ChatGPT

NCERT Class 12 Common Lab Experiments (2025)

Physics (Subject Code 042)

Experiment: Focal Length of a Convex Lens by Graphical Method

- **Subject Code:** 042 (Physics)
- **Topic:** Determination of focal length of a convex lens by plotting graphs between object distance (u) and image distance (v) or between 1/u and 1/v.
- **Aim:** To find the focal length of a convex lens by plotting graphs between u and v or between 1/u and 1/v [1].
- **Apparatus:** Optical bench, two sharp-edged pins, a convex lens (focal length ≈ 15–20 cm), three uprights for the bench, an object needle (index needle), a 1 m metre scale, and a spirit level [2].
- **Procedure:**
- Place the convex lens on the optical bench and adjust its height so that it is level and facing two fixed needles (object and image needles) placed apart on the bench.
- Vary the distance u of the object needle from the lens and adjust the image needle and the lens to obtain a sharp image. Record the corresponding image distance v.
- Repeat for several values of u and v, then plot v vs. u (or 1/v vs. 1/u) to find the focal length from the intercept or slope [1] [3].
- Calculate focal length f using the lens formula or graph.
- **Precautions/Safety:** Perform the experiment in a well-lit but not direct sunlight environment. Ensure the optical bench is horizontal (use a spirit level) and the lens and needles are mounted securely. Do not look directly at the bright image of the Sun through the lens, and handle glass lenses carefully to avoid breakage [4] [5].
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2 marks):* Correct arrangement of the optical bench, level mounting of lens and needles, and clear execution of steps.
- *Observations & Data (2 marks):* Careful recording of u and v values with proper units; neat tabulation of readings.
- *Accuracy (2 marks):* Precision of measurements, repeated trials for concordance, and minimizing systematic errors (e.g., using spirit level).
- *Analysis/Calculation (2 marks):* Correct plotting of graph, accurate determination of focal length from graph or formula, and consistent units.
- *Presentation (2 marks):* Neat and labeled graphs/tables, clear units, and a concise conclusion stating the focal length.

[6] [4]

Experiment: Focal Length of a Concave Lens (Using a Convex Lens)

- **Subject Code:** 042 (Physics)
- **Topic:** Determination of focal length of a concave (diverging) lens using a convex (converging) lens.

- **Aim:** To find the focal length of a concave lens with the help of a convex lens [7].
- **Apparatus:** Optical bench, two sharp-edge pins (object and image needles), one convex lens, one concave lens, meter scale, lens holders, and a spirit level [8].
- **Procedure:**
- Fix the convex lens on the bench and place the object pin at a distance greater than the focal length of the convex lens. Adjust to get a sharp image of the object on a screen; this gives a real image of the convex lens.
- Without moving the object pin, remove the screen and convex lens. Insert the concave lens at the position where the convex lens was, so that it forms a virtual image of the pin coincident with the previous real image.
- Adjust the concave lens and a second pin (image needle) so that the virtual image of the concave lens coincides with the original image position. Record the distance between the concave lens and the second pin – this distance is taken as the focal length of the concave lens [9] [10].
- Repeat to obtain two concordant readings of focal length.
- **Precautions/Safety:** Place the concave lens very close to the convex lens to ensure proper imaging; keep the object pin fixed during the experiment. Handle the lenses gently and ensure no sudden shifts occur between measurements. Perform the experiment on a steady bench and use thin, sharp pins for precise alignment [11] [12].
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Correct alignment of convex and concave lenses on the optical bench; proper step sequence to obtain virtual image.
- *Observations & Data (2):* Accurate marking of lens positions and recorded distances; consistency across trials.
- *Accuracy (2):* Precise positioning of pins and lenses; minimal parallax error; use of spirit level to ensure alignment.
- *Analysis/Calculation (2):* Correct application of lens formula if needed; computing focal length correctly from measured distances.
- *Presentation (2):* Clear drawing/diagram of arrangement, neat data table, labeled axes (if any), and a summary of the focal length.

[7] [12]

Experiment: Angle of Minimum Deviation for a Glass Prism

- **Subject Code:** 042 (Physics)
- **Topic:** Determination of the angle of minimum deviation of a light ray passing through a glass prism and plotting deviation vs. incidence.
- **Aim:** To determine the angle of minimum deviation for a given glass prism by plotting a graph between the angle of incidence and the angle of deviation [13].
- **Apparatus:** Optical bench with prism and table, spectrometer or semicircular protractor, adjustable collimator or light source, a rotating prism table, and sharp-edge pins (or slit & telescope) for ray alignment [13].
- **Procedure:**
- Fix the prism on the rotating table and align a narrow beam of light (from a lamp or collimator) to fall on one face of the prism at some incidence angle. Place pins (or telescope) to locate the incident ray.
- Rotate the prism to measure the emergent ray for different incident angles. For each incidence angle, trace the path of the emergent ray and measure the deviation angle.

- Identify the incident angle for which the deviation is minimum (prism rotated to symmetric configuration). Record the corresponding minimum deviation.
- Plot a graph of deviation (δ) vs. incidence angle (i). From the graph or observations, determine the angle of minimum deviation and use it to calculate the refractive index if required.
- **Precautions/Safety:** Handle the glass prism carefully to avoid chipping or cuts. Ensure all optical components (collimator, telescope, prism) are firmly fixed and avoid sudden movements. Turn off the light source when adjusting components to prevent eye fatigue. Mark pins gently to prevent sliding. Ensure measurements are done when prisms are at room temperature to avoid index changes.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Correct mounting of prism and alignment of light source; systematic variation of incidence angle.
- *Observations & Data (2):* Precise reading of angles using protractor or spectrometer; consistent identification of minimum deviation.
- *Accuracy (2):* Use of sharp pins or slit for well-defined rays; careful rotation to locate true minimum deviation; repeat measurements.
- *Analysis/Calculation (2):* Accurate plotting of δ vs. i graph; correct reading of minimum deviation; calculation of refractive index if asked.
- *Presentation (2):* Neat graph with labeled axes, table of readings, diagram of prism setup, and final answer highlighted.

[13] [14]

Experiment: Refractive Index of a Glass Slab (Using Travelling Microscope)

- **Subject Code:** 042 (Physics)
- **Topic:** Determination of the refractive index of a glass slab using a travelling microscope and observing apparent shift.
- **Aim:** To determine the refractive index of a glass slab using a travelling microscope [15].
- **Apparatus:** Travelling microscope with vernier scale, glass slab of known thickness, lycopodium powder (or fine dust), a plane mirror or cross-wire for focusing, and source of light. (A slab thickness measuring device may also be used.) [16].
- **Procedure:**
- Clean and measure the slab's thickness t using a micrometer. Place the slab on a level surface. Sprinkle a thin layer of lycopodium powder on one face. Focus the microscope on a dust particle on the top surface (mark reading).
- Without moving slab, focus the microscope on the corresponding visible dust particle on the bottom surface seen through the slab (apparent position due to refraction). Record the apparent thickness t' by the stage readings [17].
- Repeat for several locations to get concordant readings of t'.
- Calculate the refractive index $n = t/t'$ [15].
- **Precautions/Safety:** Clean all optical surfaces (microscope lens, glass slab) before use. Ensure focusing screws of the microscope are moved gently in one direction only to avoid backlash error [18]. Do not scratch the slab with the stage. Handle the microscope and slab gently. Avoid parallax by keeping eye straight to scales.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Proper leveling of slab and microscope; correct focusing procedure.

- *Observations & Data (2):* Accurate measurement of slab thickness and apparent shift; recording multiple readings for consistency.
- *Accuracy (2):* Using fine screw adjustments, repeated measurements for concordance, and correct scale reading (accounting for vernier least count).
- *Analysis/Calculation (2):* Correct formula $n = t/t'$ applied; error analysis if done; units included.
- *Presentation (2):* Clear tabulation of actual and apparent thicknesses, showing calculations, and stating refractive index with units.

19 18

Experiment: I–V Characteristic of a PN Junction Diode

- **Subject Code:** 042 (Physics)
- **Topic:** Plotting the forward and reverse bias I–V characteristics of a PN junction diode and determining its forward threshold and reverse saturation current.
- **Aim:** To draw the current–voltage characteristic curve of a given PN junction diode in both forward and reverse bias (and determine its forward cut-in voltage and reverse saturation current).
- **Apparatus:** PN junction diode on a board, a suitable DC power supply (0–10 V), an ammeter (milliamp range), a voltmeter (0–10 V), connecting wires, and a breadboard or diode board 20 .
- **Procedure:**
- Connect the diode in forward bias with the ammeter in series and voltmeter across the diode.
- Vary the supply voltage in small steps (e.g., 0.2 V) and note the current for each voltage up to about 10 V or the diode's rating 20 .
- Plot the forward I–V curve on graph paper. Identify the point where current rises sharply – this is the forward cut-in voltage.
- Reverse bias the diode (flip connections) and repeat measurements for small voltages up to a few volts; record the very small reverse current (saturation current). Plot reverse I–V (semilog if needed) to estimate reverse saturation current.
- **Precautions/Safety:** Never increase the reverse voltage beyond diode's safe limit (too high reverse voltage can break the diode) 20 21 . Use series resistance if necessary to limit current. Ensure correct polarity before taking readings to avoid damaging the diode. Perform measurements quickly in reverse bias to avoid overheating. Observe lab safety when handling power supplies and instruments.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Correct connection of diode with meters; systematic variation of voltage.
- *Observations & Data (2):* Accurate recording of current and voltage (especially at low reverse currents); tabulation.
- *Accuracy (2):* Using appropriate meter ranges; careful measurement near threshold; noting multiple data points.
- *Analysis (2):* Correct plotting of I–V curves; determination of cut-in voltage from graph; estimation of reverse saturation current.
- *Presentation (2):* Neat plotted curves with labeled axes; clear marking of key points (e.g., 0.7 V threshold); concise conclusion with diode parameters.

20 21

Chemistry (Subject Code 043)

Experiment: Estimation of $KMnO_4$ Using Mohr's Salt (Redox Titration)

- **Subject Code:** 043 (Chemistry)
- **Topic:** Determination of the molarity and strength of a given potassium permanganate ($KMnO_4$) solution by redox titration against standardized ferrous ammonium sulphate (Mohr's salt).
- **Aim:** To determine the molarity and strength of the given $KMnO_4$ solution, by titrating it against a standard solution of ferrous ammonium sulphate (Mohr's salt) [22] .
- **Apparatus:** Conical flasks (100 mL), burette (50 mL) and stand, pipettes (20 mL) and filler, glass rod, volumetric flask (100 mL), weighing balance, funnel, wash bottle.
- **Reagents:** $KMnO_4$ solution (unknown concentration), standard Mohr's salt crystals ($FeSO_4·(NH_4)_2SO_4·6H_2O$), 4 N H_2SO_4.
- **Procedure:**
- **Prepare Standard Mohr's Salt:** Weigh accurately ~1.96 g of Mohr's salt and dissolve in ~10 mL 4 N H_2SO_4 in a 100 mL volumetric flask; dilute to the mark with distilled water to get 0.05 M solution [23] .
- **Titration:** Pipette 20.0 mL of the standard Mohr's salt solution into a conical flask, add ~10 mL of 4 N H_2SO_4, and titrate with the $KMnO_4$ solution from the burette. Continue dropwise until a permanent pale pink end-point is reached (self-indicator $KMnO_4$) [24] . Note the volume of $KMnO_4$ used. Repeat for at least two concordant readings.
- Calculate the molarity of $KMnO_4$ using the relation $2\,\mathrm{KMnO_4} + 10\,\mathrm{Fe^{2+}} \rightarrow \ldots$ (ratio 1:5) [23] and determine its strength (g/L).
- **Precautions/Safety:** Use only distilled water and clean glassware to prevent contamination. Perform titration in a well-ventilated area and wear safety goggles, as concentrated H_2SO_4 is corrosive. Add $KMnO_4$ slowly near the end-point to avoid overshooting. Ensure complete dissolution of Mohr's salt by adding a little acid to prevent its oxidation.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Accurate preparation of standard solution and proper titration technique (no air bubbles, consistent swirling).
- *Observations & Data (2):* Careful recording of titrant volumes (at least two concordant titres) and preparation details.
- *Accuracy (2):* Correct use of molar ratios ($KMnO_4$:Fe^{2+} = 1:5), precise weighing of salts and volumes, and performing replicates.
- *Analysis/Calculation (2):* Correct computation of $KMnO_4$ molarity and strength (g/L) using titration formula.
- *Presentation (2):* Clear tabulation of observations, labeling of end-point color change (colorless to pale pink), and final values with units.

[22] [23]

Experiment: Estimation of $KMnO_4$ Using Oxalic Acid (Redox Titration)

- **Subject Code:** 043 (Chemistry)
- **Topic:** Determination of the molarity and strength of a given $KMnO_4$ solution by titration against standardized oxalic acid solution.
- **Aim:** To determine the molarity and strength of the given $KMnO_4$ solution by preparing and titrating against standard oxalic acid solution [25] .

- **Apparatus:** Conical flasks (250 mL), burette (50 mL), pipette (20 mL), volumetric flasks (100 mL), conical flask (100 mL), boiling water bath or hotplate, funnel, wash bottle.
- **Reagents:** $KMnO_4$ solution (unknown), pure oxalic acid ($H_2C_2O_4·2H_2O$), 4 N H_2SO_4.
- **Procedure:**
- **Prepare Standard Oxalic Acid:** Weigh ~0.252 g of oxalic acid dihydrate and dissolve in distilled water to make 100 mL of M/50 (0.02 M) solution [26].
- **Titration:** Pipette 20.0 mL of the oxalic acid solution into a conical flask, add about 10 mL of 4 N H_2SO_4. Heat the solution to ~60–70 °C (in a water bath). Titrate with $KMnO_4$ from the burette, stirring continuously, until a permanent pale pink color persists [26]. Record the volume of $KMnO_4$ used. Repeat to obtain concordant readings.
- Calculate $KMnO_4$ concentration using the reaction $5H_2C_2O_4 + 2KMnO_4 + 6H_2SO_4 \rightarrow \ldots$ (molar ratio $KMnO_4$:oxalic = 2:5).
- **Precautions/Safety:** Handle hot solutions with care to avoid burns. Oxalic acid is toxic – avoid ingestion and skin contact. Use gloves and eyewear. Ensure the flask is never heated to dryness. Add $KMnO_4$ slowly near end-point to avoid overshoot, and cool titrated solution before disposing. Perform titration quickly once acid is added to prevent decomposition.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Proper preparation of oxalic acid solution; careful heating and timely titration.
- *Observations & Data (2):* Recording temperatures, volumes of reagents, and clear end-point note (onset of pink).
- *Accuracy (2):* Correct 2:5 stoichiometric ratio, replicate titrations for concordance, constant temperature maintenance.
- *Analysis/Calculation (2):* Correct formula usage to compute $KMnO_4$ molarity; conversion to g/L strength.
- *Presentation (2):* Organized data table, labeled color change (colorless → pink), and final answers with units.

[25] [26]

Experiment: Effect of Concentration on Rate of Reaction (Thiosulphate–HCl)

- **Subject Code:** 043 (Chemistry)
- **Topic:** Investigation of how the concentration of reactants affects the rate of the reaction between sodium thiosulphate and hydrochloric acid.
- **Aim:** To study the effect of concentration on the rate of reaction between sodium thiosulphate ($Na_2S_2O_3$) and hydrochloric acid (HCl) [27].
- **Apparatus:** Five 100 mL conical flasks, burettes or pipettes, stop-watch, meter scale, cross mark on paper (50 mL measuring flask optional), safety goggles.
- **Reagents:** 0.1 M $Na_2S_2O_3$ solution, 1.0 M HCl, distilled water.
- **Procedure:**
- Label five flasks as 1–5. To flask 1–5 add $Na_2S_2O_3$ solution in volumes 10, 20, 30, 40, 50 mL respectively. Dilute each to 50 mL by adding distilled water (i.e. keeping [acid constant, varying [thiosulphate]) [28].
- Place a paper with a marked cross beneath flask 1. Pipette 10 mL 1 M HCl into a separate small beaker. Quickly add the HCl to flask 1, start the stopwatch immediately, and observe the solution from above. Stop the clock when the cross just becomes invisible (due to sulfur precipitate). Record the time.

- Repeat for flasks 2–5, each time using 10 mL of HCl and fresh cross. The concentration of thiosulphate in flasks 1–5 are 0.02, 0.04, 0.06, 0.08, 0.10 M respectively.
- Calculate rate as $1/t$ for each case and plot $1/t$ vs. concentration to show rate $\propto$ [$Na_2S_2O_3$].
- **Precautions/Safety:** Ensure all glassware is clean. Keep the distance between the eye and flask constant to avoid parallax. Add acid quickly but safely and start the stopwatch immediately. Do not ingest or touch chemicals. Conduct the experiment under a fume hood or well-ventilated area as SO_2 gas is produced. Wear gloves and goggles to avoid skin/eye contact.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Correct preparation of concentration series (with dilution) and simultaneous addition of acid.
- *Observations & Data (2):* Accurate timing for each run; recording volumes and times in a table.
- *Accuracy (2):* Use of consistent cross mark, repeating trials to improve reliability, and precise measurement of volumes.
- *Analysis (2):* Correct calculation of rate (1/t), plotting graph to verify rate law, and interpretation (linear relation indicates first order w.r.t. [$Na_2S_2O_3$]).
- *Presentation (2):* Clear data table and graph, labeled axes (Rate vs. [$S_2O_3^{2-}$]), and conclusion on how rate varies with concentration.

[29] [28]

Experiment: Separation of Plant Pigments by Paper Chromatography

- **Subject Code:** 043 (Chemistry)
- **Topic:** Separation and identification of chlorophylls, xanthophylls, and carotenes from leaf and flower extracts using paper chromatography, and calculation of Rf values.
- **Aim:** To separate pigments from extracts of leaves and flowers by paper chromatography and determine their Rf values [30].
- **Apparatus:** Whatman No. 1 filter paper strips, developing jar with lid, rubber cork with hook, capillary tubes, scissors, pencil, ruler, beakers, funnel.
- **Reagents:** Leaf and flower extracts (prepared in advance by grinding in appropriate solvent), developing solvent (e.g., petroleum ether:acetone or methanol), distilled water, dilute HCl (for streaking).
- **Procedure:**
- **Sample Prep:** Grind leaves or petals with a drop of acetone to make concentrated pigment solutions. Spot a small drop of each extract on the chromatogram line (≈1–2 cm from bottom) using capillary tubes [31] [32]. Use one strip per sample.
- **Developing:** Suspend the paper strip (cork hook) in a jar containing the solvent (just below the pigment spot), cover, and allow solvent to rise until near top. Remove and mark solvent front immediately. Let strip dry. If needed, develop pigments (e.g. iodine chamber for visualization).
- **Observation:** Identify separated bands of pigments (chlorophyll a/b, xanthophylls, carotene) by color. Measure distance traveled by each pigment (from origin to center of spot) and distance of solvent front. Compute Rf = (distance of pigment spot)/(distance of solvent front).
- **Precautions/Safety:** Use capillary tubes carefully to avoid broken glass. Handle organic solvents in a fume hood and away from open flames (petroleum ether is highly flammable). Avoid spilling solvent. Ensure the paper does not touch sides of jar or go above solvent level. Keep the setup still until development is complete. Mark solvent front quickly to avoid evaporation error.
- **Evaluation Rubric (10 marks):**

- *Setup & Procedure (2):* Correct preparation of chromatography strips and development (proper distance from origin, adequate solvent level).
- *Observations & Data (2):* Clear separation of pigment bands and accurate measurement of distances (origin, spot centers, solvent front).
- *Accuracy (2):* Use of proper solvent system, equal spot sizes, and consistent technique (avoid leading/trailing of spots).
- *Analysis (2):* Correct calculation of Rf values and identification of pigments from colors.
- *Presentation (2):* Labeled diagram or photo of strip with moves marked, table of distances and Rf values, and identification of each pigment.

[30] [32]

Experiment: Preparation of Ferrous Ammonium Sulphate (Mohr's Salt) Crystals

- **Subject Code:** 043 (Chemistry)
- **Topic:** Synthesis of pure ferrous ammonium sulphate ($FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$) by crystallization.
- **Aim:** To prepare a pure sample of ferrous ammonium sulphate (Mohr's salt) [33].
- **Apparatus:** 250 mL beaker, 100 mL beaker, funnel, filter paper, stir rod, weigh bottle, balance, and watch glass.
- **Reagents:** 70 g ferrous sulphate ($FeSO_4 \cdot 7H_2O$), 3.5 g ammonium sulphate, 2–3 mL dilute H_2SO_4 (to prevent oxidation), ethanol (for washing).
- **Procedure:**
- Add 70 g $FeSO_4 \cdot 7H_2O$ and 3.5 g $(NH_4)_2SO_4$ to a 250 mL beaker. Add ~2–3 mL dilute H_2SO_4 to prevent oxidation of Fe^{2+} [34].
- Boil ~20 mL water to expel O_2, then gradually add the hot water to the salts while stirring until fully dissolved [35].
- Filter the hot solution if necessary to remove impurities. Transfer to a china dish and allow to cool undisturbed. Place the dish on a cold water bath to facilitate crystallization of light-green Mohr's salt crystals [36].
- Decant mother liquor. Wash the crystals with a small amount of ethanol and dry them between filter papers [37].
- **Precautions/Safety:** Add acids slowly and in well-ventilated area as fumes (SO_2) may evolve. Prevent Fe^{2+} from oxidizing by adding acid promptly. Handle hot liquids with care to avoid burns. Use a dust mask while weighing powders to avoid inhalation. Do not disturb the solution during crystallization and wear gloves when washing crystals with ethanol (flammable).
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Correct proportions of reagents, controlled addition of water, and gentle heating.
- *Observations & Data (2):* Careful noting of color changes, crystal formation, and any purification steps (filtering, washing).
- *Accuracy (2):* Weighing reagents precisely; minimizing Fe^{2+} oxidation by acid addition; obtaining pure crystals (no green tint in mother liquor).
- *Analysis (2):* Yield calculation (optional) and description of crystalline product.
- *Presentation (2):* Clear description of crystals (color, shape) and conclusion that Mohr's salt was obtained.

[33] [34]

Biology (Subject Code 044)

Experiment: In Vitro Pollen Germination

- **Subject Code:** 044 (Biology)
- **Topic:** Examination of pollen grains germinating on an artificial medium and calculation of germination percentage.
- **Aim:** To study and calculate the percentage of pollen germination on a slide [38].
- **Apparatus:** Microscope with eyepiece micrometer, cavity glass slides, cover slips, dropper, watch glass or Petridish, forceps.
- **Reagents:** Mature pollen from a seasonal flower (e.g. Tradescantia, lily, or Clitoria), pollen germination medium (e.g. 10% sucrose solution with calcium nitrate and boric acid [39]), or boiled honey solution.
- **Procedure:**
- Prepare pollen germination solution by mixing 10 g sucrose, 30 mg calcium nitrate, 10 mg boric acid in 100 mL distilled water [39]. Keep it warm (37–40 °C).
- Place a drop of this medium on a cavity slide. Dust pollen grains onto the drop with forceps or a brush. Carefully place a cover slip.
- Incubate the slide in a moist chamber at room temperature for 10–30 minutes. Observe under the microscope. Count total pollen grains and number of germinated grains (tube length ≥ grain diameter).
- Calculate the percentage germination = (number of germinated grains/total grains) × 100.
- **Precautions/Safety:** Use fresh, mature pollen and freshly prepared medium. Avoid spillage of medium. Clean slides and cover slips before use [40]. Handle the microscope gently. Keep the incubation time controlled to prevent overgrowth. Label slides. Dispose of biological material properly.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Proper preparation of germination medium and consistent incubation conditions.
- *Observations & Data (2):* Accurate counting of pollen grains (total vs. germinated) under the microscope; replication (multiple fields).
- *Accuracy (2):* Correct identification of germination (tube vs. non-germinated), using a cover slip of even thickness, and fine focus to avoid counting errors.
- *Analysis (2):* Correct calculation of germination percentage; discussion of factors affecting germination (e.g. medium composition).
- *Presentation (2):* Well-drawn diagram of pollen tubes, labeled chart of counts, and final percentage with proper explanation.

[38] [39]

Experiment: Mitotic Divisions in Onion Root Tip

- **Subject Code:** 044 (Biology)
- **Topic:** Preparation of temporary slides of onion root tips to observe and study the stages of mitosis.
- **Aim:** To prepare a temporary mount of onion root tips to study mitosis [41].
- **Apparatus:** Microscope slides and cover slips, forceps, razor blade or blade, droppers, beaker, watch glass, Bunsen burner.

- **Reagents:** Onion bulbs, 1 N HCl, aceto-orcein or acetocarmine stain, distilled water.
- **Procedure:**
- Induce root growth by placing onion basal plate in water. Cut 1–2 mm root tips and place in 1 N HCl at 60 °C for 5 min to hydrolyze. Rinse in water.
- Transfer one root tip to a slide, add a drop of stain (e.g. 2% aceto-orcein). Macerate gently with needle to spread cells, and place a cover slip. Apply slight pressure to spread cells into a thin layer.
- Observe under low then high power microscope. Identify cells in different mitotic stages (prophase, metaphase, anaphase, telophase) [42] . Optionally draw or photograph stages.
- **Precautions/Safety:** Clean slides and cover slips thoroughly to avoid contamination [43] . Handle HCl with care (corrosive) – use small volumes and rinse glassware afterwards. Do not exert excessive pressure that could break the cover slip. Dispose of onion remnants safely.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Correct cell preparation and staining; effective spreading of cells without air bubbles.
- *Observations & Data (2):* Identification and counting of cells in each stage; noting proportions (e.g., mitotic index).
- *Accuracy (2):* Proper staining and focusing; distinguishing similar stages (e.g., early vs. late prophase).
- *Analysis (2):* Drawing labeled diagrams of cells at various stages; calculation of mitotic index if required.
- *Presentation (2):* Clear micrographs or sketches, properly labeled, and a concluding statement on mitosis in onion root tip.

[41] [43]

Experiment: Isolation of Plant DNA

- **Subject Code:** 044 (Biology)
- **Topic:** Extraction of deoxyribonucleic acid (DNA) from plant tissue (e.g., pea seeds, spinach, or onion) to obtain visible DNA fibers.
- **Aim:** To isolate DNA from available plant material like pea seeds, spinach, onion, etc. [44] .
- **Apparatus:** Beakers, pestle and mortar, stirrer, centrifuge tubes, water bath (or hotplate), wooden sticks or spatula, funnel with cheesecloth, alcohol in test tubes.
- **Reagents:** Plant material (spinach leaves or banana is common), extraction buffer (detergent/soap, salt, water), cellulase (optional), protease (optional), protease.
- **Procedure:**
- Chop ~5 g of plant tissue and grind in 20–30 mL of warm (60 °C) extraction buffer containing detergent and salt (to lyse cells and precipitate proteins) [45] .
- Filter the homogenate through cheesecloth into a beaker to remove debris. Optionally treat with protease and RNase.
- Gently pour chilled ethanol (equal volume, cold) down the side of the filtrate in a test tube so that DNA precipitates at the interface as white strands. Collect DNA strands with a glass rod.
- **Precautions/Safety:** Use gloves and goggles to handle detergent and enzymes. Do not eat or inhale any reagents. Ethanol is flammable – keep away from heat. Ensure plant material is well-chopped to improve yield. Work quickly to avoid DNA shearing.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Effective tissue grinding and buffer composition (adequate detergent and salt).
- *Observations & Data (2):* Visible strands of DNA precipitated; noting any opalescent layer.

- *Accuracy (2):* Using chilled ethanol (–20 °C) to maximize yield; gentle mixing to preserve long DNA strands.
- *Analysis (2):* Explaining the role of each reagent (detergent to lyse membranes, salt to stabilize DNA, etc.) and purity checks (protein contamination).
- *Presentation (2):* Photographs or sketches of DNA threads, a brief explanation of DNA appearance, and conclusion confirming DNA isolation.

[44] [46]

Experiment: Examination of T.S. of Testis and Ovary (Gametogenesis)

- **Subject Code:** 044 (Biology)
- **Topic:** Identification of germ cell stages by studying permanent slides of testis and ovary sections under the microscope.
- **Aim:** To identify the stages of gamete development, i.e. transverse sections of testis and ovary through permanent slides [47] .
- **Apparatus:** Compound microscope (high power), prepared permanent slides of T.S. testis and T.S. ovary, lens cleaning tissue.
- **Procedure:**
- Place the testis slide on the stage, focus under low power to locate seminiferous tubules. Increase magnification to observe cells in various stages (spermatogonia, spermatocytes, spermatids). Draw or note characteristics.
- Replace with ovary slide. Identify structures: ovule in different stages, embryo sac (if visible). Locate oogonia or oocytes.
- Record distinguishing features of gametogenesis in each (e.g. large polar nuclei in egg cell).
- **Precautions/Safety:** Handle slides carefully to avoid breakage. Clean lenses before use and focus from low to high power slowly [48] . Do not apply pressure on slides. Use correct eye piece and objective cleaning.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Correct handling of slides; focusing technique from low to high power.
- *Observations & Data (2):* Identification of spermatogenic cells (spermatogonia, spermatocyte, spermatids) and ovarian follicles/cells; noting any polar bodies.
- *Accuracy (2):* Drawing clear diagrams of observed cells; labeling cell types and stages accurately.
- *Analysis (2):* Comparing male vs. female gametogenesis features; discussion of any stage differences (e.g. syncytial egg).
- *Presentation (2):* Well-labeled drawings, scale estimation if possible, and a concluding statement on the observed gamete development.

[47] [48]

Experiment: Controlled Pollination (Emasculation, Bagging, Tagging)

- **Subject Code:** 044 (Biology)
- **Topic:** Performing emasculation, bagging, and tagging on plant flowers to achieve controlled (artificial) pollination.
- **Aim:** To perform emasculation, bagging and tagging for controlled pollination [49] .

- **Apparatus:** Flowers of suitable plants (large, bisexual flowers like lady's finger or hibiscus), magnifying lens, forceps, fine scissors or scalpel, camel-hair brush, small paper bags or butterfly pollination bags, tags, labels, rubber bands, alcohol for sterilizing tools.
- **Procedure:**
- **Emasculation:** On an unpollinated flower (female parent), carefully remove all anthers before they dehisce, using forceps or scissors, without damaging the stigma or style [50]. Sterilize instruments in alcohol before and after use.
- **Bagging:** Immediately cover the emasculated flower with a paper bag to prevent unintended pollination by wind or insects (bag secured with rubber band) [51]. Label the bag with experiment details.
- **Pollination:** After 1–2 days, collect pollen from the chosen male parent flower using a clean brush and dust it onto the stigma of the emasculated flower through the bag opening (or remove bag carefully to perform pollination, then re-bag) [52].
- **Tagging:** Label the pollinated flower with details (male and female parent, date) using a tag tied to the plant stem [53].
- **Precautions/Safety:** Use sterile tools to avoid contamination of stigma. Perform emasculation before anther dehiscence to ensure no self-pollination [54]. Work gently to avoid damaging flower parts. Ensure bags are secure but allow some air circulation. Only use healthy plants.
- **Evaluation Rubric (10 marks):**
- *Setup & Procedure (2):* Correct selection of male/female parents and timing of emasculation.
- *Observations & Data (2):* Detailed notes on parent plants used, dates of emasculation and pollination; any notes on flower condition.
- *Accuracy (2):* Ensuring complete removal of anthers, preventing self-pollination; applying pollen evenly.
- *Analysis (2):* Explanation of each step's purpose (e.g. emasculation avoids self-pollination), and prediction of expected outcome (fruit/seed formation).
- *Presentation (2):* Proper labeled drawings or photos of each step (emasculated flower, bagged flower, tagged flower), and a summary of the hybridization attempt.

[49] [50]

---

[1] [2] [3] [5] [6] Full text of "'Lab Manual(English)' — NCERT Class 12 Physics"
https://archive.org/stream/ncert-lelm3/lelm308_djvu.txt

[4] Full text of "'Lab Manual(English)' — NCERT Class 12 Physics"
https://archive.org/stream/ncert-lelm3/lelm313_djvu.txt

[7] [8] [9] [10] [11] [12] [13] [14] Full text of "'Lab Manual(English)' — NCERT Class 12 Physics"
https://archive.org/stream/ncert-lelm3/lelm309_djvu.txt

[15] [16] [17] [18] [19] [20] [21] Experiments 14-18.pmd
https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXII/physics/lelm310.pdf

[22] [23] [24] [25] [26] [27] [28] [29] [31] [34] [35] [36] [37] Grade XII - Chemistry Lab Manual - 2024-2025 | PDF | Salt (Chemistry) | Precipitation (Chemistry)
https://www.scribd.com/document/790830267/Grade-XII-Chemistry-Lab-Manual-2024-2025