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Semester 1 - Practical Notes

Human Anatomy, Physiology and Pathophysiology I

Complete Subject Manual

17 practicals and activities. Use the PDF bookmarks to move between practicals. Page numbers restart within each practical; the page counts below exclude the promotion page.

Contents

No.	Practical	Pages
1	Study of Compound Microscopes	6
2	Epithelial and Connective Tissue Microscopy	3
3	Muscular and Nervous Tissue Microscopy	2
4	Identification of Axial Bones	2
5	Identification of Appendicular Bones	2
6	Introduction to Hemocytometry	3
7	Total Blood Count by Cell Analyser	2
8	WBC Count and Differential Count	3
9	RBC Count and Interpretation	2
10	Bleeding Time and Clotting Time	2
11	Haemoglobin Estimation and Interpretation	2
12	Blood Group Determination	2
13	Erythrocyte Sedimentation Rate	2
14	Pulse Rate Heart Rate and Blood Pressure	2
15	ECG Recording and Interpretation	3
16	Cardiovascular and Integumentary Systems	3
17	Case Studies in Pathophysiology	4

Study of Compound Microscopes

Experiment 1 - Practical Notes

Aim

To identify the parts of a compound light microscope, explain their functions and use a prepared slide to compare low- and higher-power views.

Apparatus

- Compound brightfield microscope.
- Instructor-provided prepared slide.
- Manufacturer-approved optical-cleaning materials.
- Notebook and pencil.

Learning Outcomes

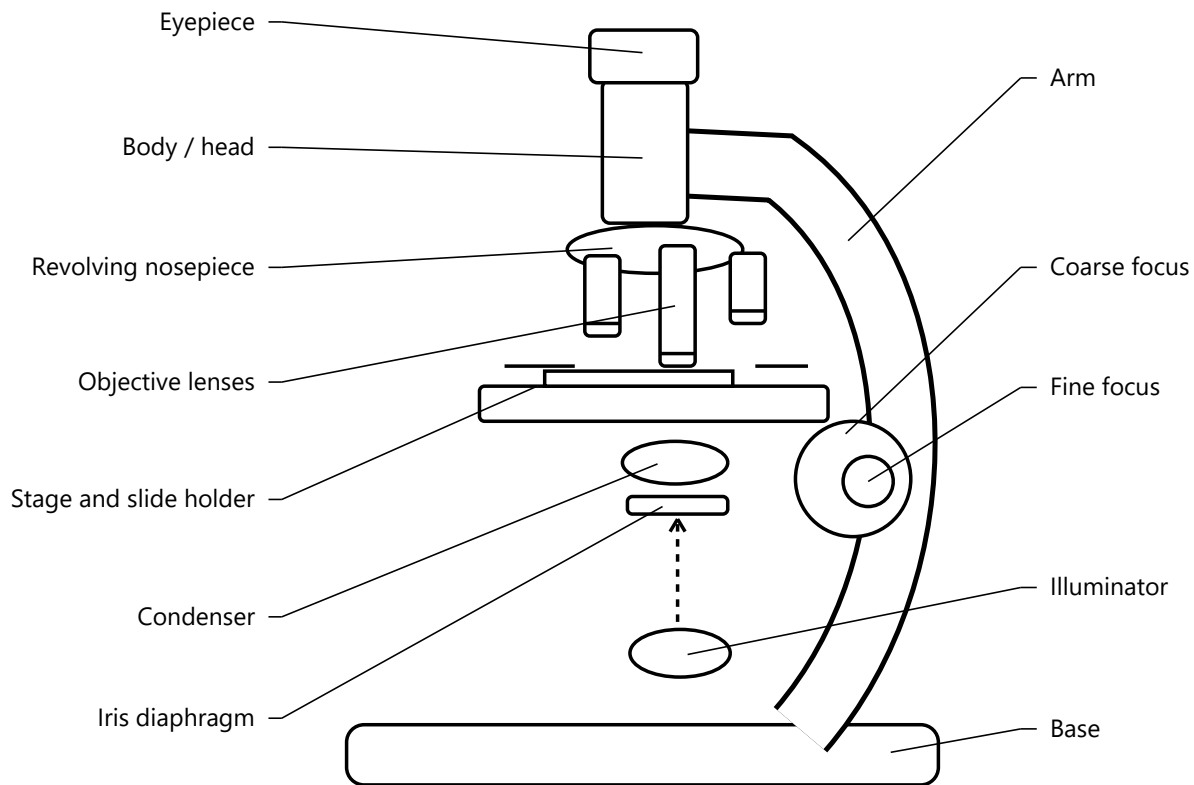
- Identify the main parts and state their functions.
- Focus a prepared slide at low and higher power.
- Calculate total magnification.
- Explain the difference between magnification and resolution.

Contents

• Parts and functions	Page 2
• Principle and magnification	Page 3
• Procedure and precautions	Page 4
• Observations, calculations and result	Page 5
• Viva questions and answers	Page 6

Parts and Functions

Identify these parts on the microscope in your laboratory. Positions differ by model.



Simplified schematic; not to scale.

Part / group	Main function
Eyepiece and objective	Provide two stages of image magnification.
Revolving nosepiece	Selects an objective and holds it in the optical path.
Stage and slide holder	Support and position the prepared slide.
Condenser and iris diaphragm	Shape the illumination reaching the specimen.
Coarse and fine focus	Make large and small focusing adjustments.
Arm, base and illuminator	Support the instrument and supply transmitted light.

Quick check: Point to each part and state one function.

Principle and Magnification

Principle

- A compound microscope uses an objective and an eyepiece together.
- The objective collects light from the specimen and contributes to a magnified, inverted intermediate image.
- The eyepiece enlarges the intermediate image for visual observation.

Simplified Light Path

Illuminator → Condenser → Specimen → Objective → Eyepiece

Total Magnification

Total magnification = Objective magnification × Eyepiece magnification

Example: 40x objective × 10x eyepiece = **400x** total magnification.

Common Teaching Configuration

Objective	Eyepiece	Total magnification
4x	10x	40x
10x	10x	100x
40x (dry)	10x	400x

Confirm the markings on your own lenses. This table assumes visual observation with no extra magnification factor.

Magnification and Resolution

- **Magnification:** How large the image appears. A larger image alone does not guarantee more visible detail.
- **Resolution:** The ability to separate nearby details. It depends on the optics and illumination, not magnification alone.

Procedure and Precautions

Use the instructor-provided prepared slide and the operating manual for your microscope model.

Procedure

1. Set up

Place the microscope on a stable bench. Identify the controls and inspect the supplied slide before switching on the illuminator.

2. Select low power

Engage the lowest-power objective, commonly 4x. Check clearance between the objective and slide from the side.

3. Position the slide

Secure the prepared slide on the stage. Bring the region of interest over the stage opening.

4. Focus at low power

Use coarse focus cautiously at low power, then fine focus. Keep the objective clear of the slide and avoid forcing any control.

5. Increase magnification

Centre the feature first. Move through 10x to 40x dry objectives when available; refine with fine focus and adjust illumination as instructed.

6. Observe and record

Record lens markings and calculate total magnification. Describe image appearance and sketch what you actually observe.

7. Finish and store

Return to low power and remove the slide with adequate clearance. Switch off, clean accessible optics as instructed and cover after the lamp has cooled.

Precautions

- Use fine focus at 40x; coarse movement can strike the slide.
- Keep fingerprints off lenses. Use manufacturer-approved optical-cleaning materials.
- Use the correct dry objective. Use immersion oil only with a specified immersion objective.
- Carry and store the instrument as directed by its manufacturer.

Observations, Calculations and Result

Fill in your own observations. Numerical examples below are not laboratory results.

Name: _____ Date: _____ Roll no.: _____

Microscope model: _____ Prepared slide: _____

Observation Table

View	Objective	Eyepiece	Total	Appearance / feature
1	____ x	____ x	____ x	_____
2	____ x	____ x	____ x	_____
3	____ x	____ x	____ x	_____

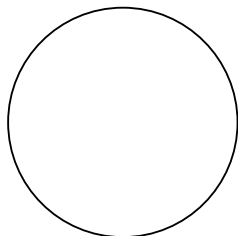
Worked Example: Field of View

Field diameter = Eyepiece field number (FN) ÷ Objective magnification.

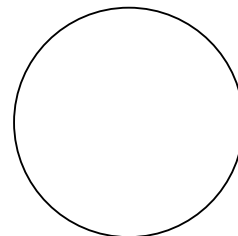
- Example only: assume FN = 18 mm.
- With a 10x objective: $18 \div 10 = \mathbf{1.8 \text{ mm}}$.
- With a 40x objective: $18 \div 40 = \mathbf{0.45 \text{ mm}}$.

Assumes no additional lens factor. Use your own instrument specifications.

Your Labelled Sketches



Low-power view



Higher-power view

Result - Complete After Observation

I identified _____ and observed the prepared slide at _____ x total magnification. On increasing objective power, I noted _____.

Viva Questions

Questions and Answers

1. Why is it called a compound microscope?

The objective and eyepiece provide two successive stages of magnification.

2. What is the total magnification for 10x × 40x?

400x, assuming no other lens factor.

3. Does a larger image always show more detail?

No. Magnification enlarges the image; resolution separates close details.

4. Why start at low power?

It helps you find and centre a feature before observing a smaller field at higher power.

5. Which focusing control should you use at 40x?

Fine focus. Large coarse movements risk contact between the objective and slide.

6. Why does the field of view become smaller?

For a fixed field number, increasing objective magnification reduces specimen field diameter.

Epithelial and Connective Tissue Microscopy

Experiment 2 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To identify epithelial and connective tissues on prepared slides using cell arrangement, extracellular matrix and characteristic structures.

Principle

Epithelium consists of closely arranged cells supported by a basement membrane. Classification considers the number of layers and the shape of surface cells. Connective tissues usually have more extracellular matrix; the arrangement of fibres and cells helps distinguish their types.

Requirements

- Compound microscope, instructor-labelled prepared tissue slides and slide list.
- Notebook and pencil for labelled sketches; lens-cleaning materials approved for the instrument.

Procedure

1. Survey at low power

Inspect the whole section and identify a surface, lumen or broad matrix area. Record the slide label without assuming the tissue from colour alone.

2. Examine epithelium

Identify the free surface and underlying tissue. Count the apparent cell layers and assess the shape of cells nearest the surface.

3. Examine connective tissue

Look for fibres, cells, ground substance and any lacunae or mineralised arrangement. Compare more than one field.

4. Compare diagnostic features

Use the identification tables below. Explain two visible features supporting each identification.

5. Record

Draw a small labelled field and write the slide, objective, total magnification and visible structures.

Human Anatomy, Physiology and Pathophysiology I

Epithelial Identification Guide

Type	Typical feature	Common location
Simple squamous	One layer of flattened cells	Alveoli; vessel lining
Simple cuboidal	One layer; roughly square profile	Kidney tubules
Simple columnar	Tall cells; often basal nuclei	Intestinal lining
Pseudostratified ciliated	Nuclei at different levels; all cells contact the basement membrane	Respiratory epithelium
Stratified squamous	Several layers; flat surface cells	Skin surface or oral lining
Transitional	Layered; rounded surface cells when relaxed	Urinary bladder

Connective Tissue Identification Guide

Type	Visible feature	Main role
Areolar	Loose fibres and scattered cells	Support and packing
Adipose	Large adipocyte spaces; peripheral nuclei	Energy storage and insulation
Dense regular	Parallel collagen bundles	Tensile support in tendons
Hyaline cartilage	Chondrocytes in lacunae; glassy matrix	Support and smooth joint surfaces
Bone	Mineralised matrix; lamellar organisation	Support and protection
Blood	Cells suspended in fluid matrix	Transport and defence

Observations and Record

Slide / tissue	Two observed identifying features	Magnification
Epithelial slide	_____	___ x
Connective slide	_____	___ x

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- A 10x eyepiece with a 40x objective gives 400x total magnification.

Human Anatomy, Physiology and Pathophysiology I

- An identification should link appearance to structure: a thin single layer of flattened cells supports simple squamous epithelium; visible layered flat surface cells support stratified squamous epithelium.

Result

Slide ____ was identified as ____ because ____ and ____ were visible. A labelled sketch and magnification are recorded.

Precautions

- A sectioning angle can alter apparent cell shape and layer count.
- Do not identify a tissue from staining intensity alone.
- Use prepared slides; do not obtain or process human tissue for this exercise.

Viva Questions and Answers

1. How is epithelial classification made?

By layer number and surface-cell shape, with special features where relevant.

2. What distinguishes connective tissue generally?

Its extracellular matrix and supporting cell and fibre organisation.

3. Are empty-looking spaces always artefacts?

No; adipocyte lipid may be removed during preparation, leaving an apparent empty cell space.

Muscular and Nervous Tissue Microscopy

Experiment 3 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To distinguish skeletal, cardiac and smooth muscle and identify basic nervous-tissue features on prepared slides.

Principle

Muscle is specialised for contraction; fibre shape, striations and nuclei help separate its types. Nervous tissue contains neurons and supporting glial cells. Neurons receive, integrate and transmit signals through their specialised structure.

Requirements

- Prepared skeletal, cardiac, smooth muscle and nervous tissue slides.
- Compound microscope and drawing materials.

Procedure

1. Locate the tissue

Survey each slide at low power and distinguish longitudinal from transverse sections.

2. Compare muscle fibres

At a suitable higher power, look for striations, branching and nuclear position. A feature absent in one field may be clearer in another.

3. Identify nervous tissue

Locate a neuronal cell body if visible and distinguish it from smaller supporting-cell nuclei. Follow visible processes without assuming that every line is an axon.

4. Draw

Make separate sketches for the three muscle types and a nervous-tissue field. Label only structures seen or clearly identified by the instructor.

5. Relate structure to function

State how the observed arrangement is compatible with voluntary movement, cardiac pumping, visceral contraction or neural signalling.

Comparison of Muscle Types

Feature	Skeletal / cardiac	Smooth
Cell shape	Long unbranched / branched	Spindle-shaped
Striations	Present / present	Not visible as striations
Nuclei	Multiple peripheral / usually central	Single central
Control	Mainly voluntary / involuntary	Involuntary
Typical site	Attached to skeleton / heart	Walls of hollow organs

Human Anatomy, Physiology and Pathophysiology I

Neuron: Structures to Identify

- Cell body: contains the nucleus and much of the synthetic machinery.
- Dendrites: generally receive input; an axon carries signals away from the cell body.
- Glial nuclei: smaller supporting-cell profiles around neural structures; slide appearance varies with the region and stain.

Observations and Record

Tissue	Striations / branching / nuclei	Identification
Muscle slide 1	_____	_____
Muscle slide 2	_____	_____
Nervous tissue	Cell body / processes / glia	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Identification exercise: a branched striated fibre with centrally located nuclei supports cardiac muscle; a long unbranched striated fibre with peripheral multiple nuclei supports skeletal muscle.
- A section showing spindle-shaped cells without visible striations supports smooth muscle when the slide and section quality are suitable.

Result

The supplied muscle slides were identified using ____ and _____. The nervous-tissue sketch shows ____ at ____ x.

Precautions

- Do not confuse transverse muscle sections with another tissue solely because striations are absent.
- Intercalated discs may not be clear in every cardiac preparation.
- A routine stained slide cannot establish every neuron's functional direction.

Viva Questions and Answers

1. Which muscle is voluntary?

Skeletal muscle is mainly under voluntary control.

2. What are intercalated discs?

Specialised junctional regions connecting cardiac muscle cells.

3. What is the role of glia?

They support and maintain the environment of nervous tissue.

Identification of Axial Bones

Experiment 4 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To identify the adult axial skeleton and state the location and main features of representative bones.

Principle

The adult axial skeleton forms the central framework: skull, auditory ossicles, hyoid, vertebral column and thoracic cage. Its usual count is 80 bones. Counts depend on adult fusion and exclude variable accessory bones.

Requirements

- Articulated skeleton or labelled models, isolated teaching bones and anatomical charts.
- Notebook and an identification checklist.

Procedure

1. Orient the skeleton

Identify anterior, posterior, superior and inferior views. Locate the skull, vertebral column and thorax.

2. Study the skull

Identify the eight cranial bones and fourteen facial bones. Locate major sutures, orbit and mandible on the model.

3. Study vertebrae

Compare cervical, thoracic and lumbar vertebrae. Identify the atlas, axis, sacrum and coccyx; relate their appearance to position.

4. Study the thoracic cage

Identify sternum and ribs. Distinguish true ribs 1-7, false ribs 8-12 and floating ribs 11-12.

5. Record a spot identification

For each bone, state its name, location, one landmark and one function; do not rely only on size.

Skull Bone Checklist

Group	Bones	Count
Cranial	Frontal 1; parietal 2; temporal 2; occipital 1; sphenoid 1; ethmoid 1	8
Facial	Mandible 1; vomer 1; maxillae 2; zygomatic 2; nasal 2; lacrimal 2; palatine 2; inferior nasal conchae 2	14
Associated	Malleus, incus and stapes on each side; hyoid	6 + 1

Human Anatomy, Physiology and Pathophysiology I

Regional Features

- Cervical vertebrae generally show transverse foramina; atlas and axis have specialised forms.
- Thoracic vertebrae articulate with ribs. Lumbar vertebrae have substantial bodies for load bearing.
- The sternum has manubrium, body and xiphoid process. Identify these parts rather than counting them as separate adult bones.

Observations and Record

Bone / model	Landmark observed	Location / function
Skull bone	_____	_____
Vertebra	_____	_____
Rib / sternum	_____	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Usual adult count: skull 22 + ossicles 6 + hyoid 1 + vertebral column 26 + ribs 24 + sternum 1 = 80.
- Vertebral column count: 7 cervical + 12 thoracic + 5 lumbar + fused sacrum 1 + fused coccyx 1 = 26 adult bones.

Result

I identified ____ axial bones and recorded a diagnostic landmark for each. The usual adult axial bone count is 80.

Precautions

- Handle isolated bones and models as directed; fragile projections may break.
- Count the fused sacrum as one adult bone, not as five separate adult bones.
- Not every model includes the auditory ossicles or hyoid.

Viva Questions and Answers

1. What distinguishes a thoracic vertebra?

It has articular facets associated with ribs.

2. Which vertebra has the dens?

The axis, or second cervical vertebra.

3. Why are ribs 11 and 12 called floating?

They have no anterior attachment to the sternum.

Identification of Appendicular Bones

Experiment 5 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To identify the limb and girdle bones and distinguish the usual adult appendicular count from the axial count.

Principle

The appendicular skeleton includes the upper and lower limbs and their girdles. Its usual adult count is 126. Girdles connect the limbs to the central skeleton; limb arrangements reflect upper-limb mobility and lower-limb weight bearing.

Requirements

- Articulated skeleton, isolated bone models and upper- and lower-limb charts.
- Notebook and identification record.

Procedure

1. Identify girdles

Locate the clavicle and scapula on each side and the two hip bones. Identify the acetabulum and scapular glenoid cavity.

2. Identify upper limb

Locate humerus, radius and ulna. Use anatomical position: the radius is lateral on the thumb side, and the ulna is medial.

3. Identify the hand

Locate carpals, metacarpals and phalanges. The thumb has two phalanges; each other digit has three.

4. Identify lower limb

Locate femur, patella, tibia and fibula. Tibia is the main medial weight-bearing leg bone; fibula is lateral.

5. Identify foot and record

Identify the tarsal group, metatarsals and phalanges. Record name, side where determinable, landmark and joint relationship.

Hand and Foot Checklist

Group	Names to identify	Count per side
Carpals	Scaphoid, lunate, triquetrum, pisiform, trapezium, trapezoid, capitate, hamate	8
Tarsals	Talus, calcaneus, navicular, cuboid, medial/intermediate/lateral cuneiforms	7
Long bones of digits	Metacarpals / metatarsals; phalanges	5 + 14 in each hand or foot

Human Anatomy, Physiology and Pathophysiology I**Observations and Record**

Bone	Side / identifying landmark	Joint relationship
Upper limb	_____	_____
Lower limb	_____	_____
Girdle bone	_____	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Each upper limb plus its girdle: 2 girdle bones + humerus 1 + radius/ulna 2 + carpals 8 + metacarpals 5 + phalanges 14 = 32; both sides = 64.
- Each lower limb plus hip bone: 1 + femur 1 + patella 1 + tibia/fibula 2 + tarsals 7 + metatarsals 5 + phalanges 14 = 31; both sides = 62.
- Total appendicular bones = 64 + 62 = 126. Together with 80 axial bones, the usual adult total is 206.

Result

I identified ____ appendicular bones, correctly stated their location and recorded representative landmarks.

Precautions

- Use anatomical position when naming medial and lateral structures.
- Do not count the ilium, ischium and pubis as three separate adult hip bones after fusion.
- Confirm landmarks before assigning right or left to an isolated bone.

Viva Questions and Answers**1. Which forearm bone is on the thumb side?**

Radius in anatomical position.

2. What forms the hip bone?

Ilium, ischium and pubis fuse to form one hip bone on each side.

3. How many carpals and tarsals are on one side?

Eight carpals in the wrist and seven tarsals in the foot.

Introduction to Hemocytometry

Experiment 6 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To identify an improved Neubauer counting chamber and calculate concentration from counted cells, dilution and chamber volume.

Principle

Hemocytometry counts cells in a known volume. The improved Neubauer grid has nine large 1 mm² squares and a 0.1 mm depth beneath its correctly seated special coverslip. Concentration = counted cells × dilution factor ÷ counted volume. One mm³ equals one µL.

Requirements

- Improved Neubauer chamber and its specified coverslip.
- Microscope, calibrated pipettes, instructor-prepared control suspension and approved diluent.
- Gloves and the laboratory's specimen-handling materials.

Procedure

1. Inspect the chamber

Identify the ruled areas, central counting grid and depth marking. Confirm that the chamber is the improved Neubauer type.

2. Seat the coverslip

Use the special coverslip according to the manufacturer's instructions. Incorrect seating changes chamber depth.

3. Prepare the control

Mix the instructor-provided control suspension and record the assigned dilution. Dilution factor is total mixture volume divided by original suspension volume.

Human Anatomy, Physiology and Pathophysiology I

4. Load and settle

Fill by capillary action without overflow, bubbles or incomplete coverage. Allow the stated settling time before counting.

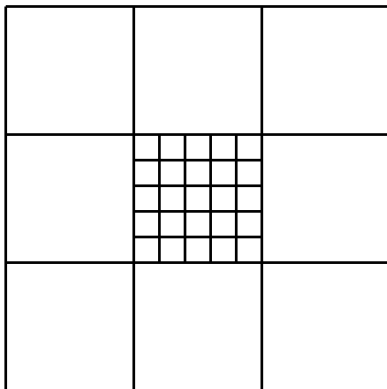
5. Count consistently

Use the assigned squares. Include cells touching top and left borders; exclude bottom and right borders, applying the same rule throughout.

6. Calculate

Record the area counted, depth and total cells. Convert the calculated concentration to the requested units.

Chamber Geometry



Improved Neubauer chamber

Grid: 3 mm × 3 mm

Each large square: 1 mm²

Chamber depth: 0.1 mm

Central square: 25 groups

Schematic; not to scale.

Region	Area	Volume at 0.1 mm depth
One large square	1 mm ²	0.1 µL
Four corner squares	4 mm ²	0.4 µL
Five central group squares	$5 \times 0.04 = 0.20 \text{ mm}^2$	0.020 µL

Human Anatomy, Physiology and Pathophysiology I

Observations and Record

Quantity	Symbol / unit	Record
Cells counted	N	___
Dilution factor	D	___
Area × depth	mm ² × mm = μL	___

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Example: 120 cells counted in 4 large squares. Volume = $4 \times 1 \text{ mm}^2 \times 0.1 \text{ mm} = 0.4 \text{ μL}$. With $D = 20$, concentration = $120 \times 20 \div 0.4 = 6000 \text{ cells/μL}$.
- A 1:20 dilution uses 1 volume of original suspension plus 19 volumes of diluent, giving 20 total volumes.
- Counts from two chambers should be assessed for agreement under the laboratory criterion, not merely averaged after a faulty fill.

Result

For $N = \text{___}$, $D = \text{___}$ and counted volume = $\text{___} \text{ μL}$, the calculated concentration is $\text{___} \text{ cells/μL}$.

Precautions

- Do not use an ordinary slide coverslip when the chamber requires a special coverslip.
- Reject visibly faulty fills instead of attempting to compensate mathematically.
- Use controls or supplied specimens; collection and clinical testing are performed by trained staff.

Viva Questions and Answers**1. What is the chamber depth?**

0.1 mm for a correctly assembled standard improved Neubauer chamber.

2. Why use a border rule?

It prevents counting a cell twice at neighbouring square boundaries.

3. Why does dilution appear in the numerator?

The diluted suspension has fewer cells per volume than the original.

Total Blood Count by Cell Analyser

Experiment 7 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To observe a cell-analyser demonstration, identify the main CBC parameters and check the consistency of a teaching report.

Principle

Automated haematology analysers may use impedance, optical methods and haemoglobin photometry. A CBC reports red cells, white cells, platelets and derived red-cell indices. Instrument flags, quality-control status and specimen quality must be considered before interpretation.

Requirements

- Laboratory cell analyser, its operating instructions and acceptable control results.
- Instructor-provided appropriately collected specimen or demonstration material.
- An anonymised or fictional CBC printout.

Procedure

1. Check the demonstration

Confirm instrument readiness and the current control result with the instructor. Observe the specified start-up and identification process.

2. Check the specimen

Review correct identification, suitable anticoagulant, mixing and absence of visible clot. Trained staff manage collection and analyser loading.

3. Observe analysis

Note the basic measuring principles and the distinction between directly measured and calculated parameters.

4. Read the report

Record the units, instrument flags and laboratory intervals. Confirm whether the report includes a differential count.

5. Check consistency

Use the red-cell-index formulas below on a fictional report. Discuss discrepancies or flags with the instructor; do not diagnose from one number.

Parameters and Meaning

Parameter	Meaning	Interpretive point
RBC, Hb, Hct	Cell number, haemoglobin concentration and red-cell volume fraction	Assess together, not interchangeably
WBC / differential	Total white cells / types of white cells	Use absolute counts when appropriate
Platelets	Platelet number	Count is not the same as platelet function
MCV, MCH, MCHC	Red-cell size and haemoglobin indices	Support classification, not a diagnosis alone

Human Anatomy, Physiology and Pathophysiology I

Observations and Record

Parameter	Usual reporting unit	Teaching report / own record
RBC / WBC	$10^{12}/L$ / $10^9/L$	_____
Haemoglobin / haematocrit	g/dL or g/L / % or L/L	_____
Platelets / MCV	$10^9/L$ / fL	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Fictional report: Hb 13.5 g/dL, Hct 42%, RBC 4.8 million/ μ L.
- $MCV = Hct(\%) \times 10 \div RBC(\text{million}/\mu\text{L}) = 42 \times 10 \div 4.8 = 87.5 \text{ fL}$.
- $MCH = Hb(g/dL) \times 10 \div RBC(\text{million}/\mu\text{L}) = 28.1 \text{ pg}$. $MCHC = Hb \times 100 \div Hct(\%) = 32.1 \text{ g/dL}$.
- Unit checks: $RBC 4.8 \text{ million}/\mu\text{L} = 4.8 \times 10^{12}/L$; $WBC 6800/\mu\text{L} = 6.8 \times 10^9/L$.

Result

The analyser principles and ____ reported parameters were identified. Calculated indices were checked using the fictional data, and the instructor reviewed any flags.

Precautions

- Do not interpret a flagged result as valid until reviewed under laboratory procedures.
- Do not run a clotted or unidentified specimen as an ordinary valid specimen.
- Intervals vary with laboratory, age and other factors; use the interval printed on the report.

Viva Questions and Answers**1. What does MCV describe?**

Average red-cell volume.

2. Is a CBC always a differential count?

No; verify whether a differential was included in the requested analysis.

3. Why run quality controls?

They help establish that the analytical system is performing acceptably.

WBC Count and Differential Count

Experiment 8 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To calculate a manual white-cell count and identify the major white-cell types on an instructor-prepared stained smear.

Principle

A validated WBC diluent allows leukocytes to be counted while reducing interference from red cells. In an improved Neubauer chamber, four corner squares have volume 0.4 μL . A differential describes the proportions of white-cell types; an absolute count combines the percentage with the total WBC count.

Requirements

- Improved Neubauer chamber, special coverslip, pipettes and laboratory-approved WBC diluent.
- Instructor-prepared blood control or supplied specimen and prepared stained smear.
- Microscope and counting record.

Procedure

1. Record the dilution

Use the supplied dilution or prepare the assigned dilution under instructor supervision. For $D = 20$, one original volume is included in twenty total volumes.

2. Load and count

Mix the diluted material, load the chamber correctly and allow the prescribed settling. Count the four large corner squares using one border rule. Count the second chamber as directed.

3. Calculate total WBC

Sum the cells and use $N \times D \div 0.4$ to obtain cells/ μL . Review chamber agreement before reporting.

Human Anatomy, Physiology and Pathophysiology I

4. Examine the smear

Find a suitable monolayer region on the instructor-prepared smear. Use the prescribed microscope objective and a systematic path that avoids repeatedly counting the same cells.

5. Record the differential

Classify the assigned number of WBCs, commonly 100 for a teaching exercise. Sum the type counts and calculate percentages.

6. Interpret cautiously

Calculate selected absolute counts and compare with the supplied laboratory intervals. Explain that a small manual differential has counting uncertainty.

White-cell Recognition Guide

Cell type	Typical stained appearance	Broad role
Neutrophil	Segmented nucleus; fine granules	Innate defence
Lymphocyte	Dense rounded nucleus; variable cytoplasm	Adaptive immune functions
Monocyte	Larger cell; folded nucleus	Phagocytic and immune functions
Eosinophil	Often bilobed; conspicuous eosinophilic granules	Allergy and parasite-related responses
Basophil	Dark granules may obscure the nucleus	Allergic and inflammatory responses

Observations and Record

Count category	Number observed	Calculated result
Corner squares 1-4	___; ___; ___; ___	Total N = ___
Neutrophils / lymphocytes	___ / ___	___% / ___%
Monocytes / eosinophils / basophils	___ / ___ / ___	___% / ___% / ___%

Human Anatomy, Physiology and Pathophysiology I

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Total WBC: $N = 136$, $D = 20$, counted volume = $0.4 \mu\text{L}$. $\text{WBC} = 136 \times 20 \div 0.4 = 6800/\mu\text{L}$.
- Illustrative differential of 100 cells: neutrophils 60, lymphocytes 30, monocytes 6, eosinophils 3, basophils 1; total = 100.
- Absolute neutrophils = $6800 \times 60/100 = 4080/\mu\text{L}$. A percentage alone can mislead when the total WBC count changes.

Result

Total WBC = ____ cells/ μL . Differential total = ____ cells. Absolute ____ count = ____ cells/ μL ; interpretation uses the supplied laboratory interval.

Precautions

- Do not confuse the four WBC corner squares with the five smaller RBC counting groups.
- Do not count in a thick smear region where cells overlap excessively.
- Apply specimen precautions and instructor disposal procedures; do not undertake unsupervised blood collection.

Viva Questions and Answers

1. Why calculate an absolute differential count?

It expresses the number of a particular WBC type per volume, rather than only its proportion.

2. What is the count factor at $D = 20$?

For four large squares, $\text{WBC} = N \times 50/\mu\text{L}$.

3. Can a differential alone diagnose infection?

No; the count must be considered with clinical assessment and other findings.

RBC Count and Interpretation

Experiment 9 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To calculate a manual red-cell concentration and explain the chamber-area and dilution factors.

Principle

A validated isotonic RBC diluent preserves countable red cells. Five group squares in the centre of the improved Neubauer grid have total area 0.20 mm^2 ; with depth 0.1 mm the counted volume is $0.020 \mu\text{L}$. Red-cell concentration alone does not describe haemoglobin content or identify the cause of anaemia.

Requirements

- Improved Neubauer chamber and specified coverslip.
- Instructor-supplied control or specimen, calibrated pipettes and approved RBC diluent.
- Microscope and count sheet.

Procedure

1. Confirm dilution

Record the assigned dilution, commonly 1:200 in the teaching calculation. Use the laboratory-approved diluent and procedure.

2. Prepare the chamber

Seat the special coverslip and load the well-mixed dilution without bubbles or overflow. Allow the specified settling time.

3. Select counting groups

Identify the four corner and one central group squares within the central 1 mm^2 area. Each group is 0.04 mm^2 and contains sixteen small squares.

4. Count

Count all cells in the five selected groups with the same border rule. Record group totals and assess the second chamber as required.

5. Calculate and interpret

Use $N \times D \div 0.020$. Report units and compare with the provided interval alongside Hb, Hct and red-cell indices.

Human Anatomy, Physiology and Pathophysiology I**Observations and Record**

Group square	Cells counted	Record
Central-grid corner groups	____; ____; ____; ____	Subtotal: ____
Central group	____	Total N: ____
Dilution / concentration	D: ____	____ cells/ μ L

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Illustrative count: $N = 480$, $D = 200$. $RBC = 480 \times 200 \div 0.020 = 4,800,000$ cells/ μ L.
- Thus the usual factor for this exact area and dilution is 10,000. A different area or dilution needs a different factor.
- $4,800,000/\mu L = 4.8$ million/ μ L $= 4.8 \times 10^{12}/L$.

Result

$N =$ ____ and $D =$ ____ . RBC concentration = ____ cells/ μ L, equivalent to ____ $\times 10^{12}/L$.

Precautions

- Do not count five large 1 mm² squares when the method calls for five central group squares.
- Mix before loading because cells can settle in the dilution.
- Do not equate an RBC count with a haemoglobin concentration or a confirmed diagnosis.

Viva Questions and Answers**1. Why use an isotonic diluent?**

To help preserve red-cell integrity for counting.

2. What is the counted volume for five groups?

0.020 μ L at a 0.1 mm chamber depth.

3. What makes the count factor change?

Dilution, counted area or chamber depth.

Bleeding Time and Clotting Time

Experiment 10 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To distinguish primary haemostasis from clot formation and calculate intervals using a supervised demonstration or simulation.

Principle

Bleeding time is the interval until bleeding stops under a specified test method and is influenced by platelet and small-vessel function. Whole-blood clotting time records a method-specific clot endpoint and relates more to coagulation. These historical teaching tests are not interchangeable with modern platelet studies, PT or aPTT; bleeding time is rarely used clinically today.

Requirements

- Instructor-selected video, simulated timing record or approved demonstration.
- Timer, endpoint descriptions and observation sheet.
- Any invasive demonstration is conducted only by authorised trained staff under institutional procedures.

Procedure

1. Identify the method

Record whether the demonstration concerns bleeding time or clotting time. Note the named method, time-zero definition and endpoint.

2. Observe bleeding endpoint

In a simulation or authorised demonstration, record the start and the first endpoint meeting the stated method. Do not carry out cuts or punctures on classmates.

3. Observe clot endpoint

Record when the stated clot criterion is reached and the conditions shown, including temperature where relevant.

4. Calculate intervals

Subtract the starting timestamp from each endpoint. Write both minutes and seconds; a decimal minute is not the same as a minute:second notation.

5. Discuss limitations

Compare the recorded interval with the method-specific laboratory interval. Discuss observer dependence and why modern investigations may be preferred.

Human Anatomy, Physiology and Pathophysiology I

Observations and Record

Test	Start / endpoint	Elapsed interval
Bleeding-time simulation	___ / ___	___ min ___ s
Clotting-time simulation	___ / ___	___ min ___ s
Method / conditions	_____	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Illustrative bleeding record: start 09:02:00; endpoint 09:05:30. Interval = 3 min 30 s = 3.5 min.
- Illustrative clotting record: start 09:10:00; endpoint 09:14:45. Interval = 4 min 45 s = 4.75 min.
- These times demonstrate arithmetic and are not patient findings or universal normal limits.

Result

Bleeding-time simulation: ___ min ___ s. Clotting-time simulation: ___ min ___ s. Method-specific limitations were identified.

Precautions

- Use the approved simulation rather than student self-puncture or improvised cuts.
- Do not stop medicines or infer a bleeding disorder from a classroom timing result.
- Test conditions and endpoint definitions must be recorded; different methods cannot be compared by one universal cutoff.

Viva Questions and Answers**1. Which process is especially relevant to bleeding time?**

Primary haemostasis involving platelets and small vessels.

2. Are clotting time and aPTT the same?

No; they have different procedures and endpoints.

3. Why is bleeding time uncommon today?

It is difficult to perform reproducibly and more suitable investigations are available.

Haemoglobin Estimation and Interpretation

Experiment 11 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To observe a prescribed haemoglobin estimation method, calculate a teaching result and interpret it with the supplied laboratory interval.

Principle

Haemoglobin concentration describes the oxygen-carrying pigment in a volume of blood. Modern analysers may use validated non-cyanide photometric methods. A visual acid-haematin teaching method, where used, has different limitations. The named method, calibration and control status must accompany the result.

Requirements

- Instructor-selected analyser or photometer and its specified reagent system.
- Appropriate control, calibrator and supplied specimen or demonstration material.
- Method instructions and observation sheet.

Procedure

1. Identify the method

Record the instrument or teaching method and the reporting unit. Do not combine reagents or procedures from different methods.

2. Check readiness

Observe the instrument blank or zero, calibrator and control checks as prescribed.

3. Observe preparation

The instructor prepares and measures the supplied material using the method-specific quantities and reaction time.

4. Read the result

Record the reported Hb or blank-corrected absorbance. Apply the calibration calculation only if it is the validated calculation for that method.

5. Interpret

Compare with the supplied age- and context-appropriate interval. Consider CBC indices and clinical assessment; a low Hb finding does not itself establish the cause.

Human Anatomy, Physiology and Pathophysiology I**Observations and Record**

Item	Value / description	Record
Method and unit	Instrument / g/dL or g/L	_____
Calibrator / control	Assigned concentration / accepted result	_____
Specimen result	Reported Hb or absorbance	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- One-point linear teaching example: standard Hb = 15.0 g/dL; standard absorbance = 0.50; test absorbance = 0.40, all blank-corrected.
- $Hb = (0.40 \div 0.50) \times 15.0 = 12.0 \text{ g/dL} = 120 \text{ g/L}$.
- This formula requires a valid linear method and matched conditions; use the instrument's calibration when the method is not a simple one-point comparison.

Result

Method: _____. Haemoglobin = ____ g/dL or ____ g/L. The result was considered with the supplied interval and other relevant information.

Precautions

- Use only the specified reagent system; do not prepare hazardous historical reagents for this exercise.
- Turbidity, clots or poor specimen identification can invalidate a result.
- Do not infer iron deficiency from Hb alone or advise treatment from the classroom result.

Viva Questions and Answers**1. What does Hb concentration measure?**

The mass concentration of haemoglobin in blood.

2. How are g/dL and g/L related?

Multiply g/dL by 10 to obtain g/L.

3. Why is a visual teaching method limited?

Colour matching and observer judgement can reduce precision compared with validated instrument measurement.

Blood Group Determination

Experiment 12 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To interpret a supervised ABO and RhD grouping demonstration using reagent reactions and controls.

Principle

In forward grouping, specific antibodies detect red-cell antigens through agglutination. Reverse ABO grouping checks plasma reactions with known reagent cells when applicable. RhD testing uses the specified anti-D method and controls. Classroom grouping is not a substitute for a transfusion laboratory work-up.

Requirements

- Instructor-prepared simulated grouping kit or authorised laboratory demonstration.
- Anti-A, anti-B and anti-D reagents, relevant controls and approved method instructions.
- Labelled reaction record; no unsupervised blood collection.

Procedure

1. Confirm identification

Check the demonstration material and reagent identity, expiry and quality-control status.

2. Set up reactions

The instructor follows the validated slide, tube or other method. Maintain separate reaction areas and avoid reagent carryover.

3. Read within the method

Record agglutination only within the specified time and conditions. Distinguish a true reaction from drying artefact or an invalid control.

4. Interpret forward ABO

Use the pattern in the table. Confirm that controls and any required reverse grouping agree; unresolved discrepancies need laboratory investigation.

5. Interpret RhD

A valid anti-D reaction supports D antigen detection under the method. A non-reactive result is interpreted by the laboratory's algorithm; do not invent a weak-D conclusion.

6. Record limitations

State that clinical transfusion decisions require authorised testing, compatibility assessment and the complete patient context.

Human Anatomy, Physiology and Pathophysiology I

Forward ABO Pattern

Anti-A	Anti-B	Forward ABO interpretation
+	–	A
–	+	B
+	+	AB
–	–	O

Reverse Grouping Check

In a suitable adult demonstration, group A plasma reacts with B reagent cells, group B plasma with A reagent cells, group O plasma with both, and group AB plasma with neither. Special age groups and discrepant reactions require the laboratory's procedure.

Observations and Record

Reagent	Reaction + / –	Control status
Anti-A	_____	_____
Anti-B	_____	_____
Anti-D	_____	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Fictional valid forward grouping: anti-A positive, anti-B negative. The forward ABO pattern supports group A.
- If anti-D is positive with a valid control, the teaching interpretation is RhD positive.
- If a control is invalid or forward and reverse ABO results disagree, record "unresolved" rather than assigning a definitive group.

Result

Forward ABO pattern: _____. Control validity: _____. Teaching ABO / RhD interpretation: ____ / _____, subject to the complete laboratory method.

Precautions

- Do not use a classroom or home grouping result for transfusion or pregnancy care.
- Read at the specified time; dried mixtures may mimic agglutination.
- Do not assume ABO and RhD cover every clinically relevant blood-group antigen.

Viva Questions and Answers

1. What does anti-A detect?

A antigen on red cells in a valid forward-grouping test.

2. Why use reverse ABO grouping?

It provides a complementary plasma-reaction check when appropriate.

3. Does group matching alone prove transfusion compatibility?

No; other antigens and antibodies and compatibility procedures matter.

Erythrocyte Sedimentation Rate

Experiment 13 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To observe a Westergren-type ESR demonstration and report sedimentation with method, time and units.

Principle

ESR describes red-cell settling under standardised conditions and is commonly expressed in mm at one hour. Increased plasma proteins can promote red-cell aggregation, but anaemia, cell shape and other factors also affect sedimentation. ESR is a non-specific finding and does not identify one disease by itself.

Requirements

- Westergren-type system and its instructions, vertical stand and timer.
- Instructor-provided anticoagulated material or a simulated reading.
- Temperature and observation record.

Procedure

1. Confirm method

Record the tube or instrument type, required anticoagulant and any prescribed dilution. Use the method-specific preparation rather than assuming one dilution for every system.

2. Observe filling

The instructor fills to the stated mark without bubbles or clot. Note that a correct initial level is required.

3. Set vertically

Place the tube upright in a stable stand, protected from vibration and unsuitable temperature conditions. Start timing as prescribed.

4. Read

At the stated endpoint, usually one hour for the classical method, read the clear-plasma column above the red cells in millimetres.

5. Interpret

Report method and interval and compare with the supplied laboratory range. Discuss non-specificity and confounding factors.

Human Anatomy, Physiology and Pathophysiology I

Observations and Record

Item	Required record	Observation
Method / temperature	System and room condition	_____
Start / reading time	___ / ___	_____
Sedimentation	Clear-plasma column	___ mm at 1 h

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Illustrative classical reading: clear-plasma column 18 mm after one hour. Report ESR = 18 mm at 1 h under the stated method.
- Do not divide a 30-minute observation into a guessed one-hour result: sedimentation is not assumed to be a simple linear process.

Result

ESR by ___ method = ___ mm at ___ h. The measurement conditions and interpretive limitations are recorded.

Precautions

- Keep the tube vertical and the timing consistent.
- Clots, bubbles, vibration or an incorrect fill level can invalidate the reading.
- Do not use ESR alone to diagnose infection, autoimmune disease or malignancy.

Viva Questions and Answers**1. What is read in the classical test?**

The height of clear plasma above the settled red cells at the stated time.

2. Why can tube tilt matter?

It changes the sedimentation conditions and can distort the measurement.

3. Why is ESR non-specific?

Many inflammatory and non-inflammatory factors can change it.

Pulse Rate Heart Rate and Blood Pressure

Experiment 14 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To measure a supervised resting pulse and blood pressure and distinguish pulse rate from heart rate.

Principle

Pulse is the palpable arterial pressure wave; heart rate is the number of cardiac cycles per minute. They are usually equal in a regular effective rhythm but may differ. Blood pressure measurement depends on preparation, cuff size, arm position and repeated readings; one classroom reading does not diagnose hypertension.

Requirements

- Timer, validated upper-arm BP device and suitable cuff sizes.
- Stethoscope for the instructor-prescribed auscultatory demonstration.
- Consenting adult volunteer under classroom supervision or simulation.

Procedure

1. Prepare

Explain the activity and obtain consent. For a resting BP measurement, avoid exercise, smoking and caffeine for 30 minutes beforehand when following the standard procedure; allow at least five minutes of quiet seated rest.

2. Position

Seat with back supported, feet flat and legs uncrossed. Support the bare upper arm at heart level. Select the cuff specified for the measured arm circumference.

3. Measure pulse

Palpate the radial pulse with finger pads, not the thumb. Record rate and rhythm. Count for a full minute when irregular or when the protocol requires it.

4. Measure BP

Use the validated device instructions. Keep the volunteer still and silent. Repeat readings with the prescribed interval, commonly at least one minute, and record each result.

5. Observe auscultation

Where demonstrated, the first Korotkoff sounds identify systolic pressure and disappearance identifies adult diastolic pressure under the prescribed method.

6. Record and interpret

Record arm, cuff, position, device and readings. Do not change a person's treatment on the basis of the exercise.

Human Anatomy, Physiology and Pathophysiology I

Observations and Record

Measurement	Reading 1	Reading 2
Pulse / heart rate	___ beats/min	___ beats/min
Blood pressure	___ / ___ mmHg	___ / ___ mmHg
Arm / cuff / position	_____	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Regular pulse exercise: 36 beats in 30 s gives $36 \times 2 = 72$ beats/min. Use a full-minute count when required rather than extrapolating an irregular rhythm.
- Fictional BP readings: 124/78 and 122/80 mmHg. Arithmetic mean = 123/79 mmHg.
- An auscultated heart rate of 84/min with a radial pulse of 78/min gives a pulse deficit of 6/min, if counted under an appropriate comparable protocol.

Result

Pulse: ___ beats/min; rhythm: ___. BP readings: ___ and ___ mmHg. Device, cuff, arm and position are documented.

Precautions

- Use a cuff that fits the arm; an unsuitable cuff can bias the result.
- Do not measure over clothing or while the person talks.
- Concerning symptoms during a volunteer activity require the supervising clinician's attention.

Viva Questions and Answers**1. Why support the arm at heart level?**

It helps standardise hydrostatic effects on the reading.

2. Why can pulse and heart rates differ?

Some cardiac cycles may not generate a palpable peripheral pulse.

3. Does one high reading establish hypertension?

No; correct repeated assessment and clinical evaluation are required.

ECG Recording and Interpretation

Experiment 15 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To observe a standard 12-lead ECG recording, identify the principal waves and calculate a teaching heart rate.

Principle

An ECG records electrical potential differences associated with cardiac activity. Ten electrodes provide twelve standard leads: I, II, III, aVR, aVL, aVF and V1-V6. P reflects atrial depolarisation, QRS ventricular depolarisation and T ventricular repolarisation. An ECG is not a direct measurement of pumping strength.

Requirements

- ECG machine and instructions, electrodes and approved skin-preparation supplies.
- Consenting supervised volunteer, manikin or supplied anonymised trace.
- Ruler and calculation sheet.

Procedure

1. Prepare

Explain the recording, obtain consent and maintain privacy. Position the person comfortably as required and check identity and recording details.

2. Place electrodes

The trained demonstrator identifies anatomical landmarks. Use the machine's limb-electrode labels rather than relying on colour codes, which differ between systems.

3. Record

Ask the person to remain still. Check contact quality and interference before recording at the stated speed and gain.

4. Check the trace

Record calibration, lead labels and artefacts. Reversed or misplaced electrodes can alter the tracing.

5. Read systematically

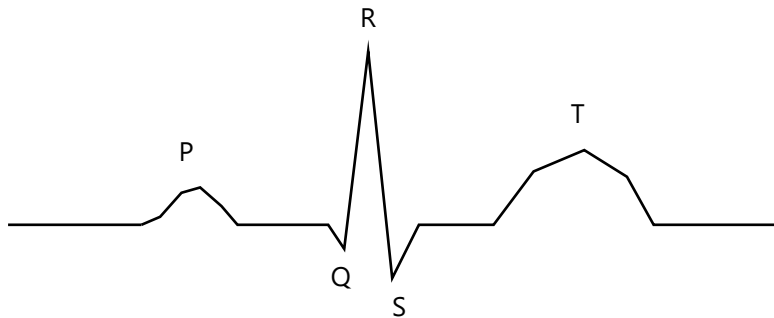
Assess rate and regularity; identify P, QRS and T; measure intervals where instructed. Relate observations to the supervising clinician's interpretation, not an independent diagnosis.

Human Anatomy, Physiology and Pathophysiology I

Chest Electrode Positions

Electrode	Standard position	Check
V1 / V2	Fourth intercostal space at right / left sternal border	Identify the space anatomically
V4	Fifth intercostal space, left midclavicular line	Place before locating V3
V3	Midway between V2 and V4	Do not guess a fixed rib space
V5 / V6	Left anterior / midaxillary line, level with V4	Keep the same horizontal level

Wave Identification



P: atrial depolarisation QRS: ventricular depolarisation T: ventricular repolarisation

Schematic; not a diagnostic tracing and not to scale.

Intervals to Locate

PR is measured from the start of P to the start of QRS. QRS duration is measured across the ventricular complex. QT extends from QRS onset to T-wave end and varies with rate; any corrected QT uses a stated validated formula.

Observations and Record

Feature	Measurement / observation	Record
Calibration	Speed and gain	___ mm/s; ___ mm/mV
Rate / rhythm	R-R spacing and regularity	_____
Waves / intervals	P, QRS, T and measured interval	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

Human Anatomy, Physiology and Pathophysiology I

- At 25 mm/s: one 1 mm small square = 0.04 s; one 5 mm large square = 0.20 s. At 10 mm/mV, 1 mm vertically = 0.1 mV.
- For a regular rhythm with four large squares between R waves: rate = $300 \div 4 = 75$ beats/min.
- For an irregular rhythm on a complete 10-second trace, 12 QRS complexes give $12 \times 6 = 72$ /min as an approximate average.
- Do not use these shortcuts when the speed or trace duration differs from the assumptions.

Result

Recording speed: ____ mm/s; gain: ____ mm/mV. Calculated rate: ____ beats/min. Waves and artefacts were identified and reviewed with the instructor.

Precautions

- Preserve consent, privacy and appropriate electrode placement during volunteer recording.
- Check speed and gain before measuring; do not use a 25 mm/s factor on a 50 mm/s trace.
- Clinical concerns or symptoms are referred to the supervising clinician; a classroom interpretation does not exclude heart disease.

Viva Questions and Answers

1. Why are there twelve leads but ten electrodes?

Leads are calculated electrical views; several are derived from the limb electrodes.

2. What does QRS represent?

Ventricular depolarisation.

3. How does artefact affect interpretation?

Movement or poor contact can mimic or obscure electrical patterns.

Cardiovascular and Integumentary Systems

Experiment 16 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To identify major cardiovascular and skin structures and relate their arrangement to circulation, protection and temperature regulation.

Principle

The heart drives pulmonary and systemic circulation. Valves favour forward flow, while vessels distribute and return blood. The integumentary system includes skin and its appendages; the epidermal barrier, dermal structures and subcutaneous tissue have distinct roles.

Requirements

- Heart, vessel and skin models; approved charts or prepared tissue slides.
- Notebook and label checklist.

Procedure

1. Orient the heart

Identify right and left sides, atria, ventricles, septa and the major vessels. Use anatomical orientation rather than the viewer's left and right.

2. Trace circulation

Trace blood from systemic veins through the right heart, lungs, left heart and aorta. Identify all four valves in order.

3. Compare vessels

Identify lumen and wall on a chart or slide. Relate arterial wall structure, venous return and thin capillary exchange surfaces to function.

4. Study skin

Identify epidermis and dermis. Locate hair follicles, sweat glands, sensory structures and blood vessels; distinguish hypodermis below the skin.

Human Anatomy, Physiology and Pathophysiology I

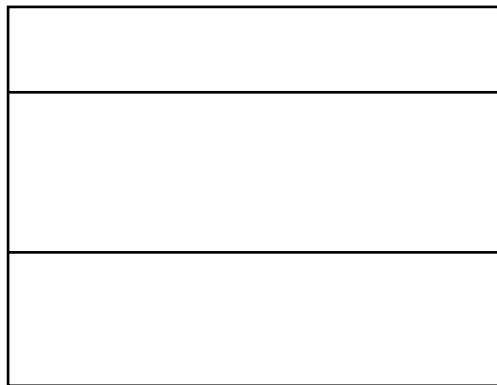
5. Relate function

Explain barrier protection, sensation, heat loss and the link between dermal blood flow and thermoregulation. Record a labelled flow sequence and a skin-layer sketch.

Blood-flow Pathway

Venae cavae → right atrium → tricuspid valve → right ventricle → pulmonary valve → pulmonary arteries → lungs → pulmonary veins → left atrium → mitral valve → left ventricle → aortic valve → aorta → systemic tissues.

Skin Layers



Epidermis - avascular outer barrier

Dermis - vessels, nerves and glands

Hypodermis - adipose tissue below skin

Simplified layers; not to scale.

Region	Structures / features	Function
Epidermis	Keratinising epithelium; no vessels	Barrier protection
Dermis	Connective tissue, vessels, nerves and appendages	Support, sensation and heat exchange
Hypodermis	Adipose and connective tissue below skin	Cushioning and insulation

Human Anatomy, Physiology and Pathophysiology I

Observations and Record

Structure	Identification	Function
Heart / valve	_____	_____
Vessel	_____	_____
Skin layer / appendage	_____	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Teaching cardiac-output calculation: heart rate 72/min $\times$ stroke volume 70 mL/beat = 5040 mL/min = 5.04 L/min. These assumed values are not measurements.
- Structural comparison: the epidermis has no blood vessels; nutrients reach it from the underlying dermal circulation.

Result

The blood-flow pathway and major valves were identified. The skin sketch labels epidermis, dermis and relevant appendages.

Precautions

- Arteries are defined by flow away from the heart, not by oxygen content.
- Do not confuse the pulmonary artery with an oxygen-rich systemic artery.
- The hypodermis is below the skin proper; use the terminology specified by the instructor.

Viva Questions and Answers

1. Which side pumps to the lungs?

The right ventricle sends blood through the pulmonary artery.

2. Which valve lies between left atrium and ventricle?

The mitral, or bicuspid, valve.

3. How can skin participate in temperature control?

Sweating and changes in dermal blood flow influence heat exchange.

Case Studies in Pathophysiology

Experiment 17 - Practical Notes

Name: _____ Roll no.: _____ Date: _____

Aim

To connect selected clinical presentations with basic mechanisms and identify appropriate information and referral needs.

Principle

A case study separates observations, possible explanations and confirmed findings. The cases below are fictional learning exercises covering anaemia, thalassemia, haemophilia, leprosy, gout, hypertension and ischemic heart disease. They do not describe real patients or provide individual prescriptions.

Requirements

- Fictional case sheets, the supplied laboratory intervals and relevant anatomy charts.
- Discussion worksheet with no patient identifiers.

Procedure

1. Extract facts

List stated symptoms, measurements and confirmed diagnoses. Do not add unreported results.

2. Explain mechanism

Connect the findings to a relevant physiological process without claiming certainty from an isolated finding.

3. Consider alternatives

Name information or investigations the clinician may need to distinguish possible causes.

4. Identify urgency

Separate a routine learning discussion from signs requiring urgent clinical assessment.

5. Summarise

Write a brief mechanism, a relevant next information need and a respectful communication point for each case.

Fictional Cases and Discussion

Anaemia

Case: A fictional adult reports fatigue; Hb is 9.5 g/dL, MCV 70 fL and the laboratory report identifies low ferritin.

Pathophysiology: Reduced Hb can reduce oxygen delivery. Low MCV indicates microcytosis. Low ferritin supports iron depletion in this teaching context, but inflammation and the broader history affect interpretation.

Human Anatomy, Physiology and Pathophysiology I

Discussion: Identify relevant CBC values; discuss dietary intake, blood loss and other possible causes with the instructor. The clinician determines the cause and treatment. Do not assume that all anaemia is iron deficiency.

Thalassemia

Case: A fictional student has longstanding microcytosis, a family history of a haemoglobin disorder and a clinician-requested haemoglobin analysis.

Pathophysiology: Thalassemia is inherited impaired globin-chain production. Severity ranges from mild trait to serious anaemia. Small cells can resemble other causes of microcytosis; CBC alone does not establish the subtype.

Discussion: Discuss family history, CBC, specialised haemoglobin testing and, when indicated, genetic assessment. Do not assume iron deficiency or recommend iron solely because MCV is low.

Haemophilia

Case: A fictional child has recurrent joint bleeding and a documented specialist diagnosis of factor VIII deficiency.

Pathophysiology: Haemophilia A involves factor VIII deficiency; haemophilia B involves factor IX. Impaired coagulation can cause prolonged bleeding and joint or muscle bleeds. Platelet count need not be low.

Discussion: Relate the deficient factor to secondary haemostasis. Discuss specialist coagulation assessment and the established care plan. New severe bleeding requires urgent clinical attention; the learner does not prescribe factor replacement.

Leprosy

Case: A fictional adult has a pale skin patch with reduced sensation and has been referred for assessment of possible Hansen's disease.

Pathophysiology: Leprosy can affect skin and peripheral nerves, producing sensory loss and weakness. Loss of protective sensation can lead to unnoticed injuries. The described signs require clinical assessment rather than a diagnosis from colour alone.

Discussion: Discuss respectful history-taking, sensory and nerve assessment by trained clinicians and timely specialist care. Use non-stigmatising language. No collection, culture or handling of infectious material is part of this case exercise.

Gout

Case: A fictional adult has a sudden painful swollen first-toe joint. The clinician considers gout and other causes of acute arthritis.

Pathophysiology: Monosodium urate crystals can trigger inflammation. An elevated serum urate alone does not prove gout, and acute joint symptoms may have other causes, including infection.

Discussion: Identify the joint pattern and need for clinician-led assessment. Discuss serum urate, selected imaging and joint-fluid crystal examination where clinically indicated. Do not delay urgent assessment of a hot swollen joint with systemic symptoms.

Human Anatomy, Physiology and Pathophysiology I

Hypertension

Case: A fictional adult has elevated readings at several properly conducted appointments. The clinician requests a structured BP record.

Pathophysiology: Persistently raised arterial pressure increases cardiovascular risk, but diagnosis depends on appropriate repeated assessment and the applicable clinical criteria. Technique, stress and timing can affect a reading.

Discussion: Check cuff fit, rest, arm position and recording method. Discuss ongoing clinician follow-up and the existing treatment plan. Do not alter medicines or diagnose from one classroom reading.

Ischemic Heart Disease

Case: A fictional adult reports exertional chest discomfort and has been referred for cardiovascular evaluation. A second scenario introduces new ongoing chest pain at rest.

Pathophysiology: Reduced coronary blood supply relative to myocardial oxygen demand can cause ischaemia. Symptoms, ECG and relevant tests are assessed together; a normal-looking teaching trace does not rule out disease.

Discussion: Distinguish a planned assessment case from new potentially urgent symptoms. Ongoing chest pain, severe breathlessness or collapse requires immediate emergency escalation, not a classroom calculation. Do not make medication or dose decisions from the scenario.

Observations and Record

Case	Mechanism / key observation	Information or next-care need
Anaemia	_____	_____
Thalassemia	_____	_____
Haemophilia	_____	_____
Leprosy	_____	_____
Gout	_____	_____
Hypertension	_____	_____
Ischemic Heart Disease	_____	_____

Worked Example

The numbers below are illustrative; enter your own observations in the record.

- Illustrative anaemia index check: with Hb 9.5 g/dL and additionally assumed Hct 28% and RBC 4.0 million/ μ L, $MCV = 28 \times 10 \div 4.0 = 70$ fL, matching the microcytic pattern in the first fictional case.
- A calculated index helps classify a pattern; it does not establish its cause.

Human Anatomy, Physiology and Pathophysiology I

Result

For all seven fictional cases, the stated findings, likely mechanism, missing information and appropriate care pathway were discussed.

Precautions

- Use fictional or fully authorised anonymised material only.
- Do not diagnose or recommend starting, stopping or changing treatment from a classroom case.
- Respond promptly to urgent symptoms and avoid stigmatising language.

Viva Questions and Answers

1. Why distinguish a finding from a diagnosis?

One finding may have multiple causes and needs contextual assessment.

2. Why can thalassemia resemble iron deficiency on a CBC?

Both may cause microcytosis; specialised assessment can distinguish them.

3. Why is a raised serum urate insufficient to diagnose gout?

Many people with raised urate do not have gout, and joint symptoms require evaluation.

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