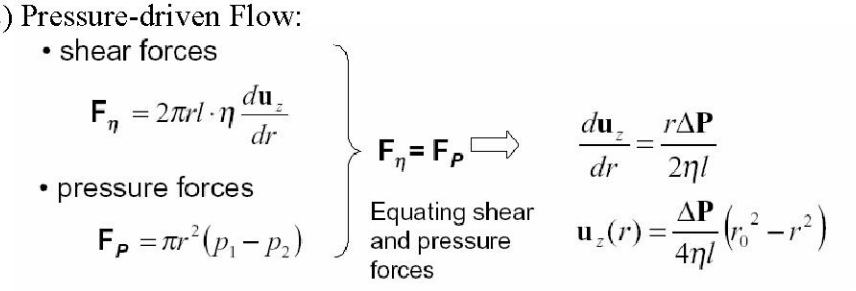
[Final Exam Solution]

1.

(1) Pressure-driven Flow: Flow which pumped by pressure difference between channel inlet and outlet. Its flow profile is parabolic shape. Usually it is generated by syringe pump.

Electro Osmotic Flow (EOF): Flow driven by electrophoresis which charged particles separated based on mass and charge. It has plug flow shape and generated by applied potential.

(2) Pressure-driven Flow:



=> Volume flow rate (velocity*area) scales with $\frac{1}{r^4}$ because velocity scales with $\frac{1}{r^2}$.

Electro Osmotic Flow (EOF):

- Both shear force and coulomb force scales with outside area of cylinder r

=> Volume flow rate and velocity are <u>independent</u> of channel radius r

~ So <u>EOF is much preferred</u>!!!

(3) Any two pumpless flow techniques are OK.

2.

(1)	flourescence	mass spectro	SPR	QCM
portability	b	b	b	g
Labeling free	b	g	g	g
Quantification	b	g	g	g
Sensitivity	g	g	g	g

(2) confocal scanning: an optical approach

deconvolution : a computer approach

(3) a decrease in frequency refraction index gold m/z

3.

(1) $R = \frac{\rho \cdot L}{A}$ - Both sides logarithm

$\ln R = \ln \rho + \ln L - \ln A$ - Both sides derivate

$\frac{dR}{R} = \frac{d\rho}{\rho} + \frac{dL}{L} - \frac{dA}{A} = \frac{d\rho}{\rho} + \varepsilon(1+\upsilon)$

Here, ρ is constant so $d\rho = 0$

Therefore, $GF = \frac{1}{\varepsilon}\frac{dR}{R} = (1+\upsilon)$

(2) $q_c = (S_2 - S_1)IT_c - K\Delta T - 0.5I^2R$

: The rate of heat flow includes 3 terms. First term is heat flow by Seeback effect, second term by conduct and the other by electrical resistance.

$w = (S_2 - S_1)I\Delta T + I^2R$

: The total electrical power includes 2 terms. First term is power by Seeback effect and the other by electrical resistance.

4.

(1) Fluorescent activated cell sorting (FACS): FACS is one of the common methods to evaluate cell population. Laser interrogation and signal processing followed by sort decision and Charged droplets deflect by electrostatic field from plates held at high voltage (+/- 3000 volts), etc.

(2) Seebeck coefficient: $S = \frac{dV}{dT}$; S is the Seebeck Coefficient with units of Volts per Kelvin.

S is positive when the direction of electric current is same as the direction of thermal current.

(3) Lab-on-a-chip (LOC): Chip that allows dilution, mixing, reaction, separation of sample on it.

(4) Enzyme-Linked Immuno Sorbent Assay (ELISA): ELISA is valuable tools for use in clinical labs. That can measure antibodies or antigens and inexpensive, rapid, quantitative, specific sensitive (pg/ml). Also it can be automated, etc.

(5) Anodic bonding: Electrostatic bonding or thermal bonding between Si wafer and glass with lots of Na+.

- Merits
  - Good adhesive strength
  - Glass bonding: Optical transparency
  - Vacuum hermetic sealing possible
- Demerits
  - Outgas (H2) emerges at the bonding interface
  - Possibility to destroy circuit devices due to strong electric field which was produced when bonding
  - Sodium ion is incompatible with CMOS

5.

(1)

	Piezo electric	Electro thermal
fractional stroke	<	
energy density	<	
speed	>	

(2) Passive way: make winding channel
Active way: shake the flow
etc.

(3) Because this approach stems from the highly specific immunoreaction between the membrane marker proteins and labeling antibodies.