



PRACTICAL LANGUAGE MASTER PIECE.

TERMINOLOGIES USED

Examine – Very broad term! It may require using all the senses and optical microscopes to locate features needed by the examiner where possible and necessary. N.B- handlens is a simple microscope (optical microscope)

Displace- Deflect an organ in the question as instructed. Eg displace the heart anteriorly or forward. Requires you to adjust the heart with the ventricle on top while both atria at the bottom. N.B. displacement must be in respect to animal, unless the setter restricts it in respect to you.

Sclerites- hard exo-skeleton plates. **Tergites (tergum)**-Found on the dorsal side, **Sternites (sternum)**-Found on ventral side of cockroach and **pleuron (pleurites)** found on the lateral side.

Surface area = $2 \times (\text{number of full small squares} + \text{number of half small squares}/2)$

For a toad surface area to volume ratio can be established. 1. Toad placed on the white sheet of paper and outline traced, using a ruler and pencil the outline is housed in squares of 1cm^2 and then area is determined/Outline made on a graph paper having an array of lines. Volume is determined by pouring water in a measuring cylinder and then fully submerging the toad in water. The volume is established from the formula = volume of water with submerged toad – initial volume of water (CM^3). The surface area to volume ratio is then computed from

this expression = $\frac{\text{surface area}}{\text{volume}}$

Proximal- part nearer to the point of attachment.

Distal- Part far from the point of attachment.

Some Common Organ deflections.

Organ	Displacement and the possible results.
Liver	Anteriorly- Expose the hepatic portal vein.
Alimentary canal/gut/gastro-intestinal tract.	Left- to exposes veins draining the alimentary canal. Right-Exposes arteries supplying the alimentary canal.
Stomach(Rat)	Right -to expose structures previously covered e.g. kidney

Duodenum	Right- exposes origin of bile duct.
Ileum	Left- to expose tributaries of hepatic portal vein
Caecum	Down wards-Expose chain of lymphnodes.

Without displacement- Organs drawn in their natural States or insitu.

Display-Requires you to displace any obscuring organ or structure so that you locate the instructed features in the questions. Display instruction has **a lot of silent procedures** to be performed. Eg in a **Cockroach** to display the nervous system requires you to adjust or deflect the alimentary canal for proper vision. **In some situations, removing the obscuring structure(s) may be inevitable.**

Tributary- Branch of a main vein. They drain blood from organs to the main vein eg Tributaries of Hepatic portal vein in rats, drain blood from the alimentary canal into a larger Hepatic portal vein.

Distributary- Branch of main artery which supply blood to the organs eg intestinal arteries in the ileum branch from the main vessel, dorsal Aorta.

Superficial features- Features seen after skinning off ie removing the skin. It Entails **Blood vessels, nerves, Musculature (muscles) and glands.**

Portal system- Made up of many small blood vessels carrying from several regions into a larger vessel that pours the blood into a single organ. Eg **Hepatic portal system** involving the mesentery, Hepatic portal vein and liver.

Renal portal system-involving femoral, sciatic, pelvic and renal portal vein.

Trunk- Refers to the body minus head, neck and limbs. Note- Upper trunk (thorax) and lower Trunk (abdomen)

Thoracic cavity - Organs in the coelom (space) of the thorax ie heart and lungs in Rat and Toad while ganglia, heart chambers etc in cockroaches. These can be termed as thoracic organs.

Thoracic region- part above the diaphragm and below the neck (Rat). In a cockroach it's a region posterior to the head but anterior to the abdomen. **it excludes the appendages ie limbs and wings (cockroach)**

Intestines or bowel- Parts posterior to the stomach of the animal.

Associated Organs- Organs that help others to perform their functions eg liver and pancreas are associated to the alimentary canal in rats and toads.

Salivary apparatus are associated in the cockroach. **QN- Are Hepatic or digestive caeca part of the alimentary canal or associated with the alimentary canal in a cockroach?**

Accessory-Structures attached to the system but don't share the same function eg **spleen** is accessory to the gut in toads. **Malpighian tubules** are accessory to the alimentary canal in the cockroach.

Manus(Hand)- region from the wrist onwards. It has the fingers (digits), palmar surface and some-times pads.

Pes(Foot)-Region from the ankle of the hind limb onwards. In toads its webbed, elongated, padded and with long digits.

Anterior of the cockroach-Consists of the head and thorax. Posterior consists of the abdomen.

Tegmina/elytron – Outer wing/fore/anterior wing.

Buoyant structures –Structures that float when the specimen is flooded with water. They are not closely/firmly associated with the cuticles.

Adaptations - A correct adaptation should have three components

- Structure e.g. digits on the foot
- Description of the structure e.g. digits are jointed
- How the description mentioned structure improves/enhances the functioning e.g. increased flexibility

Classification or Systematic positions – master the taxonomic units to order level with reasons. The reasons for classification must be practically seen or structural.

Structure – is any observable and drawable aspect of an organism e.g. long, narrow and pointed. **Flexibility is not structural because it's a manipulatable feature. Instead of flexibility point out the joints which lead to flexibility.**

Posterior	Found on the tail side of the particular part. E.g. Features posterior to the midgut of the cockroach include ileum, colon, rectum and Malpighian tubules.
Anterior	Features at the front/cephalic/head side.
Exclusively for	Only For. E.g. Blood vessels exclusively supplying the region anterior to the diaphragm in a rat. Implication is that only vessels that supply the anterior region to the diaphragm. The Aorta supplies both the anterior and posterior regions. Drawing the Aorta could cause you to lose drawing and labeling marks.
Blood circulation	Both veins and arteries. Sinus venosus is the only vein that supplies blood. It supplies blood to the heart.
Proximity	Structure near a structure of interest by the examiner.
Mesentery	connective tissue associated with parts of alimentary canal
Viscera	Internal organs found in the body cavities e.g. kidneys.
Visceral cavity/Coelom	Space in the thorax and abdomen containing internal organs.
Hind gut	Organs posterior to the ileum for Toad and rat and for Cockroach structures posterior to the midgut.
Ventilation	Flow of air or gases in and out eg diaphragm, trachea, intercostal muscles, rib cage, lungs
Secretion	Release of useful substances eg some parts of the Alimentary canal, gonads, adrenal gland,
Storage	Keeping food or wastes for some considerable time eg Stomach,

	crop, gizzard for storage of food.
Passage	Hollow to allow easy passage of substances eg Alimentary canal, urinogenital system and respiratory system.
Removal/elimination of unwanted materials	Removal of both metabolic and non-metabolic wastes eg Rectum, colon, lung, kidneys.

BIOLOGICAL DRAWINGS.

Drawings in biology practical are not like in fine art. These drawings are not called diagrams. A drawing is an illustration of made from the observation of a specimen by a candidate. A candidate is encouraged to consider the following to have a good biological drawing to score marks:-

- T- Title
- DL-Drawing and labeling
- M- Magnification
- O- Outline
- D- Displacements as required by question
- S- Side as required by the question
- A - Accuracy (some times)
- N- Neatness
- L – Labeling
- DO NOT LABEL (when you label you get IRR = 0 mark)
- BONUS (Following instructions to the dot)

Quality of a drawing	Key concepts to note.
Title (heading) While writing the title; the candidate should remember to include only the structures required by the question to be drawn not the whole specimen	A good title should have: <ul style="list-style-type: none"> • Part being drawn e.g. head/ ventral surface of the foot • Side/view/power of microscope used to view e.g. dorsal view/lateral view/ viewed under medium power • Code of the specimen e.g. K, P etc. • Treatment of the specimen in the process of getting the part to be drawn e.g. removing alimentary canal, displacing the heart to left or anteriorly.

Drawing	<p>A good biological drawing must be drawn following the rules below:</p> <ul style="list-style-type: none"> • Use pencils for drawing not pens; colored pencils and crayons. • Use very sharp pencils not blunt pencils. • Drawing outline must be complete including whole specimen and individual, Components required by the question. • Drawing must have no gaps/ open ends/ no holes/ breaks in the outline of all organs or structures drawn. • The correct region, side, view and section required by the question must be made. • Make a large and clear drawings occupying at least $\frac{3}{4}$ of the provided space. • Pay close attention to shape; size; and proportion of each of the component parts of the specimen drawn.
Magnification	<p>This shows the relationship between the size of actual specimen or object and the drawing.</p> <p>Magnification means the number of times the drawing is big or small compared to the real / actual specimen drawn.</p> <p>Magnification is obtained by measuring the size of the specimen especially length and the size (length) of the real drawing after which the following formula is applied:</p> $\text{Magnification} = \frac{\text{length of drawing}}{\text{length of specimen}}$ <p>NOTE</p> <ul style="list-style-type: none"> • The final value of magnification is written without units since it's a ratio. • The final value obtained must be written expressed with an X before it. Examples: X0.5; X2.0; X3 etc. Where X means times; hence X2 means times two. • Whole working and calculation of magnification is not required in the exam (unless specified). • The following expressions of magnification are wrong: 2X; X²; X₂
Accuracy	<p>Marks for accuracy are normally awarded when the candidate follows instructions in the question.</p> <p>For instance:</p> <ul style="list-style-type: none"> • When the required structures of the specimen are drawn

	<p>and those not required by the question are left out. In situations where a candidate has been instructed to cut and remove some structures e.g. alimentary canal, their inclusion leads to heavy loss of most of the marks.</p> <ul style="list-style-type: none"> • Correct view drawn as required e.g. dorsal surface of the hind foot. • Correct section drawn as required. • Correctly drawn shape; curvature; broadness etc. • Correct number of cells drawn
Neatness	<p>Marks for neatness are awarded when all the rules for biological drawing are followed.</p> <p>Marks for neatness are denied when:</p> <ul style="list-style-type: none"> • Blunt pencils are used. • The drawing has dirty spots due to dirty rubber and repeated rubbing. • Has hanging lines. • The drawing is shaded etc.
Labelling	<ul style="list-style-type: none"> • Avoid labeling on the drawing as it's not a map. • Avoid labeling structures which you are not sure if they are part of the question. • Avoid labeling in plural when the labeling line is in contact with a single structure. • Do not place arrow heads on the labeling lines. • Have straight horizontal label lines which are continuous (not dotted) • Labeling lines must not cross each other. • For parts with a thickness and drawn in double line. • Labels must start at the end of the labeling line not along the labeling line. • A candidate should avoid labeling if the question specifically requires the candidate to draw but not to label.

Common errors when drawing

- Having no title.
- Absence of magnification.
- Labeling lines with arrow heads.
- Crossing labeling lines.
- Incomplete outline with gaps.
- Shaded parts of a drawing.

- Failure to draw structures proportionately.
- Inability to show tapering nature of structures where it applies.
- Labels in plural.
- Hanging lines in the outline.
- Failure of labeling lines to contact the structure indicated.
- Lack of uniformity in the outline.
- Failure of the labeling line to enter into the space between double lines for parts with a thickness.

BODY CAVITIES

ABDOMINAL CAVITY- cavity posterior to the diaphragm and anterior to the pelvic girdles for mammals. Contains liver, pancreas, spleen, gall bladder, kidneys, gut/alimentary canal/gut, ureter, bladder, ovaries, oviduct and vessels that supply and drain those features. The diaphragm is missing in toad. Thus the thoracic features include lungs and the heart. In the cockroach the abdominal region is posterior to the third thoracic segment.

THORACIC CAVITY/THORACIC COELOM.

Animals	Descriptions
Mammals(Rat)	Organs such as heart, lungs and vessels that drain and supply them. Organs enclosed in the ribcage.
Amphibians-Toad and Frog.	Lack ribcage. Contains the heart and the lungs. Lungs slightly extend into the abdominal cavity but never considered as abdominal features.
Insect-Cockroach.	Lack ribs. It stretches from prothorax to Meta-thorax. Consists of organs such as gullet, thoracic ganglia, thoracic muscles, respiratory trunk, and salivary apparatus.

PELVIC REGION.

Posterior to the abdominal cavity at the pelvis.

Animal	Constituents
Toad/frog	Cloaca etc
Rat	Anus, penis and vagina.

ORAL/BUCCAL CAVITY.

Cavity of the mouth - Containing teeth, tongue etc.

VISCERAL CAVITY/COELOM/VISCERA.

Body cavity containing internal organs eg thoracic and abdominal cavities.

BODY REGIONS.

Animal	Descriptions.
Cockroach	Head- bears antennae, mouth parts, compound eyes, and fenestra.
	Thoracic region-contain internal and external features. External features- thoracic segments ie pro-thorax , meso-thorax and meta-thorax . Internal features- gullet, salivary apparatus, thoracic muscles, tracheal

	trunk, aorta, alary muscles, and heart chambers. N.B limbs are appendages on the thorax..
	Abdomen- ten segments (6-7 visible). The last dorsal segment/last tergum bear appendages ie anal cerci. Last ventral segment bears podical plates in females and styles in males. In between last tergum and sternum are gonapophyses which are pointed in male but blunt in females.
Toad	Head- has organs such as eyes, ear drums, mouth and nostrils. Head is dorso-ventrally flatted with streamlined shape or tapering anteriorly.
	Body of the toad is divided into the head and the trunk.
	Trunk. Consists of the thoracic, pelvic and abdominal regions. No clear distinction between thoracic and abdominal region. The thoracic and abdominal cavities form Coelom.
	Thoracic region- posterior to the neck and anterior to abdomen. Contains thoracic cavity plus external features like shoulder and skin of the armpit. Vessels that drain and supply the shoulder and armpits are not part of the thoracic cavity features. The vessels that drain and supply the lungs and heart constitute to the thoracic cavity.
Rat	Body divided into the head, neck, thoracic and abdominal regions.
	Head has eyes, whiskers, nostrils, mouth and ears.
	Neck region-externally covered by fur. Internally the superficial structures include the throat structures ie parotid, submaxillary, lymphnodes, infra-orbital lachrymal glands and neck muscles.
	Thoracic region-contains the thoracic organs ie lungs and heart with blood vessels draining and supplying. Superficial structures include the thoracic muscles and rib-cage.
	Abdomen- contains viscera eg alimentary canal, spleen, kidneys, ureter, bladder, liver etc. with blood vessels draining and supplying.
	Pelvic region- contains the vagina, anus and penis.

BODY SYSTEMS.

Digestive system	Involved in ingestion, digestion, storage of food, removal undigested food materials, absorption of products of digestion, passage of wastes, and egestion. Divided into the alimentary canal and associated organs. Alimentary canal/gastro-intestinal tract is made up of organs from the gullet to anus. Associated organs help the alimentary canal to carry out
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	<p>digestion by producing juices containing enzymes eg liver, salivary apparatus and pancreas. Tongue and Teeth don't produce juice by aid in digestion of food.</p> <p>Spleen is physically attached to the alimentary canal though has no digestion role hence termed as ACCESSORY organ.</p> <p>Spleen stores blood and lymphocytes.</p>
Relative division of the gut/alimentary canal/gastro-intestinal tract	
Cockroach	<p>Fore gut- gullet, gizzard, and crop.</p> <p>Midgut- midgut/mesenteron and hepatic/digestive caeca.</p> <p>Hind gut-ileum, colon and rectum.</p>
Toad.	<p>Fore gut- oesophagous and stomach.</p> <p>Midgut- ileum and duodenum</p> <p>Hindgut- colon and rectum</p>
Rat	<p>Fore gut- oesophagous and stomach</p> <p>Midgut-ileum , jejunum and duodenum</p> <p>Hind gut- colon, rectum and ceacum</p>

Reproductive system	System involved in sexual reproduction
	Cockroach- male- mushroom shaped gland, and ejaculatory duct.
	Female- vagina, oviducts, ovaries.
	Toad- female-ovaries, oviduct/müllerian ducts, ovisac, cloaca, Male-ureter, vesicular seminalis, testes, vasa efferentia, cloaca.
	Rat – male- sperm duct, seminal vesicle, penis, epididymis, coagulating glands
Excretory system	Female- ovary, uterus, utero-ovarian vein, vagina.
	Removal of metabolic wastes from the body.
Circulatory system/Haemal system	Specialized organs for excretion in mammals are kidneys, liver and lungs. Malpighian tubules for cockroaches. Skin and lungs for toads. Excretory organs are connected to numerous tubules and urinary bladder through which wastes pass to the external environment. Tubules plus excretory organs form the excretory system.
	Differentiate between the excretory system and excretory organs.
	Blood vessels and the heart.
	Blood vessels are either arteries or veins.

PHYSIOLOGY

Examines metabolic reactions in living organism.

Questions are set from theory, so its very important to interpret the theory behind the practical which calls for adequate preparations.

The Physiology questions hide some information that the learner must perform to reveal by carrying out various tests.

Tests generate experimental results that a learner must critically analyze and explain basing on the theoretical principles.

NOTE THE FOLLOWING TO SCORE HIGHLY.

- Pick out guiding instructions, materials and chemicals within instructions.
- Seek to understand unfamiliar words and phrases.
- Analyze questions below the table before you fill the table.
- Always be concise and precise in your observations and deductions.
- Use accurate quantity of reagents.

FOOD TESTS

These are tests carried out to identify the nutrients in test solutions using different test reagents. Food tests involve mainly:

- Recording and following test procedures
- Making and recording observations
- Making and recording conclusions/deductions.

RECORDING AND FOLLOWING TEST PROCEDURE	<p>.When dealing with test procedures keep the following in mind.</p> <ul style="list-style-type: none">• The correct test procedure must be followed very well.• The test procedure MUST be written by you (the student) whenever not provided in the examinations. Its absence leads to loss of marks.• The exact quantities MUST be clearly stated. For instance to 1 cm³ of solution K add 2 drops of iodine solution. The usage of ranges such as 2 to 3 drops must be avoided.• Exact names and states of the test reagents should be written correctly. For example Benedict's solution, iodine solution, copper (II) sulphate solution, etc.• The test procedure MUST be well sequenced.• If boiling is involved, this must be stated in the procedure. Avoid writing but heating or warming.• Avoid making the test procedures unnecessary lengthy. <p>Remember that: Wrong test procedures render your observations, conclusions and explanations unacceptable, of course leading to loss of marks.</p>
MAKING AND RECORDING	<p>Keep the following in mind:</p> <ul style="list-style-type: none">• The observation must be recorded immediately it happens.

OBSERVATIONS	<p>Don't let solution mixtures stand for some time.</p> <ul style="list-style-type: none"> The initial colour and state of the test solution must be written first followed by the intermediate and final colours and states of the mixtures. For instance a milky solution turns to a black solution. The colour changes should be recorded in the correct sequence they appear. <p>Observations should be recorded either in past tense or simple tense but never in future tense.</p> <p>Remember that: The intensity of colour changes when the test solution and test reagents are mixed. This change MUST be considered and recorded e.g. Iodine solution is brown, but when mixed with the test solution, the colour intensity reduces and the colour of the mixture becomes pale brown/ yellow.</p>
MAKING AND RECORDING DEDUCTIONS.	<p>Conclusions can become correct only when the observations are. It must be remembered that deductions must be correlated with the observations. When recording deductions:</p> <ul style="list-style-type: none"> The quantity of food substance MUST be indicated in direct correlation with observations. Examples; much starch present, traces/little amounts of starch present but not; mere starch present. The same applies to other food substances. The deduction must be precise but complete. Avoid using examples for instance 'glucose present' instead of saying much reducing sugars present.

TYPICAL EXAM FOOD TEST EXPERIMENTS

Test for starch.

Test procedure	Observation	Deduction
To 1 cm ³ of the solution in a clean test tube; add 3 drops of iodine solution	Colourless solution turns to pale brown/yellow solution	Starch absent
	Milky /turbid; solution; turned to faint blue solution/pale blue-black/ few black specks/purple solution	Little Starch present
	Milky /turbid; solution; turned to deep blue/solution;	Moderate Starch present;
	Milky /turbid; solution; turned to deep blue-	Much starch present

	black solution/black solution	
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Test for proteins.

There are three common tests for proteins. The biuret test is the most common and will be given more attention here.

Biuret test.

Test	Observation	Deduction
To 1 cm ³ of the solution in a clean test tube; add 1 cm ³ of sodium hydroxide solution; followed by 2 drops of Copper (II) sulphate solution and shake the test tube.	Colourless solution turns to a pale blue solution; and remains a pale blue solution	Proteins absent;
	Turbid solution; clears and turns to a pale blue solution; then to a pale purple solution	Little proteins present
	Turbid solution; clears and turns to a pale blue solution; then to a purple solution	Moderate proteins present
	Turbid solution; clears and turns to a pale blue solution; then to a deep purple solution/ intense purple solution;	Much proteins present

Coagulation test.

Test	Observation	Deduction
Boil 1 cm ³ of the solution in a clean test tube.	Turbid solution turned to a solid;	Much proteins present;
	Clear solution remains a clear solution;	Proteins absent;

Test for reducing sugars.

Test	Observation	Deduction
To 1 cm ³ of the solution in a clean test tube; add 1 cm ³ Benedict's solution and boil	Colourless solution turns to a pale blue solution and remains a pale blue solution.	Reducing sugars absent
	Colourless solution turned to a pale blue solution and turns to a green solution	Little reducing sugars present
	Colourless solution turned to pale blue solution; to green	Moderate reducing sugars present

	solution; and then to a yellow precipitate ;	
	Colourless solution turned to a pale blue solution; to green solution; to yellow precipitate ; and to an orange precipitate;	Much reducing sugars present
	Colourless solution turned to a pale blue solution; to green solution; to yellow precipitate ; orange precipitate and finally brown precipitate.	Very much reducing sugars present

ANATOMY

Common stains used

Stain name	Suitable for and Colour produced
Iodine solution	Starch –Blue or Black
Methylene blue	Nucleus-Blue
Acidified Phloroglucinol	Lignin-Red Suberin-Pink

MICROSCOPIC STRUCTURES.

- Epidermis of onion fleshy leaf.
- Pollen grains.
- Spores of fern, bread and mould.
- Stomata.
- Epidermal cells of leaves.
- Spirogyra.
- Leaves of mosses.
- Cross section of Non-woody stem and roots.
- Ovaries.
- Fruits.
- Insects.
- Arachnids.
- Millipedes.

CALCULATION OF MAGNIFICATION.

- Place plastic ruler with millimeter scale on the stage of the microscope.
- Measure the diameter of the field of view in millimeters.
- Convert the millimeters to micrometers (μm)

- Remember 1mm = 1000µm.
- Mount the glass slide with the specimen. Count the number of cells across the diameter of the field of view at a particular magnification.
- Calculate the actual size of a cell.
- Actual length of one cell in µm = $\frac{\text{Diameter of the field of view (µm)}}{\text{Number of cells along the length}}$
- Magnification = $\frac{\text{length of the drawing in µm}}{\text{Actual length of one cell in µm}}$

INFLORESCENCE AND SOLITARY FLOWERS

DESCRIBING AN INFLORESCENCE.

Note the following.

Number of florets, types of florets e.g. Ray and tubular.

Stalked/assessile or Unstalked/sessile

Attachment of floret -e.g. on the tip of the expanded peduncle or alternately attached along the peduncle • Arrangement of the floret - circular pattern/closely packed/ alternately /wholly /oppositely, Presence of bracts

FLORET/FLOWER DESCRIPTION OF A FLOWER.

Stamens /androecium • Number of stamens- numerous

Attachment of stamens • Staminal tube/filament tube • Corolla tube/fused with the petals • Free- if originating from the receptacle • Anthers e.g.

Bilobed, elongated/long, circular/spherical in shape • Filament e.g. hairy, smooth, long or short, thin or thick, slender

PISTIL /GYNOECIUM -Number of carpels • Stigma e.g. hairy, lobed , fused, sticky(using the finger tips), • Style e.g. long, short, thin , slender, hairy • Ovary e.g. superior or inferior, broad base, hairy, • Shape ovary e.g. oval, round, elongated/long, Advantages to being pollinated basing on the stigma
c) Petals/corolla Large/broad, veined, thin or thick, smooth, hairy, fused or free
d) Sepals/calyx Free or fused veined, hairy, smooth, tapering etc.

TASK

Visit your School compound or nearby garden and pick out the inflorescence of **AMARANTHUS SPP.**

NOTE. –Examine the two types of florets under low power of a microscope.

- Describe the structure of the inflorescence.
- Advantages and disadvantages of the floret arrangement(s).
- Interest yourself in the drawings of the florets.

Cc-Comprehensive Biology transformation initiative.

Transforming Biology Pedagogy.