LASER

1. Discuss these questions:
   a) What is a laser?
   b) What does the abbreviation stand for?

   L - - h - - - p - - f - - - - - o - - - - t - - u - - - e - e - - - s - - - - - r - - - a - - - -

   c) What are three key characteristics of laser light?
      single w ----------
      narrow b---
      high i--------
   d) Where are lasers used?
2. **Reading. Read the text and explain:**
   a) What is the difference between filament and fluorescent lamps?
   b) What is stimulated emission?
   c) What is population inversion?
   d) What is the difference between random and coherent emission?
   e) What is the function of a resonator?
   f) How can population inversion be achieved?

LASER is a light amplifier usually used to produce monochromatic coherent radiation in the infrared, visible, and ultraviolet regions of the electromagnetic spectrum.

Non-laser light sources emit radiation in all directions[1] as a result of the spontaneous emission of photons by thermally excited solids (filament lamps) or electronically excited atoms, ions or molecules (fluorescent lamps, etc.). The emission accompanies the spontaneous return of the excited species to the ground state[2] and occurs randomly, i.e. the radiation is not coherent. In a laser, the atoms, ions, or molecules are first "pumped" to an excited state and then stimulated to emit photons by collision of a photon of the same energy[3]. This is called stimulated emission. In order to use it, it is first necessary to create a condition in the amplifying medium, called population inversion, in which the majority of the relevant entities are excited. Random emission from one entity can then trigger coherent emission from the others that it passes. In this way amplification is achieved.

The laser amplifier is converted to an oscillator[4] by enclosing the amplifying medium within a resonator. Radiation then introduced along the axis of the resonator is reflected back and forth along its path by a mirror at one end and by a partially transmitting mirror at the other end. Between the mirrors the waves are amplified by stimulated emission[5]. The radiation emerges through the semi-transparent mirror at one end[6] as a powerful coherent monochromatic parallel beam of light. The emitted beam is uniquely parallel because waves that do not bounce back and forth between the mirrors quickly escape through the sides of the oscillating medium without amplification.

Some lasers are solid, others are liquid or gas devices. Population inversion can be achieved by optical pumping with flashlights or with other lasers. It can also be achieved by such methods as chemical reactions, discharges in gases, and recombination emission in semiconducting materials.

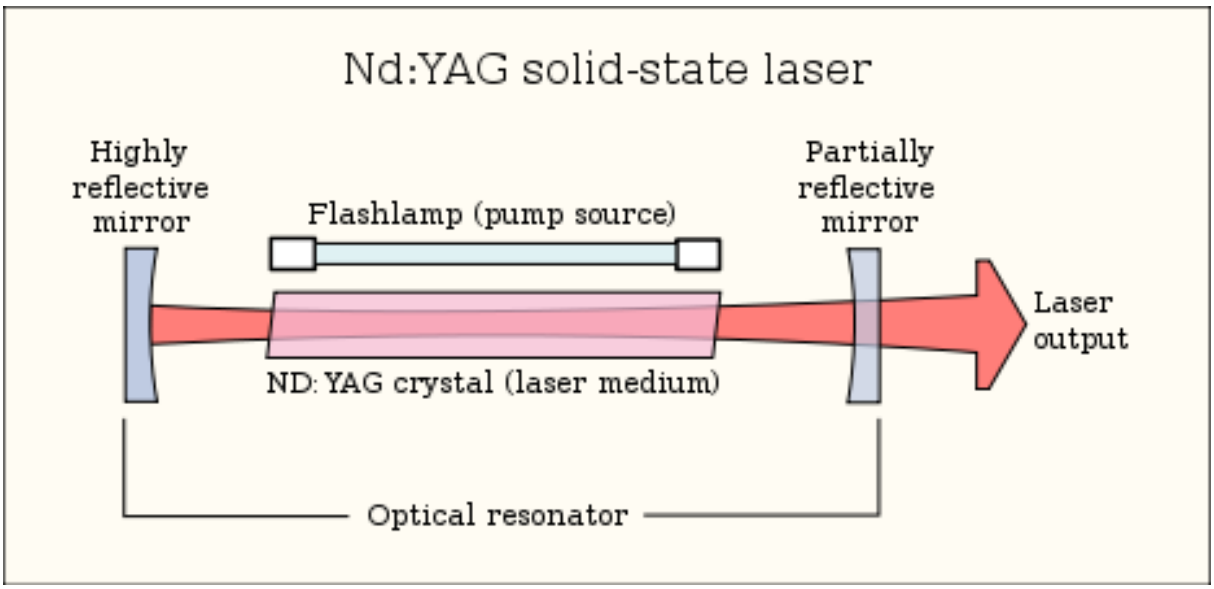
3. **Form questions to the underlined parts of the sentences.**
   1) ……
   2) ……
   3) ……
   4) ……
   5) ……
   6) ……
4. Give **nouns to the following verbs and adjectives, do not use –ing forms:**

coherent	to emit	visible
to occur	fluorescent	necessary
to amplify	electromagnetic	relevant

5. **Change the adjectives in the last column into the ones with the opposite meaning**
6. **Listening practice:** listen to and watch the video and fill in the table with relevant pieces of information https://www.youtube.com/watch?v=oUEbMjtWc-A

1	Examples of technology depending on laser	range finding devices, _____
2	The eye surgeons use laser to	reattach _____
3	The narrow beam of a laser allows the eye surgeon to	affect only_____
4	The green ball glows because	_____ can absorb energy _____ and later radiate the light.
5	When the blue light shines on a ruby, it	_____
6	In 1960, Ted Maiman demonstrated the first laser by	taking a _____ and surrounding it with _____
7	To create a laser we need an	_____ lamp
8	Electrons from a population inversion returning to the ground state release light	that starts _____
9	To reflect the light within the ruby cylinder Maiman added	_____ _____
10	Inside the resonant cavity, two things happen:	first, _____ and the light parallel to the axis _____

7. **Describing a laser. With your neighbour, try to describe a laser mentioning all its parts and explaining the functions they perform.**



8. **Relative clauses**

Compare the following three sentences and answer the sentences below them:

1. Lasers, ***which were developed in 1960,*** have become a powerful tool in almost every aspect of technology.
2. Lasers ***which are used in clinical practice*** must meet strict safety requirements.
3. The medical staff must be trained for the laser equipment ***which they use***.

In which case can the ***italicised*** clause be left out without disturbing the meaning of the sentence?

In which case the clause provides additional information which is not needed for identification of the subject?

In which cases the clause identifies the subject or the object?

In which cases can ***which*** be replaced by ***that***?

In which case can ***which*** be left out?

9. **Relative clauses – practice**

Put the following pieces of information into the form of a relative clause and fill them into respective gaps in the text. In each case decide whether the clause is defining or non-defining and should therefore be separated by comma(s).

1. Laser applications have evolved incredibly.
2. Selective photothermolysis means three given steps.
3. The tissue is to be damaged.
4. The surgeon operates the device.
5. Excessive heat may delay healing and increase scarring.

6. Storing energy between pulses enables very high power output.
7. The tubes rotate about the axis of the mirrors.
8. The scanners scan the laser beam in a present pattern.

MEDICAL LASERS

Since 1960s, laser applications (1)…… have become indispensable in medicine and surgery. There are many medical laser systems, but all of them use the principle of selective photothermolysis (2)……. three following steps: getting the right amount of the right wavelength of the laser energy to the right tissue (3)…….. .

The right wavelength

Most medical laser devices deliver only one wavelength of the laser light and the surgeon (4)…… must select the right wavelength for the specific tissue involved. Some lasers are frequency-doubled and can deliver two wavelengths of the laser light, and some are tuneable over a narrow range of wavelengths. Some lasers can be used in different modes, e.g. long pulse.

The right amount of the laser energy

Almost all medical lasers allow the surgeon to adjust the power setting and the duration of the pulse. Lasers can operate in two modes: continuous wave (CW) or pulsed mode. CW lasers emit a steady beam for as long as the laser medium is excited. If this steady beam is held on the tissue longer than the thermal relaxation time, excessive heat will be conducted in the non-target tissue (5)…… . All CW lasers can be pulsed, either mechanically or electronically. Pulsed lasers emit light in individual pulses within the range between thousandths to millionths of a second. Switching allows the laser to store energy between pulses (6)…….. .

Getting the laser energy there

The laser surgeon uses a delivery device with a handpiece to get the laser energy to the tissue. Delivery devices include fibre-optic cables or articulated arms with reflecting mirrors inside the tubes (7)…….. . The laser light is reflected from one mirror to another through the tube out to the patient. Special devices can be attached to the handpieces, including slit lamps for the use on the eyes, operating microscopes for the use in the ears and throat, insulated fibres for the use with endoscopes in gastrointestinal and bronchial surgery, and scanners (8)…… . Thus, the time a CW beam dwells on a target tissue can be controlled.

Sources:
Zemanová, Alena (2007) ***Angličtina pre fyzikov***; Univerzita Komenského Bratislava
www.youtube.com