

IESO 2026 — TURIN
PRACTICAL TEST 2 — OPTICAL PETROGRAPHY

Polarizing Microscope & Mineral Identification

A short practical guide for observing minerals in thin section

1. What is a polarizing microscope?

A polarizing microscope is used to study minerals and rocks in thin section. The thin section is about 30 μm thick, so many minerals are transparent. Polarized light reveals optical properties that are difficult or impossible to see with an ordinary microscope.

2. Two ways to observe the same mineral

PPL — Plane-Polarized Light: one polarizer only. Look for colour, pleochroism, relief, cleavage and crystal shape.

XPL — Crossed Polarized Light: the analyser is inserted and crossed with the polarizer. Look for interference colours, extinction, twinning, and exsolutions.

3. A simple observation sequence

1. Start at low magnification in XPL. Find a clear area and understand the whole texture (also observe in PPL if necessary).
2. Increase magnification and choose one crystal at a time.
3. Observe in PPL: colour, pleochroism, relief and cleavage.
4. Insert the analyser and observe in XPL.
5. Rotate the stage: watch interference colours and extinction.
6. Compare several crystals. Do not identify a mineral from one feature only.

4. Key terms

Term	Meaning
Cleavage	Regular planes of weakness in a mineral.
Pleochroism	A change of colour when the stage is rotated in PPL.
Relief	How strongly a grain stands out from the mounting medium (not from the neighbouring grains) in PPL.
Interference colours	Colours produced by the optical behaviour of a mineral in XPL.
Extinction	A crystal becomes dark during stage rotation in XPL.
Isotropic	Looks the same when looked from any angle
Twinning	A regular repeated relationship between parts of a crystal.
Exsolution	Striped intergrown patterns
Foliation	A preferred planar orientation of minerals, common in many metamorphic rocks.
Crystallisation sequence	Presence of euhedral, subhedral and anhedral minerals (i.e., an order of crystallization is recognizable)
Euhedral mineral	Mineral showing a well recognizable geometric shape
Subhedral mineral	Mineral showing a (not so well) recognizable geometric shape
Anhedral mineral	Minerals without a recognizable geometric shape; it is interstitial relative to the other minerals

5. Mineral identification

Use several observations together: PPL + XPL + crystal relationships.

QUARTZ

PPL: Colourless; low relief; no obvious cleavage.

XPL: Low interference colours, commonly grey/white.

Best clue: No obvious cleavage + low interference colours.

PLAGIOCLASE

PPL: Colourless; low relief; cleavage may be visible.

XPL: Low interference colours; polysynthetic twinning forms repeated parallel bands; compositional concentric zoning.

Best clue: Repeated parallel twin lamellae; compositional concentric zoning.

K-FELDSPAR

PPL: Colourless; low relief; cleavage may be visible; slightly turbid if argillified.

XPL: Low interference colours; twinning may occur; exsolutions may occur.

Best clue: exsolutions + twinning + argillification.

Note: in microcline the twinning is a cross-hatched (tartan) pattern; orthoclase may show simple (Carlsbad) twinning. K-feldspar often looks slightly turbid, unlike clear quartz.

BIOTITE

PPL: Brown to green-brown; strong pleochroism; one excellent cleavage.

XPL: High-order interference colours, though these are partly masked by the strong brown-green body colour, so the grain can look dull rather than bright; extinction on rotation.

Best clue: Brown-green pleochroic sheet + strong cleavage.

MUSCOVITE

PPL: Usually colourless; one excellent cleavage; sheet-like.

XPL: Bright, high-order interference colours.

Best clue: Colourless mica + perfect cleavage + bright colours.

AMPHIBOLE

PPL: Often green/brown; pleochroism commonly occur; two cleavages.

XPL: Moderate interference colours; normal or inclined extinction at ca. 20° occur.

Best clue: Two cleavages meeting at about 60° / 120°.

PYROXENE

PPL: Commonly pale, but augite and orthopyroxene are often faintly coloured with weak pleochroism; prismatic; two cleavages.

XPL: Moderate interference colours; normal or inclined extinction at ca. 45° occur.

Best clue: Two cleavages meeting at about 90°.

GARNET

PPL: Colourless, pink, or pale brown; very high relief; isotropic (remains dark on rotation); typically forms euhedral (dodecahedral/isometric) crystals; clean or heavily fractured; no cleavage.

XPL: Completely isotropic (extinct / isotropic under crossed polars, meaning it stays black throughout a 360° rotation); anomalous birefringence may rarely occur.

Best clue: Very high relief, completely isotropic (black under XPL), and rounded or multi-sided (dodecahedral) crystal shapes with heavy fracturing.

6. From minerals to rock texture

Feature	Plutonic rocks — often	Metamorphic rocks — often
Crystal size	Medium to large; slow cooling allows growth.	Variable; recrystallization can produce new grains.
Orientation	Usually no strong preferred orientation.	Preferred orientation may produce foliation.
Grain relationships	Crystallisation sequence (order of crystallization recognizable).	Recrystallization and deformation may be visible.
Deformation	Usually weak or absent.	Bent, stretched or recrystallized grains may occur.
Foliation	Normally absent.	May be present (though not every metamorphic rock is foliated).

A practical rule: do not identify the rock from one mineral. First identify possible minerals, then look at grain size, shape, orientation, grain boundaries and deformation. The diagnosis comes from mineral properties + mineral relationships + texture.

7. Quick identification table

Mineral	PPL	XPL	Key clue
Quartz	Colourless; no obvious cleavage	Low colours	No cleavage + low interference
Plagioclase	Colourless	Low colours	Polysynthetic twins; compositional concentric zoning
K-feldspar	Colourless; slightly turbid	Low colours	Cross-hatch / simple twinning; exsolutions, argillification
Biotite	Brown; pleochroic	High but masked by brown	Brown + cleavage
Muscovite	Colourless; perfect cleavage	Bright	Sheet-like + bright colours
Amphibole	Green/brown; 2 cleavages	Moderate	~60°/120° cleavages; normal or inclined extinction at ca. 20°
Pyroxene	Pale to faintly coloured; 2 cleavages	Moderate	~90° cleavages; normal or inclined extinction at ca. 45°
Garnet	Colourless, pink, or pale brown; very high relief	Completely isotropic, black	Very high relief, completely isotropic (black), rounded or multi-sided (dodecahedral) crystal

LOOK → CHECK → COMPARE → DECIDE