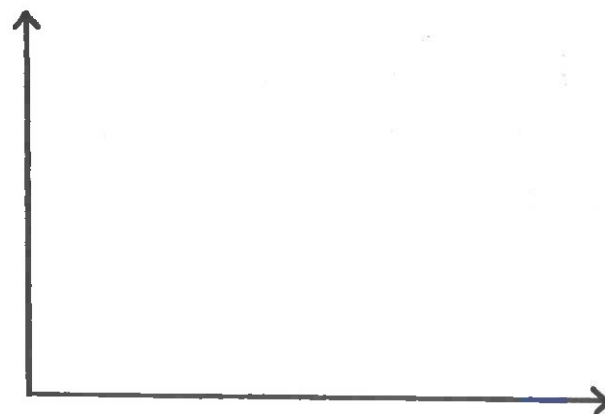
Mitotic Index

Mitotic Index

1 2 3 4 5

$$\left(\frac{\text{---}}{\text{---}} \right) \times$$

$$\boxed{} \left(\right) \times =$$



Investigate Herbicide



Common Problems





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)

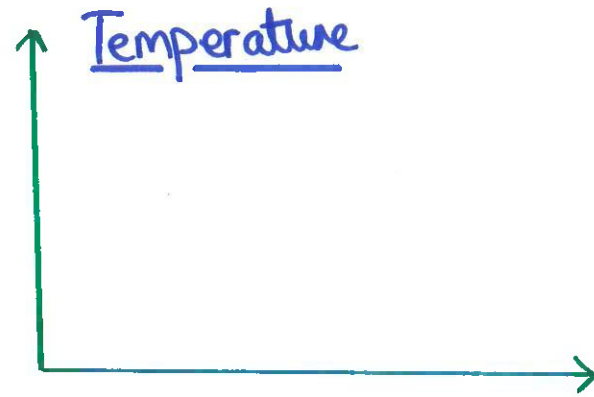
Q Make 30cm³ of 0.75mol dm⁻³ NaCl from a stock solution of 1.8mol dm⁻³





Factors Affecting Membrane Permeability

1 2 3 4 5



- ① _____ →
-
-
- ② _____ →
-
-
- ③ _____ →
-
- ④ _____ →
-
-

-
- e.g.
-
-



Investigate the Effect of Temperature or Alcohol Concentration on membrane Permeability

1

2

3

4

5



e.g.



e.g.





Dissection

Safety

→
→

→
→

Mass Transport Organ

Animals

e.g.

→
↳
→
→
→

↳

Plant

→
→
→
→
→
↳

→
→

Gas Exchange Organ

Insect

→
→
→
↳
→
↳

Fish

→
↳
→
→
→
↳

↳



Investigate the Effect of Antimicrobial Substances on Microbial Growth

1

2

3

4

5

Method

→

e.g.

→

e.g.

→

→

→

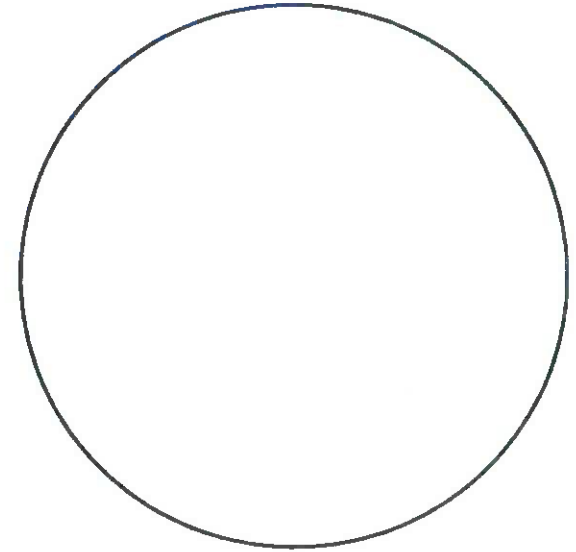
→

↳

→

→

→



Clear Zone

→

→

→



Monomer

Polymer

Introduction to the Biological Molecules

1 2 3 4 5

_____:

_____:

e.g.

Polymers

Molecules	Elements	Monomers	Polymers

Not Polymers



Condensation & Hydrolysis Reactions

1 2 3 4 5

Condensation

_____:

Hydrolysis

_____:



Monosaccharides & Disaccharides

1 2 3 4 5

Glucose

+

→

+

→

+

→

Alpha Glucose

+

→

Glucose

_____ :

→

Beta Glucose

→

→

Alpha Glucose

Beta Glucose

Glycosidic Bond

→

→

→



Polymers of Carbohydrates

1 2 3 4 5

[illegible]



Triglycerides

Structure

-
-
-
-
-
-
-
-
-
-

Saturated Fatty Acids

-
-

Functions

Unsaturated Fatty Acids

-
-
-



Phospholipids & Cholesterol

1 2 3 4 5

Structure

Functions



e.g.



e.g.



Cholesterol





Introduction to Proteins

1 2 3 4 5

Proteins

_____ :
_____ :

Amino Acids

Proteins

Types of Proteins





Protein Structure

1 2 3 4 5

Primary
Structure

Secondary
Structure

Tertiary
Structure

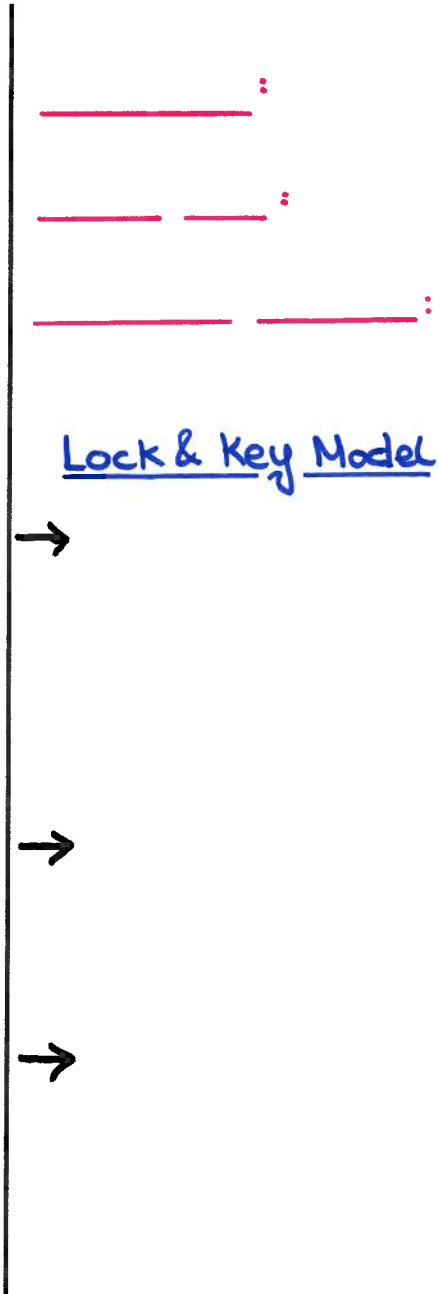
Quaternary
Structure



Enzymes

Active Site

Metabolic
Pathway



Enzymes

Induced Fit Model



- 1
- 2
- 3
- 4
- 5

Enzymes



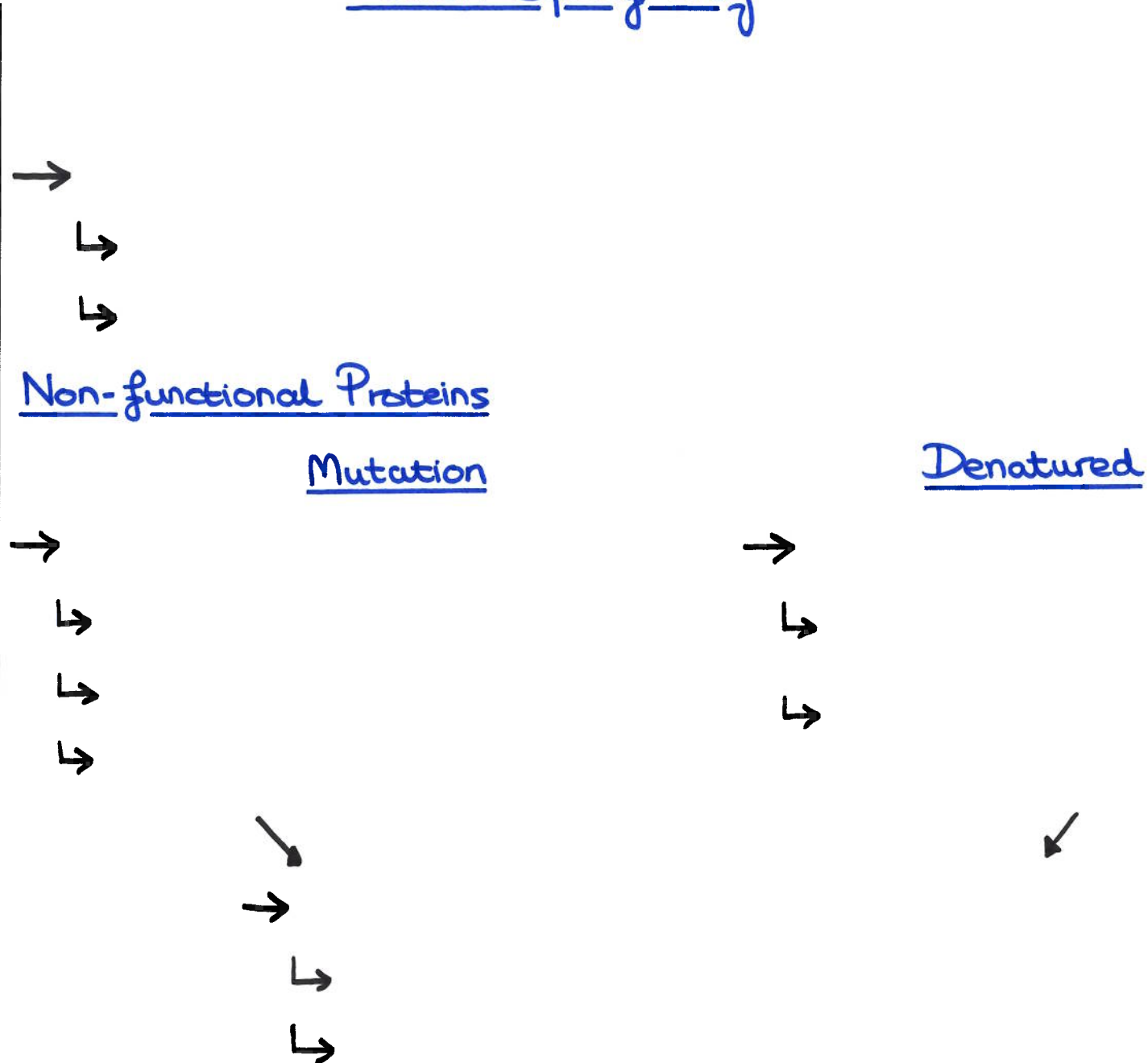
e.g.





Protein Specificity

1 2 3 4 5





Enzymes

1 2 3 4 5

1)

2)

3)

4)

5)



1)





Enzyme Activity...

1 2 3 4 5

2) _____ (_____)



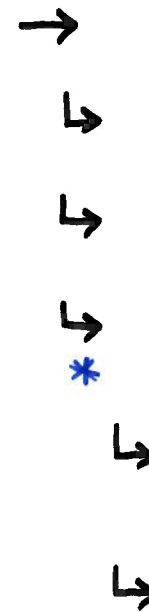
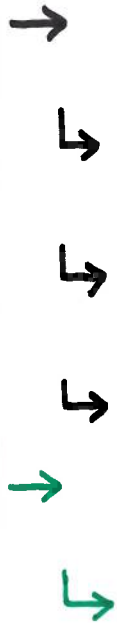
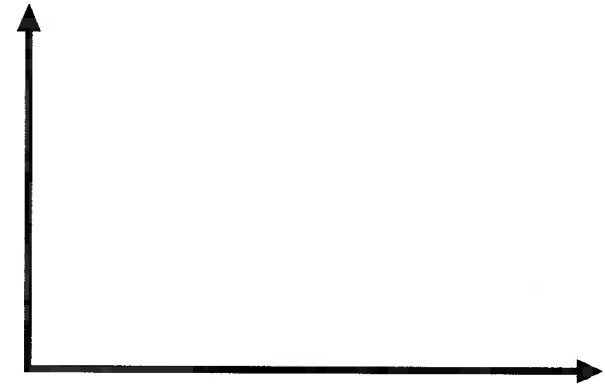
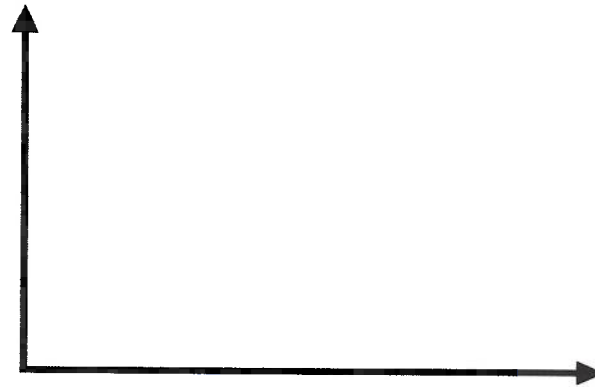


Enzyme & Substrate Concentration

1 2 3 4 5

Enzyme Concentration

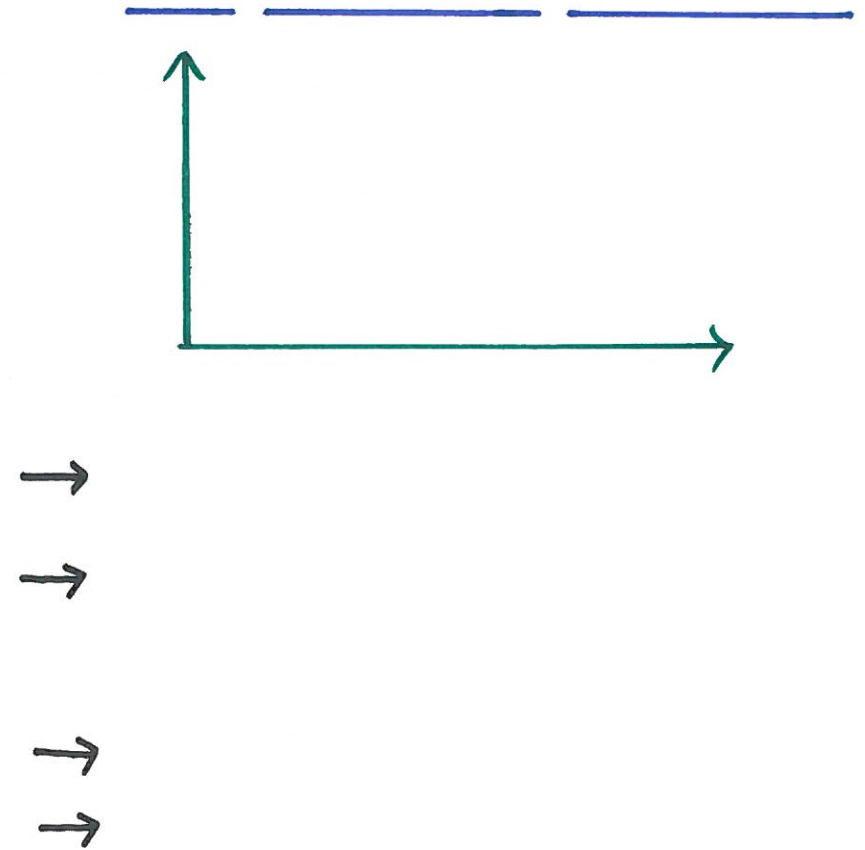
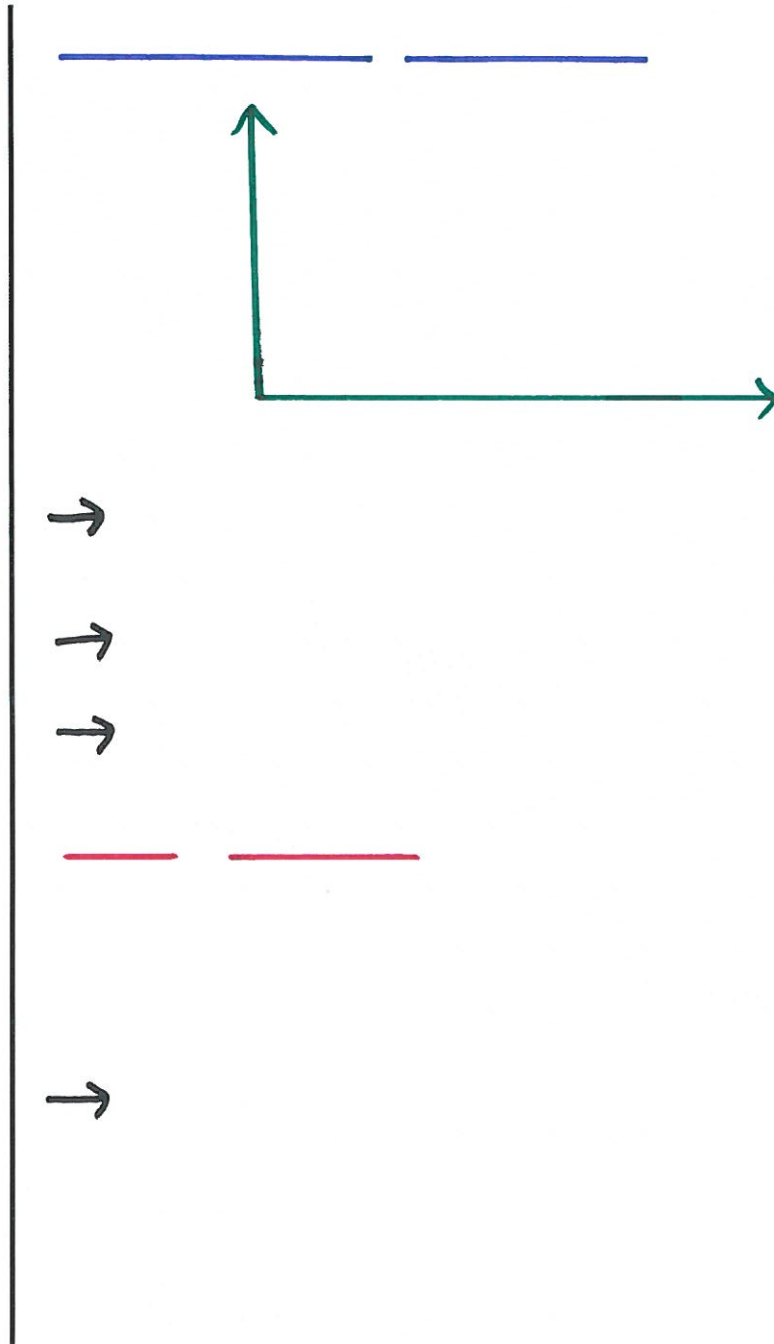
Substrate Concentration





Enzyme Activity...

1 2 3 4 5



Before:

After:



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





Semi-Conservative DNA Replication

1 2 3 4 5

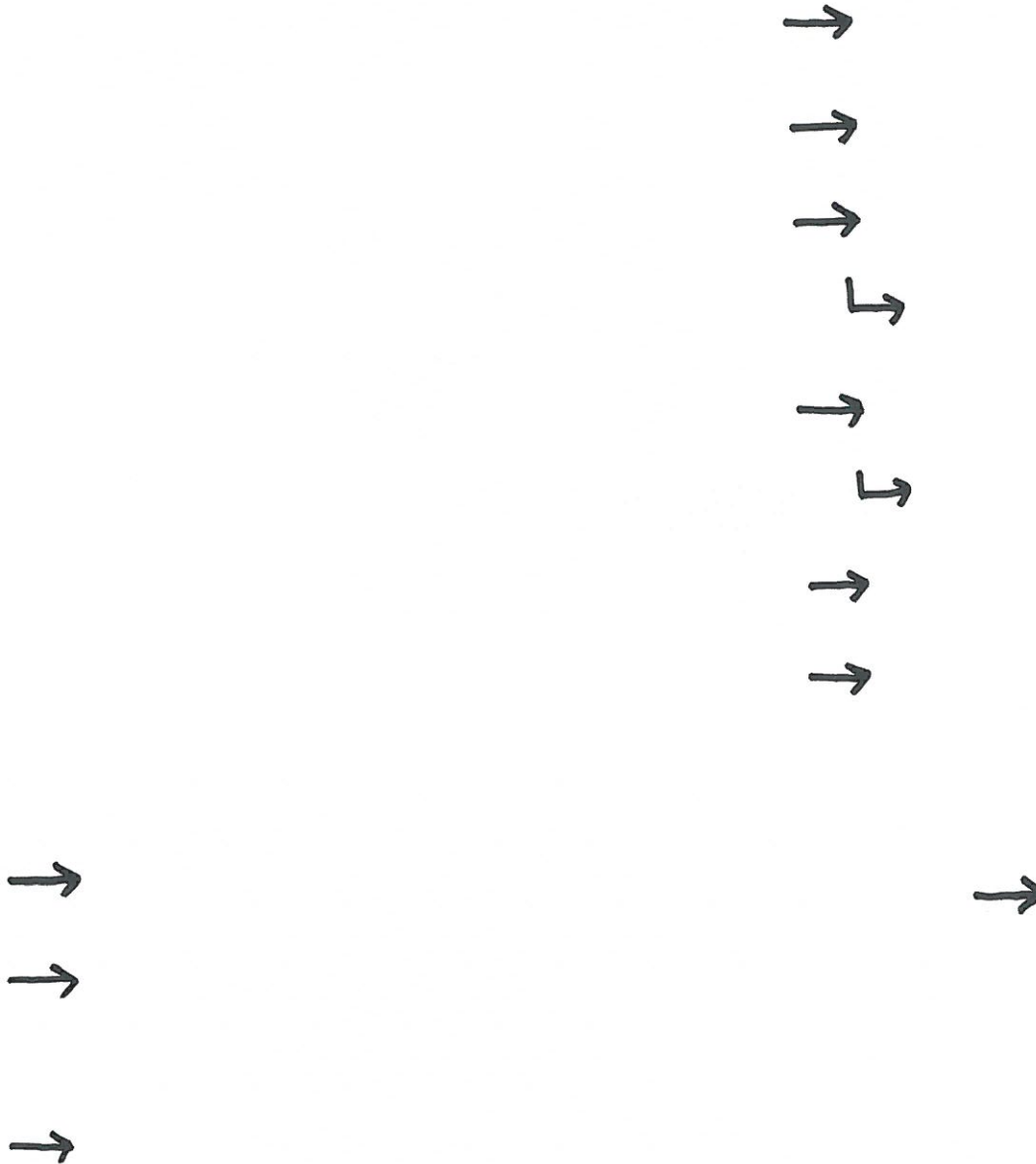
DNA Helicase

Complementary
Base Pairing

DNA Polymerase

Phosphodiester
Bonds

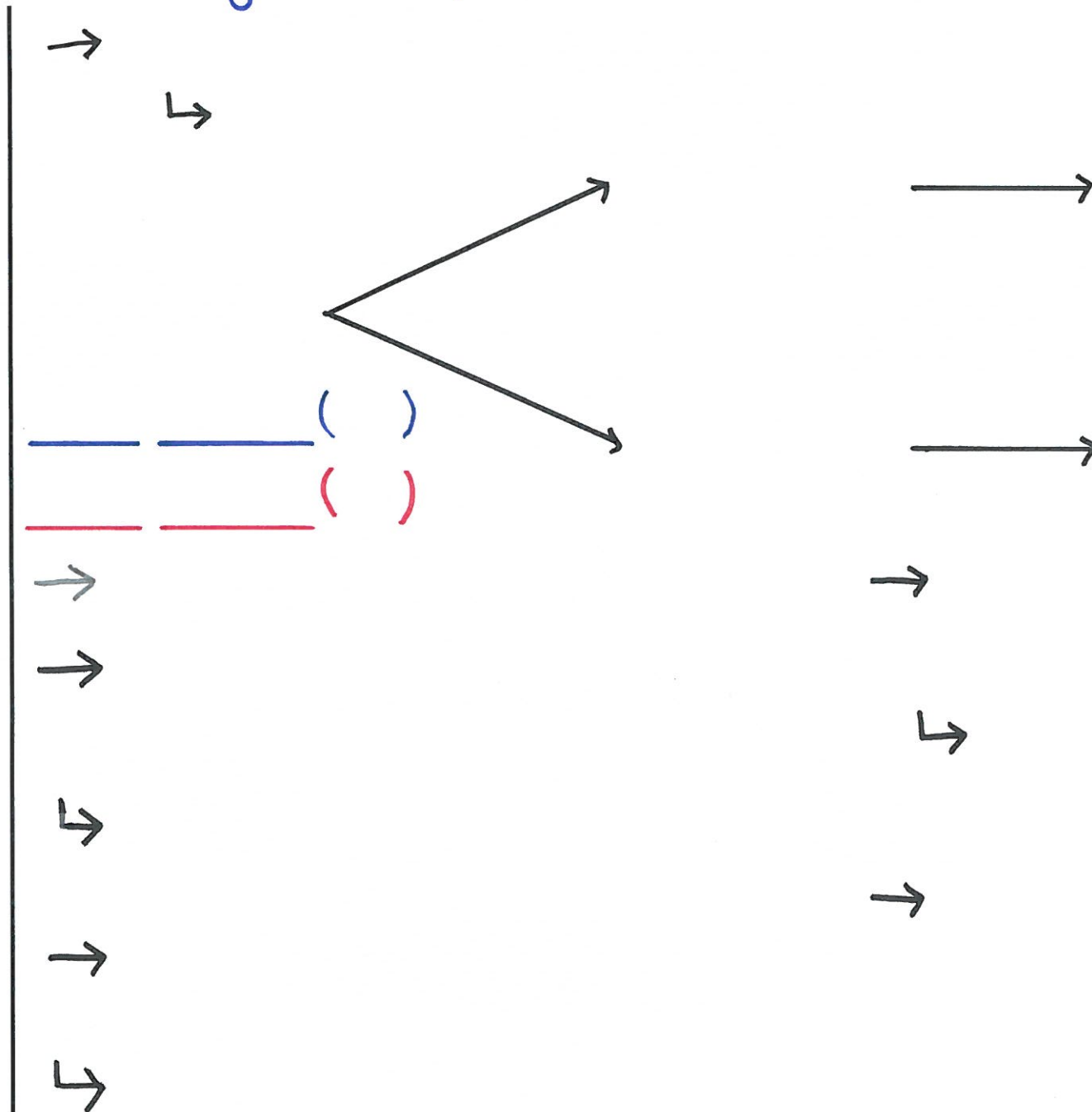
Anti-parallel





Proving DNA Replication is Semi-Conservative

1 2 3 4 5





ATP

1 2 3 4 5

ADP

ATP is useful because:

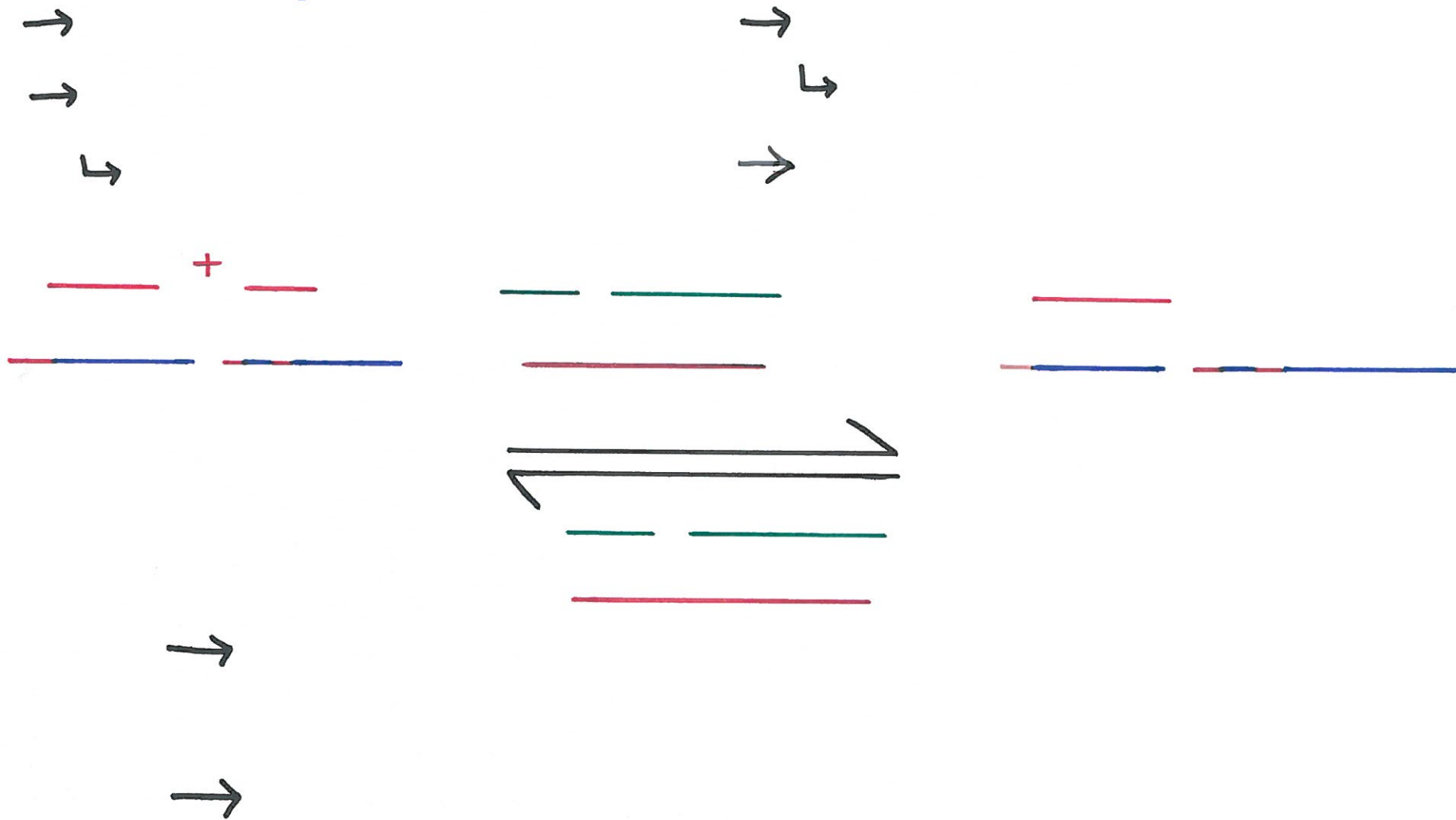
P_i

ATP

Condensation

Hydrolysis

Phosphorylate





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:

pH (acidity) (H^+)



Co-transport

Sodium Ions (Na^+)



Condensation



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



Phosphate Ions (PO_4^{3-})



Eukaryotic Cells

1 2 3 4 5



TT

Chitin

Plants

Animal

Algae: →
→

Fungi: →
→



Lysosomal
Enzymes /
Lysozymes

Eukaryotic Cell Organelles 1

1 2 3 4 5

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





TT

Specialised
Cells

Specialised
Cell

Tissue

Organ

Organ System

Eukaryotic Cells

Cell Organisation

_____ : →
 →

Specialised Cell

Tissue

Organ

Organ System

1

2

3

4

5



Transcription

1



2

3

Translation

4

5

Exocytosis

6

7

Production & Secretion of Proteins

1 2 3 4 5



Prokaryotic Cell Structure

1 2 3 4 5

Loop of DNA



Cytoplasm



Small Ribosomes



Cell membrane



Capsule



Cell Wall



Plasmids



Flagella





Prokaryotes Vs Eukaryotes

1 2 3 4 5

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



Viruses

1 2 3 4 5



Reproduction:





TT

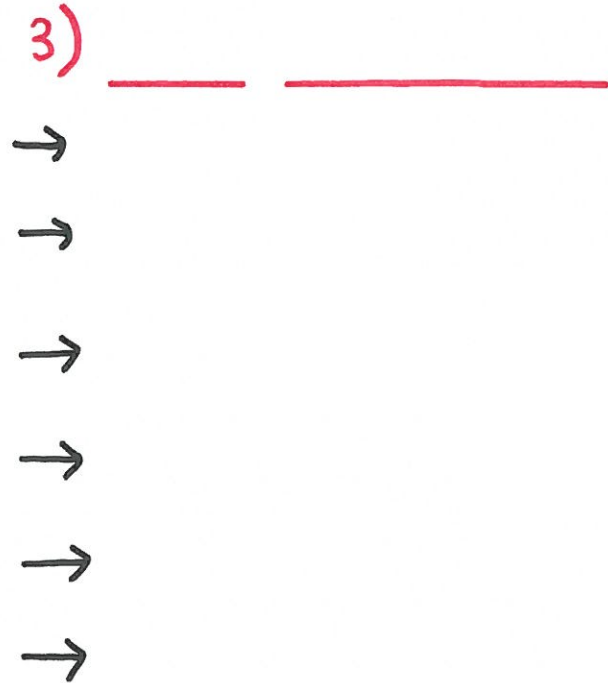
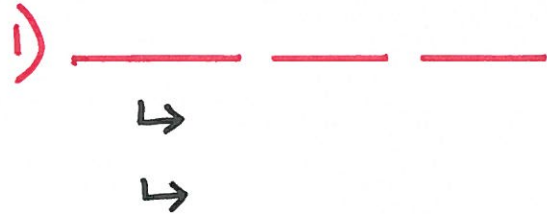
Cell Fractionation
- Break cells open

Isotonic

Filter Solution

Ultra Centrifugation

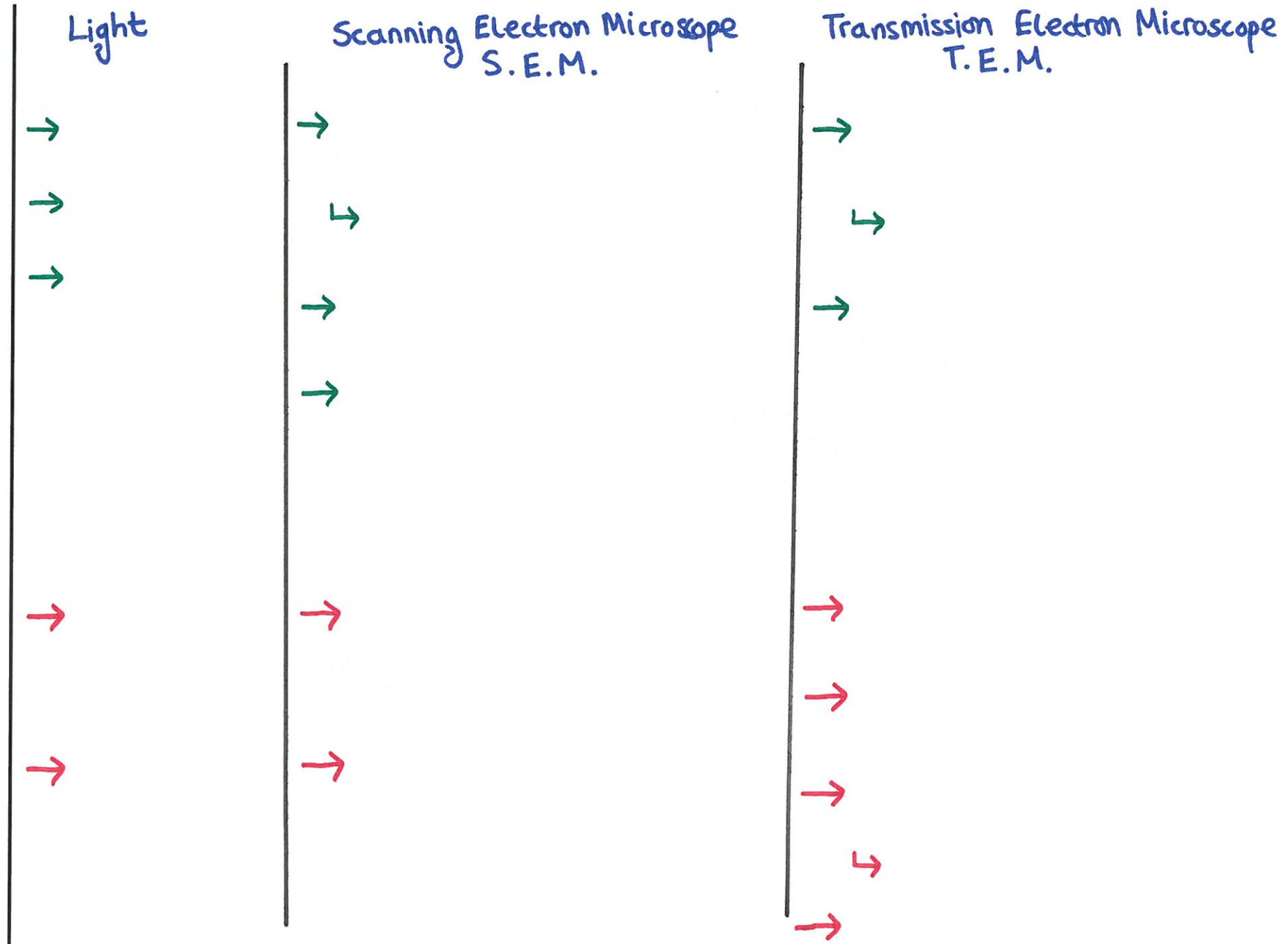
Cell Fractionation





Comparing Microscopes

1 2 3 4 5





Order of Magnitude Calculations

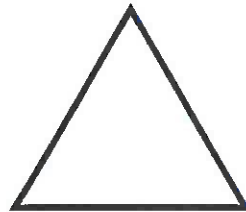
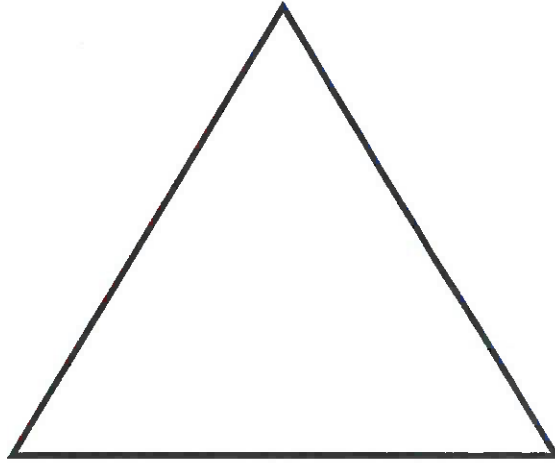
1 2 3 4 5

Magnification

_____:

_____:

Resolution





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

Cancer

→

→

→

→

↳

Treatments

→

→

→

Mitosis:

→

→

→

→

Cell cycle

Calculate...

→

→

→

Q.

How many minutes do they spend in anaphase?

1)

2)



TT

Mitosis

Cancer

PMAT

Binary Fission

1 2 3 4 5

_____ :





Cell Membrane

1 2 3 4 5

Glycoprotein

Channel Protein

Glycolipid

Structure

Function

Cell Surface Receptor

Carrier Protein





Transport Across Membranes - Diffusion

1 2 3 4 5

_____ :
→

A

B

① Concentration Gradient

→

↳

② Diffusion Distance

→

→

③ Surface Area

→

→

Exam Question

→

↳

→

↳

→



Facilitated
Diffusion

Facilitated Diffusion

1 2 3 4 5

Protein Channels



Carrier Proteins





Transport Across Membranes: Active Transport & Co-Transport 1 2 3 4 5

Active Transport



Co-Transport



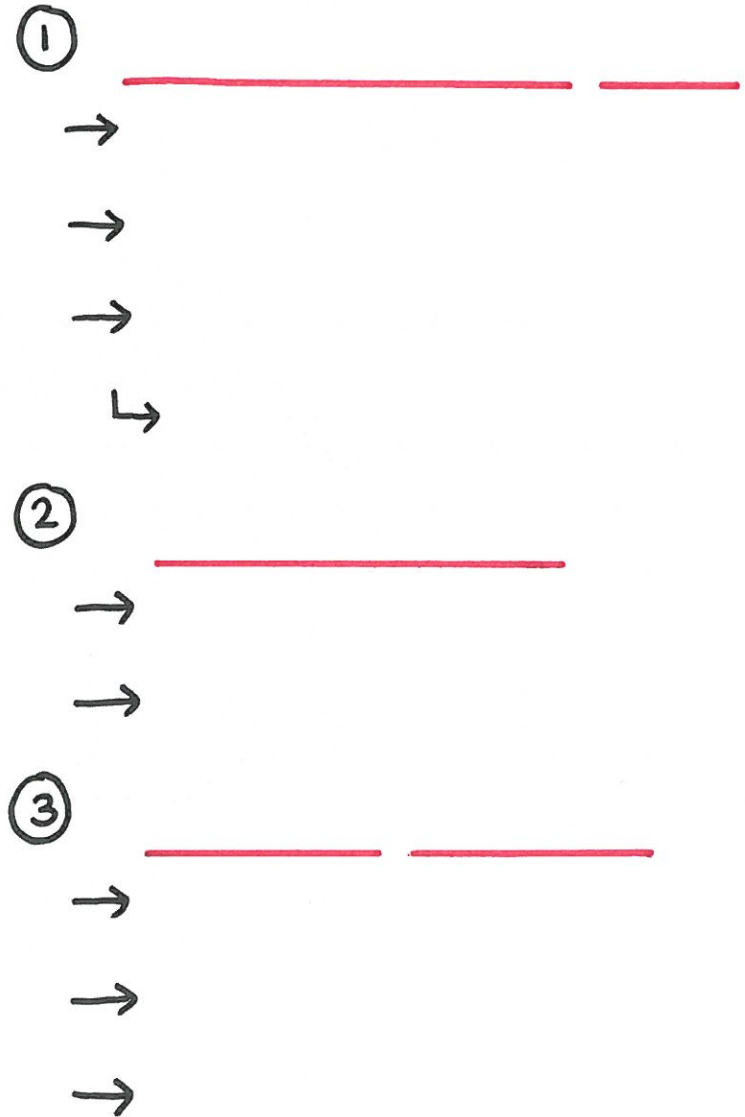
Co-Transport : Absorption of Glucose

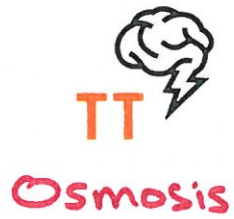
1 2 3 4 5

Sodium-
Potassium
Pump

Co-Transport

Facilitated
Diffusion





Transport Across Membranes - Osmosis

1 2 3 4 5

_____ :

•

•

•

•

•

•

•

•

High water
Potential

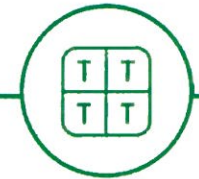
Exam Question

→

→

→

Low water
Potential



TT TOP TIP

Water potential is
opposite to solute
concentration



1 2 3 4 5

e.g.

The Immune Response

- 1)
- 2)
- 3)
- 4)

Antigen



Phagocytosis

1 2 3 4 5

Non-Specific Immune Response



White Blood Cells

Specific Immune Response



e.g.



TT

T_H Cells

T_C Cells

Antibodies

Antigen-Antibody
Complex

Plasma Cells

Clonal Selection

Monoclonal
antibodies

Agglutination

The Immune System

② T-cells (T-Lymphocytes)

→

→ Types 1)
 2)

→

→

③ B-Cells (B-Lymphocytes)

_____ :

→

→

↳

→

_____ :

④ Plasma Cells

_____ :

→

→

→

→

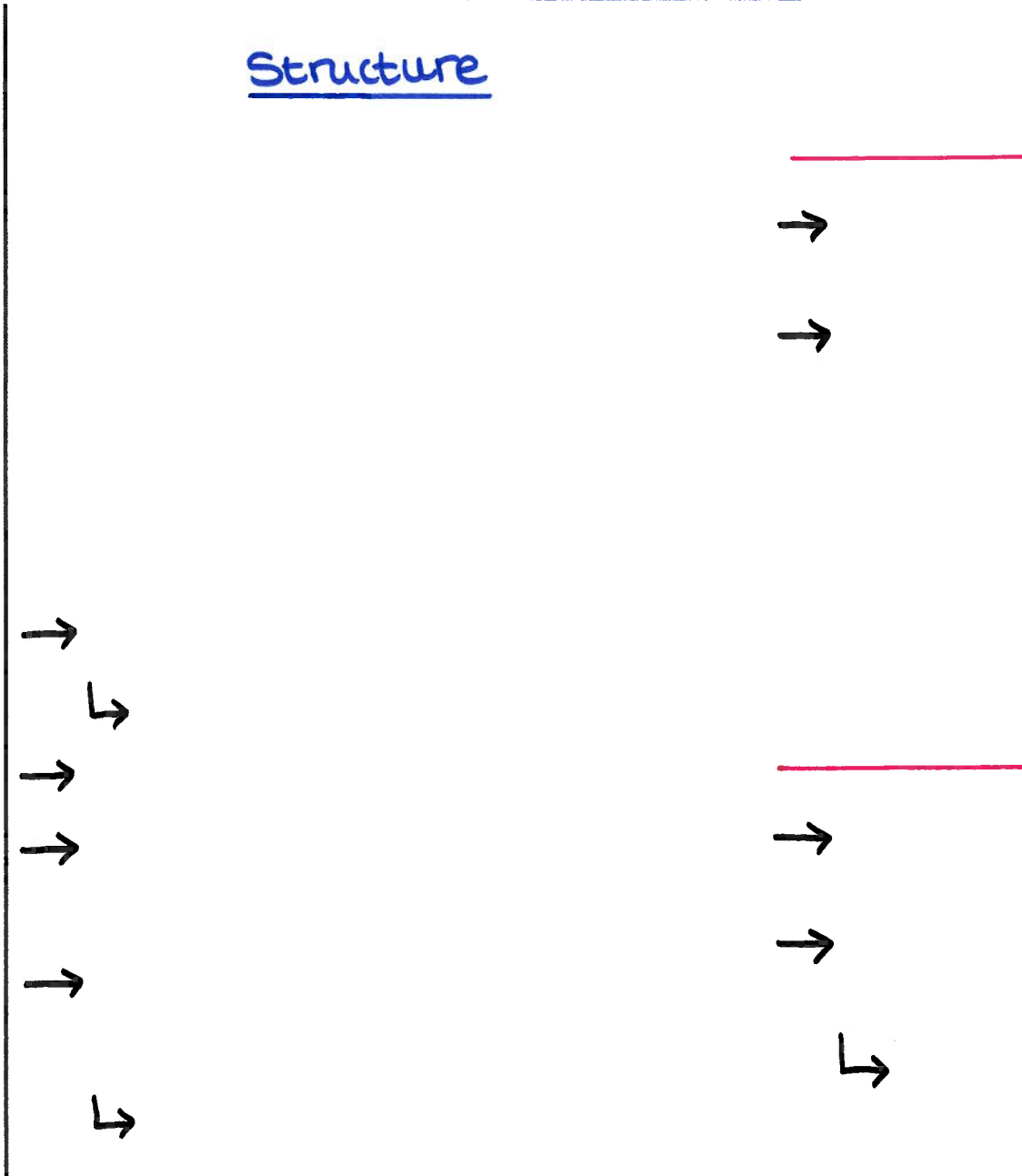


Antibodies

1 2 3 4 5

Structure

Function





Primary & Secondary Response

1 2 3 4 5

e.g.

Primary Immune Response

Secondary Immune Response





Monoclonal
Antibodies

Antigen-Antibody
Complex

Monoclonal Antibodies

1 2 3 4 5

Targeting Medication:

-
-
-
-
-

Medical Diagnosis:

- 1)
- 2)
- 3)
- 4)

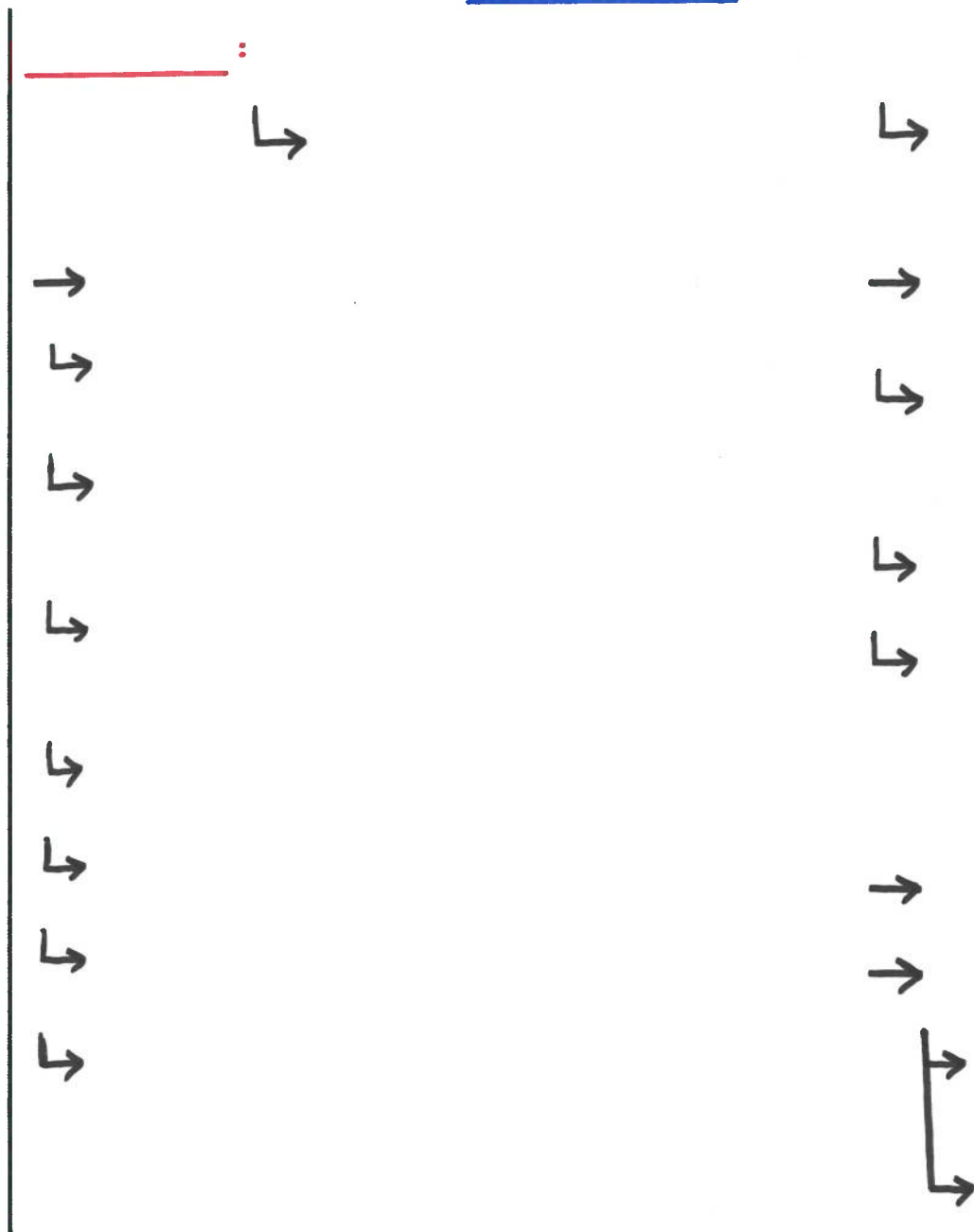
5)

6)



Vaccines

1 2 3 4 5





Types of Immunity.

1 2 3 4 5

→	→	→	→
→ → → → ↘		→ → → → ↘ ↘ ↘	



ELISA Test

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



Virus Reproduction

AIDS

- 1)
- 2)
- 3)
- 4)
- 5)
- 6)



Digestion & Absorption

1 2 3 4 5

_____ :

Carbohydrates

Polysaccharide



Monosaccharide

_____ :

Lipids

Micelles



Amylase

_____ :

Maltase



Digestion & Absorption: Proteins

1 2 3 4 5

Endopeptidase

_____ :

_____ :

Exopeptidase

_____ :

Membrane
Bound
Dipeptidase

Amino Acid Absorption



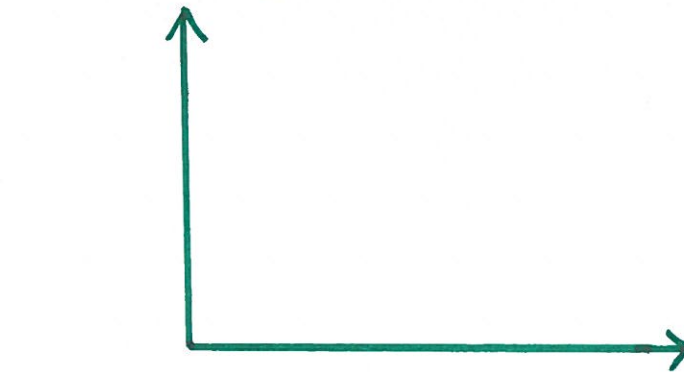


Haemoglobin

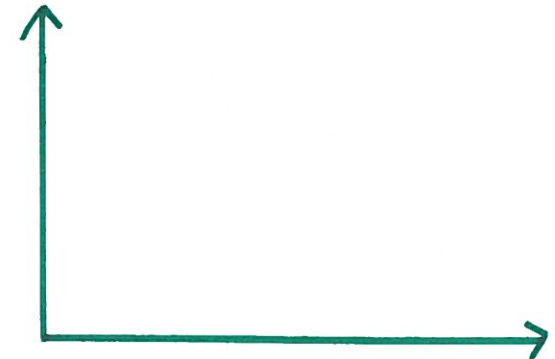
Haemoglobin

1 2 3 4 5

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

①



②



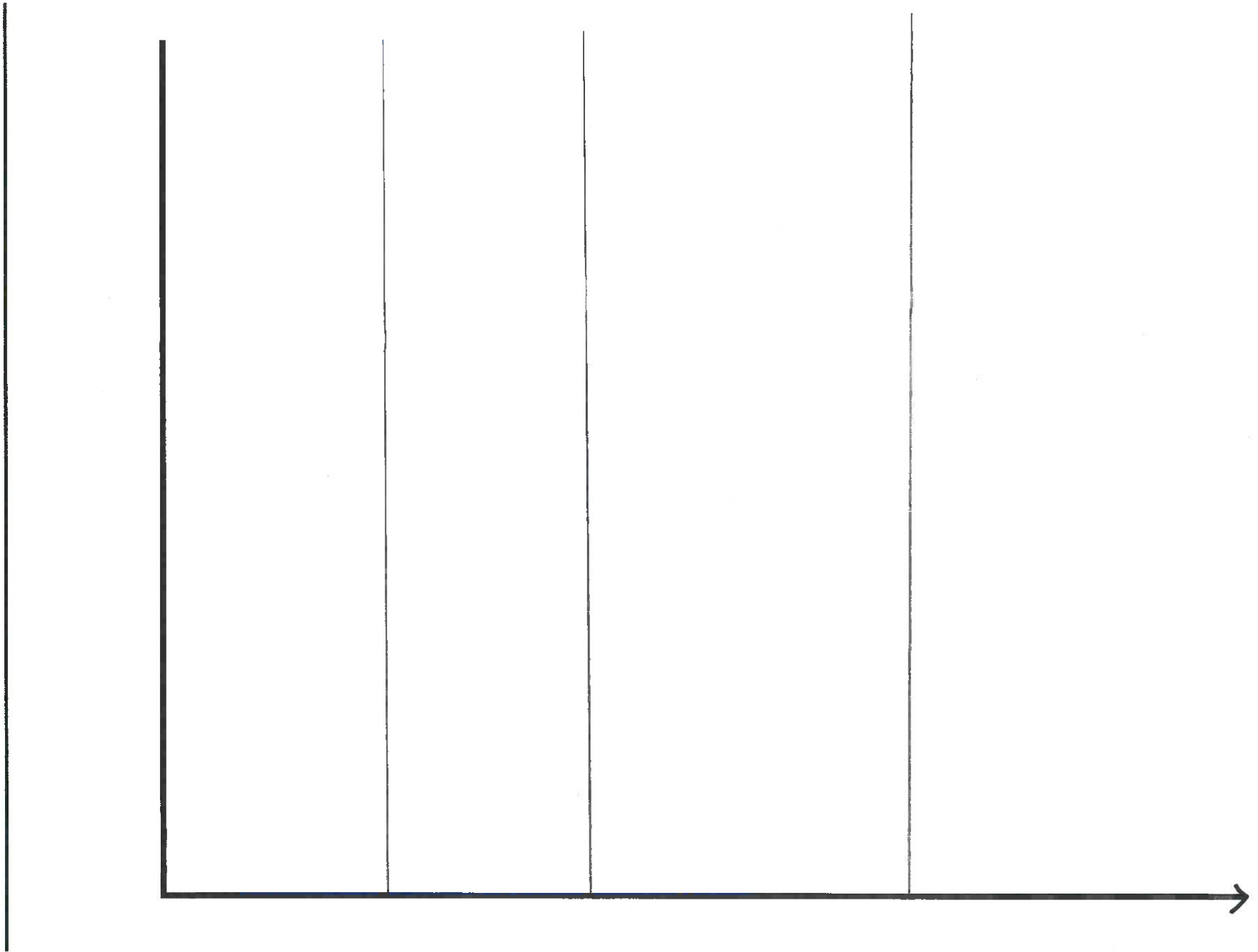
③





Cardiac Cycle Graphs

1 2 3 4 5





Cardiovascular Disease + Blood Circulation

1

2

3

4

5

Atheroma

Blood Circulation

_____ :

_____ :

_____ :

Thrombosis

Aneurysm

Atheroma

→

→

→

↘

→

→

→

Myocardial
Infarction



Formation & Return of Tissue Fluid

1 2 3 4 5

Formation

Return





TT

Transpiration

Transport in Plants : Xylem

1 2 3 4 5

Xylem:

→

→

→

↳

Cohesion - Tension Theory

→

↳

→

→

→

Factors Affecting the Rate
of Transpiration

1)

2)

3)

4)

↳

Cohesion



Mass Transport in Plants: Phloem

1 2 3 4 5

Phloem:

→

→

→

1)

2)

Evidence for Mass Flow / Translocation → Radioactive Labeling

→

→

→

→ Ringing Experiments

→

→

→

→

↳

However...

→

→



Source

Mass Flow Hypothesis / Translocation

1 2 3 4 5

Sink

_____ →

1)

2)

3)

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

- 1)
- 2)
- 3)

Insects

Fish

Trachea

Diffusion

Ventilation

Filaments

Lamellae

Counter
Current Flow



Water loss



Circulation of
Blood





Gas Exchange in Plants

1 2 3 4 5

Mesophyll

Gas Exchange in Plants

Stomata

Adaptations for Plants

Guard Cells

→
↳
→
→
→

4)
↳
5)

1)
2)
3)
→
→

Stomata Close to Save Water

→
→
↳



TT

Gas Exchange in Humans

1 2 3 4 5

Short Diffusion
Pathway

Structure:

Adaptations for Efficient Gas Exchange

Alveoli

Ventilation

Circulation

Diffusion Distance:



Surface Area: →



Concentration Gradient:





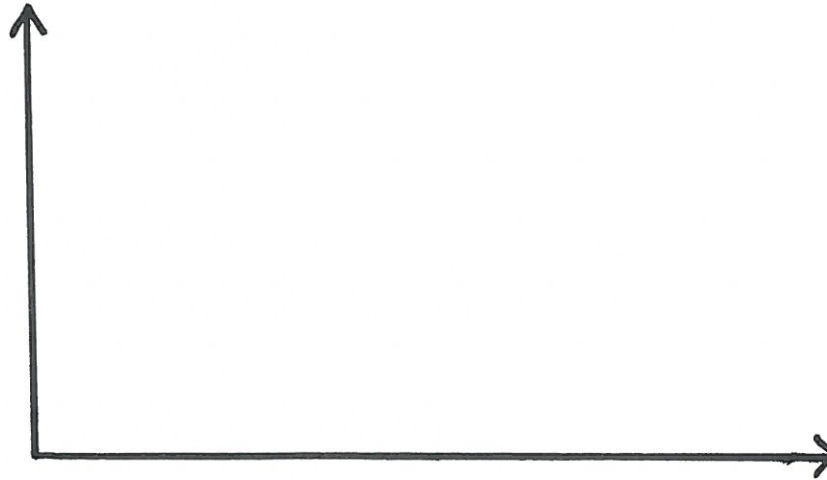
Ventilation

1 2 3 4 5

Tidal Volume

Spirometer Trace

Breathing /
Ventilation
Rate



=

X

Pulmonary
Ventilation /
Respiratory
minute
ventilation

____ :
____ / ____ :

AQA : _____

Edexcel : _____

Oxygen
Consumption

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





TT

Universal

DNA is Universal, Non-Overlapping & Degenerate

1

2

3

4

5

Non-overlapping

Degenerate

Genome

Proteome

Transcription

Translation

_____ :

_____ - _____ :

_____ :

_____ :

_____ :

Protein Synthesis







TT

Gene

DNA, Genes & Chromosomes

1 2 3 4 5

Locus

Eukaryotes →

→

→

→

→

Prokaryotes →

→

→

→

→

Mitochondria + Chloroplasts

→

→

→

⋮

⋮

⋮

Not all DNA codes for proteins / polypeptides / functional RNA

→

↳

DNA Triplet



Protein Synthesis : Transcription

1 2 3 4 5

Splicing

DNA Helicase

Hydrogen Bonds

Complementary
Base Pairing

RNA Polymerase



Prokaryotes vs. Eukaryotes

Prokaryotes: →



Eukaryotes:



TT
Codon

Protein Synthesis - Translation

1 2 3 4 5

Anticodon

→
→
→

→
→
→
→



Homologous
Pairs

Before Meiosis

1 2 3 4 5

_____ : →
 →



Introduction to Meiosis

1 2 3 4 5

Meiosis

_____ :

Mitosis

_____ :

Gametes

_____ :

_____ :

Haploid (n)

Meiosis

Mitosis



Diploid ($2n$)



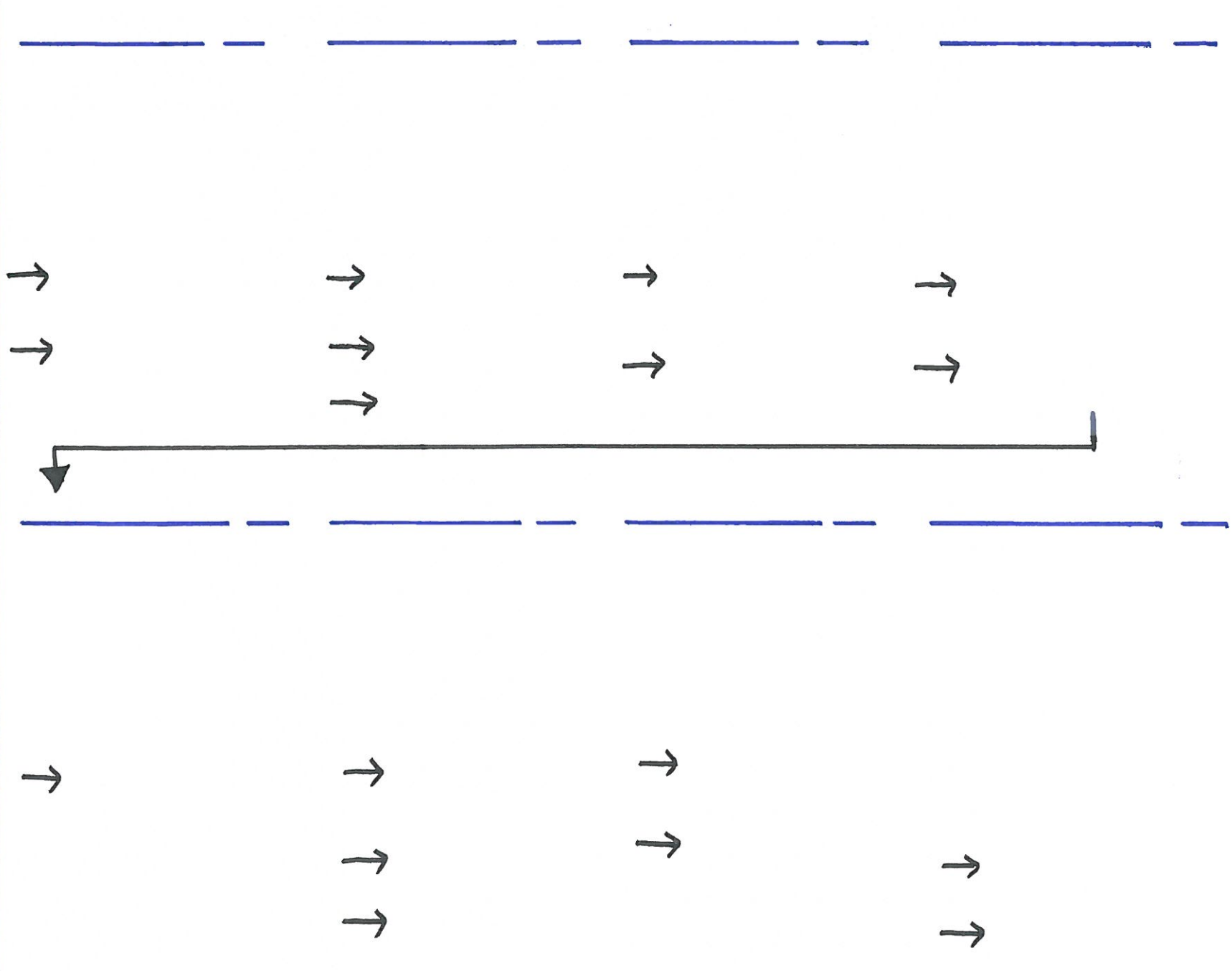
Fertilisation





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





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)

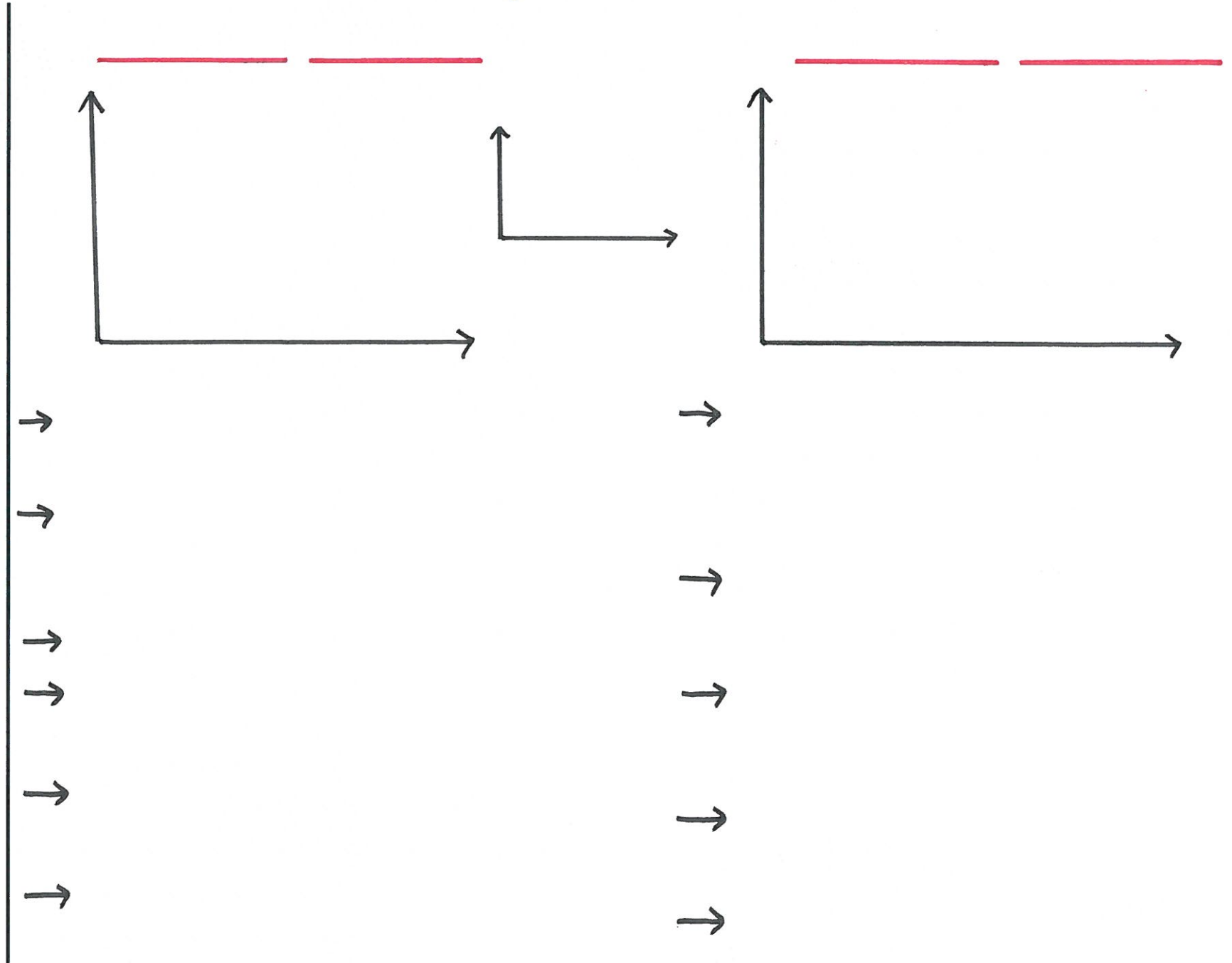


Directional & Stabilising Selection

1 2 3 4 5

Directional
Selection

Stabilising
Selection





Species

Species & Taxonomy

1 2 3 4 5

_____:

Courtship Behaviour



Phylogenetic
Classification

_____ = _____:



=



Phylogenetics



—

—



—

—

Taxon

Binomial Naming System



Biodiversity

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
Intraspecific

Investigating Diversity

1 2 3 4 5

Comparing Genetic Diversity

→

→

} :

Diversity/Variation

Can be caused by

→

→

→ Standard Deviation

Interspecific

Sampling a Population

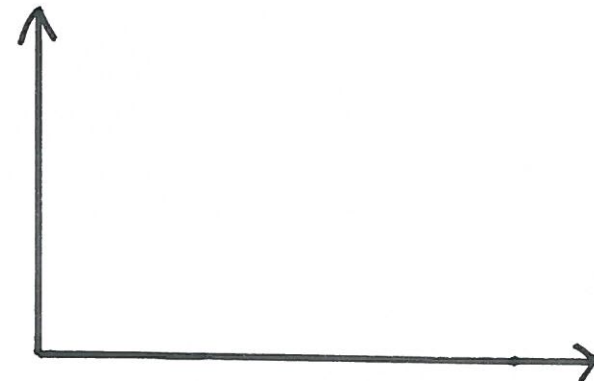
→

Large Sample Size

→

Selected at Random

→





Investigating Populations: Sampling.

1 2 3 4 5

Sampling.

→

→

↳

→

Random Sampling.

→

→

→

→

↳

Non-Random Sampling.

e.g.

→

→

How many samples to do?

→

→

→

→

