PIPADOR REVISION

MRCOG Part 1 Revision Notes

LASER in Medicine

MEDICAL PHYSICS • LECTURE 513

VISUAL EXAMINATION REVISION NOTES

2026 Edition

513

MRCOG PART 1 REVISION NOTES | MEDICAL PHYSICS

LASER in Medicine

Laser physics, tissue effects, O&G applications and laser safety

LASER	CO_2	Nd:YAG	Class 4
Light Amplification by Stimulated Emission of Radiation	10,600 nm — water absorption	1,064 nm — deep coagulation	Surgical lasers

■ KEY FACTS: Learning objectives

- Define LASER and the properties of laser light (monochromatic, coherent, collimated).
- Explain how lasers are produced and how wavelength, power density and tissue absorption determine tissue effects.
- Describe gynaecological and obstetric applications and laser safety (classification, eye protection, fire, plume, governance).

513.1 Key definitions

Term	Definition
LASER	Light Amplification by Stimulated Emission of Radiation
Monochromatic	Single wavelength (one colour)
Coherent	Waves in phase in time and space
Collimated	Parallel beam with minimal divergence — can be focused to a very small spot
Lasing medium	Material producing the laser light (gas — CO_2, argon; solid — Nd:YAG, KTP; semiconductor — diode)
Population inversion	More atoms in the excited state than the ground state — needed for amplification
Power density (irradiance)	Power ÷ spot area (W/cm²) — determines whether tissue is cut, vaporised or coagulated
Chromophore	Tissue component that absorbs a given wavelength (water, haemoglobin, melanin)

■ IN PLAIN ENGLISH: LASER

A laser produces an intense, perfectly focused beam of light of **one colour**. Each colour is absorbed by different tissue components — the CO_2 laser by **water** (precise cutting), the Nd:YAG by tissue more deeply (coagulation). Changing power and spot size changes the effect.

513.2 How lasers work

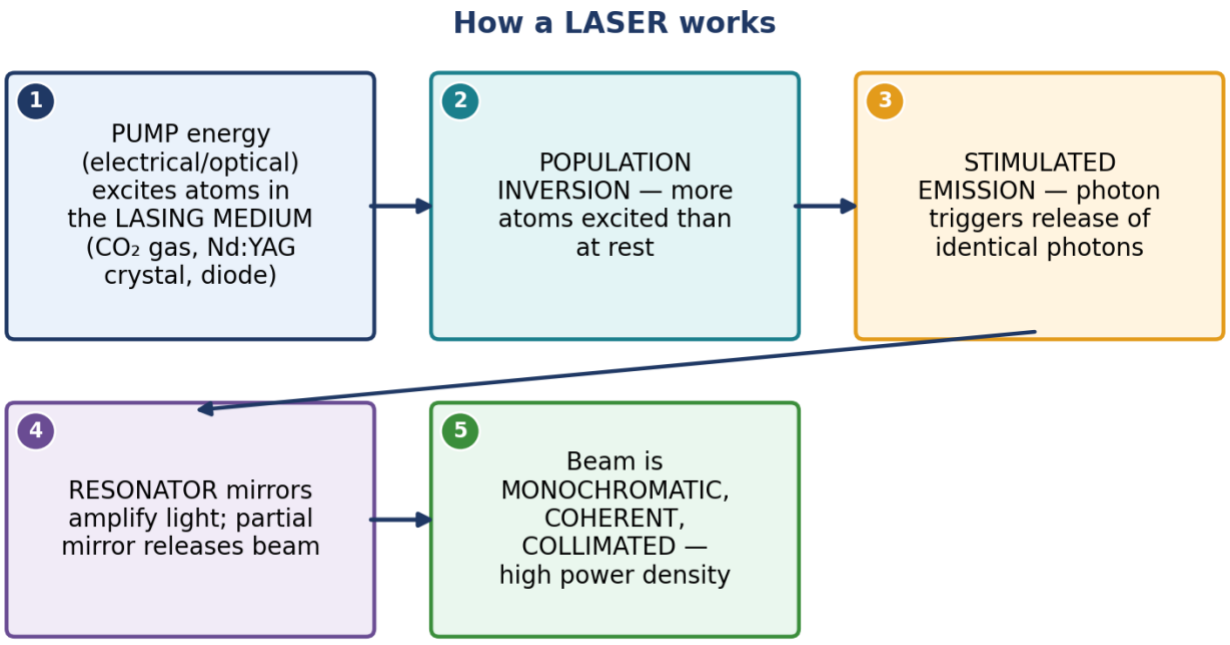


Figure 513.1 — How a laser works

■ KEY EQUATIONS

Power density (W/cm²) = power (W) ÷ spot area (cm²) — halving spot diameter quadruples power density

Energy (J) = power (W) × time (s); fluence (J/cm²) = energy ÷ area

Photon energy E = h c ÷ λ (shorter wavelength = higher energy)

513.3 Laser types and tissue effects

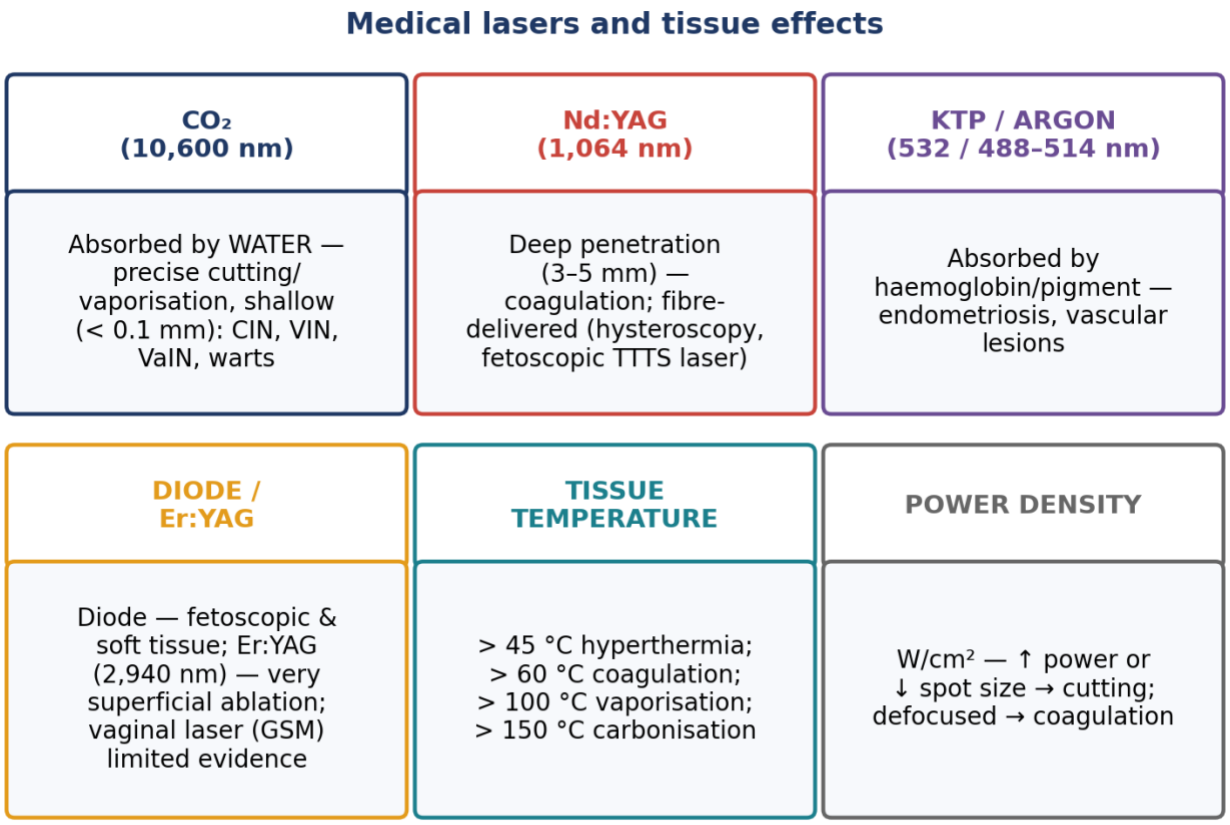


Figure 513.2 — Medical lasers and tissue effects

Tissue temperature	Effect
37–45 °C	Hyperthermia — reversible
45–60 °C	Protein denaturation, coagulation begins
60–100 °C	Coagulation necrosis (haemostasis)
> 100 °C	Vaporisation (water boils) — cutting/ablation
> 150 °C	Carbonisation (charring) — undesirable, ↑ thermal damage

513.4 Applications in O&G

Application	Laser and notes
Cervical intraepithelial neoplasia	CO_2 laser ablation/excision (now largely replaced by LLETZ, which provides histology)
VIN/VaIN/anogenital warts	CO_2 laser vaporisation — tissue-sparing, good cosmesis; no histology
Endometriosis	CO_2/KTP laparoscopic vaporisation
Hysteroscopy	Nd:YAG/diode for septum, adhesions, ablation (historical)
Twin-to-twin transfusion syndrome	• Fetoscopic laser photocoagulation of placental anastomoses (Nd:YAG or diode) — Solomon technique • ↑ survival vs amnioreduction
Genitourinary syndrome of menopause / SUI	• Vaginal CO_2/Er:YAG laser — limited evidence

Application	Laser and notes
	• NICE interventional procedures guidance: use only with special arrangements/research
Other	Tubal surgery (historical), photodynamic therapy (research)

513.5 Laser safety

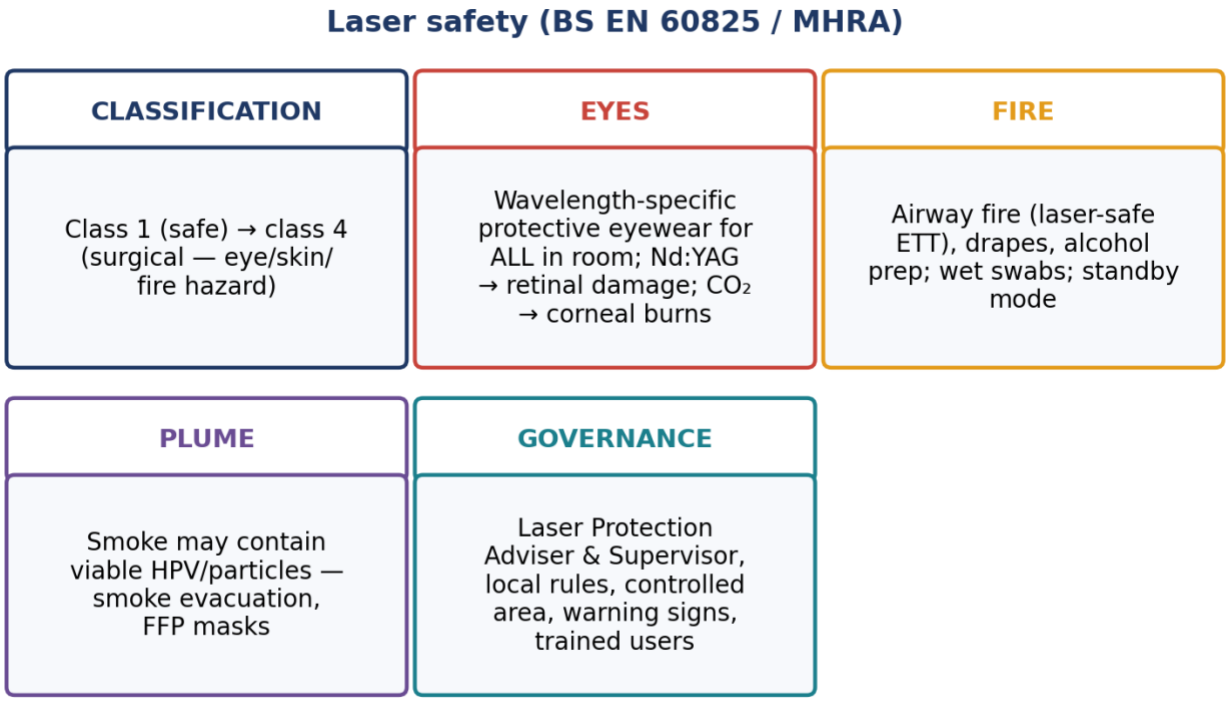


Figure 513.3 — Laser safety

- **Eye hazards**: visible/near-infrared (e.g. Nd:YAG 1,064 nm, KTP 532 nm) penetrate to the retina — permanent damage
  - Far-infrared (CO_2) absorbed by cornea → corneal burns.
  - Eyewear must match the wavelength (optical density marked).
- **Fire**: oxygen-enriched atmosphere, alcohol skin prep, drapes, airway (laser-resistant tubes); keep saline nearby; standby mode when not firing.
- **Laser plume**: may contain viable viral DNA (HPV), carcinogens and particulates — smoke evacuation and FFP2/3 masks.
- **Governance**: Laser Protection Adviser (LPA) and Laser Protection Supervisor (LPS), local rules, controlled area with warning signs and interlocks, trained and authorised users (MHRA guidance; BS EN 60825).

■ COMMON PITFALLS

Wearing eyewear for the wrong wavelength.

Using vaginal laser for GSM outside research/special arrangements.

Leaving the laser armed when not in use.

513.6 Must-know summary

■ EXAM TIP

- LASER: monochromatic, coherent, collimated light from stimulated emission in a lasing medium with population inversion.
- Tissue effect depends on wavelength (chromophore), power density (W/cm²) and exposure time: coagulation (60–100 °C) → vaporisation (> 100 °C).
- CO_2 (10,600 nm, water, precise) — CIN/VIN/warts; Nd:YAG (1,064 nm, deep coagulation, fibre) — fetoscopic TTTS, hysteroscopy; KTP/argon (haemoglobin).
- Safety: class 4, wavelength-specific eyewear, fire, plume evacuation, LPA/LPS, controlled area.

■ MNEMONIC / MEMORY AID

Laser light — 'MCC': Monochromatic, Coherent, Collimated.